

Air Quality Support for Review of ANPS

Review of PM_{2.5} Concentration Target and PM_{2.5} Exposure
Reduction Target

Department for Transport

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Quality information

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1. Introduction

In 2018, the Department for Transport (DfT) published the Airports National Policy Statement (ANPS). The ANPS outlines a policy framework for decision making on applications for a new Northwest Runway (NWR) at Heathrow Airport. The 2018 ANPS (hereafter referred to as “the ANPS”) was informed by information available at that time. Though emissions of particulate matter with an aerodynamic diameter of up to 2.5 μm (PM2.5) were considered, PM2.5 concentrations were not assessed as part of the previous ANPS and therefore no comparison was made with PM2.5 targets in place at that time. It should be noted that though PM2.5 limits and targets were in place at the time through the Air Quality Standards Regulations 2010, these were less stringent than those introduced under the Environment Act 2021 and set by the subsequent Environmental Targets (Fine Particulate Matter) (England) Regulations 2023. For this reason, it has been necessary to take an alternative approach to the consideration of PM2.5 than that used for other pollutants considered as part of the ANPS review (nitrogen oxides (NOX), nitrogen dioxide (NO2), particulate matter with an aerodynamic diameter of up to 10 μm (PM10), and ammonia (NH3)).

PM2.5 is capable of penetrating deep into the lungs and entering the bloodstream, therefore exposure to these particles can cause severe respiratory and cardiovascular health effects. PM2.5 has a range of sources including road traffic, aircraft emissions and natural processes. The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 introduced a PM2.5 exposure reduction target of 35% by 2040 compared to 2018 conditions, and a concentration target of 10 $\mu\text{g}/\text{m}^3$ by the end of 2040. PM2.5 concentrations are projected to reduce over the coming years, primarily due to the decarbonisation of transport and energy sectors. The profile of transport PM2.5 emissions sources is expected to change during this time. This due to the reduction in tailpipe PM2.5 emissions from improved emissions standards and the increased electrification of the vehicle fleet. However, the projected rate of reduction in PM2.5 vehicle emissions is less than that projected for NOX vehicle emissions. This is due to the contribution to PM2.5 from non-tailpipe vehicle emissions, such as brake and tyre wear. The non-tailpipe sources of PM2.5 are not expected to reduce with improving emissions standards nor with the increased electrification of the vehicle fleet. PM2.5. Therefore, it is important to consider how increases in road and aircraft traffic arising from the proposed Heathrow expansion could impact PM2.5 concentrations in the surrounding area.

This report details the assessment of changes in road and aircraft related emissions to consider future road and airside PM2.5 contributions at existing PM2.5 monitoring locations in the vicinity of Heathrow airport. The approach taken provides indicative outputs which are focused on existing monitoring locations in the area, rather than accurately projecting future concentrations or changes in concentrations. The detailed dispersion modelling of emissions would be a more robust means of projecting future PM2.5 impacts from the operation of a new NWR at Heathrow Airport, which will be carried out as part of any planning process. This report also considers how population location changes, and population growth, may affect progress towards the PM2.5 Population Exposure Reduction Target (PERT) (Defra, 2024c).

2. PM2.5 Legislation

In the UK, the Air Quality Standards Regulations 2010 (HM Government, 2010) (as amended in 2016) (HM Government, 2016), 2019 (HM Government, 2019), and 2020 (HM Government, 2020) are an important legislative framework governing air quality. These regulations are derived from EU law, specifically the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC (the 'Air Quality Directive') (Council of the European Union, 2008). Following the UK's exit from the European Union, these regulations are classified as 'assimilated law' pursuant to the EU (Withdrawal) Act 2018 (HM Government, 2018) (as amended in 2023 (HM Government, 2023)). This means that relevant directives previously applied directly or indirectly to the UK are still relevant to the environmental assessment within this report. However, the EU will no longer have a role in enforcement, this having passed to the UK Government and the relevant Secretary of State.

The limit values (LVs) for pollutants defined within these regulations are legally-binding on the UK Government and have been set for the protection of human health and of vegetation. They are considered to apply everywhere (with the exception of the carriageway and central reservation of roads and any locations where the public do not have access).

The Environment Act 1995 (HM Government, 1995) defines a Local Air Quality Management (LAQM) regime, under which local authorities have responsibility to monitor ambient air quality in their areas regularly against set Air Quality Objectives. If they identify that the objectives are unlikely to be met within the specified timescale, they must then designate an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) aimed at ensuring the objectives are eventually met. The objectives of relevance to the LAQM regime were set by the Air Quality (England) Regulations 2000 (HM Government, 2000) and Air Quality (England) (Amendment) Regulations 2002). These are not legally binding on the government as LVs are but require action on the part of local authorities to address them under LAQM. The Environment Act 2021 amended the Environment Act 1995 to set a new course for the UK's environmental policy post-Brexit and requirement for the government to develop a National Air Quality Strategy (AQS).

The Environment Act 2021 set out the framework for new legally binding targets including two with relevance to PM2.5. The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 then set two new targets for PM2.5. These requirements were not in place at the time of the previous assessments for the ANPS 2018. The new PM2.5 targets are legally binding for national government, and the AQS, published in 2023 (Defra 2023), establishes an expectation that local authorities use the powers open to them to contribute to the meeting of these targets.

The relevant AQS assessment levels for PM2.5 are presented in Table 1.

Table 1 Relevant AQS PM2.5 Assessment Levels (for the Protection of Human Health)

AQS Objective Concentration or Reduction Target	Measured as	Regulation
20 µg/m ³ *	Annual Mean	Air Quality Standards Regulations 2010
10 µg/m ³ **	Annual Mean Concentration Target (AMCT) to be achieved by 2040	The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023
35% Reduction	Population Exposure Reduction Target (PERT) compared to 2018 to be achieved by 2040	The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023
25 µg/m ³	Stage 1 Limit Value to be achieved and maintained by 1st January 2015 onwards	EU Directive 2008/50/EC
20 µg/m ³	Stage 2 Limit Value to be achieved and maintained by 1st January 2020 onwards	EU Directive 2008/50/EC

**Note an amendment of the Air Quality Standards Regulations was released in 2020 updating the PM2.5 limit value ('The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020). **Note new legally binding national PM2.5 targets.*

For a more complete background and legislative detail, reference should be made to the AQS, which provides further information on PM2.5 legislation.

3. Methodology

3.1 Receptors

Residential and other sensitive land uses (such as schools and hospitals) are generally considered appropriate for assessment against long term air quality objectives. However, as air quality modelling is beyond the scope of this assessment, it was not possible to quantify PM2.5 concentrations at preferable relevant locations. Instead, existing non-background monitoring locations were identified in the vicinity of Heathrow Airport and used as receptors to represent residential and other sensitive land use exposure. These monitors are generally in more exposed locations (i.e. closer to the road than residential and other sensitive land uses) and therefore, using them to represent sensitive receptors is considered to be suitably precautionary in light of the limitations of the assessment. However, it is acknowledged that this approach may not be representative of the exposure of all people impacted by the development. Modelling (anchored to the measurements) would provide greater understanding as to the likely locations of increased concentrations.

Assessment of impacts for planning or consideration of air quality as part of LAQM processes focus on specific, worst-case receptors and the monitors in the area have been located by local authorities in order to meet those requirements. Local monitors therefore represent worst-case locations to help identify potential impacts on residential or other sensitive uses. These monitoring locations will usually be in locations identified as experiencing worse conditions than are representative of the wider area, such as junctions and/or canyons.

Compliance with the LVs set by the Air Quality Standards Regulations (2010) is determined using an alternative specification for receptors and monitoring locations which include the requirements that monitoring locations and receptors be:

- At least 25 m from major junction; and
- Representative of at least 100 m road length.

It should be noted that as the local monitoring stations have been located in order to meet the requirements of LAQM, many of them represent locations that are not relevant to compliance with national targets and concentrations at such locations are expected to be higher, typically due to their proximity to major junctions.

The designation of monitoring sites is set out within Defra's technical guidance document, LAQM TG:22 (Defra, LAQM TG:22, 2022). Not all monitoring site types are represented in the study area considered in this assessment, which was defined based on the location of monitoring sites in the vicinity of Heathrow Airport with sufficient PM2.5 data capture to represent annual mean concentrations. For the purposes of this assessment Kerbside and Roadside sites have been treated as non-background and sites designated as Background are treated as such.

3.2 Traffic Data

Projected traffic counts for all major roads in the area were provided by the DfT as AM, Inter Peak (IP) and PM flows, covering a 12-hour period. This was provided for 2050 for a future baseline, or Do Minimum (DM) scenario, and for 2054 for two expansion cases, or Do Something scenarios (identified as DS1 and DS2). The two different DS scenarios relate to differing assumptions regarding mode share, which assumptions are discussed, below. Although the assessment year considered should usually be the same between DM and DS scenarios, this difference between DM and DS assessment years is an artifact of the available data and DM data for 2054 could not be provided within the timeframe for inclusion within this assessment. This difference in year results in an increase in projected impacts as there will be further traffic growth between 2050 and 2054 which is unrelated to the airport expansion, but which is treated as part of the expansion for the purposes of this assessment.

It should be noted that there is significant inherent uncertainty in the traffic modelling used for this analysis, as the National Transport Model (NTM) v5 which was used is not an airport specific behavioural model, and Heathrow's unique travel patterns, especially for passengers and shift based employees, are only approximated through adjustment. This uncertainty could be reduced with the development of a scheme-specific transport model to include the more granular detail on factors that are limited by the NTM, such as mode share and driver behaviour both with and without the NWR scheme in operation.

The traffic outputs provided are based on the NTM's 'Core' scenario. DfT usually model a range of scenarios around this Core scenario and in the most recent National Road Traffic Projections in 2022 (DfT, 2022), DfT considered a traffic range of approximately 20% around the Core scenario in 2050. This has not been possible

due to the limitations of resources for this analysis and therefore it should be noted there is uncertainty around all the scenarios presented in this analysis. Again, this uncertainty could be reduced with the development of a scheme-specific transport model to include the more granular detail on factors that are particularly prevalent to airport schemes.

DM represents the 2050 road network without any expansion at Heathrow but including all other committed schemes and policies. DS1 and DS2 represents the 2054 network with all committed schemes likely to have a cumulative effect within the study area, policies and the Heathrow expansion but with 2050 background traffic. DS1 represents expansion without Surface Access Targets while DS2 represents expansion with previous 2040 Surface Access Targets from the 2018 ANPS but shifting the target year to 2050 (accounting for the later opening date for the third runway). The 2018 ANPS sets a target to increase the passenger public transport share to 55% and halve the number of staff car trips to and from the airport relative to a 2013 baseline. It should be noted that the DS2 scenario reflects illustrative surface access targets and the modelling does not include a corridor-specific assessment of any public transport improvements which may be needed to achieve this. The traffic scenarios are outlined in Table 2.

Table 2 Traffic Model Scenarios

Scenario	Description
Do-Minimum (DM)	2050 road network without any expansion at Heathrow Airport. Includes all other committed schemes and policies.
Do-Something (DS1)	2054 road network with expansion at Heathrow Airport. Includes all other committed schemes and policies. Does not account for Surface Access Targets.
Do-Something (DS2)	2054 road network with expansion at Heathrow Airport. Includes all other committed schemes and policies. Accounts for the impact of the Surface Access Targets from the 2018 ANPS, but with a target year of 2050 as opposed to 2040.

As the traffic data provided by DfT represents average AM peak, IP and PM peak, totalling 12 hours of the day whilst air quality tools and assessment use Annual Average Daily Traffic (AADT), adjustment was required. In order to convert the 12 hours of data to represent AADT, data from DfT Automatic Traffic Counters (ATCs) located close to the Heathrow Airport expansion area were gathered (Department for Transport, 2026). Count point data are published by DfT for a network of locations across the country, with either measured or projected flows being published annually for many of the locations. ATC monitor ID 26118 was chosen as it had had the most recent manual count of the nearby ATCs (2022). It is also located alongside one of the links experiencing a potentially significant increase in traffic flow and is also located close to sensitive receptors. A scaling factor was calculated from the ATC data by dividing the reported AADT by the total of the manually counted AM, IP, and PM flows. This process effectively extracted the factor considered by DfT transport professionals as representing the relationship between 12-hour and 24-hour AADT and was therefore considered to be suitable.

3.3 PM2.5 Sources

There are a number of published data sources which consider the proportions of measured or projected concentrations of PM2.5 which can be attributed to different sources. These have been reviewed in order to consider the likely contributions at local monitoring locations. Source apportionment is highly locationally specific, depending on the relationship with local sources and geography which may influence dominant meteorological conditions. Close to a busy road, we would expect to see higher proportions of concentrations being related to road emissions, whilst those from other sources may be stable or reduce with distance from those sources. Close to an airport, we would expect to see higher proportions of concentrations being related to airside emissions for example.

Defra assesses air quality across the country to determine compliance against agreed LVs (as set out in Section 2) using both measurements and the Pollution Climate Mapping (PCM) model. The most recently published base data from the PCM is for 2023 and provides projections up to 2040 (Defra, 2024b). Data representing 2023 has been reviewed for the study area to identify likely source apportionment. This shows that for the area including the existing Heathrow Airport and the proposed area for extension, the background contribution represents the largest proportion of concentrations. The remainder is identified as being from road sources including tyre and brake wear, road abrasion and vehicle emissions. Whilst allowance is given within the dataset for other local sources (listed as “Residual”) these are zero across the study area. This therefore supports an assumption that for the area in question, the concentration source apportionment is split between background and roadside sources. As a conservative approach, it has therefore been assumed that the portion of measured concentrations

that are not attributable to backgrounds, are from road related sources. Concentrations related to aircraft emissions have been considered in addition to this which leads to some double counting.

3.4 Background Calibrations

Background PM2.5 monitoring sites in the vicinity of Heathrow Airport were reviewed and those with sufficient data capture were compared with the corresponding 2021 based Defra mapped background concentrations for the same year and location (Defra, 2024a). Whilst the 2021 based mapped backgrounds were calibrated, by Defra, against 2021 measured national data, all years after this are projected and have not been calibrated using real world measurements. They may therefore vary from actual conditions in certain areas and years depending on specific meteorological conditions and geography and Defra therefore recommend local review to identify whether calibration is required. This process of comparison was carried out for 2022, 2023 and 2024 (the most recent years for which ratified data were available) in order to ensure that any anomalous data would be identified. The mapped background PM2.5 concentrations at all of the background monitoring locations were higher than the monitored concentrations, meaning that real measurements were notably lower than was projected to be the case by Defra's 2021 based background maps. Therefore, a background calibration was required to adjust the data to better represent actual conditions. The calibration was carried out following the approach set out within LAQM TG:22 (Defra, LAQM TG:22, 2022) by dividing the monitored background concentrations for the most recently available year of data (2024) by the corresponding mapped background concentrations to give a background calibration factor. The mean of these factors was used to adjust the mapped backgrounds across the study area.

Details of the background calibration are shown in Table 3 for 2024. Locations of the monitors used alongside non-background monitoring sites in the wider study area are shown Table 3.

Table 3 Background calibration

Monitor ID	Local Authority (LA)	Purpose	X	Y	Grid Square	2024 Monitored PM2.5 Background (µg/m³)	2024 Mapped PM2.5 Background (µg/m³)	Calibration Factor
BAA_OAKS	Spelthorne	LA (LAQM)	505729	174496	505500_174500	6.9	7.9	0.88
SUN_01	Spelthorne	LA (LAQM)	510063	170204	510500_170500	7.5	8.3	0.91
HIL	Hillingdon	AURN (LV compliance)	506951	178605	506500_178500	7	8.2	0.85
HIL4	Hillingdon	LA (LAQM)	505671	177605	505500_177500	6	8.0	0.75
Mean								0.85

3.5 Monitoring Sites

Air quality monitoring data was required to establish baseline air quality for the assessment. Monitoring of PM2.5 is undertaken by Defra as part of their Automatic Urban and Rural Network (AURN) of monitoring sites across the UK. A primary purpose of the AURN monitoring is to inform compliance reporting under the requirements of the Air Quality Standards Regulations 2010 and the Environment Act 2021 targets. As well as the AURN, PM2.5 monitoring is also undertaken by Local Authorities, as part of their LAQM responsibilities under the requirements of Environment Acts (1995 and 2021). The primary goal of LAQM is to protect public health and the environment by systematically monitoring, assessing, and reducing harmful pollutants to meet national air quality objectives. An important distinction between the AURN and LAQM monitoring is that data gathered for LAQM is not used to inform compliance reporting against the Air Quality Standards Regulations 2010 and Environment Act 2021 targets. Typically, monitoring sites that are part of the AURN are also subject to be robust QA/QC and audit procedures.

Non-background PM2.5 monitoring sites in the surrounding local authorities were initially identified based on their distance from the existing Heathrow airport and proposed expansion area, these are shown in Table 4. Subsequent review of the monitoring sites and data has identified that not all the monitoring sites are appropriate to inform this assessment.

As discussed in Section 3.4, a calibration factor was required to account for modelled background PM2.5 concentrations being higher than the monitored PM2.5 concentrations. At two of the monitors shown in Figure 1 (SLH 9 and Harefield Hospital) the measured PM2.5 concentration data remains below the modelled background PM2.5 concentration even after calibration. As a result, these two monitoring sites could not be used to inform this assessment. In addition, two further monitors shown on Figure 1 (HS5 and HS9) were also excluded from the assessment, due to them being located in environments that were considered too complex to account for using the indicative approach applied in this assessment. Specifically, they are impacted by emissions from multiple adjacent roads. As the approach within this indicative assessment relies on the relationship between the monitor and a single adjacent road, the additional links and the relationship between them is too complex to be accurately represented by the assessment. Whilst it is unlikely that the exclusion of HS5 would alter the conclusions of the assessment, HS9 has historically reported concentrations that are higher than those reported here. A more detailed level of assessment would be required to determine the PM2.5 impact of a new NWR at this location. Finally, one other monitoring site shown on Figure 1 (Tavistock) has been excluded due to being located over 200 m from any road included within the traffic data provided, and over 3 km from Heathrow airport. This site is too far from the emissions sources for impacts to be calculated using the assessment approach.

The 2024 monitoring data for the remaining sites has been extracted, and the corresponding Defra mapped PM2.5 background concentrations calibrated using the factor calculated in Table 3. The details of the sites and the calibrated backgrounds are shown in Table 4. The locations of these sites were reviewed to identify whether they are suitable to represent:

- Locations where there is the potential for airside emissions to affect concentrations of PM2.5¹;
- Locations where there is the potential for Road Traffic emissions to affect concentrations of PM2.5²; and
- Locations considered potentially relevant for consideration of the Limit Value³.

Table 4 Wider Monitoring Sites and Background PM2.5 Concentrations (2024)

Monitor ID	Local Authority	Type	Purpose	X	Y	Measured PM2.5 Conc. (µg/m³)	Mapped PM2.5 Background (µg/m³)	Calibrated PM2.5 Background (µg/m³)	Road Portion (%)
LHR2 ¹	Hillingdon	Airport	LA (LAQM) ¹	508600	176700	7	8.0	6.8	3
HRL ¹	Hillingdon	Airport	AURN (Limit Value compliance) ²	508295	177800	7	8.0	6.8	3
T55 ^{1,2,3}	Hillingdon	Airport	LA (LAQM) ¹	505207	177072	7	8.0	6.8	3
T54 ¹	Hillingdon	Airport	LA (LAQM) ¹	505729	174496	7	7.9	6.7	5
HS4 ^{2,3}	Hounslow	Roadside	LA (LAQM) ¹	521084	178499	13	8.7	7.4	43
LHRBR ^{2,3}	Hillingdon	Roadside	LA (LAQM) ¹	508279	176949	8	8.0	6.8	15
Harlington High Street b) ^{1,2,3}	Hillingdon	Roadside	LA (Indicative Sensor) ³	508824	177081	7.7	8.0	6.8	12
Green Lane,, Northwood ^{2,3}	Hillingdon	Roadside	LA (Indicative Sensor) ³	509310	191450	8.1	7.9	6.6	18

¹ Local Authority (LAQM) monitoring sites utilise EU reference method analysers to measure PM2.5 concentrations for the purpose of reviewing local air quality against the national air quality objectives.

¹ Monitors located within 1.5 km of Heathrow airport

² Locations within 30 m of roads for which traffic data have been provided and within 2 km of the proposed

³ Potentially meeting the requirements set out in section 3.1, although it is not within the scope of this report to determine actual relevance.

² AURN monitoring sites utilise EU reference method analysers to measure PM2.5 concentrations for the purpose of review of compliance reporting under the requirements of the Air Quality Standards Regulations 2010.

³ Local Authority (Indicative Sensor) monitoring sites utilise non-EU reference method analysers to measure PM2.5 concentrations for the purpose of understand background levels and reviewing local air quality against the national air quality objectives.

3.6 2024 Source Apportionment

As noted in section 3.3, all non-background PM2.5 was assumed to be due to contributions from local roads. The contribution from local roads was calculated by subtracting the calibrated 2024 background concentration from the monitored concentration. This approach risks overestimating the proportion of non-background concentration attributable to roads sources. However, this is a precautionary assumption in the context of this assessment.

Alternative sources of data were explored to inform the 2024 source apportionment. As noted in section 3.3 the national air quality compliance model data for 2024 (Defra) with base year of 2023, indicated that all concentrations of PM2.5 within the study area related to either background or road sources. The proportion of the total that is identified as from road sources varied depending on location and is between 3% and 19%, which demonstrates the extent to which source apportionment varies by location. This data reflects the proportion of the total concentration that represents road sources at specific locations identified within the PCM model. For the monitoring sites considered in this assessment, as noted in Table 4, the proportion of the total that represents road sources varies between 3% and 43%. This increased variance is due to the greater exposure to traffic emissions identified at roadside sites in congested locations when compared to locations which are representative of average exposure. Due to this difference in location type and proportions, the compliance model data was used to inform the approach, but the specific data was not used.

The Defra National Air Emissions Inventory (NAEI) publish national emissions data. The most recently published data from this source also represents 2023 but is provided as emissions by sector for each 1 km x 1 km grid square. This shows that road emissions within the study area represent between 4% and 46% of emissions within each grid square. However, the location of the emission sources within each grid square will significantly affect the extent to which these proportions of emissions affect concentrations at specific locations and this data should therefore not be used as indicative of wider relationships between sources in the area. It should be noted that whilst the compliance model data and the proportions set out in Table 4 relate to proportions of projected or measured concentrations at specific locations close to road sources, the NAEI data relates to total emissions within a grid square which therefore does not include consideration of PM2.5 from outside the grid square or secondary PM2.5 so they are not comparable but help to inform the assessment and understand the sources in the area. Whilst the road component of the measured concentrations set out in Table 4 shows a similar range of percentages to that identified for emissions in the NAEI, these represent very different pieces of data and are therefore not comparable,

As the monitoring locations considered for this assessment are roadside and kerbside locations, they will be largely influenced by road emissions as indicated above, and therefore it is considered appropriate to assume that the portion of the measured concentration that isn't represented by the calibrated background represents the road increment.

With regards to airside contributions, the PM2.5 background maps do not include separate contributions from 'Aircraft' sources. Instead, the 'Aircraft' source contribution to background PM2.5 is included in the 'Other' source group within the PM2.5 background maps, which includes contributions from other sources including shipping and off-road machinery. However, it is noted that the NOX background maps do include a separate contribution from 'Aircraft' sources, as well as an 'Other' source group containing the same non-aircraft sources included in the 'Other' PM2.5 source group. In the absence of this information for PM2.5, it has been assumed that the proportion of 'Aircraft' in the 'Other' source for PM2.5 is in the same proportion as the 'Aircraft' source to the 'Aircraft + Other' sources in the NOX background maps. Therefore, the proportion of 'Aircraft' NOX concentrations within the 'Aircraft' + 'Other' source groups was calculated, and the same proportion has been applied to the PM2.5 concentrations from 'Other' sources. Whilst there is some uncertainty in this approach to determining the proportion of aircraft-related PM2.5 contributions, in the absence of alternative data, this is deemed the best available approach. Section 3.9.2 provides some validation of this approach by comparing it to the source apportionment provided by Defra's PCM model.

3.7 2050 Baseline (Do Minimum)

The latest year of data available in the Defra background maps is 2040, and this was used for future year scenarios to represent background conditions in both 2050 and 2054. Assuming the current trend of year-on-year reductions in background PM2.5 continues, the use of 2040 to represent later years is considered precautionary. The 2040 background was calibrated to represent local conditions using the factor (0.85) calculated in Table 3. This information is summarised in Table 5.

In order to calculate a suitable road increment for the 2050 baseline (DM) scenario, the relationship between 2024 road emissions and 2050 road emissions was identified using the most recent Emissions Factor Toolkit (EFT) (v14.1). This approach was suggested and agreed with Defra. This was carried out using the same AADT data, settings and road type for 2024 and for 2050 to identify the emissions trend for road vehicle emissions in the area surrounding the proposed Heathrow expansion area. The relationship between these emissions was calculated and used to estimate the change in road increment over time, assuming a linear relationship between changes in road emissions and road contribution to PM2.5 concentrations. The change in emissions incorporated within the EFT takes into account projected uptake of electric vehicles and alternative technology, as well vehicle turnover. Whilst the production of this tool by Defra has been based on conservative assumptions, it is possible that increased uptake of alternative fuel vehicles, led by future policy will result in these assumptions being overly conservative. The calculated 2024 road increment was multiplied by the calculated factor to adjust for the reduced vehicle emissions expected in 2050. This 2050 road increment was then added to the 2040 background to give a projected 2050 concentration. These concentrations represent the future baseline or DM scenario in this assessment.

The trend between the roads increment of the Defra background maps between 2024 and 2040 was also reviewed as a potential indicative approach to identify likely future road increment concentrations. This approach assumes that the road increment measured in locations close to a road would follow the same trend as the road portion of the projected background maps for that location. This would involve calculating the relationship between the road portion of the background maps in 2024 and 2040 and then applying that as a factor to the calculated road increment measured in 2024 to give a calculated 2040 road increment. Whilst this approach has the benefit of accounting for any projected traffic growth, it does limit the assessment to a greater temporal extent as background maps are only published to 2040, whilst the EFT considers changes in emissions to 2050. Nevertheless, a comparison was carried out between the potential outputs using the different approaches and this showed that the road increment was largely similar between the two approaches, with the approach of using the EFT trend resulting in slightly lower road increment at all sites. This follows the trend that would be expected when considering 2040 against 2050 concentrations.

Aircraft contributions in the baseline are assumed to have been captured in the 2040 Defra background maps.

Table 5 2040 to 2050 Baseline- Projected PM2.5 Monitoring Concentrations and Backgrounds

Monitor ID	Grid Square	2040 Calibrated Background (µg/m³)	2050 Projected Total (µg/m³)	2050 Projected Road Contribution (µg/m³)	2050 Projected Road Contribution (%)
LHR2	508500_176500	6.1	6.2	0.188	3
HRL	508500_177500	6.0	6.2	0.189	3
T55	505500_177500	6.0	6.2	0.182	3
T54	505500_174500	5.9	6.2	0.294	5
HS4	521500_178500	6.6	11.6	4.949	43
LHRBR	508500_176500	6.1	7.1	1.065	15
Harlington High Street b)	508500_177500	6.0	6.8	0.806	12
Green Lane, Northwood	509500_191500	5.8	7.1	1.271	18

3.8 Road Do Something (DS) Scenario

The EFT (v14.1) was used to assess projected future road PM2.5 concentrations based on changes to traffic flows. Two different traffic scenarios were used to model the impact of Heathrow expansion on PM2.5 concentrations:

- 1) Core Scenario – using traffic projections from the NTM for the nearest link to each monitor. This represents plausible estimates for the increase in traffic at the locations considered
- 2) Reasonable Worst-Case Scenario– using the 99th percentile of the increase in traffic flows on motorways, A-roads, and B-roads in the NTM due to the Heathrow expansion, on roads in the vicinity of Heathrow Airport. The 99th percentile was chosen to remove extreme outliers which may represent modelling artifacts rather

than realistic impacts. These percentage increases are applied to forecasted trips on roads adjacent to each of the monitoring sites the DM scenario to obtain 'reasonable worst case' estimates for the number of trips which might occur in the DS scenarios.

Three monitoring locations (LHR2, HRL and T54), considered as part of the wider assessment were excluded from the consideration of roadside impacts. This was due to them being located adjacent to roads not included in the NTM.

Traffic data for the roads that are used to inform the assessment of roadside impacts are shown in Table 6.

Table 6 AADT Flows Used

Monitor	Nearest Road Type	Traffic Link ID ¹	DM 2050	Core Scenario 2054		Reasonable Worse-Case Scenario 2054	
				DS1	DS2	DS1	DS2
T55	A Road	36199_30057	8530	9595	8439	10562	8925
HS4	A Road	30917_36110	5276	5336	5281	6532	5520
LHRBR	A Road	30068_35948	6414	7623	6435	7941	6710
Harlington High Street b)	A Road	30493_31314	5082	5651	5025	6293	5318
Green Lane, Northwood	B Road	31355_31361	2576	2582	2554	5376	3131

¹Links are paired e.g. westbound and eastbound links added together, however, only one link is shown for ease of reporting.

The nearest road links to each monitor were used to create a two-way AADT flow, with Heavy Duty Vehicle (HDV) % also calculated. DM data was input to the EFT (v14.1) with speeds provided by the DfT as average speeds by road type. The EFT was run to calculate the projected emissions from adjacent roads in the DM scenario in 2050. The outputs from the EFT were compared to the calculated DM road concentrations to provide a locationally specific dispersion factor representing the relationship between emissions and concentrations for the specific location.

The DS1 and DS2 flows for each scenario were then entered into EFT v14.1 and a resulting emission factor was extracted for each link used, in each scenario. The dispersion factor calculated from the DM traffic emissions was then applied to the emissions calculated for each DS scenario to provide a road concentration for each DS scenario. This was added to the future baseline to provide a total concentration. The EFT outputs are shown in Table 7.

Table 7 EFT Outputs (g/km/s)

Monitor	DM	Core Scenario		Realistic Worst-Case Scenario	
		DS1	DS2	DS1	DS2
T55	0.00151	0.00169	0.00149	0.00186	0.00158
HS4	0.00093	0.00094	0.00093	0.00115	0.00097
LHRBR	0.00113	0.00134	0.00114	0.00140	0.00118
Harlington High Street b)	0.00090	0.00100	0.00089	0.00111	0.00094
Green Lane, Northwood	0.00045	0.00046	0.00045	0.00095	0.00055

3.9 Airside DS Scenario

The airside contribution of PM2.5 concentrations in the DS scenario (both DS1 and DS2) has been estimated using the proportional increase in air traffic movements (ATMs) compared to the DM scenario. The calculation steps have been set out below.

Step 1: Calculate the proportional increase in ATMs between each scenario for the worst-case year

The change in ATMs between the DM and DS scenarios for each future year for which data was provided was calculated and the worst-case change identified. Table 8 shows the projected DM and DS ATMs and change in ATMs for the year expected to experience the largest increase in ATMs.

Table 8 Projected Increase in Air Traffic Movements

Year	ATMs – Do Minimum Scenario	ATMs – Do Something Scenario	Change in ATMs	Percentage Change in ATMs (%)
2055	455,685	722,367	+266,682	+58.5

Step 2: Calculate the aircraft proportion of Defra background concentrations

As described in Section 3.6, it has been assumed that the proportion of 'Aircraft' in the 'Other' source for background PM2.5 is in the same proportion as the 'Aircraft' source to the 'Aircraft + Other' sources in the NOX background maps. An additional exercise has been undertaken to assess whether this assumption is reasonable by considering the alternative source apportionment of Defra's Pollutant Climate Mapping (PCM) model. Details of this analysis are outlined in Section 3.9.2.

Step 3: Apply the percentage increase to the background concentration from 'Aircraft' sources

The percentage increase in ATMs was applied to the 'Aircraft' proportion to determine the anticipated change in PM2.5 concentrations as a result of the additional ATMs.

Step 4: Add the estimated PM2.5 concentrations from additional ATMs to the total PM2.5 concentration for each model year

The PM2.5 concentration from the additional ATMs was added to the projected monitored PM2.5 concentration in each model year to determine the monitored concentration as a result of the scheme's operation.

3.9.1 Sensitivity Test – Relationship between Increased ATMs and Increased Emissions

An additional sensitivity test has been undertaken to assess the projected increase in PM2.5 emissions compared to the projected increase in ATMs reported in the Airports Commission's modelling assessment. That assessment, which was published in 2015, considered the air quality impact from the operation of a new NWR. The results of the sensitivity test can be found in Section 4.2.1 of this report.

3.9.2 Pollutant Climate Mapping and Source Apportionment

An exercise has been undertaken to assess the percentage contribution of aircraft sources in Defra's PCM model. The most recently available data was used (Defra, 2024c), which includes a base year of 2023. Source apportionment is available for PM2.5, which provides the contribution from different sources for all PCM links. The PCM receptor locations at which the concentrations are reported are roadside and at the centre point for each PCM link.

The closest PCM link to each monitoring site within close proximity to Heathrow Airport was identified. The percentage of the 'Aircraft' source contribution of PM2.5 to the 'Other' source contribution (category BF8 in the PCM data, which is equivalent to the 'Other' category in the Defra Background Maps) of PM2.5 was calculated for each site to determine whether the use of NOX proportions is appropriate.

Table 9 shows the nearest PCM link to each monitoring site, including those that are more than 1.5 km from the Airport, the modelled aircraft contribution to roadside concentrations in 2023, and the proportion of 'Aircraft' source emissions. The source apportionment values include a category for 'Aircraft Support'. Proportions with and without the 'Aircraft Support' are also included in Table 9, as is the equivalent calculation using the Defra background maps.

Table 9 PCM Model Source Apportionment for PM2.5 for 2023 and Background Map Approach¹

Monitor ID	Nearest PCM Link	Road Name	Approximate Distance to Nearest PCM Link	PM2.5 Contributions (µg/m ³)					NOX Contributions (µg/m ³)			
				PCM 'Aircraft'	PCM 'Aircraft Support'	PCM 'Aircraft' + 'Aircraft Support'	PCM 'Aircraft' + 'Aircraft Support' to BG Map 'Other'	PCM 'Aircraft' to BG Map 'Other'	BG Map 'Aircraft'	BG Map 'Other'	BG Map 'Aircraft' + 'Other'	BG Map 'Aircraft' to BG Map 'Aircraft' + 'Other'
LHR2	802016112	A4	216 m	0.53	0.18	0.71	94.3%	70.0%	31.7	1.1	32.8	96.6%
HRL	802017099	A437	412 m	0.21	0.07	0.28	87.4%	66.1%	13.2	1.1	14.3	92.3%
T55	802026118	A4	42 m	0.16	0.04	0.20	79.2%	62.9%	8.1	1.2	9.3	86.8%
T54	802038599	A3044	1200 m	0.14	0.03	0.18	75.3%	60.8%	24.0	1.1	25.1	95.5%
HS4	802016867	A315	12 m	0.02	0.00	0.02	29.9%	23.1%	1.1	1.5	2.6	41.4%
LHRBR	802016112	A4	22 m	0.53	0.18	0.71	94.3%	70.0%	31.7	1.1	32.8	96.6%
Harlington High Street b)	802017099	A437	0 m	0.21	0.07	0.28	87.4%	66.1%	13.2	1.1	14.3	92.3%
Green Lane,, Northwood802008049	A4125	450 m	0.01	0.00	0.01	41.8%	32.5%	0.8	0.6	1.4	55.9%	

¹ As described in Section 3.6

The 'Aircraft' + 'Aircraft Support' contribution to 'Other' sources of PM2.5 concentrations, shown in Table 9, are of a similar magnitude to the NOX proportions. The NOX proportions are slightly higher than the PM2.5 proportions, and therefore the use of NOX proportions provides a slightly more precautionary estimation than if the PM2.5 proportions were applied. Despite the use of a more precautionary approach, only a small PM2.5 contribution is expected from airside sources when compared to the contribution from the road source.

3.10 Assumptions and Limitations

The approach to this assessment is intended to provide a proportionate assessment of potential PM2.5 impacts due to the proposed expansion of Heathrow, based on the data available and agreed scope. The findings of this assessment are indicative and likely overestimate PM2.5 concentrations and the impact of Heathrow Expansion on concentrations. A detailed dispersion modelling assessment of surface access traffic emissions and airside source emissions, in line with relevant national and industry standard guidance, would be required to give the most robust assessment of potential PM2.5 impacts.

The key assumptions and limitations are as follows:

- Background concentrations reported within maps provided by Defra for 2024 and 2040 have been scaled using a calibration factor from background monitoring sites in close proximity to Heathrow Airport following guidance set out within TG22 (Defra, LAQM TG:22, 2022). This is due to monitored PM2.5 concentrations being lower than mapped background concentrations.
- It has been assumed that mapped background concentrations in years beyond 2040 will remain unchanged from 2040. This can be considered as a precautionary assumption as it assumes the current trend of year-on-reductions in background PM2.5 concentrations up to 2040 will not continue beyond 2040.
- The methodology outlined in this report will result in an overestimation of PM2.5 concentrations at the monitoring sites assessed. This is due to the assumption that all non-background PM2.5 was from local road contribution sources. It is inevitable that a proportion of the non-background is from sources other than the road contribution, including an airside contribution at monitoring locations close to the airport. This approach, therefore, risks overestimating the proportion of non-background concentration attributable to roads sources.
- Some of the monitoring sites used in the assessment are located for the purpose of LAQM and are sited closer to key roads or junctions than Defra's sites which are located to assess compliance with the LVs. They are therefore likely to measure worst-case concentrations.
- Use of the latest version of the Defra background maps and the EFT means that this assessment is subject to the assumptions and limitations of those tools.
- The assessment is restricted to locations where monitoring of PM2.5 is currently available, due to the constraints associated with the indicative approach. An estimation of PM2.5 concentrations elsewhere, i.e. at the façade of residential dwellings, schools, and hospitals, has not been undertaken. This is a known limit on the spatial extent of the assessment. A detailed assessment of PM2.5 impacts utilising dispersion modelling will be required to consider the dispersion of emissions and subsequent contributions to PM2.5 concentrations at locations where exposure is relevant for the purpose of compliance reporting and LAQM.
- There is significant inherent uncertainty in the NTM outputs (traffic modelling) used for this analysis, as NTMv5 is not an airport-specific behavioural model and Heathrow's unique travel patterns, especially for passengers and shift-based employees, are only approximated through adjustment.
- The DS2 traffic scenario includes consideration of changes to mode share that will require increases in the use of public transport compared to the current mode share. The location and nature of these public transport schemes have yet to be determined and there may be PM emissions related to these schemes that have not been accounted for.
- The DS2 represents indicative surface access targets, including assumptions about passenger and staff targets. While passenger targets are consistent with those set out in the draft HENPS, the staff targets are illustrative given the draft HENPS sets a requirement for promoters to propose staff targets.
- As traffic flows provided for the DM scenario represent 2050 conditions, whilst those for the DS1 and DS2 scenarios represent conditions in 2054 with the expansion in place. This discrepancy in the year represented within the traffic data will lead to an overestimate of impacts relating to the expansion as increases in traffic in the area that are unrelated to the expansion will be included within the projections and assumed to be due to the expansion.

- The calculations do not consider the spatial distribution of airside PM2.5 emissions and instead considers the emissions from Heathrow Airport as whole. With the addition of a new runway, it is likely that changes at the monitoring sites closer to that new runway would be greater than those closer to the existing runways, assuming most of the additional ATMs will be associated with the new runway.
- The estimated impact from aircraft is based solely on the proportional increase in ATMs. In reality, the relationship between ATMs and total airside emissions would not be linear and would be influenced by meteorological conditions and operating conditions of the airport. No other elements of the assessment use this level of linearity between emissions and concentration.
- The proportion of baseline PM2.5 contributions from airside sources has been estimated using data from Defra's background maps, based on the relationship between NOX "Aircraft" source contributions. A sensitivity analysis of PM2.5 contributions from airside sources has demonstrated that use of the Defra backgrounds is a slightly more precautionary approach.

4. Changes in PM2.5 Concentrations

Projected changes in PM2.5 concentrations will influence population exposure metrics, particularly in the context of the PM2.5 Exposure Reduction Target set by the 2021 Environment Act. The assessment of emissions conducted to inform the Airport Commission's Modelling Assessment (Airports Commission, 2015), did not consider impacts on PM2.5 concentrations. However, it can be reasonably assumed to follow a similar trend to PM10, reflecting a gradual reduction over time. The assessment indicates that baseline emissions of road PM are likely to decline in future, albeit at a slower rate than the anticipated reduction in NO2. This is predominantly due to the persistent influence of non-exhaust sources such as brake and tyre wear and road abrasion, which are typically more prevalent in heavier electric vehicles. As traffic and airside emissions will increase because of the proposed airport expansion, the anticipated changes in PM2.5 concentrations will directly affect the population-weighted exposure metric. If baseline PM2.5 levels do not decrease sufficiently, or if localised increases occur in response to the expansion, there is a heightened risk that the local population exposure could rise, undermining progress toward the Exposure Reduction Target set by the 2021 Environment Act.

The Airport Commission's Modelling conducted in 2015 (Airports Commission, 2015) indicated mostly negligible changes in PM10 for receptors surrounding the proposed boundary of the expansion. PM2.5 was not considered in the 2015 modelling assessment as the 2021 Environment Act PM2.5 targets were not in place at the time of its publication. However, assuming similar patterns, this current work conversely indicates that localised increases in PM2.5 are likely, particularly north of the proposed new runway. This is because the increase in ATMs and associated emissions due to the Heathrow expansion will predominantly relate to the operation of the new runway, thus having a greater magnitude of impact at receptors closer to it. The Review of Airside Emissions Sources that forms part of this Air Quality Support for Review of ANPS, concluded that the Airport Commission's modelling of PM10 potentially over-estimated PM10 concentration to a small extent due to assumptions made on non-aircraft-related airside emissions sources.

4.1 Changes in Road PM2.5 Contribution

Using the projected baseline 2050 roads contribution in Table 5 and the scaling factors calculated in Table 7, projected monitored roads contributions for the future DS scenarios were calculated. These concentrations and the differences between the DS and Baseline contributions are shown in Table 10. The values provided in Table 10 and other tables in Section 4 are reported to no more than 3 significant figures, to reflect the indicative nature of this assessment.

Table 10 Projected Changes in Road PM2.5 Contribution ($\mu\text{g}/\text{m}^3$)

Monitor ID	2050 DM Road contribution	2054 Core Scenario DS1 Roads contribution	2054 Core Scenario DS2 Roads contribution	2054 Reasonable Worse Case DS1 Roads Contribution	2054 Reasonable Worse Case DS2 Roads Contribution
T55	0.18	0.21	0.18	0.23	0.19
HS4	4.95	5.01	4.95	6.13	5.18
LHRBR	1.27	1.27	1.26	2.65	1.55
Harlington High Street b)	0.19	0.21	0.19	0.23	0.20
Green Lane, Northwood	0.18	0.21	0.18	0.23	0.19

4.2 Changes in Airside PM2.5 Contribution

Table 11 shows the projected monitored concentrations with the additional ATMs for each model year in the DS scenario for 2055, which had the largest increases in ATMs. Projected concentrations have been estimated using the anticipated increase in ATMs and the estimated 'Aircraft' contribution to PM2.5 background concentrations. It is anticipated that a small contribution to PM2.5 concentrations is expected as a result of the Heathrow expansion. Higher contributions from aircraft are expected at those locations closest to the airport, such as LHR2 and LHRBR.

Table 11 Projected Changes in Aircraft PM2.5 Contribution (µg/m³) for 2055

Monitor ID	Projected Total Concentration – DM	Projected 'Other' Concentration – DM	Projected 'Other' Concentration – Additional DS ATMs	Projected Total Concentration – DS
LHR2	6.25	0.46	0.26	6.51
HRL	6.22	0.28	0.15	6.37
T55	6.20	0.22	0.11	6.31
T54	6.22	0.36	0.20	6.41
HS4	11.7	0.27	0.07	11.8
LHRBR	7.14	0.46	0.26	7.40
Harlington High Street	6.84	0.28	0.15	7.00
Green Lane	7.06	0.11	0.04	7.10

Analysis of PM2.5 source apportionment from the most recent PCM model (2023 base year) shows contributions from 'Aircraft' sources of a similar magnitude to those shown in Table 11. 'Aircraft' sources contribute less than 1 µg/m³ to total PM2.5 concentrations, with higher contributions at those sites closest to the airport, such as LHR2 and LHRBR.

It should be noted that the above analysis only considered the proportional change in ATMs and does not consider the impact of fleet evolution at the airport in future years. It is likely that the aircraft fleet currently used at Heathrow Airport will be different than that used in the future year scenarios. For example, super heavy aircraft (such as the Airbus A380) are being gradually retired from operation and replaced with smaller, more efficient aircrafts which are capable of flying similar distances. This aligns with strategies including the UK's Jet Zero Strategy (Department for Transport, 2022).

4.2.1 Sensitivity Test

An additional sensitivity test has also been undertaken to assess the projected increase in PM2.5 emissions compared to the projection increase in ATMs reported in the Airports Commission's modelling assessment.

The sensitivity test includes the impact from just aircraft, and aircraft plus Ground Support Equipment (GSE). It should be noted that the values below represent 2030, as this was the model year in the Airports Commission's modelling assessment. It is not possible to project this increase to 2055. Table 12 shows the percentage change in PM2.5 emissions and ATMs outlined in the Airport's Commission's modelling assessment.

Table 12 Projected Change in ATMs and PM2.5 Emissions from Airport's Commission's Modelling Assessment

Scenario	DM Emissions (te/yr)	DS Emissions (te/yr)	Change (te/yr)	Percentage Change
Air Traffic Movements				
Additional Runway	484,151	722,473	+238,322	+49.2%
PM2.5 Emissions				
Aircraft (take-off, climb, approach, landing, taxi)	179.3	286.8	+107.5	+60.0%

Aircraft + GSE	190.3	300.5	+110.2	+57.9%
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Source: (Airports Commission, 2015)

The test demonstrates that an approximately 49% increase in ATMs as a result of the additional runway at Heathrow Airport would result in an approximately 60% increase in PM2.5 emissions. An increase in PM2.5 emissions of 60% would not directly result in an increase in PM2.5 concentrations of 60% due to the influence of dispersion. It is not possible to project the influence of this increase in emissions on PM2.5 concentrations without detailed modelling.

4.3 Changes in Total PM2.5 Concentrations

Table 13 to Table 16 show the total change in PM2.5 concentrations as a result of increases in ATMs and road traffic for each of the traffic scenarios tested. It should be noted that the aircraft contribution does not change between DS scenarios.

Results from this analysis suggest that Heathrow Expansion is not expected to cause new exceedances in targets. While most monitoring sites are projected to remain within with Annual Mean Concentration target of 10 $\mu\text{g}/\text{m}^3$ with expansion, results suggest that the local authority monitoring site HS4 is at risk of exceedance in both the with and without expansion scenarios. This site is located approximately 11.4 km east of the airport and the elevated PM2.5 concentrations are likely due to traffic congestion and other local sources of emissions to air. However, it should be borne in mind that this analysis makes various conservative assumptions, as discussed in section 3.10, which may result in higher concentrations being projected than will be the case in reality. Furthermore, the impact of expansion on PM2.5 concentrations is assessed to be minimal in the scenario with illustrative surface access targets (DS2), even under reasonable worst-case assumptions about traffic impacts

Table 13 Projected Changes in PM2.5 Concentrations (Core Scenario)- DS1

Monitor ID	2050 DM concentration ($\mu\text{g}/\text{m}^3$)	2054 DS1 Roads contribution ($\mu\text{g}/\text{m}^3$)	2054 DS* Aircraft Contribution ($\mu\text{g}/\text{m}^3$)	2054 DS1 concentration ($\mu\text{g}/\text{m}^3$)	DS1 – DM concentration ($\mu\text{g}/\text{m}^3$)	DS1-DM % change
LHR2 ^a	6.24	0.19	0.26	6.50	+0.26	4
HR ^a	6.22	0.19	0.15	6.37	+0.15	2
T55	6.20	0.21	0.11	6.33	+0.13	2
T54 ^a	6.21	0.29	0.19	6.40	+0.19	3
HS4	11.6	5.01	0.06	11.7	+0.12	1
LHRBR	7.12	1.27	0.26	7.58	+0.46	6
Harlington High Street b)	6.83	0.89	0.15	7.07	+0.24	3
Green Lane, Northwood	7.07	1.27	0.03	7.10	+0.03	<1

*Applicable to DS1 and DS2. ^aApplicable to Airside emissions only and therefore the roads contribution shown is for the DM scenario throughout

Table 14 Projected Changes in PM2.5 Concentrations (Core Scenario)- DS2

Monitor ID	2050 DM concentration ($\mu\text{g}/\text{m}^3$)	2054 DS2 Roads contribution ($\mu\text{g}/\text{m}^3$)	2054 DS* Aircraft Contribution ($\mu\text{g}/\text{m}^3$)	2054 DS2 concentration ($\mu\text{g}/\text{m}^3$)	DS2 – DM concentration ($\mu\text{g}/\text{m}^3$)	DS2-DM % change
LHR2 ^a	6.24	0.19	0.26	6.50	+0.26	4
HRL ^a	6.22	0.19	0.15	6.37	+0.15	2
T55	6.20	0.18	0.11	6.31	+0.11	2
T54 ^a	6.21	0.29	0.19	6.40	+0.19	3
HS4	11.6	4.95	0.06	11.6	+0.06	1
LHRBR	7.12	1.07	0.26	7.38	+0.26	4

Monitor ID	2050 DM concentration (µg/m³)	2054 DS2 Roads contribution (µg/m³)	2054 DS* Aircraft Contribution (µg/m³)	2054 DS2 concentration (µg/m³)	DS2 – DM concentration (µg/m³)	DS2-DM % change
Harlington High Street b)	6.83	0.79	0.15	6.97	+0.14	2
Green Lane, Northwood	7.07	1.26	0.03	7.09	+0.02	<1

*Applicable to DS1 and DS2. ^Applicable to Airside emissions only and therefore the roads contribution shown is for the DM scenario throughout

Table 15 Projected Changes in PM2.5 Concentrations (Reasonable Worse Case Scenario)- DS1

Monitor ID	2050 DM concentration (µg/m³)	2054 DS1 Roads contribution (µg/m³)	2054 DS* Aircraft Contribution (µg/m³)	2054 DS1 concentration (µg/m³)	DS1 – DM concentration (µg/m³)	DS1-DM % change
LHR2^	6.24	0.19	0.26	6.50	+0.26	4
HRL^	6.22	0.19	0.15	6.37	+0.15	2
T55	6.20	0.23	0.11	6.35	+0.15	2
T54^	6.21	0.19	0.19	6.30	+0.08	1
HS4	11.6	6.13	0.06	12.8	+1.24	10
LHRBR	7.12	1.32	0.26	7.63	+0.51	7
Harlington High Street b)	6.83	0.99	0.15	7.17	+0.34	5
Green Lane, Northwood	7.07	2.65	0.03	8.48	+1.41	17

*Applicable to DS1 and DS2. ^Applicable to Airside emissions only and therefore the roads contribution shown is for the DM scenario throughout

Table 16 Projected Changes in PM2.5 Concentrations (Reasonable Worse Case Scenario)- DS2

Monitor ID	2050 DM concentration (µg/m³)	2054 DS2 Roads contribution (µg/m³)	2054 DS* Aircraft Contribution (µg/m³)	2054 DS2 concentration (µg/m³)	DS2 – DM concentration (µg/m³)	DS2 – DM % change
LHR2^	6.24	0.19	0.26	6.50	+0.26	4
HRL^	6.22	0.19	0.15	6.37	+0.15	2
T55	6.20	0.19	0.11	6.32	+0.12	2
T54^	6.21	0.19	0.19	6.30	+0.08	1
HS4	11.6	5.18	0.06	11.9	+0.29	2
LHRBR	7.12	1.11	0.26	7.43	+0.31	4
Harlington High Street b)	6.83	0.84	0.15	7.02	+0.19	3
Green Lane,, Northwood	7.07	1.55	0.03	7.37	+0.30	4

Applicable to DS1 and DS2. ^Applicable to Airside emissions only and therefore the roads contribution shown is for the DM scenario throughout

5. Population Location Changes

Heathrow expansion will ultimately result in a change to the proximity of receptors to the airport, and the surrounding road network due to both the construction of a new runway and changes to the road network. As both aircraft (and other airside sources) and road traffic are sources of PM2.5, this proximity change will lead to a change in the magnitude of exposure for surrounding receptors.

The proposal would include homes and businesses to be demolished to accommodate the expansion of the airport. These receptors are primarily located to the northwest of the airport (shown in blue in Figure 2). This represents a population currently situated in areas of high PM2.5 exposure, which will no longer be present with the expansion. The extent to which this distributional change in exposure contributes towards achieving the Exposure Reduction Target set by the 2021 Environment Act is relative to the increase in exposure at receptors and the number of receptors who aren't removed due to the expansion of the airport and will be located closer to airport emissions sources. As previously stated, dispersion modelling of emissions associated with the Heathrow expansion would be the most robust means of identifying the spatial distribution of air quality impacts and the effect of the expansion of the Exposure Reduction Target.

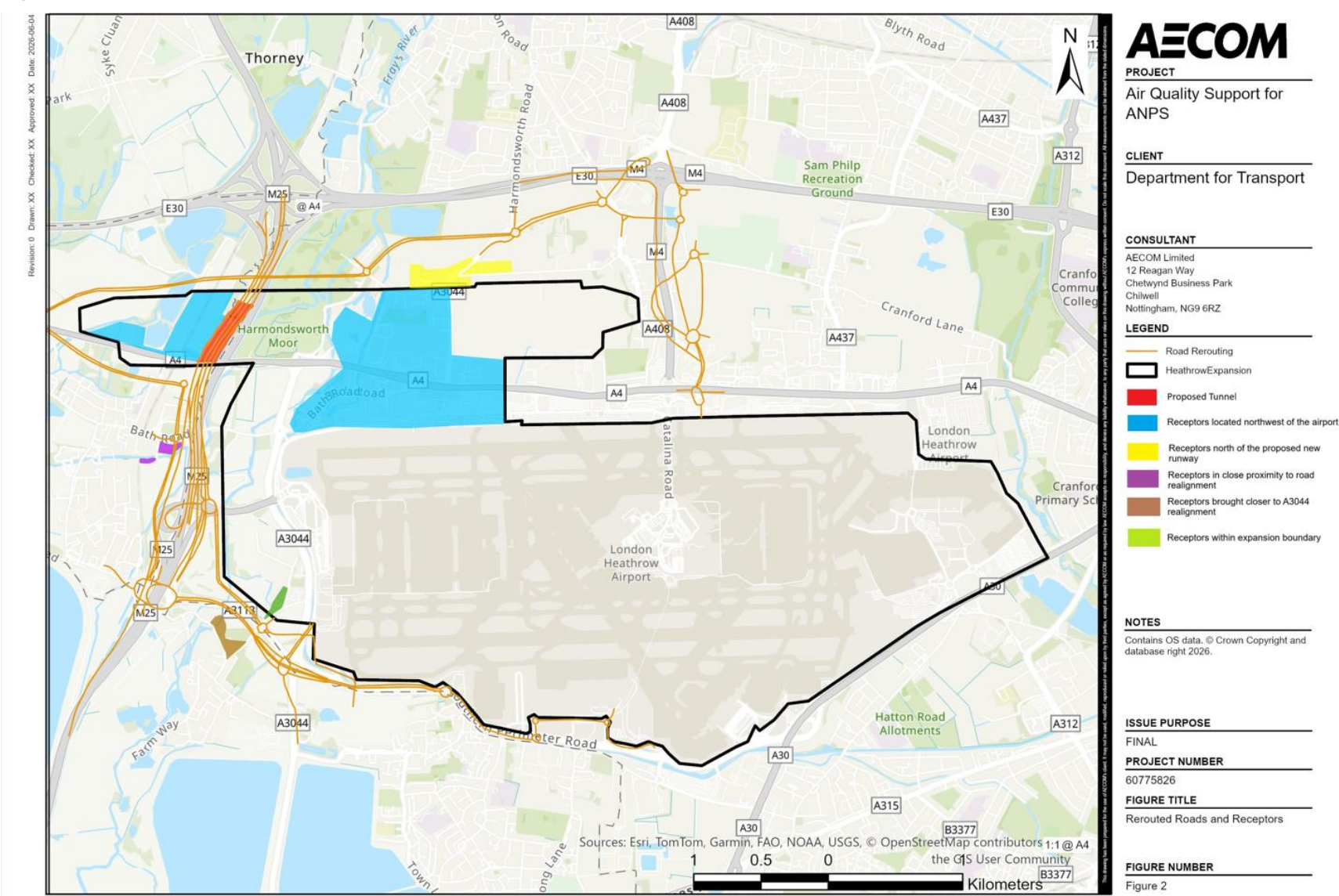
On the northeastern side of the airport, road realignments (orange links in Figure 2) are expected to alter exposure to PM2.5. A new tunnel is proposed for the M25 (highlighted in yellow in Figure 2), which could potentially change near-road exposure for households currently in close proximity to the road (shown in purple in Figure 2), by relocating emissions further from some residential facades, introducing physical separation for others but increasing exposure for receptors adjacent to tunnel portals and vents. The effect on exposure related to this tunnel (highlighted in red in Figure 2) is therefore complex and dependent on the distribution of receptors. Detailed dispersion modelling would be the most robust means of projecting the impact of the tunnel on Emissions Reduction Targets. Receptor exposure at locations close to the A3044 will be affected by the new road alignment of the A3044. Multiple receptors have been identified within 200m of this road (Airports Commission, 2015), and for these receptors, PM2.5 exposure will likely increase. The net effect of the M25 works and the A3044 works at individual receptors, with regards to the PM2.5 target, depends on the balance between reduced contributions from the M25 tunnel section and increased contributions from the M25 tunnel portals and A3044 (shown in brown in Figure 2).

An increase in exposure is also anticipated for receptors located immediately north of the proposed new runway (shown in yellow in Figure 2). This is attributed to the proximity of the primary sources of PM2.5, which include aircraft during the landing and take-off cycle, taxiing, and ground support activities. The magnitude of this increase will depend on runway usage patterns, prevailing winds, and dispersion, but proximity alone indicates a likely rise in local PM2.5 levels for these receptors. This increase in exposure could potentially affect the population-weighted exposure metric which underpins the PM2.5 Exposure Reduction Target (Defra, 2024c) at individual receptors located close to the proposed new runway.

The eastward shift of the M4 will also redistribute traffic-related PM2.5 concentrations. Homes moved further from this are likely to experience reduced exposure, whereas receptors brought closer to the realigned carriageway may see increases. The net change in exposure will again depend on the balance between these proximity shifts and any alterations in traffic volumes and speeds.

The expansion of the airport will therefore affect the exposure of the population to PM2.5. Decreases are expected due to the demolition of currently high exposure receptors, and potentially from the rerouting of the M25 underground. At the same time, increases are expected due to the addition of the new runway, which introduces airside emissions closer to receptors not being demolished to the north, the new road alignment of the A3044, highlighted as in close proximity to multiple receptors, and the impact of the M25 tunnel portals. The net change in exposure will depend on the extent of these changes and the size of the population affected by each, as well as absolute changes in concentrations discussed elsewhere. A more detailed level of assessment would be required to inform judgement on the impact of the expansion on the Exposure Reduction Target and whether or not mitigation is required and to what level.

Figure 2 Exposure Reduction Risks and Opportunities



6. Population Growth

The purpose of the PM2.5 Exposure Reduction Target set by the 2021 Environment Act is to improve air quality by reducing levels of PM2.5 across the country and improving public health. The approach of exposure reduction targets does not solely focus on whether a scheme is likely to lead to an exceedance of limit values but instead considers that appropriate mitigation measures are implemented from the design stage, ensuring the minimum amount of pollution is emitted and that exposure is minimised as far as possible.

Population growth associated with the delivery of new homes around the airport will clearly be a constraint to the achievement of the PM2.5 Exposure Reduction Target, by introducing the potential for new exposure, the level to which depends on their proximity to airside emissions sources, new road alignments, and/or existing road routes used to access the airport. The introduction of new exposure could offset, to some extent, the benefit of any future reduction in ambient PM2.5 concentrations, as suggested by Defra's background maps, which could make the target harder to achieve.

Planning applications (Mayor of London, 2026) primarily indicate population expansion on the eastern side of the airport, which, given the potential proximity to realigned surface access routes and airside activity, could place more residents within zones of higher incremental PM2.5 depending on runway use, dispersion, and prevailing winds. This growth may increase the population-weighted exposure for the eastern side of the Heathrow expansion.

7. Conclusions

This assessment has utilised a high-level approach to provide an indicative assessment of PM2.5 impacts due to the proposed expansion of Heathrow Airport. The assessment has considered the impact of additional emissions associated with increased traffic on the road network and additional emissions associated with an increase in ATMs. The assessment is subject to the assumptions and limitations described in Section 3.10.

The assessment has been informed by traffic data sourced from the NTM and aircraft data sourced from ATM forecasts, both provided by DfT, for scenarios both with and without the proposed Heathrow expansion in operation including the impact of illustrative surface access targets. Baseline PM2.5 measurement data has been sourced from the AURN UKAIR resource published by Defra and the LAQM resources published by the relevant local authorities.

The emissions generated by additional traffic movements and additional ATMs have been estimated to provide a projection of the PM2.5 impact of the expansion. The impact contribution has been added onto the background contribution measured at a number of PM2.5 monitoring sites in the vicinity of Heathrow Airport, to provide a projection of total PM2.5 concentrations with and without the expansion in operation at these sites. For the purpose of this assessment, the monitoring sites were used to represent air quality at sensitive receptors. As noted in section 3.10 this represents a limited geographical extent due to the availability of data.

Results from this analysis suggest that Heathrow Expansion is not expected to cause new exceedances of PM2.5 targets. While most monitoring sites are projected to remain within with Annual Mean Concentration target of 10 µg/m³ with expansion, results suggest that the local authority monitoring site HS4 is at risk of exceedance in both the with and without expansion scenarios. This site is located approximately 11.4 km east of the airport and the elevated PM2.5 concentrations are likely due to traffic congestion and other local sources of emissions to air. However, it should be borne in mind that this analysis makes various conservative assumptions, as discussed in Section 3.10, which may result in higher concentrations being projected than will be the case in reality. Furthermore, the impact of expansion on PM2.5 concentrations is assessed to be minimal in the scenario with illustrative surface access targets (DS2), even under reasonable worst-case assumptions about traffic impacts.

Other monitoring site locations considered in the assessment are not projected to exceed the targets or limit values, even when taking into account a reasonable worst-case scenario aimed at identifying the risk of exceedances. It is, however, noted that a detailed assessment of air quality impacts associated with the expansion of the airport, utilising advanced dispersion modelling, would need to be undertaken to provide a more robust consideration of PM2.5 impacts and concentrations. It is particularly recommended that consideration of the potential for effects close to the Hounslow monitors HS4 and HS9 as these have reported high concentrations and are therefore considered to be sensitive locations.

With regards to exposure, localised changes in exposure are expected. Increases in exposure will occur due to increased traffic movements and ATMs, highways interventions, as well as airside operations moving closer to receptors to the north of the airport. Decreases in exposure will occur due to the removal of existing receptors from the site of the expansion works, and due to highways interventions, including the tunnelling of a section of the M25. However, it is impossible to quantify the overall extent of changes to exposure and related exposure reduction targets, due to the complexity of variable that affect exposure, including those described here and the potential for the introduction of new exposure associated with population growth. It is again noted that a detailed assessment of air quality impacts would need to be undertaken to provide a more robust consideration of the impact of the proposed expansion on exposure reduction targets.

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