Appendix A

TOPIC BASED SCHEMES ASSESSMENT: AOS FOR AIRPORTS NPS

A-8 AIR QUALITY

June 2018

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8 AIR QUALITY

8.1 INTRODUCTION

8.1.1 This topic based assessment considers each shortlisted airport expansion scheme under the Air Quality topic. This assessment is based upon the previous assessment undertaken as part of the Airports Commission's (AC) Sustainability Appraisal (SA) and on additional analysis undertaken by WSP to update the AC's work to take account of the UK Government's 2017 pollution mapping and air quality plan, and the updated vehicle emissions factors. It also responds to the AoS Appraisal Framework which addresses issues identified through scoping, a review of plans, policies and programmes (PPP), and also the national baseline.

8.1.2 By law, before designating an Airports National Policy Statement (NPS) an Appraisal of Sustainability (AoS) must be carried out. This AoS is a strategic level assessment. It is based on the contents of the Airports NPS. The AoS considers alternatives to the Government's preferred scheme as set out in the Airports NPS, including the outline masterplans supplied to the Airports Commission for the three shortlisted schemes. This AoS considers the impacts of expansion without the benefits of the mitigation package put forward by scheme promoters, unless stated otherwise. The Government has outlined that it expects a significant mitigation package to be put in place by the promoter of its preferred scheme to ensure that wherever possible significant effects are avoided, reduced or offset.

8.1.3 Further project-level design will be required which will inform an environmental impact assessment carried out by the promoter. This would include an assessment, which is likely to include effects identified in the AoS as well as more detailed mitigation developed as detailed design progresses. This will also be developed through consultation with both affected communities and other stakeholders.

8.1.4 Nationally, emissions which impact on air quality originate from various sources including: cars; goods vehicles; aircraft; heat and power generation plants; domestic heating; as well as any other combustion sources. Emissions from all sources influence the UK's total national pollutant emissions; however, at the local scale, it is the combination of the magnitude of sources and their proximity to receptors which influences outdoor pollutant concentrations.

8.1.5 For each of the schemes, airport expansion results in an increase in total pollutant emissions to air. This increase is dominated by the increase in emissions from aircraft and, moreover, by the increase in 'in-air' emissions i.e. engine exhaust emissions during the initial climb, climb out and approach. In contrast, in relation to the exposure of the population to pollution, in-air emissions have relatively little impact since they disperse significantly before reaching receptors; the principal emission source in proximity to sensitive receptors is road traffic. Consequently, for all future schemes, road traffic is the dominant emission source causing poor local air quality, as it is in general across the UK. It is therefore an important aspect to consider for any scheme.

8.1.6 Each of the shortlisted schemes is considered against the AoS Appraisal Framework Objectives and Questions. The Objective and Questions which are addressed within this assessment are as follows:

- **AoS Objective 13:** To improve air quality and reduce emissions consistent with EU, national and local standards and requirements.
  - **Appraisal Question 25:** Will it support compliance with local, national and European air quality requirements or legislation?

- **Appraisal Question 26:** Will it reduce the exposure to air quality for local communities and sites designated for nature conservation?

8.1.7 This assessment builds on the air quality assessment undertaken by the AC and recent analysis of demand undertaken by the Department for Transport (DfT) and reported in the UK Aviation Forecasts 2017.[1]

8.2 POLICY AND LEGISLATION

8.2.1 The following policy and legislation relevant to this assessment are summarised below and their context and applicability is explained as appropriate in the relevant sections of the assessment.

EU Air Quality Directive

8.2.2 The EU Ambient Air Quality Directive (2008/50/EC)[2] (the Directive) sets legally binding limit values for concentrations in outdoor air of major air pollutants that impact public health including Particulate Matter (as PM_{10})[3] and Nitrogen Dioxide (NO_2) and requires Member States to report concentrations to the Commission on an annual basis. The Directive brought together a number of earlier EU air quality directives and daughter directives within a single instrument. Directive 2004/107/EC of 15th December 2004 (termed 4th Daughter Directive), which covers cadmium, arsenic, nickel, mercury and polycyclic aromatic hydrocarbons (PAH),[4] was not incorporated in the overarching Ambient Air Quality Directive pending sufficient experience being gained in relation to its implementation. However, the 4th Daughter Directive contains only target values for the concentrations of these pollutants rather than legally binding limit values.

8.2.3 The limit values are transposed into UK law through the Air Quality Standards Regulations 2010.[5] From 2015, an additional limit value of 25µg/m^3 for $PM_{2.5}$ [6] applies. The UK's most recent submission to the Commission,[7] made in 2016 and based on concentrations monitored in 2015, stated that the UK complied with all limit values with the exception of NO_2. Under the Directive, where pollutant concentrations exceed the limit values, the Secretary of State must draw up and implement an Air Quality Plan so as to achieve that limit value.

EU National Emissions Ceiling Directive

8.2.4 The UK also has obligations to reduce emissions under the Convention on Long-range Transboundary Air Pollution (as extended by the Gothenburg Protocol) and the EU National Emission Ceilings Directive (NECD) (2016/2284)[8] (amending Directive 2003/35/EC and repealing Directive 2001/81/EC).

8.2.5 The NECD set annual limits on emissions of oxides of nitrogen (NOx), sulphur dioxide (SO_2), ammonia (NH_3) and non-methane volatile organic compounds (NMVOCs) from 2010. Directive 2016/2284 has not yet been transposed into UK law, but the earlier Directive 2008/81/EC was transposed by the National Emission Ceilings Regulations 2002 (SI 2002/3118).

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[1] Department for Transport (2017), UK Aviation Forecasts 2017

[2] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. [online] Accessed 04/07/2016; as amended by Directive 2015/1480 [online] Accessed 20/01/2017

[3] Particles which pass through a size-selective inlet with a 50 % efficiency cut-off at 10 µm aerodynamic diameter, as defined in ISO 7708:1995, Clause 6 (Defra, 2015. *Air Pollution in the UK 2014*. [online] Accessed 16/06/2016).

[4] European Parliament and Council of the European Union, 2004. Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. [online] Accessed 16/06/2016.

[5] The Air Quality Standards Regulations 2010 - Statutory Instrument 2010 No. 1001 [online] Accessed 04/07/2016.

[6] $PM_{2.5}$ is particulate matter with a diameter less than 2.5microns (0.0000025m)

[7] Defra, 2016. *Air Pollution in the UK 2015, Compliance Assessment Summary*. [online] Accessed 04/07/2016.

[8] European Parliament and Council of the European Union, 2016. Directive 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emission of certain atmospheric pollutants. [online] Accessed 20/01/2017.

8.2.6 In 2012, the Gothenburg Protocol was amended to set legally binding emissions reductions commitments for key air pollutants including $PM_{2.5}$ and NOx, to be achieved by 2020. The reductions are specified as a percentage reduction in relation to 2005 emissions levels. The 2020 targets currently apply to years after 2020. The 2016 revision to the NECD implements these targets as emission ceilings and sets new ceilings for 2030.

UK Air Quality Strategy and Regulations

8.2.7 The Environment Act 1995 required that a National Air Quality Strategy (AQS) be published, containing policies for assessment and management of air quality. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland was first published in March 1997 and last updated in 2007. The AQS sets a framework for the improvement of air quality into the long term and sets objectives for the concentration of pollutants in air.

8.2.8 Many of the objectives in the AQS have been made statutory in England through the implementation of the following Regulations:

- Air Quality (England) Regulations 2000;[9] and
- Air Quality (England) (Amendment) Regulations 2002.[10]

8.2.9 Under Part IV of the Environment Act 1995 and the Environment (Northern Ireland) Order 2002, there is a requirement for local authorities to review and assess air quality in their area and to declare Air Quality Management Areas (AQMAs) where an Air Quality Objective (AQO) is exceeded. At the time of writing, the majority of local authorities within the UK had declared at least one AQMA; the vast majority of AQMAs (>94%) are declared as a result of exceedances of the AQO for annual mean NO_2. Exceedances of the daily mean objective for PM_{10} is the second most common reason (~15% of AQMAs; a number of AQMAs being declared for both PM_{10} and NO_2). Moreover, traffic is the most significant local pollution source within the majority of AQMAs.

Air Quality and Ecosystems

8.2.10 Impacts on sensitive ecological receptors are considered against two distinct metrics – critical levels and critical loads. Critical levels are concentrations of pollutants in ambient air and are set out in the Directive and Air Quality Standards Regulations 2010.[4] The Directive specifies the requirements for the macroscale siting of sampling points for the protection of vegetation and natural ecosystems which exclude sampling within 20km of agglomerations and within 5km of other built up areas, industrial installations and busy motorways. Critical loads are standards set with regard to the deposition of pollutants on soils and the surface of vegetation. They are not transposed into regulations.

8.3 BACKGROUND TO THE ASSESSMENT

8.3.1 This assessment draws on information presented in the following AC reports:

- Jacobs, 2014. *6. Air Quality: Baseline*;[11] and
- Jacobs, 2015. *Module 6: Air Quality Local Assessment – Detailed Emissions Inventory and Dispersion Modelling;*[12]

  together with the DfT's aviation demand forecasts published in the 'DfT, 2017. UK Aviation Forecasts 2017'.[13]

[9] Air Quality (England) Regulations 2000, Statutory Instrument No 928. [online] Accessed 04/07/2016.
[10] Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument No 3043. [online] Accessed 04/07/2016.
[11] Jacobs, 2014. *6. Air Quality: Baseline*. [online] Accessed 06/01/2016.
[12] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*. [online] Accessed 06/01/2016.
[13] Department for Transport, 2017. *UK Aviation Forecasts 2017*

8.3.2 Baseline national and local assessments have been undertaken on behalf of the AC to allow a comparative assessment between the 'do minimum' (without airport expansion)[14] and 'do something' (with airport expansion) scenarios for 2030.[15] These baseline assessments highlight an on-going risk of exceedance of AQOs at roadside locations, and the risk of exceedance of national emissions targets. Road traffic is the dominant emission source causing poor air quality at sensitive receptors (human health and ecosystems) and is one of the most important sources when considering the impact upon local air quality conditions.

8.3.3 WSP has not undertaken any additional emissions or impacts modelling within this assessment, but has undertaken an analysis of the implications of recent work undertaken by DfT on expanded airport capacity on the AC's forecasts.

8.3.4 NOx concentrations are important in terms of the potential impacts on sensitive ecosystems (through contribution to nitrogen and acid deposition), whilst NO_2 is important in terms of potential impacts on human health.

8.3.5 Previous studies have demonstrated that airports have little impact on fine particulate matter (PM_{10} or $PM_{2.5}$) concentrations.[16] Emissions and concentrations of PM_{10} have, however, been quantified to inform both the national and local assessment.

8.3.6 The Government published an Air Quality Plan for Nitrogen Dioxide (the 2015 Plan) and associated evidence base including Pollution Climate Mapping (PCM) modelling[17] in December 2015,[18] after the AC's work was concluded. In November 2016, the High Court ordered the Government to produce a modified Air Quality Plan. This was published in July 2017 (2017 Plan). The Government has now also published for consultation a draft Clean Air Strategy, which sets out the Government's approach for reducing air pollution from all sources. [19]

8.3.7 Additional work has been undertaken by WSP to assess the implications of the 2017 Plan and PCM modelling, and the updated vehicle emissions factors, on the conclusions of the AC's air quality assessment in relation to EU Directive limit value compliance.[20,21,22] Further details are provided in Section 8.6 and 8.7.

[14] Represents the conditions which would exist if the scheme did not go ahead
[15] Jacobs, 2014. 6. *Air Quality: Baseline*. [online] Accessed 06/01/2016.
[16] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*, p. 8. [online] Accessed 06/01/2016.
[17] The Government uses a combination of monitoring and modelling to assess compliance with EU limit values. Modelling is undertaken using the Pollution Climate Mapping (PCM) model, and pollutant concentrations are modelled at background locations (on a 1km resolution grid covering the UK) and roadside locations (approximately 9000 A-roads and motorways) across the UK.
[18] Defra, 2016. *Air quality in the UK: plan to reduce nitrogen dioxide emissions*. [online] Accessed 09/01/2017.
[19] Defra, 2017. *UK plan for tackling roadside nitrogen dioxide concentrations*, July 2017 [ref] Accessed 17/09/2017
[20] WSP | Parsons Brinckerhoff, 2016. *Air Quality Re-analysis, impact of new pollution climate mapping projection and national air quality plan*. [online] Accessed 01/12/2016
[21] WSP, February 2017. *Updated Air Quality Re-Analysis, published as part of the draft Airports NPS Consultation documentation*
[22] WSP, October 2017. *2017 Plan Update to Air Quality Re-Analysis*

8.4 INTERACTION WITH OTHER TOPICS

8.4.1 The assessment of the topic is closely related to other topic-based assessments in the AoS. In particular, the following interactions are noted:

Table 8.1: AoS Topic Interactions

Topic	Interaction
Community and Quality of Life	Increased emissions from additional aircraft and traffic movements have the potential to reduce air quality and lead to health impacts upon local residents and receptors. Air quality will have indirect effects on communities and community facilities in particular through effects on quality of life.
Carbon	Emissions to air also include CO_2 and other greenhouse gases from the combustion of fuels associated with Air Transport Movements (ATMs), surface access and operation of the airport infrastructure. The two topics are therefore often linked.
Biodiversity	Changes in air quality can impact biodiversity receptors via deposition, in particular nitrogen deposition on sensitive ecosystems.
Resources and Waste	Extraction, processing, transportation, installation and maintenance of materials typically require the consumption of energy; as a result, atmospheric emissions (including greenhouse gases) are released. This is true of materials both on and off active sites. Disposal of waste to landfill also has the potential to contribute to adverse impacts on air quality, through the generation and release of gases such as methane, carbon dioxide and (as a far smaller percentage) Volatile Organic Compounds (VOC).
Historic Environment	Particulate matter deposition can affect and degrade the fabric of historic structures.

8.5 ASSESSMENT CRITERIA

8.5.1 The existing and future baseline scenarios have been considered, as well as the future scenarios with each of the three schemes in place, through the following principal metrics:

Table 8.2: Principal Metrics used to Consider Existing and Future Scenarios

Measure	Assessment metric	Assessment Area
EU Directive limit value compliance (NO_2)	EU limit values	Wider Study Area
Change in emissions to air (NO_X, PM_{10}, $PM_{2.5}$)	Compliance with NECD limits and Gothenburg Protocol limits	Traffic Model Simulation Area
Ambient pollutant concentrations (human health) (NO_2, PM_{10})	UK National AQOs	Principal Study Area
Change in Population Exposure to Air Pollution (NO_2, PM_{10})	No of properties and population experiencing change in pollution exposure	Principal Study Area
Ambient pollutant concentrations (ecosystem health) (NO_X)	UK National AQOs	Wider Study Area
Pollutant deposition (N)	Non-statutory Critical Loads	Wider Study Area

8.5.2 For all schemes, the AC's assessment has considered three different study areas:

- Principal Study Area, defined as the area within 2km of the scheme boundary,
- Wider Study Area, which includes all roads for which a significant change in traffic has been forecast,[23] and
- Traffic Model Simulation Area, which includes all modelled roads.[24]

8.5.3 Total forecast emissions of NO_x, PM_{10} and $PM_{2.5}$ have been compared to the NECD and Gothenburg Protocol targets.

8.5.4 Predicted concentrations of NO_2 have been compared to the annual mean EU Directive limit value. A Compliance Risk Assessment was carried out utilising data available from the Defra PCM road model. In addition, an assessment has been made of the number of properties predicted to experience changes in NO_2 and PM_{10} concentrations of increasing magnitudes.

8.5.5 For designated habitats, assessment has been made against the NOx critical level, whilst the predicted increase in nitrogen deposition has also been considered.

8.5.6 An overall judgement of the significance of the impacts has been made based on the findings of the work carried out to date using professional judgement, taking into account the uncertainties identified during the review, and based on Section 3 of the AoS to which this appendix is attached (which is reproduced below in relation to air quality).

8.5.7 It should be noted that schemes are assessed individually against the requirements of the SEA Regulations and presented together for comparison. This means that although the nature of effects can vary between schemes, the significance may be the same.

8.5.8 The schemes were appraised against the AoS Objective and Questions using the notation set out in Table 8-3 below. The classification was based on professional judgement.

[23] Area shown in Figures 4.2, 5.2 and 6.2 for each option, in Jacobs, 2015. Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling Figures and Appendices

[24] Areas shown in Figures 4.3, 5.3 and 6.3 for each option, in Jacobs, 2015. Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling Figures and Appendices

Table 8.3: Classification of Significant Effects in the AoS

CLASSIFICATION OF SIGNIFICANT EFFECTS IN THE AOS	
++	Significant Positive effect: e.g. removal or reduction in exceedance of EU Directive limit value; net reduction in national emissions of pollutants by >1%; net reduction in exposure at properties exceeding national objectives; removal or reduction of exceedance of critical levels or critical loads over internationally designated sites
+	Positive effect: e.g. reduction in risk of exceedance of EU Directive limit value; net reduction in national emissions of pollutants by <1%; net reduction in exposure over residential properties at risk of exceeding national objectives; removal or reduction of exceedance of critical levels or critical loads over nationally designated sites
-	Negative effect: e.g. increase in risk of exceedance of EU Directive limit value; net increase in national emissions of pollutants by <1%; net increase in exposure over residential properties at risk of exceeding national objectives; introduction or worsening of exceedance of critical levels or critical loads over nationally designated sites
--	Significant Negative effect: e.g., introduction of or worsened exceedance of EU Directive limit value; net increase in national emissions of pollutants by >1%; net increase in exposure at properties exceeding national objectives; introduction or worsening of exceedance of critical levels or critical loads over internationally designated sites
+/-, ++/--	Mixed Positive and Negative effect: e.g. spatially varying impacts with no dominant characteristic from above criteria
?	Unknown effect
	No relationship/Neutral effect: e.g. no impact on emissions to air

8.6 SUMMARY OF BASELINE

8.6.1 In relation to air quality, consideration is given to both the local and national baseline. This has involved drawing on the results of national and local air quality monitoring, as well as projections of total emissions available from the National Atmospheric Emissions Inventory (NAEI).

8.6.2 Data presented by Defra[7] indicate that there has been a long term, statistically significant year-on-year decrease in NO_2 concentrations at urban non-roadside sites from 1992 to 2015. At urban traffic sites, the trend is less consistent, with four of the eight long term monitoring sites showing a significant downward trend over time but the other four showing no significant trend.

8.6.3 PM_{10} concentrations show a definite decreasing trend at urban background and the majority of urban traffic sites across the UK, but year-on-year variability is higher than for NO_2 due to the influence of meteorological conditions, local traffic variations and transboundary transport into the UK. Long-term $PM_{2.5}$ monitoring shows some sites have shown a significant downward trend to date, with no significant change at other sites. Whilst $PM_{2.5}$ concentrations have fallen since the early 1990s, emissions have been stable since around 2002.

8.6.4 National emissions data published by Defra demonstrates that there has been a long term decrease in the emission of air pollutants covered by the Gothenburg Protocol, NOx, SO_2, NH_3, NMVOCs and PM (data available for 1992 – 2015). Total emissions of PM_{10} and $PM_{2.5}$ decreased to around 2008 but have since stabilised; total emissions of NOx show reductions year-on-year.

FUTURE BASELINE AND ISSUES

8.6.5 Defra provides projections of background and roadside air quality for the assessment of compliance with EU Directive limit values based on modelling undertaken using the PCM model. Significant improvements in local air quality are predicted over time. The 2017 Plan[25] stated that in 2015 thirty seven (of forty three) zones in the UK exceeded the statutory annual mean limit value for NO_2. These included the Greater London Urban Area and the South-East Zone potentially affected by airport expansion. Without the implementation of measures over and above existing actions to improve air quality, the PCM model projections accompanying the 2017 Plan identified that compliance would not be achieved in Greater London until 2028 and, in the South-East, not until 2023 (Baseline scenario). With the implementation of Clean Air Zones (CAZ), compliance was brought forward to 2026 in Greater London and 2022 in the South East (CAZ scenario). Additional actions were required to bring compliance in Greater London forward to 2025 (CAZ + additional measures scenario). These conclusions are dependent on projected reductions in emissions from road transport and the performance of stricter vehicle emissions standards in addition to the performance and implantation timescales of the CAZ and additional actions identified in the 2017 Plan. The pollutant of greatest concern is NO_2.

8.6.6 Revised emissions projections and target levels were published by Defra after the completion of the AC's work.

8.6.7 The latest report,[26] with emissions to 2015, indicates that total UK emissions are within the NECD ceiling levels set for 2010 and that progress has been made towards meeting the Gothenburg Protocol emission reduction commitments for 2020.

8.6.8 However, the reports also indicate that $PM_{2.5}$ emissions are projected to exceed their 2020 Gothenburg targets; partly as a result of methodological changes relating to emissions from domestic wood burning, though it should be noted that estimating emissions of particles, and of $PM_{2.5}$ specifically, is subject to high uncertainty. NO_X emissions are projected to marginally exceed the revised 2020 targets.

8.6.9 Emissions of NOx and $PM_{2.5}$ are currently projected to exceed the 2030 NECD targets without additional measures to reduce baseline emissions.

8.7 APPROACH TO ASSESSMENT OF AIR QUALITY

8.7.1 The approach to the assessment of air quality for the AoS has been twofold:

- → A review of the assessment and reporting undertaken by the AC for the construction and operation phases of the schemes; and
- → A re-analysis of the results of the AC's assessment of operational impacts in light of the Government's 2017 Plan and updates to vehicle emissions factors.

[25] Defra, 2017. *UK.* Plan for tackling roadside nitrogen dioxide concentrations. Technical Report [https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017] Accessed 19/09/2017.
[26] Ricardo Energy and Environment, 2017, *UK Informative Inventory Report* (1990 to 2015). [online] Accessed 19/09/2017.

8.7.2 The assessment carried out by the AC[27] to determine the impact of the three schemes considered impacts during both the construction phase and the operational phase in 2030. The operational phase assessment included quantification of aircraft and surface access emissions,[28] and utilised ADMS Airport software. Emissions estimates and modelling were carried out for 2030 (which coincides with the traffic forecast year). The assessment of impacts during construction was undertaken qualitatively.

8.7.3 The AC analysis of air quality impacts make use of a "worst case" scenario. It is based upon the AC's passenger demand scenario that results in the greatest likely air quality impact consistent with the Promoters' preferred business model, namely: Carbon Traded Global Growth for Heathrow NWR and Heathrow ENR; and Carbon Traded Low Cost is King scenario for Gatwick Second Runway. Higher passenger demand growth would result in a greater number of air traffic movements and surface access trips, and greater resulting emissions of air pollutants from aircraft, airport, and surface access sources.

8.7.4 The additional re-analysis study[22] was undertaken by WSP on behalf of the Department for Transport and considered the implications of the 2017 Plan and PCM modelling on the conclusions of the AC's air quality assessment. Specifically, the study considered:

- The change in projected roadside nitrogen dioxide concentrations with the 2017 Plan PCM modelling;
- Whether the new projections indicate that the shortlisted schemes will or will not cause or contribute to exceedances of EU Directive limit values;
- The potential impacts of mitigation on compliance with EU Directive limit values (from either the 2017 Plan or scheme-specific measures identified by the AC);
- The DfT's *UK Aviation Forecasts 2017*;[29]
- Whether the new projections will change the conclusions of the AC's compliance assessment; and
- Uncertainties in the future PCM projections and in the AC's modelling of impacts, including the opening date for the scheme, the rate of growth and operations at full capacity.

8.7.5 This additional re-analysis was the latest in a series of reports by WSP, taking into consideration the impact of airport expansion on compliance with EU Directive limit values[34] (WSP | Parsons Brinckerhoff re-analysis, and Updated WSP re-analysis).

8.7.6 No new modelling work was undertaken for the additional study. It was based on a re-analysis of existing datasets that have been published in summary, graphical or tabular form in:

- AC's *Air Quality Local Assessment*;[30]
- UK Government's 2017 Plan and supporting technical reports; and
- DfT (2017) *UK Aviation Forecasts 2017*.

8.7.7 The additional study followed methodologies consistent with those utilised for the AC's *Air Quality Local Assessment*.

8.7.8 As such, in relation to the assessment criteria set out in Section 8.5, the impact of the schemes on EU Directive limit value (for human health) compliance is based wholly on the additional WSP

[27] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*. [online] Accessed 06/01/2016.
[28] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling,* p. 7. [online] Accessed 06/01/2016.
[29] Department for Transport (2017), *UK Aviation Forecasts 2017*
[30] Jacobs, 2015. Module 6: Air Quality Local Assessment - *Detailed Emissions Inventory and Dispersion Modelling.*

| Parsons Brinckerhoff re-analysis, whereas the impact of the schemes on pollutant emissions, national AQOs and ecosystems is assessed with reference to the AC's work and subsequent scaling based on the recent DfT work on airports capacity.

8.7.9 Subsequent to the AC's work and modelling on air quality, alternative surface access schemes have been proposed by the promoter of the London Heathrow Extended Northern Runway (LHR-ENR) scheme. The alternative surface access schemes (Iteration 3 and Iteration 4) have been considered, qualitatively, in this study (Appendix D). This Appendix relates primarily to the AC's surface access strategy and provides only a summary of impacts of the surface access scheme iterations where they significantly alter these conclusions.

APPROACH TO SCALING EMISSIONS TO TAKE ACCOUNT OF DFT AVIATION FORECASTS

8.7.10 To revise the original estimates of emissions to take account of the DfT's 2017 forecasts, a simple scaling approach was developed. This assumed a linear relationship between aircraft movements (ATMs) and emissions. That is to say, if aircraft movements increase by 10%, then emissions will similarly increase by a factor of 10%. The scaling factor is calculated as the ratio between the DfT's 2017 forecasts and the AC's forecasts, and applied to the AC's reported emissions.

8.7.11 The AC reported on the total emission of pollutants from activities associated with the various emissions sources on the airport (airside emissions) and from road transport. The latter emissions were reported as a total emission from all roads within the study areas for the schemes and hence included both airport-related and non-airport related vehicles. The scaling factor is applied to the airport-related component only.

8.7.12 The AC and DfT estimates of aircraft movements are provided in Table 8.4. For each option, the AC demand model that gave the greatest likely air quality impact consistent with the Promoters' preferred business model was selected for full analysis by the AC. This means that, for Gatwick the assessment was based on the Carbon Traded Low Cost is King scenario and for both Heathrow options, the assessment was based on the Carbon Traded Global Growth scenario. This assessment update follows the same conservative approach in that the impact of the expansion with the DfT's 2017 forecasts was based on the DfT high growth scenario (2017 High).

Table 8.4: ATM per year in the AC and revised DfT (2017 High) demand models for 2026 and 2030. DM = Do Minimum (Without Expansion); With Option = With Airport Expansion Option (2R, NWR, ENR as appropriate).

	2026		2030	
	DM	With Option	DM	With Option
Gatwick 2R				
AC Low Cost is King (A)	279,019	354,601	279,677	464,066
DfT 2017 High (B)	287,715	338,988	287,736	373,953
Ratio of DfT to AC ATM (C)	1.03	0.96	1.03	0.81
Heathrow NWR				
AC Carbon Traded Global Growth (A)	481,399	567,832	484,208	722,534
DfT 2017 High (B)	479,441	723,990	481,714	741,246
Ratio of DfT to AC ATM (C)	1.00	1.28	0.99	1.03
Heathrow ENR				
AC Carbon Traded Global Growth (A)	481,399	568,069	484,208	702,967

	2026		2030	
	DM	With Option	DM	With Option
DfT 2017 High (B)	479,441	705,737	481,714	709,553
Ratio of DfT to AC ATM (C)	1.00	1.24	0.99	1.01
A = AC demand model; B = DfT 2017 forecasts; Calculated as C = B/A				

8.7.13 The 'Do Minimum' and 'with Option' emissions forecasts were scaled separately, to reflect changes in fleet mix and activities explicitly taken into account in the AC's assessment.

8.7.14 Since the AC's assessment only considered ambient air quality impacts in 2030, for years other than 2030 the ratio of the change in Air Traffic Movements in the DfT's new forecasts (year specific) and the AC's demand model for 2030 is used in assessing the likely implications for local ambient air quality of opening in years prior to 2030.

8.8 MITIGATION INCLUDED IN ASSESSMENT

8.8.1 The AC's assessment took into account mitigations by design. These are mitigations brought about by the re-alignment of airport access roads, physical changes in surface access and physical alignments of the airport infrastructure (e.g. runway and apron layouts) and, for construction, through the implementation of a Construction Environmental Management Plan (CEMP) and Construction Logistic Plan. As such, the data presented in this assessment relate to the airport options prior to the application of mitigation measures proposed by the scheme promoters or the AC.

8.8.2 However, the AC's assessment included consideration of the potential impacts of additional mitigations, proposed by the promoters for the schemes and/or the AC. These mitigations were not formally included in the assessment but an indication (qualitative or semi-quantitative as appropriate) was given of the potential for the mitigation to reduce negative impacts of the scheme on pollutant emissions and, for LHR-NWR and LHR-ENR, on compliance with EU limit values. (Table 4.16, 5.16 and 6.16 of the air quality assessment).[16]

8.8.3 The potential for these mitigation measures to reduce the impacts of the schemes has been considered in this assessment. Further details are provided in Section 8.10.

8.9 ASSESSMENT OF SHORTLISTED SCHEMES

LONDON GATWICK SECOND RUNWAY (LGW-2R)

8.9.1 The proposal is for a new full length runway to the south of and parallel to the existing runway at Gatwick Airport. The space between the runways would be set at 1,045m, which would provide room for the required supporting airport infrastructure – a new terminal building, main pier and satellite. It would also be needed to permit simultaneous independent mixed mode operations on each runway, as proposed by the scheme promoter, which would enable the proposed operating capacity of 560,000 air transport movements per annum.[31]

EU DIRECTIVE LIMIT VALUE COMPLIANCE (WSP RE-ANALYSIS)

8.9.2 WSP's re-analysis of the AC's impact assessment[22] in relation to compliance with EU directive limit values indicates that LGW-2R is at low risk of impacting on the UK compliance with limit values.

[31] Airports Commission, 2015. *Final Report*. [online] Accessed 16/06/2016.

8.9.3 The conclusion has low vulnerability to uncertainties associated with the projection of future pollution concentrations and to the rate of growth in demand from a 2025 opening year since in the sensitivity testing analysis the scheme is only at risk of triggering non-compliance with EU Directive limit values when maximum levels of uncertainty are applied to the Government's PCM model projections. In addition, the conclusion is not sensitive to the implementation of actions to improve air quality set out in the Government's 2017 Plan.[19]

8.9.4 The risks relate to impacts (from both airside and landside sources) alongside roads in the vicinity of the airport and, therefore, local mitigation measures relating to airside and/or surface transport could reduce the risk of impacting on compliance.

POLLUTANT EMISSIONS

8.9.5 The NAEI projects UK total emissions of NOx and $PM_{2.5}$ up to and including the year 2030. These projections include emissions from Gatwick airport without expansion.

8.9.6 The AC's assessment states that the LGW-2R scheme is predicted to increase emissions of NOx from the Traffic Model Simulation Area by 1.9 kt/yr (0.4% of the estimated 2030 emissions for the UK). With the latest NAEI projections (published in 2016[29]), this increases emissions from 531 kt/yr to 533 kt/yr. $PM_{2.5}$ emissions increase by less than 0.1 kt/yr,[32] from 97 kt/yr to 97.1 kt/yr (an increase of 0.07%).[33]

8.9.7 Total UK emissions of NOx in 2030 are expected to meet the Gothenburg Protocol emission reduction commitment for 2020 but are currently projected to exceed the NECD commitment for 2030;[8] emissions of $PM_{2.5}$ are currently projected to exceed their targets for 2020 and 2030.

8.9.8 The current baseline NAEI 2030 projections[26] are 122.4% of the 2030 NOx target, with the proportion increasing to 122.8% with the second runway. The baseline NAEI 2030 projections are 159.0% of the NECD 2030 $PM_{2.5}$ target, increasing to 159.1% with the second runway.

8.9.9 DfT's latest estimates of the growth in demand and the increase in ATMs with a second runway are lower than assessed by the AC (Table 8-4). As such, the AC's emissions are a conservative estimate of future emissions. However, this has no material impact on the conclusions relating to the projected exceedance of NECD targets for 2030. The exceedance itself is not sensitive to assumptions relating to the rate of growth, rather it is a result of baseline emissions exceeding the target prior to the addition of the emissions resulting from airport expansion.

UK AIR QUALITY OBJECTIVE COMPLIANCE AND POPULATION EXPOSURE

8.9.10 In the AC's assessment the maximum modelled annual mean NO_2 concentration with the scheme in place at any receptor is 38.6µg/m^3 in 2030.[34] The maximum incremental change brought about by the scheme at any receptor is 13.1µg/m^3. Predicted PM_{10} concentrations are all well below the annual mean AQO. The predicted incremental changes in PM_{10} concentrations are all less than 4µg/m^3.

8.9.11 There are 20,985 properties where annual mean NO_2 concentrations within the Principal Study Area are predicted by AC to be higher with the scheme (on average by 2.1 µg/m^3), with 51,328

[32] Rounded to 1 decimal place.
[33] kt/yr = kilotonnes per year = 1000 tonnes per year = 1000 te/yr
[34] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling,* p. 43. [online] Accessed 06/01/2016.

people affected. There are 62 “at risk” properties (>32 µg/m^3) that would experience an increase in NO_2 concentrations.[35]

8.9.12 Should the second runway be operational prior to 2030, there is risk of worsened exceedance of the UK’s air quality objective for annual mean NO_2. However, taking into account the latest projections of improvements in roadside air quality, roadside concentrations in the vicinity of Gatwick airport are likely to be around 10% higher in 2025 than 2030, but still lower than projected at the time of the AC’s assessment. This risk would apply at substantially fewer than the 62 “at risk” properties identified by the AC.

8.9.13 If demand grows at the rate estimated by the DfT (with slower growth than assessed by the AC), then the risk of worsened exceedance of the air quality objective would be reduced but not eliminated.

ECOSYSTEM IMPACTS

8.9.14 The scheme would not cause any new exceedances of the lower or upper bounds of the critical loads, and no new exceedances of the critical level are predicted – although some worsening of existing exceedances of critical loads and levels is likely in proximity to roads experiencing an increase in traffic with the scheme including over Mole Gap to Reigate Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI); an improvement is predicted at the Buchan Hill Ponds SSSI. Cumulative effects on air quality may arise from the airport expansion in combination with other major infrastructure development delivered in support of the National Networks National Policy Statement, or residential, commercial or infrastructure development associated with nearby local authority’s plans for growth, delivered in support of local development plans.

LONDON HEATHROW EXTENDED NORTHERN RUNWAY (LHR-ENR)

8.9.15 The proposal is for an extension of the existing northern runway at Heathrow Airport to the west. This would effectively create two separate runways, each 3,000m in length, with a 650m safety area in between, enabling them to be operated independently. The scheme would provide an operating capacity of 700,000 air transport movements per year.

8.9.16 Since the publication of the AC’s report, revised surface access strategies for LHR-ENR have been developed. The conclusions of the updated WSP re-analysis[22] took into account the updated strategy. An initial screening of the impacts of the surface access variations is provided in Appendix D.

EU DIRECTIVE LIMIT VALUE COMPLIANCE (WSP RE-ANALYSIS)

8.9.17 The AC’s report identified that there was a risk that the unmitigated scheme would impact on compliance with EU Directive limit values in the Greater London Urban Area. WSP’s updated re-analysis of the AC’s impact assessment[22] confirmed the risk and concluded that the LHR-ENR scheme impacts on compliance with limit values in the re-analysis core scenario (i.e. taking account the actions in the Government’s 2017 Plan); with the updated surface access strategy, the scheme is unlikely to impact on modelled compliance with limit values in the core scenario.

[35] ‘At risk’ properties defined by AC Commission as properties at which concentrations exceed 32µg/m3 (80% of the air quality objective) with the scheme.

8.9.18 The conclusion is, however, subject to some uncertainty. The risk of an impact on compliance with limit values increases the earlier the assumed opening year. For early opening (assessed for 2026 in the re-analysis), the risk is high (very high without the updated access strategy) and the option (without updated access strategy) is likely to impact on zone compliance due to impacts in central London and/or impacts in the vicinity of the airport. Moreover, a risk exists, due to impacts in central London, whether or not the updated surface access strategy is implemented but the updated strategy is required to reduce risks in the vicinity of the airport (from very high to high in 2026, and very high to medium in 2030). A risk also exists whether or not the Government's 2017 Plan actions are fully implemented.

8.9.19 With the updated surface access strategy, the level of risk is primarily dependent on the timing of the introduction of, and effectiveness of, the Government's 2017 Plan measures. It is largely independent of assumptions relating to the impact of the option itself, the rate of growth in demand or the direct mitigation of airside emissions.

8.9.20 Additional measures aimed at targeting high NO2 concentrations at the local level and across London could potentially mitigate this risk further.

POLLUTANT EMISSIONS

8.9.21 The NAEI projects UK total emissions of NOx and $PM_{2.5}$ up to and including the year 2030. These projections include emissions from Heathrow Airport without expansion.

8.9.22 The AC's assessment states that the LHR-ENR scheme is predicted to increase emissions of NOx from the Traffic Model Simulation Area by 2.0 kt/yr (0.4% of projected 2030 emissions for the UK). Taking into account the latest available NAEI projections (published in 2017[29]), total emissions increase from 531 kt/yr to 533 kt/yr. $PM_{2.5}$ emissions increase by 0.1 kt/yr, from 97.0 kt/yr to 97.1 kt/yr (an increase of 0.1%).

8.9.23 Total UK emissions of NOx in 2030 are expected to meet the Gothenburg Protocol target emission reduction commitment for 2020 but are currently projected to exceed the NECD commitment for 2030[26]; emissions of $PM_{2.5}$ are currently projected to exceed their targets for 2020 and 2030.

8.9.24 The current baseline NAEI 2030 projections[26] are 122.4% of the 2030 NOx target with the proportion increasing to 122.8% with the extended runway. The baseline NAEI 2030 projections are 159.0% of the NECD 2030 $PM_{2.5}$ target, increasing to 159.2% with the extended runway.

8.9.25 DfT's latest estimate of growth in demand and ATMs with the extended runway are higher than assessed by the AC, by around 4% (Table 8-4). This has only a marginal impact on emissions, with NOx emissions potentially increasing by 2.1kt/yr with DfT demand model in comparison to the 2.0kt/yr assessed by the AC.

UK AIR QUALITY OBJECTIVE COMPLIANCE AND POPULATION EXPOSURE

8.9.26 In the AC's assessment the maximum modelled annual mean NO_2 concentration with the scheme in place at any receptor impacted by the scheme (within the Principal Study Area)[36] is 37.2µg/m^3 in 2030. This occurs to the north of the extended runway close to the A3044. The maximum incremental change brought about by the scheme at any receptor is 14.0µg/m^3.

[36] Note: The pollutant concentrations provided for the Principal Study Area apply to selected receptors only. Concentrations at other receptors may exceed these concentrations, but are unaffected by the scheme.

8.9.27 Predicted PM_{10} concentrations are all well below the annual mean AQO. The predicted incremental changes in PM_{10} concentrations are all less than 6µg/m^3.

8.9.28 There are 38,656 properties where annual mean NO_2 concentrations within the Principal Study Area are predicted by AC to be higher (on average by 0.7 µg/m^3) with the scheme, with 100,392 people affected. There are 113 "at risk" properties (>32 µg/m^3) that would experience an increase in annual mean NO_2 concentrations.[37]

8.9.29 Should the extended runway be operational prior to 2030, there is risk of worsened exceedance of the UK's air quality objective for annual mean NO_2. However, taking into account the latest projections of improvements in roadside air quality, which show that in the vicinity of Heathrow, roadside concentrations are likely to be around 5% higher in 2025 than 2030, but markedly lower than projected at the time of the AC's assessment this risk would apply at substantially fewer than the 113 "at risk" properties identified by the AC.

ECOSYSTEM IMPACTS

8.9.30 The scheme is not predicted to cause any new exceedances of the lower or upper bounds of nitrogen deposition critical loads. The scheme is predicted to cause new exceedances of the Critical Level at the South West London Waterbodies RAMSAR / SPA and the Wraysbury Reservoir SSSI, however it is judged that the Critical Level does not strictly apply at these locations (based on the macro-scale siting requirements for monitoring in the EU Directive).[2]

8.9.31 Cumulative effects on air quality may arise from the airport expansion in combination with other major infrastructure development delivered in support of the National Networks National Policy Statement, or residential, commercial or infrastructure development associated with nearby local authority's plans for growth, delivered in support of local development plans.

LONDON HEATHROW NORTHWEST RUNWAY (LHR-NWR)

8.9.32 The proposal is for a new full length runway to the northwest of the current northern runway at Heathrow Airport.

8.9.33 The horizontal separation between the new runway and the current northern runway is 1,045m, allowing it to operate independently of the existing runways. When the scheme promoter's proposed alternation pattern is factored in this would allow a forecast operating capacity of 740,000 air transport movements per year.

[37] 'At risk' properties defined by AC as properties at which concentrations exceed 32µg/m3 (80% of the air quality objective) with the scheme.

EU DIRECTIVE LIMIT VALUE COMPLIANCE (WSP RE-ANALYSIS)

8.9.34 WSP's updated re-analysis of the AC's impact assessment[22] concludes that the LHR-NWR scheme does not impact on modelled compliance with limit values in the re-analysis core scenario (i.e. taking account of updated vehicle emissions factors, the measures in the Government's 2017 Plan).

8.9.35 The conclusion is, however, subject to some uncertainty. The risk of an impact on compliance with limit values increases the earlier the assumed opening year. For early opening (assessed for 2026 in the re-analysis), the risk is high and the option is likely to impact on compliance with limit values due to impacts in central London. The risk falls to medium in 2030.

8.9.36 Impacts near the airport do not, in general, affect zone compliance. That is to say, whilst the scheme impacts on compliance with EU limit values alongside some roads in the vicinity of the airport in some sensitivity tests in the updated re-analysis, total pollutant concentrations in central London with the scheme are generally higher.

8.9.37 As such, the level of risk is primarily dependent on the timing of the introduction of, and effectiveness of, measures in the Government's 2017 Plan. It is largely independent of assumptions relating to the impact of the option itself, the rate of growth in demand or the direct mitigation of option-related emissions.

8.9.38 Additional measures aimed at targeting high NO_2 concentrations at the local level and across London could potentially mitigate this risk further.

POLLUTANT EMISSIONS

8.9.39 The NAEI projects UK total emissions of NOx and $PM_{2.5}$ up to and including the year 2030. These projections include emissions from Heathrow Airport without expansion.

8.9.40 The AC's assessment states that LHR-NWR is predicted to increase emissions of NOx from the Traffic Model Simulation Area by 2.5 kt/yr (0.5%). Taking into account the latest NAEI projections (published in 2016[26], this would increase emissions from 531 kt/yr to 534 kt/yr. $PM_{2.5}$ emissions increase by 0.1 kt/yr, from 97.0 kt/yr to 97.1 kt/yr (an increase of 0.12%).

8.9.41 Total UK emissions of NOx in 2030 are expected to meet the Gothenburg Protocol target emission reduction commitment for 2020 but are currently projected to exceed the NECD commitment for 2030[26]; emissions of $PM_{2.5}$ are currently projected to exceed their targets for 2020 and 2030.

8.9.42 The current baseline NAEI 2030 projections[26] are 122.4% of the NECD 2030 NOx target with the proportion increasing to 122.9% with the additional runway.

8.9.43 LHR-NWR is expected to increase total UK emissions of $PM_{2.5}$ by around 0.2% of the NECD 2030 target. The baseline NAEI 2030 projections are 159.0% of the NECD 2030 $PM_{2.5}$ target, increasing to 159.2% with the north-west runway.

8.9.44 DfT's latest estimate of ATMs with the new runway are higher than assessed by the AC, by around 9% (Table 8-4). This has only a marginal impact on emissions, with NOx emissions potentially increasing by 2.8 kt/yr with DfT demand model in comparison to the 2.5 kt/yr assessed by the AC.

UK AIR QUALITY OBJECTIVE COMPLIANCE AND POPULATION EXPOSURE

8.9.45 In the AC's assessment, the maximum modelled annual mean NO_2 concentration with the scheme in place at any receptor is 34.7µg/m^3 and occurs to the north-east of the airport, at Bath Road (A4).[38] The maximum incremental change brought about by the scheme at any receptor is 10.8µg/m^3 and occurs to the north-west, adjacent to the new third runway, where the predicted concentration for LHR-NWR is 32.9 µg/m^3.[39]

8.9.46 Predicted PM_{10} concentrations are all well below the annual mean AQO. The predicted incremental changes in PM_{10} concentrations are all less than 6µg/m^3.

8.9.47 There are 47,063 properties where annual mean NO_2 concentrations within the Principal Study Area are predicted to be higher with the scheme (on average by 0.9 µg/m^3), with 121,377 people affected. There are 14 "at risk" properties (>32 µg/m^3) that would experience an increase in annual mean NO_2 concentrations.

8.9.48 Should the new runway be operational prior to 2030, there is risk of worsened exceedance of the UK's air quality objective for annual mean NO_2, albeit a relatively low risk if the Government's actions to improve air quality are fully and effectively implemented. However, taking into account the latest projections of improvements in roadside air quality, which show that in the vicinity of Heathrow, roadside concentrations are likely to be around 5% higher in 2025 than 2030, but markedly lower than projected at the time of the AC's assessment. This risk would apply at substantially fewer than the 14 "at risk" properties identified by the AC.

ECOSYSTEM IMPACTS

8.9.49 The scheme would not cause any new exceedances of the lower or upper bounds of nitrogen deposition critical loads. The scheme is predicted to cause new exceedances of critical levels at the South West London Waterbodies RAMSAR / SPA and the Wraysbury Reservoir SSSI, however it is judged that the Critical Level does not strictly apply at these locations (based on the macro-scale siting requirements for monitoring in the EU Directive).[2]

8.9.50 Cumulative effects on air quality may arise from the airport expansion in combination with other major infrastructure development delivered in support of the National Networks National Policy Statement, or residential, commercial or infrastructure development associated with nearby local authority's plans for growth, delivered in support of local development plans.

SUMMARY

8.9.51 WSP's updated re-analysis[22] of the AC's air quality assessment in relation to EU Directive limit value compliance concludes that LGW-2R is at low risk of impacting on the UK's compliance with EU Directive limit values, whether considering impacts alongside individual roads or compliance within a zone.

8.9.52 In contrast, whilst the core scenarios for LHR-NWR, and LHR-ENR with updated surface access arrangements, based on available data, show they do not impact on UK's modelled compliance with limit values in the Greater London Urban Area, the updated WSP study shows that, both options remain at risk of impacting on UK's compliance with limit values in the Greater London Urban Area.

[38] Jacobs, 2015. *Module 6: Air Quality Local Assessment, Detailed Emissions Inventory and Dispersion Modelling*, p 64. [online] Accessed 16/06/2016.
[39] Jacobs, 2015. *Module 6: Air Quality Local Assessment, Detailed Emissions Inventory and Dispersion Modelling*, p 64. [online] Accessed 16/06/2016.

8.9.53 An important component of the updated re-analysis work was the sensitivity testing of the above conclusions in light of model uncertainty and mitigation measures, both at national level (2017 Plan) and project specific level, in the assessment assumptions.

8.9.54 The analysis demonstrated that the conclusion that LGW-2R is unlikely to affect compliance with EU Directive limit values is robust and largely independent of the scheme opening date and/or uncertainties such as future vehicle emissions. Given exceedance of the limit value is predicted in only the most conservative scenario testing, local mitigation measures could potentially significantly reduce the risk of exceedance.

8.9.55 The risk of LHR-ENR with updated surface access strategy or LHR-NWR affecting compliance with EU Directive limit values increases the earlier the assumed opening year. The risk is high in 2026, reducing to medium by 2030, when projected concentrations with the schemes fall below 90% of the limit value in the core forecasts (with 2017 Plan actions) and below 95% of the limit value in the baseline scenarios.

8.9.56 The conclusions for all options are largely unaffected by assumptions relating to the rate of growth in demand.

8.9.57 The direct mitigation of airport impacts, with measures considered by the AC, reduces the risks of impacts in the vicinity of the airport. However, reductions in risk of impacts in central London, from either LHR-NWR or LHR-ENR (with updated surface access strategy) primarily rely on the mitigation of impacts from vehicle emissions on the overall and wider road network (measures undertaken by local and national government under the 2017 Plan) rather than mitigation of the impact of the airport expansion scheme alone.

8.9.58 The AC Report[40] found that, comparing the three schemes, the construction of LHR-NWR will result in the greatest number of properties potentially affected by elevated dust and particulate matter concentrations; the fewest properties are affected by the construction of LGW-2R. With construction mitigation in place, which will be defined within a CEMP, the impacts should, however, be negligible for all three schemes. A Construction Logistics Plan will also ensure that congestion, and consequently emissions, associated with site deliveries are minimised.

8.9.59 Without increased airport capacity, total emissions of NOx in 2030 are currently projected to be below the 2020 Gothenburg Protocol targets but to exceed the NECD target for 2030. Emissions of $PM_{2.5}$ potentially exceed the 2020 Gothenburg and 2030 NECD targets without airport expansion[41]. Airport expansion has a relative small impact on total UK emissions. With airport expansion, emissions increase but by less than 2.8 kt/yr NOx (or 0.6% of the 2030 NECD target) and 0.12 kt/yr PM_{10} (0.2% of the 2030 target) in all options.

8.9.60 Concentrations of NO2 predicted within the AC's report remain below the UK's national air quality objectives whether any of the proposed schemes are developed or not.[42] The maximum predicted change in concentrations with any of the schemes in place is 14.0 µg/m3 (with the proposed LHR-ENR). Analysis of the number of affected properties indicates that all three schemes bring about a reduction in air quality (increase in concentrations) at more properties than experience no change or an improvement in air quality. Of the three schemes, emissions associated with the proposed LHR-NWR are predicted to adversely impact concentrations at the largest number of properties but maximum concentrations are lowest with this scheme. With earlier opening of the schemes, there is a risk of worsened exceedances of the UK objectives at some properties. However, the latest Government projections show generally lower concentrations than assessments made at the time of the AC's assessment. As such, the risk is considered low

[40] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*. [online] Accessed 06/01/2016.

[41] Based on Ricardo Energy and Environment, 2016, *UK Informative Inventory Report* (1990 to 2014). [online] Accessed 08/12/2016

[42] Jacobs, 2015. *Module 6: Air Quality Local Assessment, Detailed Emissions Inventory and Dispersion Modelling*, Executive Summary. [online] Accessed 16/06/2016.

provided Government actions under the 2017 Plan to improve air quality are implemented and effective.

8.9.61 None of the three schemes bring about any new exceedances of the nitrogen critical loads at designated habitats although worsening of existing exceedances is predicted, including at internationally designated sites. The Heathrow schemes increase NOx concentrations significantly, however the AC states that the Government's interpretation of the EU Directive[2] is that the critical level does not strictly apply at the habitats (having regard to their proximity to an area with a population >250,000).

8.9.62 A review of the AC's modelling and assumptions[43] concluded that, whilst there are uncertainties surrounding future year predictions, consistent assumptions have been made where necessary for each of the three schemes; appropriate assessment methodologies have been followed.

8.9.63 A reduction in future vehicle emissions has been assumed, based on the Emissions Factors Toolkit (EFT) v6.0.2. There is emerging evidence that the effect of the imposition of tighter emissions testing (RDE) procedures may ensure greater conformity between emissions standards and real world emissions.[44] However, there is still uncertainty surrounding this assumption. It is considered that each of the three schemes has the potential to impact on compliance with EU Directive limit values or to bring about exceedances of national air quality objectives. That is to say, all schemes cause an increase in pollutant concentrations at properties at risk of exceeding the air quality objective for annual mean NO_2 and the sensitivity testing undertaken as part of WSP's re-analysis of the data showed that, with increasing conservatism in assumptions, all schemes could potentially impact on compliance with EU Directive limit values. In 2030, the risk is categorised as low for Gatwick 2R and medium for LHR-NWR and LHR-ENR (with updated surface access strategy) or very high for LHR-ENR without access strategy. The risk increases for LHR-NWR and LHR-ENR for opening in earlier years.

8.9.64 Consequently, based on Table 3.2 of the AoS, it is considered that each of the three schemes has the potential to bring about negative air quality impacts relative to the baseline. However, taking into account the greater level of risk of impacting on compliance with EU limit values, LHR-NWR and LHR-ENR have the potential to bring about significant negative air quality impacts.

8.9.65 This conclusion applies whether or not any surface access strategy iteration is employed for LHR-ENR. Based on a qualitative review of the variations (Appendix D), it is concluded that Iteration 4 has limited potential to reduce the risk of negative impacts with LHR-ENR, but that Iteration 3 could reduce the impacts. However, this applies to impacts in the vicinity of the airport. It does not apply to the risk of impacts from airport related traffic in central London. As such, the risk of impact on EU Directive limit value compliance remains and the scheme remains at risk of causing significant negative effects.

[43] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*. [online] Accessed 06/01/2016.
[44] Department for Transport, 2016. *Vehicle emissions testing programme: conclusions* [online] Accessed 4.8.2016

Objective 13: To Improve Air Quality and Reduce Emissions Consistent with EU, National and Local Standards and Requirements.

Question 25: Will it support compliance with local, national and European air quality requirements or legislation?

SEA Criteria	LGW-2R[45]	LHR-ENR	LHR-NWR
Description of Impact (including receptor)	A reassessment of compliance[22] with the EU Air Quality Directive taking account the Government's 2017 Air Quality Plan indicates that LGW-2R will not impact on compliance with EU limit values. This conclusion has low vulnerability to uncertainties since sensitivity testing demonstrated that the option is at low risk of impacting on compliance with limit values. NOx and $PM_{2.5}$ emissions are currently projected to exceed the NECD target for 2030 – but the increase with the scheme is a very small fraction of the target. The maximum predicted annual mean NO_2 concentration with the scheme in place at any receptor in Principal Study Area is 38.6 µg/m^3 in 2030.[46]	A reassessment of compliance[22] with the EU Air Quality Directive taking into account the Government's 2017 Air Quality Plan indicates that LHR-ENR impacts on compliance with EU limit values. With the updated surface access strategy and actions set out in the 2017 Plan, the option does not impact on modelled compliance with limit values in any potential opening year (2026 onwards). Given the inherent uncertainties in air quality modelling, there remains, however, a risk that the option could impact on compliance with limit values and the risk increases the earlier the assumed opening year for the option. The risk is high until 2030 with the updated access strategy; very high in all years without the updated access strategy. NOx and $PM_{2.5}$ emissions are currently projected to exceed the NECD target for 2030 – but the increase with the scheme is a very small fraction of the target. The maximum predicted annual mean NO_2 concentration with the scheme in place at any receptor in Principal Study Area is 37.2 µg/m^3 in 2030.	A reassessment of compliance[22] with the EU Air Quality Directive taking into account the actions in the Government's 2017 Air Quality Plan indicates that LHR-NWR does not impact on modelled compliance with limit values in any potential opening year (2026 onwards). Given the inherent uncertainties in air quality modelling, there remains, however, a risk that the option could impact on compliance with limit values. The risk is high until 2030. NOx and $PM_{2.5}$ emissions are currently projected to exceed the NECD target for 2030 – but the increase with the scheme is a very small fraction of the target. The maximum predicted annual mean NO_2 concentration with the scheme in place at any receptor in Principal Study Area is 34.7µg/m^3 in 2030
Direct/ Indirect/ Cumulative	**Direct and Cumulative** The emissions which are associated with construction and operational activities will have Direct effect on air quality. There is a risk of Cumulative effects on air quality where airport expansion coincides with other major infrastructure developments.	**Direct and Cumulative** The emissions which are associated with construction and operational activities will have Direct effect on air quality. There is a risk of Cumulative effects on air quality where airport expansion coincides with other major infrastructure developments.	**Direct and Cumulative** The emissions which are associated with construction and operational activities will have Direct effect on air quality. There is a risk of Cumulative effects on air quality where airport expansion coincides with other major infrastructure developments.

[45] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*. [online] Accessed 06/01/2016.
[46] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*, p. 64. [online] Accessed 06/01/2016

Question 25: Will it support compliance with local, national and European air quality requirements or legislation?

SEA Criteria	LGW-2R[45]	LHR-ENR	LHR-NWR
Probability (High, Medium, Low, Very Low)	**Construction: Very Low** There is a very low probability that the emissions arising from construction activities will have adverse effects on air quality. **Operation: Low** There is a low probability that the emissions arising from operational activities will have adverse effects on air quality.	**Construction: Very Low** There is a very low probability that the emissions arising from construction activities will have adverse effects on air quality. **Operation: High** There is a high probability that the emissions arising from operational activities will have adverse effects on air quality (Highest without surface access variation).	**Construction: Very Low** There is a very low probability that the emissions arising from construction activities will have adverse effects on air quality. **Operation: High** There is a high probability that the emissions arising from operational activities will have adverse effects on air quality.
Phase, Duration (Long-term, Medium-term, Short-term), Frequency	**Construction: Long-term, Intermittent** Air quality effects arising from construction activities will occur intermittently depending on the construction activities underway, the location and proximity of sensitive receptors, and the prevailing meteorological conditions at the time. There is the potential for effects throughout the construction period. **Operation: Long-term, Continuous** Air quality effects from the operation of the proposed scheme will occur from commencement of operation.	**Construction: Long-term, Intermittent** Air quality effects arising from construction activities will occur intermittently depending on the construction activities underway, the location and proximity of sensitive receptors, and the prevailing meteorological conditions at the time. There is the potential for effects throughout the construction period. **Operation: Long-term, Continuous** Air quality effects from the operation of the proposed scheme will occur from commencement of operation.	**Construction: Long-term, Intermittent** Air quality effects arising from construction activities will occur intermittently depending on the construction activities underway, the location and proximity of sensitive receptors, and the prevailing meteorological conditions at the time. There is the potential for effects throughout the construction period. **Operation: Long-term, Continuous** Air quality effects from the operation of the proposed scheme will occur from commencement of operation.
Permanent/ Temporary **Irreversible/ Reversible**	**Construction: Temporary and reversible** **Operation: Permanent and Irreversible.** Operational air quality effects will be permanently associated with the airport, although it is anticipated that the significance of these effects will decrease over time as technology improves, and reduces emissions.	**Construction: Temporary and reversible** **Operation: Permanent and Irreversible.** Operational air quality effects will be permanently associated with the airport, although it is anticipated that the significance of these effects will decrease over time as technology improves, and reduces emissions.	**Construction: Temporary and reversible** **Operation: Permanent and Irreversible.** Operational air quality effects will be permanently associated with the airport, although it is anticipated that the significance of these effects will decrease over time as technology improves, and reduces emissions.

Question 25: Will it support compliance with local, national and European air quality requirements or legislation?

SEA Criteria	LGW-2R[45]	LHR-ENR	LHR-NWR
Magnitude and Spatial Extent, incl. Transboundary	**National, Medium** Construction: human health impacts potentially up to 350 metres from construction works, with the largest impacts closest to construction activities. No ecological impacts likely. Operation: contributions to national emissions. Potential for local air quality impacts within 200m of roads affected by increased traffic flows as a result of the proposed scheme.	**National, High** Construction: human health impacts potentially up to 350 metres from construction works, with the largest impacts closest to construction activities. Potential for construction dust impacts at the Staines Moor SSSI if unmitigated. Operation: contributions to national emissions. Potential for local air quality impacts within 200m of roads affected by increased traffic flows as a result of the proposed scheme.	**National, Medium** Construction: human health impacts potentially up to 350 metres from construction works, with the largest impacts closest to construction activities. No ecological impacts likely. Operation: contributions to national emissions. Potential for local air quality impacts within 200m of roads affected by increased traffic flows as a result of the proposed scheme.
Assumptions and Limitation	Future year operations, technological advances and associated emissions mean that predictions for 2030 and beyond become increasingly uncertain.	Future year operations, technological advances and associated emissions mean that predictions for 2030 and beyond become increasingly uncertain. The revised surface access strategy for Heathrow ENR has not been taken into account quantitatively in this assessment.	Future year operations, technological advances and associated emissions mean that predictions for 2030 and beyond become increasingly uncertain.
Significance	**Negative effect (-)**	**Significant Negative effect (--)**	**Significant Negative effect (--)**
	Direct and cumulative effects from emissions; very low probability of effects during construction (intermittent), and low probability of effects during operation (continuous); temporary and reversible effects during construction; permanent and irreversible effects during operation. Medium magnitude and national extent.	Direct and cumulative effects from emissions; very low probability of effects during construction (intermittent), and high probability of effects during operation (continuous) (very high without surface access strategy); temporary and reversible effects during construction; permanent and irreversible effects during operation. Medium magnitude and national extent (high magnitude without surface access strategy).	Direct and cumulative effects from emissions; very low probability of effects during construction (intermittent), and high probability of effects during operation (continuous); temporary and reversible effects during construction; permanent and irreversible effects during operation. Medium magnitude and national extent.

Question 26: Will it reduce the exposure to air quality for local communities and sites designated for nature conservation?

SEA Criteria	LGW-2R[47]	LHR-ENR	LHR-NWR
Description of Impact (including receptor)	There are no predicted exceedances of the air quality objective at any receptor location with LGW-2R. The scheme will increase exposure to pollution at 20,985 properties, of which 62 are considered 'at risk' (>32µg/m^3). There is a risk that with opening earlier than 2030 that exceedances of air quality objectives could occur. The scheme results in worsened exceedances of critical levels and critical loads over sites designated for nature conservation at 9 out of 10 sites assessed (including Mole Gap to Reigate Escarpment SAC), with one site showing a reduction in exposure to air pollution. Increase in national emissions of NOx and $PM_{2.5}$.	There are no predicted exceedances of the air quality objective at any receptor location, in either the Do Minimum or LHR-ENR scenarios, with or without Surface Access variations. The scheme will increase exposure to pollution at 38,656 properties, of which 113 are considered 'at risk' (>32µg/m^3). There is a risk that with opening earlier than 2030 that exceedances of air quality objectives could occur. The scheme results in increased exposure to pollution over sites designated for nature conservation at all 10 sites assessed, including sites where the critical level is currently exceeded and South West London Waterbodies Ramsar/SPA. No exceedances of critical loads are modelled with the scheme. Increase in national emissions of NOx and $PM_{2.5}$.	There are no predicted exceedances of the air quality objective at any receptor location, in either the Do Minimum or LHR-NWR scenarios. The scheme will increase exposure to pollution at 47,063 properties, of which 14 are considered 'at risk' (>32µg/m^3). There is a risk that with opening earlier than 2030 that exceedances of air quality objectives could occur. The scheme results in increased exposure to pollution over sites designated for nature conservation at all 7 sites assessed, including sites where the critical level is currently exceeded and South West London Waterbodies Ramsar/SPA. No exceedances of critical loads are modelled with the scheme. Increase in national emissions of NOx and $PM_{2.5}$.
Direct/ Indirect/ Cumulative	**Direct and Cumulative** The emissions which are associated with construction and operational activities will have Direct effect on air quality. There is a risk of Cumulative effects on air quality where airport expansion coincides with other major infrastructure developments.	**Direct and Cumulative** The emissions which are associated with construction and operational activities will have Direct effect on air quality. There is a risk of Cumulative effects on air quality where airport expansion coincides with other major infrastructure developments.	**Direct and Cumulative** The emissions which are associated with construction and operational activities will have Direct effect on air quality. There is a risk of Cumulative effects on air quality where airport expansion coincides with other major infrastructure developments.

[47] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*. [online] Accessed 06/01/2016.

Question 26: Will it reduce the exposure to air quality for local communities and sites designated for nature conservation?

SEA Criteria	LGW-2R[47]	LHR-ENR	LHR-NWR
Probability (High, Medium, Low, Very Low)	**Construction: Very Low** There is a very low probability that the emissions arising from construction activities will have adverse effects on exposure to air quality. **Operation: High** There is a high probability that the emissions arising from operational activities will have adverse effects on exposure to air quality.	**Construction: Very Low** There is a very low probability that the emissions arising from construction activities will have adverse effects on exposure to air quality. **Operation: High** There is a high probability that the emissions arising from operational activities will have adverse effects on exposure to air quality.	**Construction: Very Low** There is a very low probability that the emissions arising from construction activities will have adverse effects on exposure to air quality. **Operation: High** There is a high probability that the emissions arising from operational activities will have adverse effects on exposure to air quality.
Phase, Duration (Long-term, Medium-term, Short-term), Frequency	**Construction: Long-term, Intermittent** Air quality effects arising from construction activities will occur intermittently depending on the construction activities underway, the location and proximity of sensitive receptors, and the prevailing meteorological conditions at the time. There is the potential for effects throughout the construction period. **Operation: Long-term, Continuous** Air quality effects from the operation of the proposed scheme will be permanent from commencement of operation.	**Construction: Long-term, Intermittent** Air quality effects arising from construction activities will occur intermittently depending on the construction activities underway, the location and proximity of sensitive receptors, and the prevailing meteorological conditions at the time. There is the potential for effects throughout the construction period. **Operation: Long-term, Continuous** Air quality effects from the operation of the proposed scheme will be permanent from commencement of operation.	**Construction: Long-term, Intermittent** Air quality effects arising from construction activities will occur intermittently depending on the construction activities underway, the location and proximity of sensitive receptors, and the prevailing meteorological conditions at the time. There is the potential for effects throughout the construction period. **Operation: Long-tem, Continuous** Air quality effects from the operation of the proposed scheme will be permanent from commencement of operation.
Permanent/ Temporary **Irreversible/ Reversible**	**Construction: Temporary and reversible** **Operation: Permanent and Irreversible** Operational air quality effects will be permanently associated with the airport, although it is anticipated that the significance of these effects will decrease over time as technology improves, and reduces emissions.	**Construction: Temporary and reversible** **Operation: Permanent and Irreversible** Operational air quality effects will be permanently associated with the airport, although it is anticipated that the significance of these effects will decrease over time as technology improves, and reduces emissions.	**Construction: Temporary and reversible** **Operation: Permanent and Irreversible** Operational air quality effects will be permanently associated with the airport, although it is anticipated that the significance of these effects will decrease over time as technology improves, and reduces emissions.

Question 26: Will it reduce the exposure to air quality for local communities and sites designated for nature conservation?

SEA Criteria	LGW-2R[47]	LHR-ENR	LHR-NWR
Magnitude and Spatial Extent, including Transboundary	**National, Medium** Construction: human health impacts potentially up to 350m, with the largest impacts closest to construction activities. No ecological impacts likely. Operation: contributions to national emissions. Potential for local air quality impacts within 250m of roads affected by increased traffic flows as a result of the proposed scheme.	**National, High** Construction: human health impacts potentially up to 350m, with the largest impacts closest to construction activities. Potential for construction dust impacts at the Staines Moor SSSI if unmitigated. Operation: contributions to national emissions. Potential for local air quality impacts within 250m of roads affected by increased traffic flows as a result of the proposed scheme.	**National, Medium** Construction: human health impacts potentially up to 350m, with the largest impacts closest to construction activities. No ecological impacts likely. Operation: contributions to national emissions. Potential for local air quality impacts within 250m of roads affected by increased traffic flows as a result of the proposed scheme.
Assumptions and Limitation	Future year operations, technological advances and associated emissions mean that predictions for 2030 become increasingly uncertain.	Future year operations, technological advances and associated emissions mean that predictions for 2030 become increasingly uncertain. The revised surface access strategy for Heathrow ENR has not been taken into account quantitatively in this assessment.	Future year operations, technological advances and associated emissions mean that predictions for 2030 become increasingly uncertain.
Significance	**Significant Negative effect (-)**	**Significant Negative effect (--)**	**Significant Negative effect (--)**
	Direct and cumulative effects due to exceedances; very low probability of effects during construction (intermittent), and high probability of effects during operation (continuous) particularly in relation to ecosystems; temporary and reversible effects during construction; permanent and irreversible effects during operation. High magnitude and national extent.	Direct and cumulative effects due to exceedances; very low probability of effects during construction (intermittent), and high probability of effects during operation (continuous) particularly in relation to ecosystems; temporary and reversible effects during construction; permanent and irreversible effects during operation. High magnitude and national extent.	Direct and cumulative effects due to exceedances; very low probability of effects during construction (intermittent), and high probability of effects during operation (continuous) particularly in relation to ecosystems; temporary and reversible effects during construction; permanent and irreversible effects during operation. High magnitude and national extent.

8.10 MITIGATION

8.10.1 Additional mitigation measures suggested within the AC report, proposed by either the promoters or the AC, which have not been included within the modelling assessment but which could potentially be implemented, include:

- A high level of public transport provision and uptake;
- Installation of Fixed Electrical Ground Power and Pre Conditioned Air to all aircraft stands to reduce the use of auxiliary power unit (APU);
- Improve Ultra Low Emission Vehicle infrastructure both landside and airside; and
- Introduction of an airport congestion charge for travellers or a Ultra Low Emission Zone (ULEZ);
- Improved management to reduce hold times and delays / improved airport efficiency;
- Encouraging airlines to shut down an engine during taxiing;
- NOx emissions charging to encourage the cleanest aircraft; and
- Encouraging technical developments and innovations, such as alternative fuels

8.10.2 These mitigation measures have the potential, to varying degrees, to reduce overall emissions of air pollutants with the schemes, and to reduce the impacts of those emissions on pollutant concentrations.

8.10.3 In particular, the measures are predicted (based on a number of assumptions) to have the potential to reduce concentrations[48, 49] in 2030 by between 2.4 and 3.6µg/m^3 (LHR-NWR) and between 2.5 and 3.9µg/m^3 (LHR-ENR) at one location on Bath Road. These reductions are associated with the implementation of a range of scheme-specific mitigation measures set out by the AC, which individually are predicted to reduce concentrations by between 0.3 and 1.6µg/m^3. The benefits of additional mitigation proposed for LGW-2R have not been quantified, however, improvements of a similar magnitude would be anticipated.

8.10.4 However, the risks related to compliance with EU Directive limit values, and to a degree, with increased NOx concentrations and nitrogen deposition over sites designated for nature conservation outwith the immediate vicinity of the schemes, are unlikely to be significantly reduced by the mitigation proposed by the AC. Reductions in overall risk, taking account of impacts in the vicinity of the airports and, in the case of Heathrow options, in central London, is primarily reliant on the reduction in total emissions from vehicles on the public highway such as will be affected by the implementation of actions in the UK's 2017 Plan.

8.10.5 Surface Access Variation Iteration 3 for LHR-ENR has the potential to reduce the risks associated with limit value non-compliance in the vicinity of the airport but is unlikely to remove the risks associated with limit value non-compliance alongside individual links in central London or to remove the risk of impact on the zone compliance. Surface Access Variation Iteration 4 has limited potential to mitigate the impacts of LHR-ENR.

8.10.6 The mitigations shown above are those considered by the AC. They are not exhaustive and more ambitious strategies may be available but any such strategies must be seen in the context of air quality in the wider area. The principal driver for reducing adverse air quality impacts will be the actions in the Government's 2017 Plan, to be undertaken at local, regional and national levels.

[48] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*, pp. 81-83, Table 5.16. [online] Accessed 06/01/2016.

[49] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*, pp. 105-107, Table 6.16. [online] Accessed 06/01/2016

8.11 ASSUMPTIONS AND LIMITATIONS

8.11.1 The assessment of future air quality with and without airport expansion is based on modelling, and all modelling has inherent uncertainty associated with the model formulation and, in particular, with the input data and assumptions and hence the forecasts made. These uncertainties could act to either reduce or increase the predict impacts.

8.11.2 The quality / accuracy of future year assumptions and predictions (e.g. of demand / aircraft movements) are recognised within the AC's assessment as being a limitation to the assessment.

8.11.3 The PCM model used by the Government to assess EU limit value compliance is subject to uncertainty surrounding vehicle emissions and model performance on specific road links. No specific monitoring data are available to inform a discussion on how the PCM model performs in relation to real-life within the study area, or whether the vehicle emissions and projected concentrations are considered to be realistic. The emerging evidence from vehicle emissions testing indicates that new vehicles (Euro 6ab vehicles) are considerably less polluting than existing vehicles and that new testing procedures should ensure that future vehicles (Euro 6c) will have lower emissions still. However uncertainty surrounding this assumption remains.

8.11.4 To address this uncertainty, the updated re-analysis study undertaken by WSP included consideration of worst case sensitivity testing, based on applying the maximum uncertainty (as assessed by Defra and DfT's Joint Air Quality Unit) to the PCM forecasts, in which the potential underestimate of future vehicle emissions was taken into account, both in terms of increased PCM model concentrations and increased impacts from the airport expansion schemes. This was used to assess a robust level of risk of non-compliance. That is to say that, LGW-2R is at low risk of impacting on EU Directive limit value compliance, whereas LHR-ENR and LHR-NWR are at risk of impacting on limit value compliance, with the risk high for years prior to 2030 and medium in 2030, and very high for LHR-ENR without Iteration 3 of the updated surface access strategy.

8.11.5 A comparison of model outputs has been made for both the airport and road traffic. Table F1 of the *Module 6: Air Quality Local Assessment*[50] presents a comparison of Airport model outputs (excluding road traffic contributions) with monitoring. The comparison between model and monitoring in the vicinity of Gatwick shows good agreement, but in the vicinity of Heathrow a tendency to under-predict measured NOx concentrations is observed. This would have the potential effect of under-predicting NO_2 concentrations within the two Heathrow study areas. The model is potentially behaving differently in one area relative to the other, and this could be due to a number of reasons, including accuracy of the traffic model. Had scheme specific verification factors been applied then it is possible that impacts at Heathrow could be worsened. This is, however, considered unlikely to have a significant impact on the conclusions of the AoS since the risks of exceedance of AQOs and EU limit values are fully acknowledged.

8.11.6 Subsequent to the AC's work and modelling on air quality, alternative surface access schemes have been proposed by the scheme promoter of LHR-ENR. It has only been possible to consider the impacts of these variations qualitatively. Furthermore, the assessment has considered only the direct impacts of the variations. Any effects due to the redistribution of traffic on the wider road network have not been assessed.

[50] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling*, p. 162, Table F1. [online] Accessed 06/01/2016.

8.12 CONCLUSIONS

8.12.1 UK emissions of NOx are expected to meet the 2020 Gothenburg Protocol target in 2030 but are currently projected to exceed the 2030 NECD targets, regardless of the shortlisted scheme taken forwards, but the increase with the schemes is a very small fraction of the target. UK emissions of $PM_{2.5}$ in 2030 are currently projected to exceed both the 2020 Gothenburg Protocol target and the 2030 NECD target regardless of the scheme taken forwards but, as for NOx, the increase with the schemes is a very small fraction of the target.

8.12.2 The shortlisted schemes are predicted to increase emissions of NOx from the Traffic Model Simulation Area by up to 0.6%, and $PM_{2.5}$ emissions by up to 0.12% of the forecast emissions for 2030.

8.12.3 Predicted annual mean NO_2 concentrations with any of the schemes in place remain below the UK's annual mean objective at all receptors considered in 2030. Predicted PM_{10} concentrations are all well below the annual mean AQO. There is a risk that objectives could be exceeded, with any of the schemes, with opening in earlier years.

8.12.4 There is a risk of cumulative effects on air quality from each of the proposed shortlisted schemes in combination with other major infrastructure development delivered in support of the National Networks National Policy Statement, or residential, commercial or infrastructure development associated with nearby local authority's plans for growth, delivered in support of local development plans.

8.12.5 The *Business Case and Sustainability Assessment*[51] undertaken by the AC acknowledges that the impact of the LHR-NWR scheme is significantly adverse prior to mitigation. It goes on to say that with mitigation the impact could be reduced to adverse. Mitigation is predicted to reduce concentrations[52] in 2030 by between 2.4 and 3.6 µg/m^3 (LHR-NWR) and between 2.5 and 3.9 µg/m^3 (LHR-ENR) at one location on Bath Road. These reductions are associated with the implementation of a range of different mitigation measures, which individually are predicted to reduce concentrations by between 0.3 and 1.6 µg/m^3. The benefits of additional mitigation proposed for LGW-2R have not been quantified although improvements of a similar magnitude would be anticipated. However, there are uncertainties relating to the effectiveness of the measures, and implementation would rely on strict regulation and enforcement.

8.12.6 The re-analysis of the AC's model results, taking into account the measures to improve air quality set out in the Government's 2017 Plan demonstrated that LGW-2R is unlikely to impact on compliance with the EU Directive limit values. However, LHR-NWR and LHR-ENR (either with or without iterations to the surface access strategy) are at risk of impacting on the compliance of the Greater London Urban Area with EU Directive limit values.

8.12.7 None of the proposed schemes are predicted to cause exceedances of the AQOs at relevant receptors but worsened exceedances of critical levels over designated habitats are seen with all options. The schemes do not cause any new exceedances of the Critical Loads at designated habitats but do worsen existing exceedances with LGW-2R.

8.12.8 The AC's assessment of the impact of the schemes has been carried out for 2030 (due to the limits of the traffic model). Opening prior to 2030 potentially increases the risks of exceedance due to overall higher ambient pollution levels. It is recommended that further assessment of the preferred scheme is undertaken during detailed design in light of more developed surface access transport strategy operating at full capacity and for the earliest possible opening year.

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[51] Airports Commission, 2015. *Business Case and Sustainability Assessment – Heathrow Airport Northwest Runway*, p. 198, Paragraph 12.32. [online] Accessed 06/01/2016.

[52] Jacobs, 2015. *Module 6: Air Quality Local Assessment - Detailed Emissions Inventory and Dispersion Modelling,* pp. 81-83, Table 5.16. [online] Accessed 06/01/2016.

8.12.9 Overall, all schemes have the potential to increase exposure to poor air quality and worsen exceedances of the 2030 NECD commitment for NOx and $PM_{2.5}$ emissions reductions, with a consequent negative effect on air quality. The risk of the schemes impacting on compliance with EU Directive limit values with LHR-ENR or LHR-NWR results in a potentially significant negative effect in relation to compliance with European and national air quality legislation. The risk of worsened exceedances of critical loads over designated sites with LGW-2R, and worsened exceedances of critical levels with all schemes results in a potentially significant negative effect for sensitive habitats.