

9. Health

9.1 Introduction

- 9.1.1 This chapter of the ES assesses the likely significant effects of the Proposed Scheme with respect to human health effects. The chapter should be read in conjunction with **Chapter 3: Description of the Proposed Scheme** and this chapter should be read in conjunction with **Chapter 8: Noise**, the findings of which have informed the assessment of human health effects. This chapter supplements the health assessments in the 2014 Planning Permission 2012 ES.
- 9.1.2 This health assessment has assessed the likely significant effects arising from the proposed change to raise the passenger throughput cap to 19 mppa, and the resulting changes in air transport movements (ATMs) and surface access movements. The assessment also identifies the likely significant effects arising from the proposed increases to the daytime and night-time noise contours through the variation of Condition 10 for the period to the end of 2027, and from 2028 onwards (see **Section 4.4**).
- 9.1.3 The 2014 Planning Permission 2012 ES described and assessed a range of beneficial and adverse health effects, including associated mitigation and enhancement measures which would continue to apply.
- 9.1.4 The proposed variation to Condition 10 for the period up to the end of 2027, proposes that the area enclosed by the 57 dB(A) L_{eq16hr} (07:00 - 23:00) contour would not exceed 21.6 sq. km for daytime noise, and the area enclosed by the 48 dB(A) L_{eq8hr} (23:00 - 07:00) contour would not exceed 42.9 sq. km for night-time noise. Post 2027, the area enclosed by the 57 dB(A) L_{eq16hr} (07:00 - 23:00) contour would not exceed 15.5 sq. km for daytime noise, and the area enclosed by the 48 dB(A) L_{eq8hr} (23:00-07:00) contour would not exceed 35.5 sq. km for night-time noise (see **Chapter 3: Description of the Proposed Scheme**).
- 9.1.5 The proposed Condition 10 variation is predicted to result in changes in aircraft air noise only. This assessment therefore focuses on the human health effects from changes aircraft air noise only. As set out in **Chapter 6: Air quality** and **Chapter 10: Transport**, the effects of changes in air quality, transport, and noise related to road traffic will not result in significant effects at the sensitive receptors and have been scoped out of the health assessment. This approach to the assessment has been agreed with LBC through the Screening and Scoping stages (see **Sections 4.3** and **4.4**, and **Appendix 1A, 1B, and 1C** in **Volume 3: Figures and Appendices**).
- 9.1.6 Aircraft air noise occurs principally from aircraft arriving and landing, and from aircraft departing and taking-off. It is also produced by aircraft on the ground, and this occurs when aircraft are on the runway for start of take-off roll (SoR), after landing when aircraft are rolling down the runway, and if aircraft are using reverse thrust for braking.
- 9.1.7 The integration of health and its consideration in EIA is a developing area of practice. Interim and brief guidance is provided by the Institute of Environmental Management and Assessment (IEMA)¹⁵⁴. Public Health England has also issued a briefing note on health in EIA for local public health teams¹⁵⁵. The approach set out below draws from the guidance mentioned above as well as

¹⁵⁴ Institute of Environmental Management and Assessment, Faculty of Public Health and Ben Cave Associates (2017) Health in Environmental Impact Assessment: a primer for a proportionate approach. Available at: <https://www.iema.net/resources/reading-room/2017/05/01/get-primed-for-health-in-eia> [Checked November 2020].

¹⁵⁵ Public Health England (2017) Health and Environmental Impact Assessment: a briefing for public health teams in England. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/629207/Health_and_environmental_impact_assessment.pdf [Checked November 2020].

other good practice guidance on HIA from the English Department of Health, Public Health England, the Department for Communities and Local Government, the Devolved Countries in the UK; as well as international agencies and associations such as the International Finance Corporation, and the International Association for Impact Assessment^{156 157 158 159 160 161 162}.

- 9.1.8 This chapter uses the World Health Organization's (WHO) definition of health, which states that health is:

"a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity".¹⁶³

- 9.1.9 Wellbeing is related to health, with the terms used interchangeably. This chapter also uses a WHO definition for wellbeing, which is related to mental health. The WHO state that mental health is more than the absence of mental disorders and that mental health is a state of wellbeing, defined as:

"a state in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully and is able to make a contribution to her or his community".¹⁶⁴

- 9.1.10 The focus of this chapter is on community health and wellbeing and not occupational health and safety. The terms 'health', 'human health', and 'health and wellbeing' may be used interchangeably.

9.2 Limitations of this assessment

- 9.2.1 The health assessment has been informed by the findings of **Chapter 8: Noise**, which in turn has been informed by **Chapter 10: Transport**. The findings of the health assessment are therefore constrained by the assumptions and limitations set out in those assessments.
- 9.2.2 In addition, the health assessment is at a population level, and individual level effects are not identified as this would require detailed individual level baseline information which is not feasible.
- 9.2.3 District and ward level data has been used to inform the assessment and is considered representative of the existing residents living, working, and visiting the area around LLA.

¹⁵⁶ Health Development Agency. (2002). Introducing health impact assessment (HIA): informing the decision-making process, England.

¹⁵⁷ NHS Executive. (2000). Resources for HIA: Volumes 1 & 2. London: England.

¹⁵⁸ Welsh Assembly Government and Health Challenge Wales. (2004). Health impact assessment: a practical guide. Available at: https://whiasu.publichealthnetwork.cymru/files/1415/0710/5107/HIA_Tool_Kit_V2_WEB.pdf [Accessed 14 December 2020]

¹⁵⁹ Public Health Institute of Scotland. (2001). HIA: a guide for local authorities; Scottish HIA network; 2001.

¹⁶⁰ Institute of Public Health in Ireland. (2009). Health impact assessment guidance. Available at: http://2019.iph.ie/sites/default/files/documents/files/IPH%20HIA_0.pdf [Accessed 14 December 2020]

¹⁶¹ International Association for Impact Assessment. (2006). Health Impact Assessment International Best Practice Principles. Special Publication Series No. 5. Fargo, USA. Available at: https://www.iaia.org/uploads/pdf/SP5_3.pdf [Accessed 14 December 2020]

¹⁶² International Finance Corporation. (2010). Introduction to Health Impact Assessment. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_healthimpactassessment_wci_1319578475704 [Accessed 14 December 2020]

¹⁶³ World Health Organization (2019) Constitution of the World Health Organization. The Constitution was adopted by the International Health Conference held in New York from 19 June to 22 July 1946, signed on 22 July 1946 by the representatives of 61 States and entered into force on 7 April 1948. Later amendments are incorporated into this text. Available at: <https://www.who.int/about/who-we-are/constitution> [Checked November 2020].

¹⁶⁴ World Health Organization (2019) Mental Health: a state of wellbeing. Available at: https://www.who.int/features/factfiles/mental_health/en/ [Checked 17 March 2019].

- 9.2.4 Assuming an average occupancy of 2.7 persons per house, based on census data for the area, this indicates that approximately 17,742 additional residents now live within the study area for the proposed variation to Condition 10.

9.3 Relevant legislation, planning policy, technical guidance

Legislative context

Town and Country Planning (Environmental Impact Assessment) Regulations 2017¹⁶⁵

- 9.3.1 On 16 May 2017, the *2017 EIA Regulations* came into force. This mentions human health explicitly alongside consideration of population aspects. Part 1, General, Clause 4 (2a) states:

"The EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of the proposed development on the following factors (a) population and human health..."

Environmental Protection Act 1990¹⁶⁶

- 9.3.2 Part III of the *Environmental Protection Act 1990* regulates the control of emissions (including dust, noise, and light) that may be prejudicial to health or a nuisance.

Health and Social Care Act 2012¹⁶⁷

- 9.3.3 The *Health and Social Care Act 2012* (specifically sections 11, 12, 18, 22, 30, 31, and 60) place a duty of care to protect and improve public health on the Secretary of State (SoS) for Health as well as other bodies directed by the SoS for Health. This includes, but is not limited to, local authorities, including Directors for Public Health, and the National Health Service.
- 9.3.4 There is no statutory guidance on considering health in EIA.

Planning policy context

- 9.3.5 There are a number of policies and guidance at the international, national, and local level. Planning policy related to human health is outlined in **Table 9.1**.

Table 9.1 Planning policy issues relevant to human health

| Policy reference | Policy issue |
|--|--|
| International planning policies | |
| Environmental noise guidelines for the European | For average noise exposure, the Guideline Development Group (GDG) strongly recommends reducing noise levels produced by aircraft below 45 dB Lden ¹⁶⁹ as aircraft noise above this level is associated with adverse health effects. |

¹⁶⁵ HM Government (2017) Town and Country Planning (Environmental Impact Assessment) Regulation 2017. Available at: <http://www.legislation.gov.uk/ukxi/2017/571/part/1/made> [Checked November 2020].

¹⁶⁶ HM Government (1990) Environmental Protection Act 1990. Available at: <https://www.legislation.gov.uk/ukpga/1990/43/part/III> [Checked November 2020]

¹⁶⁷ HM Government (2012) Health and Social Care Act 2012. Available at: <http://www.legislation.gov.uk/ukpga/2012/7/contents/enacted> [Checked November 2020]

¹⁶⁹ Day-evening-night level. It is a descriptor of noise level based on energy equivalent noise level.

| Policy reference | Policy issue |
|---|--|
| Region, World Health Organization (2018)¹⁶⁸ | For night exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night-time below 40 dB Lnight as aircraft noise above this level is associated with adverse effects on sleep. |
| National planning policies | |
| National Planning Policy Framework (NPPF) (2019)¹⁷⁰ | <p>Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should mitigate and reduce to a minimum potential adverse impact resulting from:</p> <ul style="list-style-type: none"> ● noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life; and ● identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason. |
| Environmental noise: valuing impacts on sleep disturbance, annoyance, hypertension, productivity and quiet, 2012¹⁷¹ | The report details current understanding of the links between environmental noise and various effects including sleep disturbance, annoyance, hypertension, and related diseases. It also includes some commentary on productivity and the value of quiet areas. The report presents recommended methods to assess these impacts to support policy, programme, and project appraisal. |
| Public Health Outcomes Framework¹⁷² | This sets out the national vision and targets for public health and how public health is being improved and protected. Key target indicators include: reducing killed and seriously injured casualties on England's roads; reducing percentage of the population affected by noise; increasing utilisation of outdoor space for exercise / health reasons; increasing proportion of physically active adults; reducing the fraction of mortality attributable to particulate air pollution; reducing mortality rate from causes considered preventable; and reducing numbers of 16 - 18 year olds not in education, employment or training. |
| The Aviation Policy Framework¹⁷³ | <p>This sets out the government's policy to all the aviation sector to continue to make a significant contribution to economic growth across the country. The points included here are noted in relation to health:</p> <p>The Government's overall policy on aviation noise is to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise. This is consistent with the Government's Noise Policy, as set out in the Noise Policy Statement for England (NPSE) which aims to avoid significant adverse impacts on health and quality of life. The Government wants to strike a fair balance between the negative impacts of noise (on health, amenity (quality of life) and productivity) and the positive economic impacts of flights. The Government expects that the aviation industry will continue to reduce and mitigate noise as airport capacity grows. As noise levels fall with technology improvements the aviation industry should be expected to share the benefits from these improvements with local communities;</p> |

¹⁶⁸ World Health Organisation (2018) *Environmental noise guidelines for the European Region*. Available at: <http://www.euro.who.int/en/publications/abstracts/environmental-noise-guidelines-for-the-european-region-2018> [Checked 10 November 2020].

¹⁷⁰ HM Government (2018) *National planning policy framework*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf [Checked 10 November 2020].

¹⁷¹ Defra (2012) *Environmental Noise: valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/380852/environmental-noise-valuing-impacts-PB14227.pdf [Checked 10 September 2020].

¹⁷² Public Health England (2020) *Public health outcomes framework*. Available at: <https://fingertips.phe.org.uk/profile/public-health-outcomes-framework> [Checked 10 September 2020].

¹⁷³ HM Government (2013) *Aviation policy framework*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf [Checked 10 September 2020].

| Policy reference | Policy issue |
|---|--|
| | <p>The Government will continue to treat the 57 dB L_{Aeq} 16 hour contour as the average level of daytime aircraft noise marking the approximate onset of significant community annoyance. However, this does not mean that all people within this contour will experience significant adverse effects from aircraft noise. Nor does it mean that no-one outside of this contour will consider themselves not annoyed by aircraft noise. The Government recommends that average noise contours should not be the only measure used when airports seek to explain how locations under flight paths are affected by aircraft noise; and</p> <p>The Government recognises that the costs on local communities are higher from aircraft noise during the night, particularly the health costs associated with sleep disturbance. Noise from aircraft at night is therefore widely regarded as the least acceptable aspect of aircraft operations. However, the Government also recognises the importance to the UK economy of certain types of flights, such as express freight services, which may only be viable if they operate at night. In recognising these higher costs upon local communities, the Government expects the aviation industry to make extra efforts to reduce and mitigate noise from night flights through use of best-in-class aircraft, best practice operating procedures, seeking ways to provide respite wherever alternatives are available.</p> <p>Whilst the Government's policy is to give particular weight to the management and mitigation of noise in the immediate vicinity of airports, there may be instances where prioritising noise creates unacceptable costs in terms of local air pollution. For example, displacing the runway landing threshold to give noise benefits could lead to significant additional taxiing and emissions. For this reason, the impacts of any proposals which change noise or emissions levels should be carefully assessed to allow these costs and benefits to be weighed up.</p> |
| Development plan policies | |
| Luton Local Plan 2011-2031 (2017) ¹⁷⁴ | <p><i>'1.23 ... The Local Plan will support and promote development that is designed, constructed and managed in ways that improve health and promote healthy lifestyles.</i></p> <p><i>3.4 Luton's economic, social and environmental resources and assets will be used efficiently and sustainably to deliver economic prosperity and an improved quality of life, health and wellbeing for all the residents of the Borough...</i></p> <p><i>3.5 London Luton Airport will be improved to provide more jobs related to aviation industries and other associated business clusters and maintain London Luton Airport's key role as a sub-regional economic driver bringing wealth and job creation (including high skilled jobs) to the town and neighbouring local authorities.'</i></p> |
| Luton Health and Wellbeing Strategy 2019-2024 ¹⁷⁵ | <i>'Luton is a more equitable place where people thrive, have the opportunity to live a healthy life mentally, socially and physically; and maximize their potential.'</i> |
| Luton's joint strategic needs assessment 2020 ¹⁷⁶ | <p>Noise Pollution, Priorities</p> <ol style="list-style-type: none"> 1. Map noise complaints across the borough to provide a greater understanding of any noise hotspots affecting local residents, allowing for targeted local action. 2. Monitor measures in place ensure that the impact of noise as a result of airport expansion is mitigated. <p>Air Quality, Priorities</p> <ol style="list-style-type: none"> 1. Review current air quality strategy for Luton and ensure there is a full range of actions to improve air quality. |

¹⁷⁴ Luton Borough Council (2017) *Luton local plan 2011- 2031*, November 2017. Available at:

<https://www.luton.gov.uk/Environment/Lists/LutonDocuments/PDF/Local%20Plan/adoption/Luton-Local-Plan-2011-2031-November-2017.pdf> [Checked 10 September 2020].

¹⁷⁵ Luton Borough Council (2016) *Luton's population wellbeing strategy 2019-2024*. Available at

[https://www.luton.gov.uk/Council government and democracy/Lists/LutonDocuments/PDF/CPC/CPC%202020/Population-wellbeing-strategy-2019-2024.pdf](https://www.luton.gov.uk/Council%20government%20and%20democracy/Lists/LutonDocuments/PDF/CPC/CPC%202020/Population-wellbeing-strategy-2019-2024.pdf) [Checked 10 September 2020].

¹⁷⁶ Luton Borough Council (2015) *Luton's joint strategic needs assessment*. Available at:

[https://m.luton.gov.uk/Page/Show/Community and living/Luton%20observatory%20census%20statistics%20and%20mapping/Pages/Joint%20Strategic%20Needs%20Assessment%20-%20JSNA.aspx](https://m.luton.gov.uk/Page/Show/Community%20and%20living/Luton%20observatory%20census%20statistics%20and%20mapping/Pages/Joint%20Strategic%20Needs%20Assessment%20-%20JSNA.aspx) [Checked 10 September 2020].

| Policy reference | Policy issue |
|------------------|---|
| | <p>2. Develop and expand actions to focus on the reduction of road traffic as the major source of air pollution in the town.</p> <p>3. Ensure all major developments, and any significant developments in areas of elevated air pollution, are required to produce an air quality assessment.</p> <p>Transport, Priorities</p> <p>1. Increase the use of sustainable travel (including walking and cycling) as the 'first choice' of transport.</p> <p>2. Increase accessibility of public transport in areas in the south and east of Luton and key facilities and employment sites.</p> <p>4. Maximise the national and regional accessibility of Luton's key facilities and employment opportunities in order to attract inward investment.</p> |

Technical guidance

- 9.3.6 Planning Practice Guidance on EIA outlines the requirements of the *2017 EIA Regulations*. However, the guidance does not provide additional information in relation to defining, scoping, or assessing human health. Regard has therefore been given to the *2017 IEMA publication*¹⁵⁴.
- 9.3.7 Planning Practice Guidance on health and wellbeing that applies more broadly than EIA notes the following:
- *The link between planning and health has been long established. The built and natural environments are major determinants on health and wellbeing;*
 - *The range of issues that could be considered through the plan-making and decision-making processes, in respect of health and healthcare infrastructure, include how:*
 - ▶ *Development proposals can support strong, vibrant and healthy communities and help create healthy living environments which should, where possible, include making physical activity easy to do and create places and spaces to meet to support community engagement and social capital;*
 - ▶ *The healthcare infrastructure implications of any relevant proposed local development have been considered;*
 - ▶ *Opportunities for healthy lifestyles have been considered (e.g. planning for an environment that supports people of all ages in making healthy choices, helps to promote active travel and physical activity, and promotes access to healthier food, high quality open spaces, green infrastructure and opportunities for play, sport and recreation);*
 - ▶ *Potential pollution and other environmental hazards, which might lead to an adverse impact on human health, are accounted for in the consideration of new development proposals; and*
 - ▶ *Access to the whole community by all sections of the community, whether able-bodied or disabled, has been promoted.*
- 9.3.8 The *Air Navigation Guidance (ANG) 2017*¹⁷⁷ provides guidance on setting the Lowest Observed Adverse Effect Level (LOAEL) as 51 dB L_{Aeq,16hr} and 45 dB L_{Aeq,8hr}. *ANG 2017* states that the government advises setting a LOAEL which is the point at which adverse effects begin to be seen on a community-wide basis. As noise exposure increases above this level, so will the likelihood of experiencing an adverse effect. In line with this increase in risk, the proportion of the population likely to be significantly affected can be expected to grow as the noise level increases over the

¹⁷⁷ Department for Transport and Civil Aviation Authority (2017) *Air Navigation Guidance 2017*, [online]. Available at <https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017> [Checked November 2020]

LOAEL. For the purposes of assessing and comparing the noise impacts of airspace changes, the government has set a LOAEL of 51 dB $L_{Aeq16hr}$ for daytime noise and 45 dB L_{Aeq8hr} for night-time noise and the Civil Aviation Authority (CAA) are tasked with ensuring that these metrics are considered.

9.3.9 **Chapter 8: Noise** provides details of the relevant noise technical guidance.

9.4 Data gathering methodology

Study area

9.4.1 The study area for the desktop data gathering encompasses the LBC local authority area, key wards around LLA and, where appropriate, Lower Layer Super Output Areas¹⁷⁸.

Desk study

9.4.2 Evidence suggests that different groups within communities have varying susceptibilities to health impacts and benefits. This is because of social and demographic structure, behaviours, and relative economic circumstances. A baseline assessment provides information to better consider how potential health effects may act disproportionately upon certain communities and sensitive groups.

9.4.3 Health and relevant determinants of health baseline data has been collected and reviewed from:

- Public Health England community health profiles and local area health data;
- Luton Borough Council joint strategic needs assessment data and information; and
- Ministry of Housing, Communities & Local Government; indices of multiple deprivation 2019.

9.5 Overall baseline

9.5.1 LLA is situated at the southern end of the LBC local authority area. It is surrounded by North Hertfordshire, Stevenage, Central Bedfordshire, St. Albans, and Dacorum districts. The health of the population of LBC is significantly worse compared to the England average, with higher levels of death, illness and deprivation and higher levels of health status and life expectancy. The health of the five districts neighbouring LBC is significantly better than LBC and the England average. LLA is situated in Wigmore ward and surrounded by Crawley and Round Green wards, in Luton borough; Hitchwood, Offa and Hoo, and Kimpton wards, in North Hertfordshire district; and Caddington in Central Bedfordshire borough. The wards have a similar health profile to their respective boroughs or districts (in most cases they are better than or in line with the overall health status). The focus of this health profile is therefore on the population of LBC as representative of the residents who are most vulnerable to the health and wellbeing effects of the Proposed Scheme.

9.5.2 The health of people in LBC is generally worse than the England average. Luton is one of the 20% most deprived local authorities in England, and approximately 19% (9,650) of children in LBC live in low-income families¹⁷⁹. Life expectancy for both men and women is significantly worse in LBC than the England average.

¹⁷⁸ Super Output Areas were designed to improve the reporting of small area statistics and are built up from groups of Output Areas. Lower Layer Super Output Areas are generally the smallest scale that routine statistics go down to. they are geographical areas that have between 1,000-3,000 people and between 400-1,200 households. There are currently (as of 2011) 32,844 LSOAs in England.

¹⁷⁹ Public Health England (2019). Luton local authority health profile 2019. Available at: <https://fingertips.phe.org.uk/profile/health-profiles> [Checked 14 September 2020].

- 9.5.3 The most recent available data on strategic noise mapping shows that the impact of noise in LBC is lower than the national average and most neighbouring boroughs. These maps use national calculation methods and use data supplied by local authorities to model the percentage of the population exposed to road, rail, and air transport noise of 55 dB and 65 dB between 07:00 - 23:00. This data shows that the percentage of residents in LBC affected by noise above 65 dB is lower than in Slough, Birmingham, Wolverhampton, Hillingdon, and Redbridge. It also shows the percentage of residents in LBC affected by noise above 55 dB is also lower than those other areas, with the exception of Wolverhampton¹⁸⁰.
- 9.5.4 The most recent available data on the rate of complaints from LBC residents is below the England average. Compared to LBC, Slough and Birmingham have a lower rate of complaints, while in Wolverhampton, Hillingdon, and Redbridge the rates are higher.

Current baseline

- 9.5.5 In this community profile, the words 'significantly' and 'not significant' are used in the epidemiological sense of being a difference that is not due to chance (i.e. that this is a real difference). Where there is no statistical significance this means that the indicator is likely to be the same as the England average (i.e. no difference).
- 9.5.6 All the statistics referenced below are from the Public Health England long local health profile, unless otherwise referenced.¹⁸¹
- 9.5.7 In 2017, LBC had a population of 214,700. The population of LBC has been growing steadily over the last decade by 1 - 1.5%, though it decreased by 0.6% between 2016 and 2017¹⁸². Almost 29% of the population is under 19 years old, higher than the England average, with just over 12% of the population being over 65 years old, lower than the England average (in 2017). Approximately 40% of the population is from a minority ethnic group (and approximately 55% from a non-white UK background, 2016 figures)¹⁸³.
- 9.5.8 As previously mentioned, LBC is in the 20% most deprived areas in England with an Indices of Multiple Deprivation score of 27.6 compared to the England average of 21.8¹⁸⁴. Income deprivation, child poverty, and older people in deprivation in LBC is significantly worse than the England average (17.8%, 23.7% and 21.3% compared to 14.6%, 19.9% and 16.2%, respectively). LBC has a significantly higher proportion of low birth weight babies, lower level of child development at age 5, and a lower level of GCSE achievement compared to the England average (as of 2020, latest Public Health England information).
- 9.5.9 **Figure 9.1** shows the overall deprivation in LBC and the surrounding area in relation to LLA (highlighted by a teardrop marker)¹⁸⁵. The figure shows that deprivation in and around LLA is low.

¹⁸⁰ Luton Borough Council (2020) Luton's joint strategic needs assessment: noise pollution. Available at: https://www.luton.gov.uk/Community_and_living/Luton%20observatory%20census%20statistics%20and%20mapping/Pages/Joint%20Strategic%20Needs%20Assessment%20-%20JSNA.aspx [Checked 14 September 2020].

¹⁸¹ Public Health England (2020) Luton local health profile. Available at: https://www.localhealth.org.uk/#c=report&chapter=c01&report=r01&selgeo1=ward_2018.E05009158&selgeo2=eng.E92000001 (Checked 14 September 2020).

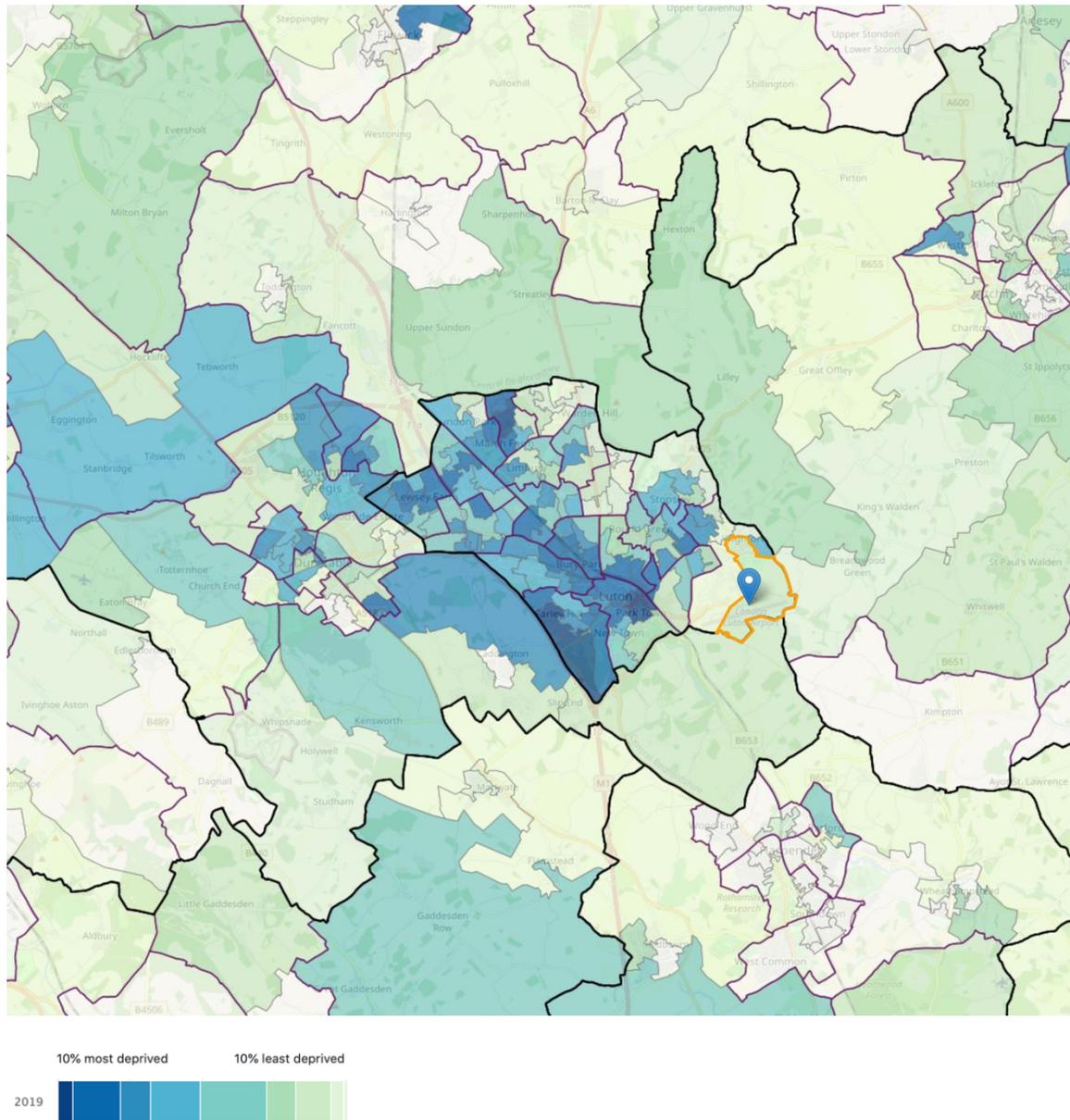
¹⁸² Luton Borough Council (2018) Luton 2017 mid-year population estimates. Available at: <https://www.luton.gov.uk/Environment/Lists/LutonDocuments/PDF/Planning/Observatory/Mid-year-population-estimate.pdf> [Checked November 2020].

¹⁸³ Public Health England (2019). Luton local authority health profile 2019. Available at: <https://fingertips.phe.org.uk/profile/health-profiles> [Checked 14 September 2020].

¹⁸⁴ Public Health England (2020) Luton local health profile. Available at: https://www.localhealth.org.uk/#c=report&chapter=c01&report=r01&selgeo1=ward_2018.E05009158&selgeo2=eng.E92000001 [Checked 14 September 2020].

¹⁸⁵ Ministry of Housing, Communities, & Local Government (2020) Indices of deprivation 2019 and 2015 explorer. Available at: http://dclgapps.communities.gov.uk/imd/ioid_index.html [Checked 14 September 2020].

Figure 9.1 Map of overall deprivation in LBC and surrounding areas

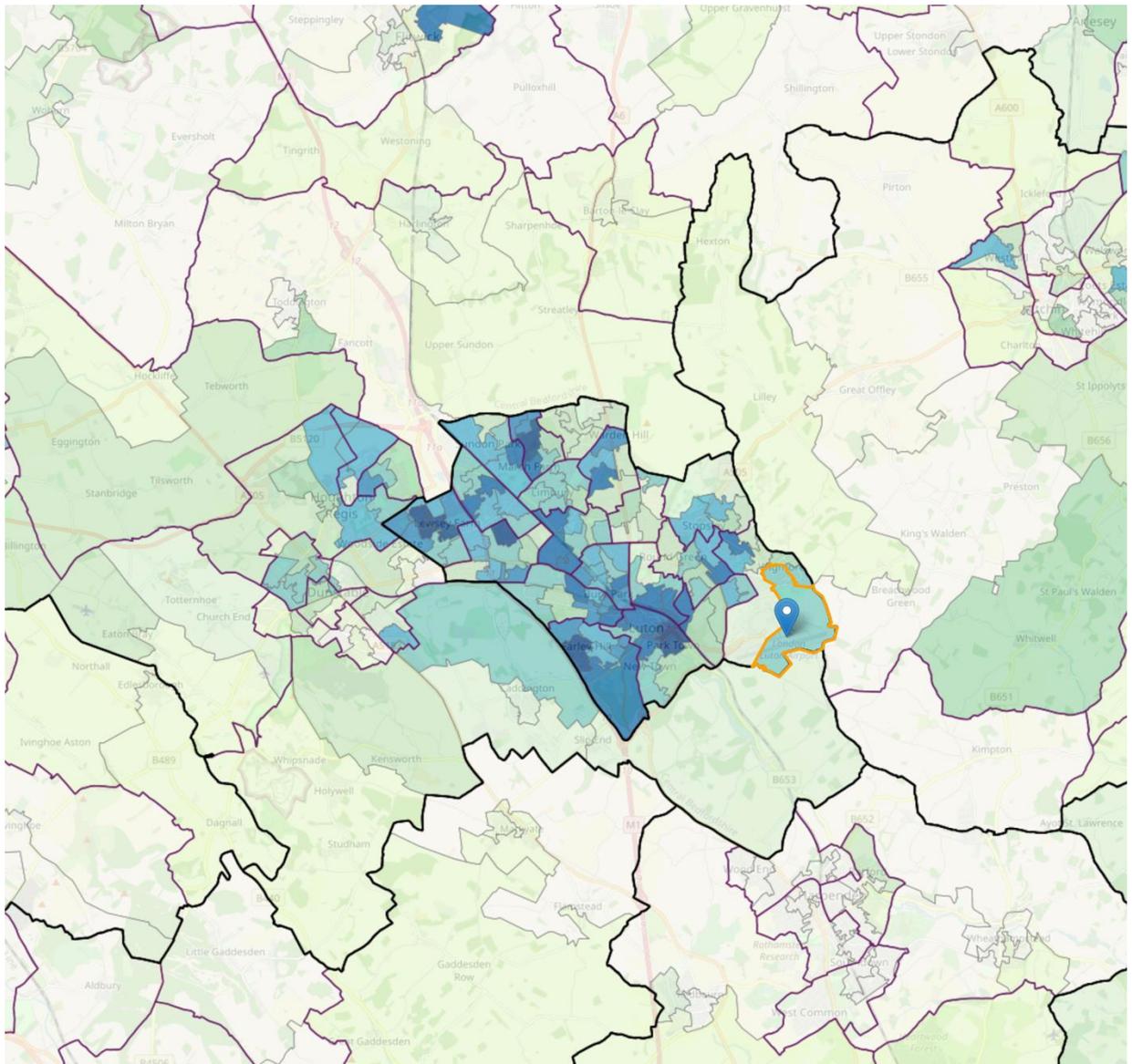


Source: English indices of deprivation 2019: mapping resources¹⁸⁶

Figure 9.2 shows health in LBC and the surrounding area in relation to LLA (highlighted by a teardrop marker). The figure shows that health deprivation immediately around LLA is moderate (top 30% of most deprived Lower Layer Super Output Areas (LSOAs)).

¹⁸⁶ Ministry of Housing, Communities & Local Government (2019). Mapping resources, interactive tools and Open Data facilities to aid user's exploration of the English indices of deprivation 2019. Available [online] at: <https://www.gov.uk/guidance/english-indices-of-deprivation-2019-mapping-resources> [Accessed November 2020].

Figure 9.2 Map of health deprivation in LBC and surrounding areas



10% most deprived 10% least deprived

2019

Source: English indices of deprivation 2019: mapping resources¹⁸⁶

- 9.5.10 Limiting long term disability is significantly better than the England average (15.6% compared to 17.6%, 2011).
- 9.5.11 Obesity in Reception Year and Year 6 children is significantly worse than the England average (as is excess weight in Year 6 children, 2015-18). Obesity in adults was significantly worse in previous years but is now in line with the England average (2017-18).
- 9.5.12 Emergency hospital admissions for all causes is significantly worse (standardised admissions ratio of 127.3 with England at 100; this suggests that for every 100 admissions in England, LBC has around 127 admissions, 2013-18). Emergency hospital admissions for coronary heart disease, heart attacks, and chronic obstructive pulmonary disease are also significantly worse (140.2, 151.5 and 136.5 admissions for every 100 admissions in England, 2013-18).

- 9.5.13 Lung cancer incidence is significantly worse compared to the England average (107 cases for every 100 cases in England, 2012-16). Breast cancer incidence is significantly lower and colorectal and prostate cancer incidence is in line with the England average (2012-16).
- 9.5.14 Early deaths in under 75 year olds, from all causes, cancers, and circulatory disease, are significantly worse than the England average (2011-15).
- 9.5.15 Hospital stays for alcohol-related harm (an indicator of mental health and wellbeing) is significantly worse (higher) than the England average (110.9 stays in LBA for every 100 stays in England, 2013-2018).
- 9.5.16 Life expectancy is 10.4 years lower for men and 6.3 years lower for women in the most deprived areas of LBC compared to the least deprived areas (2014-16).¹⁸⁷ Life expectancy, healthy life expectancy, and disability-free life expectancy are all significantly worse than the England average (2013-17).
- 9.5.17 LBC has higher estimated prevalence for depression, mixed anxiety and depression, phobias, panic disorders, and obsessive-compulsive disorder (these are hereafter termed 'common mental health disorders') compared to England and comparator areas¹⁸⁸. The current prevalence of common mental health disorders (CMD) is between 21,000 and 22,000 and is estimated to increase by a further 2,000 in the next ten years. Women are more likely to be diagnosed with a CMD than men (19.7% compared to 12.5%).
- 9.5.18 In children aged 5 to 16 years old the estimated prevalence of: overall mental health disorders is 11.5%, emotional disorders is 3.7%; conduct disorders is 6.1%; and hyperkinetic disorders is 1.7% (which are in line with the England average for 2015)¹⁸⁹. The proportion of children with social, emotional, and mental health needs in primary and secondary schools is 2.16% and 2.63% (the former is in-line and the latter is significantly worse than the England average for 2018).

Future baseline

- 9.5.19 Trends in population health and wellbeing in LBC (and the other five surrounding districts) are likely to improve slowly over time, with mortality from all causes likely to continue on the slight downward trend that it is currently on. Levels of inequality are also likely to remain the same with those from lower socio-economic backgrounds having a higher mortality than those from higher socio-economic backgrounds. LBC has a much higher level of inequalities in men for under 75 mortality from all causes, compared to the five surrounding districts.
- 9.5.20 LBC is therefore likely to continue to have lower levels of life expectancy in both men and women, and higher levels of mortality from cardiovascular disease, lung cancer and respiratory diseases compared to the five surrounding districts.
- 9.5.21 Health trends in the surrounding boroughs and districts are also likely to continue to be better than for LBC.

¹⁸⁷ Public Health England (2019). Luton local authority health profile 2019. Available at: <https://fingertips.phe.org.uk/profile/health-profiles> [Checked 14 September 2020].

¹⁸⁸ Luton Borough Council (2018) Luton mental health needs assessment. Available at: https://www.luton.gov.uk/Community_and_living/Lists/LutonDocuments/PDF/JSNA/9.2%20Adult%20mental%20health%20and%20wellbeing.pdf [Checked 14 September 2020].

¹⁸⁹ Public Health England (2020) Children and young people's mental health and wellbeing profile: East of England. Available at: <https://fingertips.phe.org.uk/profile-group/mental-health/profile/cypmh/data#page/0/gid/1938133090/pat/6/par/E12000006/ati/102/are/E06000032> (Checked November 2020).

Consultation

9.5.22 **Table 9.2** provides a summary of the issues about the Proposed Scheme that have been raised by consultees to date and the responses given.

Table 9.2 Summary of issues raised during consultation regarding health

| Issue raised | Consultee(s) | Response and how considered in this chapter | Section ref |
|---|-----------------------|---|--------------------|
| The increase in noise exposure is likely to lead to some additional cases of hypertension, stroke, ischaemic heart disease, and dementia. Furthermore, the increased noise exposure is also likely to lead to additional annoyance and sleep disturbance within the exposed population. | Luton Borough Council | This has been taken into account in the assessment of potential health impacts on affected residents. | Section 9.9 |
| Consider the health implications of noise on residents when windows are open in their homes and when they are outdoors. | Luton Borough Council | This has been taken into account in the assessment of potential health impacts on affected residents. | Section 9.9 |
| Consider the health implications of the temporary four year period of noise increases as this is a length of time that may give rise to health effects. | Luton Borough Council | This has been taken into account in the assessment of potential health impacts on affected residents. | Section 9.9 |
| Some comments received from respondents expressed concerns about the impact of the proposals on health, mental health, sleep, quality of life and wellbeing from increases in passengers, noise, and air quality. | Various | This has been taken into account in the assessment of potential health impacts on affected residents. | Section 9.9 |

9.6 Scope of the assessment

Spatial scope

9.6.1 The geographic scope of the health assessment encapsulates LLA and all areas within the furthest extending noise contour. This includes the following population groups:

- the population immediately adjacent to LLA; and
- the affected population of Luton, North Hertfordshire, St. Albans, and Dacorum.

Temporal scope

9.6.2 The key assessment year is the future year of 2028, which corresponds to the future year identified within the 2012 ES for the 2014 Planning Permission. However, there are years prior to this that also need assessment for three reasons:

1. The variation to Condition 10 presents a new area limit for the daytime 57 dB LAeq, 16 hr and night-time 48 dB LAeq, 8 hr assessment, which is based on the widest area, predicted to be in 2021 with 18 mppa.

2. As modernization reduces the noise effect from the airport operations, the 2028 year would not be the worst-case scenario. To ensure that environmental measures required to minimise significant noise effects encompass the worst-case effect from the Proposed Scheme, interim years between 2021 and 2028 also need to be assessed. The worst-case year has been identified as 2022. Additional years of 2023 and 2024 have been included in the noise assessment (see **Chapter 8: Noise**) as information to show how noise decreases, supporting the conclusion that 2022 is the worst-case year for significant effect.
3. 2024 has also been assessed in the noise assessment (see **Chapter 8: Noise**) because this is the first year where 19 mppa is predicted to be reached, the findings of which support the conclusion that 2022 is the worst-case year for significant effect.

9.6.3 To undertake the assessment of the key year of 2028, the predicted noise contours for the Proposed Scheme are compared to the baseline condition. As the proposal is to vary a condition of the 2014 Planning Permission, it is considered relevant to use the baseline of 12.5 mppa in 2028, as was assumed for the 2012 ES (as updated with runway operation and population numbers). By undertaking this comparison, it is possible to analyse the effect as would have been identified in 2012 with this different condition (given necessary adjustments for the latest knowledge). For years prior to 2028 which encompass both the change to the Condition 10 and the worst-case year, it is more appropriate to compare with what it is permissible currently, i.e. what is the actual effect that could be experienced at residences, assuming what is permissible with the existing Condition 10 contour area.

9.6.4 In summary, three non-variation scenarios are considered as a baseline for comparison:

- the extent of the existing Condition 10 for 2021 to 2027 inclusive, which provides a noise limit for airport 'in-air' operation;
- the extent of the existing Condition 10 for 2028 onwards, which provides a future noise limit for airport in-air operation; and
- the 'without Proposed Scheme' 2028 scenario of 12.5 mppa as assessed in the 2014 Planning Permission 2012 ES but updated to take into account the latest knowledge of fleet mix and runway split.

9.6.5 The temporal scope of the assessment covers the following scenarios:

- comparison of 2021 18 mppa scenario, with the existing Condition 10 limits for 2021-2027 showing the short-term change in noise levels prior to 19 mppa taking effect;
- comparison of 2022 18 mppa scenario, with the existing Condition 10 limits for 2021-2027 showing the short-term change in noise levels prior to 19 mppa taking effect;
- comparison of the 2028 19 mppa scenario, with the future baseline ('do nothing') scenario of 2028 (12.5 mppa) for long-term effects as would have been expected from the 2014 Planning Permission as assessed in the 2012 ES; and
- comparison of the 2028 19 mppa scenario, with the Condition 10 limits for 2028 onwards for long-term effects.

Potential receptors

9.6.6 Potential receptors are those locations used by people at which there is an environmental or social change that could affect a health outcome. For the proposed variation to Condition 10, this focuses on health effects associated with aircraft noise.

- 9.6.7 The scope of the assessment focuses on potential receptors, including community effects to residents, facilities such as school and hospitals, and other community facilities relevant to wellbeing such as, recreational areas and places of worship. For clarity, the key general population groups considered are:
- residents (residents living within the furthest extending noise contour) both indoors and outdoors as users of private and public green and open spaces;
 - those in employment who work around the LLA; and
 - any visitors/tourists of recreational amenities around LLA.
- 9.6.8 LLA employees are scoped out of further assessment as the change in noise contours would not directly affect them. In the instance where they reside in the area of the variation in noise contours, they are included as residents.
- 9.6.9 The key population sub-groups/sensitive receptors that have been defined in relation to their potential sensitivity to changes associated with LLA are as follows:
- older people, defined as those aged 65+ years;
 - young people, defined as those below the age of 16-18 years;
 - children, including students attending school within the proposed noise contour areas;
 - people under care in hospitals and other health and social care facilities;
 - those with disabilities; and
 - deprived (disadvantaged) communities¹⁹⁰.

Approach to identifying potential significant effects

- 9.6.10 The proposed variation to Condition 10 has potential to lead to some significant health effects. The likely effects of the proposed variation to Condition 10 that have the potential to be significant with regards to health, have undergone further assessment. These effects are summarised in the following sections.
- 9.6.11 It should be noted that when beneficial effects are identified as part of an assessment, for example reductions in aircraft noise, they do not necessarily cancel out any adverse effects that have been identified. This is because beneficial effects and adverse effects can be experienced by different groups within a community. However, they can overlap where people experience both beneficial and adverse effects at the same or at different points in time (e.g. the beneficial effect associated with provision of a new community facility or open space and the negative effect associated with additional vehicles on local roads).

Determinants of health

- 9.6.12 Population health can be influenced by a wide variety of direct and indirect factors, from modifiable factors such as lifestyle to uncontrollable factors such as genetics. The influences and effects can be wide-ranging and are likely to vary between individuals. In determining 'physical, mental, and social wellbeing', contributory factors, known as 'determinants', are considered. Determinants are a reflection of a mix of influences from an individual's society and environment.
- 9.6.13 Given the scope of the proposed variations, any interactions with human health will be limited to those associated with aircraft noise. All determinants of health unrelated to aircraft air noise have

¹⁹⁰ Those facing existing environment, health and social burdens and those on low incomes.

been scoped out of further assessment. This is because the proposed variations would lead to no change to the spatial pattern of ATMS and have been shown to not cause significant adverse impacts on air quality (see **Chapter 6: Air quality**) or on the road network (see **Chapter 10: Transport**). Therefore, the proposed variation to Condition 8 has been scoped out of the assessment, as agreed with LBC (see **Appendix 1C** in **Volume 3: Figures and Appendices**), and the variation to Condition 10 is not expected to alter any of the air quality or transport related determinants of health in ways that could adversely affect community health and wellbeing.

- 9.6.14 Health effects of physical severance have been scoped out. This is because **Chapter: 10 Transport** estimates an increase in traffic during the AM and PM peaks that is less than 4% of current traffic volumes. It also projects that the use of public transport will continue to increase, and this has the potential to lower traffic flows over time, particularly with the introduction of the Direct Air-Rail Transit (DART).

Aircraft noise: determinants of health

- 9.6.15 There are direct health effects of noise exposure on physical and mental health and wellbeing, as well as some level of indirect health effects through the effect of noise on learning and education, social capital and community cohesion, and leisure and recreation. For learning and education, this links to the potential adverse cognitive effects on children¹⁹¹. For social capital and community cohesion, this relates to the potential for noise to reduce outdoor social interaction (e.g. helping behaviour)¹⁹². For leisure and recreation, this links to potential reduced satisfaction and increased annoyance in using green and open spaces and the value of such spaces as sanctuaries from noise^{193,194}.

Aircraft noise: potential health outcomes / effects

- 9.6.16 Non-communicable diseases can be associated with changes in the noise environment. Changes in the noise environment may lead to an increase in awakenings and / or stress that manifests as sleep disturbance, high blood pressure (hypertension), and an increase in weight (overweight and obesity). Sleep disturbance may lead to an increase in heart rate and rising blood pressure while sleeping. While awake, increased noise in the daytime may also lead to a rise in blood pressure.
- 9.6.17 Mental health and wellbeing can also be associated with changes in the noise environment. Changes in noise levels can lead to sleep disturbance, annoyance, and some cognitive effects in children. For example, evidence has indicated that certain levels of aircraft noise can have small adverse cognitive effects on children, including lower reading comprehension and language acquisition. Noise can affect mental health and wellbeing via annoyance during the day and reducing the proportion of good quality sleep obtained at night.
- 9.6.18 While these effects are small on an individual basis, they have an in-combination and aggregate effect across an affected population.
- 9.6.19 The WHO issued new Environmental Noise Guidelines for the European Region in 2018. As part of the guidelines' development process, eight systematic reviews of evidence were conducted to assess the relationship between environmental noise and various health outcomes. The quality of the evidence presented in the systematic reviews was assessed by the WHO Systematic Review

¹⁹¹ Stansfeld, S.A. (2003) Noise pollution: non-auditory effects on health, *British Medical Bulletin*, 68(1), pp. 243-257.

¹⁹² Mathews, K.E. and Canon, L.K. (1975) Environmental noise as a determinant of helping behaviour, *Journal of personality and Social Psychology*, 32(4), pp. 571-577.

Page, R.A. (1977) Noise and helping behaviour, *Environment and Behavior*, 9(3), pp. 311-334.

¹⁹³ Brookfield, K. (2017) Residents' preferences for walkable neighbourhoods. *Journal of Urban Design*, 22(1), pp. 44-58.

¹⁹⁴ Gidlof-Gunnarsson, A. and Ohrstrom (2007) Noise and well-being in urban residential environments: the potential role of perceived availability to nearby green areas. *Landscape and Urban Planning*, 83(2-3), pp. 115-126.

Team (SRT). An overview of key findings from the reviews of evidence on the association between aircraft air noise and health outcomes is provided in the paragraphs below.

- 9.6.20 There is evidence on the relationship between exposure to aircraft noise, measured as L_{den} , and annoyance. The lowest category of noise exposure considered in any the systematic review that informed the WHO guidelines is 40 dB L_{den} , corresponding to approximately 1.2% High Annoyance (HA). The benchmark level of 10% HA is reached at approximately 45 dB L_{den} . The quality of this evidence was judged by the WHO SRT to be of moderate quality.
- 9.6.21 There is evidence on the relationship between exposure to aircraft noise, measured as L_{den} , and incidence of hospital admissions^{195 196} and prevalence of, and mortality due to ischaemic heart disease¹⁹⁷. The quality of this evidence was judged by the WHO SRT to be of low and very low quality. The weighted average of the lowest noise levels measured in these studies was 47 dB L_{den} and a relevant risk increase from exposure to aircraft noise was found to occur at 52.6 dB L_{den} .
- 9.6.22 There is evidence on the relationship between exposure to aircraft noise, measured as L_{den} , and the incidence^{198 199} and prevalence^{200 201 202} of hypertension. The quality of this evidence was judged by the WHO SRT to be of moderate and low quality, respectively.
- 9.6.23 There is evidence on the relationship between exposure to aircraft noise, measured as L_{den} , and the incidence of hospital admissions^{203 204} and mortality due to stroke²⁰⁵. The quality of this evidence was judged by the WHO SRT to be of very low quality for incidence and prevalence and of moderate quality for mortality.
- 9.6.24 There is evidence on the relationship between exposure to aircraft noise, measured as L_{den} , and cognitive impairment. Evidence rated moderate quality was available for impaired reading and oral

¹⁹⁵ Correia AW, Peters JL, Levy JI, Melly S, Dominici F (2013). Residential exposure to aircraft noise and hospital admissions for cardiovascular diseases: multi-airport retrospective study. *BMJ*. 347:f5561.

¹⁹⁶ Hansell AL, Blangiardo M, Fortunato L, Floud S, Hoogh K de, Fecht D et al. (2013). Aircraft noise and cardiovascular disease near Heathrow airport in London: small area study. *BMJ*. 347:f5432.

¹⁹⁷ Huss A, Spoerri A, Egger M, Roeoesli M, for the Swiss National Cohort Study Group (2010). Aircraft noise, air pollution, and mortality from myocardial infarction. *Epidemiology*. 21(6):829–36.

¹⁹⁸ Bluhm G, Eriksson C, Hilding A, Ostenson CG (2004). Aircraft noise exposure and cardiovascular risk on men. First results from a study around Stockholm Arlanda airport. In: Proceedings. 33rd International Congress and Exhibition on Noise Control Engineering, Prague, Czechia, 22–25 August 2004. Prague: Czech Acoustical Society.

¹⁹⁹ Bluhm G, Eriksson C, Pershagen G, Hilding A, Östenson CG (2009). Aircraft noise and incidence of hypertension: a study around Stockholm Arlanda airport. In: Proceedings. 8th European Conference on Noise Control 2009 (EURONOISE 2009).

²⁰⁰ Babisch W, Houthuijs D, Kwakkeboom J, Swart W, Pershagen G, Bluhm G et al. (2005b). HYENA - hypertension and exposure to noise near airports: a European study on health effects of aircraft noise. In: Proceedings. 34th International Congress on Noise Control Engineering 2005 (INTER-NOISE 2005), Rio de Janeiro, Brazil, 7–10 August 2005. Washington DC: Institute of Noise Control Engineering of the USA.

²⁰¹ Floud S, Vigna-Taglianti F, Hansell A, Blangiardo M, Houthuijs D, Breugelmans O et al. (2011). Medication use in relation to noise from aircraft and road traffic in six European countries: results of the HYENA study. *Occup Environ Med*. 68:518–24.

²⁰² Jarup L, Babisch W, Houthuijs D, Pershagen G, Katsouyanni K, Cadum E et al. (2008). Hypertension and exposure to noise near airports: the HYENA study. *Environ Health Perspect*. 116(3):329–33.

Jarup L, Dudley ML, Babisch W, Houthuijs D, Swart W, Pershagen G et al. (2005). Hypertension and exposure to noise near airports (HYENA): study design and noise exposure assessment. *Environ Health Perspect*. 113(11):1473–8. Jarup et al., 2005; 2008;

²⁰³ Correia AW, Peters JL, Levy JI, Melly S, Dominici F (2013). Residential exposure to aircraft noise and hospital admissions for cardiovascular diseases: multi-airport retrospective study. *BMJ*. 347:f5561.

²⁰⁴ Hansell AL, Blangiardo M, Fortunato L, Floud S, Hoogh K de, Fecht D et al. (2013). Aircraft noise and cardiovascular disease near Heathrow airport in London: small area study. *BMJ*. 347:f5432.

²⁰⁵ Weihofen VM, Hegewald J, Euler U, Schlattmann P, Zeeb H, Seidler A. Aircraft noise and the risk of stroke. *Dtsch Arztebl Int*. 2019;116(14):237–244. doi:10.3238/arztebl.2019.0237

comprehension²⁰⁶, for children with poorer performance on standardized assessment tests²⁰⁷, and for children having poorer long-term memory²⁰⁸.

- 9.6.25 There is evidence on the relationship between exposure to aircraft noise, measured as L_{night} and sleep disturbance. An association was found at exposure levels as low as 40 dB and over 11% of the population was characterised as highly sleep-disturbed at L_{night} levels of 40 dB. The quality of this evidence was judged by the WHO SRT to be of moderate quality.
- 9.6.26 There is also evidence that negative attitudes towards aircraft noise are especially prevalent in affected individuals who can see and hear aircraft from their house, or who fear that living in proximity of airports will have an impact on their health²⁰⁹ or property value (economic loss)²¹⁰. A lack of trust in the airport and Government authorities can enhance these negative attitudes towards airports and aircraft noise.²¹¹
- 9.6.27 The CAA publication of the 2014 Survey of Noise Attitudes (SoNA)²¹² found that around nine airports in England (including LLA) has found that $L_{\text{Aeq},16 \text{ hr}}$ for daytime noise correlates better with surveyed mean annoyance levels than L_{den} or N70 or N65 daytime events. It also provides further evidence that mean and high annoyance at given levels of aircraft noise has increased since earlier research (i.e. the ANIS study), with the implication that on the onset of significant community annoyance as previously defined in UK policy may now be at 54 dB $L_{\text{Aeq},16 \text{ hr}}$ rather than 57 dB $L_{\text{Aeq},16 \text{ hr}}$. The findings show a sharp increase in the percentage of highly annoyed between 51 - 54 and 54 - 57 dB $L_{\text{Aeq},16 \text{ h}}$. Above 54 - 57 dB, the percentage highly annoyed broadly increases with increasing exposure level.
- 9.6.28 The SoNA report finds that self-reported health status and mental wellbeing correlate with self-reported annoyance but is not statistically significantly with noise exposure, further supporting the likely importance of annoyance / tolerance as a modifying factor in health outcomes, as opposed to a purely sound-related physiological response. Key modifying factors identified from the survey for the percentage of high annoyance at given noise levels included:
- socio-economic status (i.e. C1 and B grades were more annoyed than those in socio-economic grade E, C2, D, and A in that order);
 - individuals between 55 - 74 years old; and
 - length of residence (those resident between 1 - 5 years).

²⁰⁶ Clark C, Martin R, van Kempen E, Alfred T, Head J, Davies HW et al. (2006). Exposure effect relations between aircraft and road traffic noise exposure at school and reading comprehension – the RANCH project. *Am J Epidemiol.* 163:27–37.

²⁰⁷ Sharp B, Connor TL, McLaughlin D, Clark C, Stansfeld SA, Hervey J (2014). Assessing aircraft noise conditions affecting student learning, volume 1: final report. Washington DC: Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine (<http://www.trb.org/Publications/Blurbs/170328.aspx>, accessed 5 July 2018).

²⁰⁸ Haines MM, Stansfeld SA, Job RF, Berglund B, Head J (2001b). Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children. *Psychol Med.* 31:265–77.

²⁰⁹ Schreckenber D, Faulbaum F, Guski R, Ninke L, Peschel C, Spijski J et al. (2015). Wirkungen von Verkehrslärm auf die Belästigung und Lebensqualität [Effects of transportation noise on noise annoyance and quality of life]. In: Gemeinütziges Umwelthaus gGmbH, editor, NORAH (Noise related annoyance cognition and health): Verkehrslärmwirkungen im Flughafenumfeld [Effect of transportation noise in the area of an airport] (vol. 3). Kelsterbach: Umwelthaus gGmbH (<https://www.norah-studie.de/en/publications.html>, accessed 4 July 2018)

²¹⁰ Bristow AL, Wardman M, Chintakayala VPK (2014). International meta-analysis of stated preference studies of transportation noise nuisance. *Transportation.* 42(1):71–100.

²¹¹ Schreckenber D, Benz S, Belke C, Möhler U, Guski R (2017). The relationship between aircraft sound levels, noise annoyance and mental well-being: an analysis of moderated mediation. In: Proceedings. 12th International Congress on Noise as a Public Health Problem 2017 (ICBEN 2017), Zurich, Switzerland, 18–22 June 2017. Zurich: International Commission on Biological Effects of Noise.

²¹² Civil Aviation Authority (2017) The 2014 Survey of Noise Attitudes (SoNA) Technical Report [online] Available at <http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7745> [Checked October 2018]

9.6.29 It must also be noted that community annoyance in a residential setting is not the only potential impact of noise on quality of life; the value of access to green spaces which are areas of tranquillity has also received research attention, linking it to people's wellbeing.

9.7 Environmental measures embedded into the Proposed Scheme

9.7.1 A range of environmental mitigation and enhancement measures have been embedded into the Proposed Scheme. This is outlined in **Chapter 6: Air quality** (see **Section 6.8**), **Chapter 7: Climate** (see **Section 7.8**), **Chapter 8: Noise** (see **Section 8.8**) which follows the ICAO balanced approach to noise management reducing and minimising the impact of noise, and **Chapter 10: Transport** (see measures developed in the Travel Plan).

9.8 Assessment methodology

9.8.1 The generic project-wide approach to the assessment methodology is set out in **Chapter 4: Approach to preparing the Environmental Statement**, specifically in **Sections 4.5 to 4.7**. However, whilst this has informed the approach that has been used in this human health assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this assessment.

9.8.2 The methodology is based on emerging practice for the consideration of health in EIA. This section sets out the methods for providing reasoned conclusions for the identification and assessment of any likely significant effects of the Proposed Scheme on population health. The methods provide a framework to identify:

- the likelihood of the proposed variation to Condition 10 having an effect on health; and
- if an effect is likely, whether it may be significant in EIA terms.

9.8.3 The qualitative analysis of the potential health and wellbeing effects considered:

- the nature of the effects on health determinants and their duration;
- the size and characteristics of the populations exposed to any effects, accounting for any specific vulnerabilities;
- review of scientific evidence linking the effects with health outcomes; and
- the scope for mitigation of health outcomes.

9.8.4 The determination of significance has two stages:

- firstly, the sensitivity of the receptor affected, and the magnitude of the effect upon it are characterised. This establishes whether there is a relevant population and a relevant change in health outcomes to consider; and
- secondly, a professional judgement is made as to whether or not the change in a population's health is significant. This judgement is based on the collection and presentation of data to evidence reasoned conclusions.

9.8.5 **Table 9.3** and **Table 9.4** outline sensitivity and magnitude criteria, respectively.

Table 9.3 Sensitivity criteria

| Receptor sensitivity criteria | Sensitivity rating |
|---|--------------------|
| <p>Communities with one or more of the following:</p> <ul style="list-style-type: none"> existing very low levels of physical and / or mental health; very high levels of health inequalities or inequities; very weak social and economic support networks; very high levels of deprivation; very high levels of exposure to environmental risk factors; very poor availability of or access to health and social services; very high proportion of vulnerable sub-groups (e.g. children, elderly, people with disabilities, economically inactive); and very strong views or high degrees of uncertainty about the project. <p>These communities are judged to have a very low coping capacity.</p> | Very High |
| <p>Communities with one or more of the following:</p> <ul style="list-style-type: none"> existing low levels of physical and / or mental health; high levels of health inequalities or inequities; weak social and economic support networks; high levels of deprivation; high levels of exposure to environmental risk factors; poor availability of or access to health and social services; high proportion of vulnerable sub-groups (e.g. children, elderly, people with disabilities, economically inactive); and strong views or high degrees of uncertainty about the project. <p>These communities are judged to have a low coping capacity.</p> | High |
| <p>Communities with one or more of the following:</p> <ul style="list-style-type: none"> existing moderate or average levels of physical and / or mental health; moderate or average levels of health inequalities or inequities; moderate or average levels of social and economic support networks; moderate or average levels of deprivation; moderate or average levels of exposure to environmental risk factors; moderate availability of or access to health and social services; average proportion of vulnerable sub-groups (e.g. children, elderly, people with disabilities, economically inactive); and some strong views or high degrees of uncertainty about the project. <p>These communities are judged to have a moderate coping capacity.</p> | Medium |
| <p>Communities with one or more of the following:</p> <ul style="list-style-type: none"> good levels of physical and / or mental health; low levels of health inequalities or inequities; good social and economic support networks; low levels of deprivation; low levels of exposure to environmental risk factors; good availability of or access to health and social services; low proportion of vulnerable sub-groups (e.g. children, elderly, people with disabilities, economically inactive); and no strong views or high degrees of uncertainty about the project. <p>These communities are judged to have a high coping capacity.</p> | Low |

Table 9.4 Magnitude of change criteria

| Magnitude rating | Magnitude criteria |
|------------------|--|
| Major | An impact that is expected to have major adverse or beneficial health effects, typically following one or more of the following: a large change in health risk (increase or decrease), affecting a large number of people, long-term in duration, permanent and irreversible, having a moderate-large or permanent effect on an activity that has important health benefits. |
| Moderate | An impact that is expected to have a moderate adverse or beneficial health effect, typically following one or more of the following: a moderate change in health risk (increase or decrease), affecting a moderate number of people, short-term in duration, intermittent and reversible, having a minor-moderate or long-term effect on an activity that has important health benefits. |
| Minor | An impact that is expected to have a minor adverse or beneficial health effect, typically following one or more of the following: a low change in health risk (increase or decrease), affecting a small number of people, temporary or short-term in duration, intermittent and reversible, having a minor or short-term effect on an activity that has important health benefits. |
| Negligible | An impact that is unlikely to have an effect on population or human health. |

9.8.6 The assessment will characterise the relevant changes in health outcomes for each health issue. For each professional judgement on sensitivity and magnitude, the text will set out detail on the one or more relevant factors from **Table 9.3** and **Table 9.4** that informed the significance level attributed to it. The matrix employed in this assessment is shown in **Table 9.5**.

9.8.7 Significance of effect is the product of the sensitivity of receptors and magnitude of impact. Moderate, large, or very large effects are considered 'significant'.

Table 9.5 Significant effect matrix

| | | Magnitude of impact | | | | |
|-------------|------------|----------------------------|----------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | | Very Low | Low | Moderate | High | Very high |
| Sensitivity | Very High | Minor (Not significant) | Minor (Not significant) | Major (Significant) | Major (Significant) | Major (Significant) |
| | High | Minor (Not significant) | Minor (Not significant) | Moderate (Potentially significant) | Major (Significant) | Major (Significant) |
| | Medium | Minor (Not significant) | Minor (Not significant) | Minor (Not significant) | Moderate (Potentially significant) | Major (Significant) |
| | Low | Minor (Not significant) | Minor (Not significant) | Minor (Not significant) | Minor (Not significant) | Moderate (Potentially significant) |
| | Negligible | Minor (Not significant) | Minor (Not significant) | Minor (Not significant) | Minor (Not significant) | Minor (Not significant) |

9.8.8 Modelled concentrations include the contributions from operational activity on the airport such as aircraft (including at height beyond the airport boundary) and ground support equipment (GSE), and road traffic on the modelled links (both airport-related and non-airport).

9.9 Assessment of the health effects of in-air aircraft noise

Predicted effects and their significance

Scenarios used to assess the significance of health effects of changes in noise exposure due to the proposed variation of Condition 10

- 9.9.1 The results of the noise assessment (see **Chapter 8: Noise**) and the fleet forecast (see **Appendix 3A in Volume 3: Figures and Appendices**) have informed the analysis and findings set out in this section. This includes both numbers of affected dwellings and residents (population).
- 9.9.2 The projections set out in **Chapter 3: Description of the Proposed Scheme**, show that recovery to 18 mppa is expected to occur by 2021 and reach 19 mppa by 2024.
- 9.9.3 The assessment in **Chapter 8: Noise**, shows that the worst-case year for noise exposure for residents is 2022 even though 19 mppa will only be reached in 2024. This is because of the forecasted changes in airline fleet mix from 2023 onwards which is expected to reduce noise levels even as the number of flights increases.
- 9.9.4 The assessment below focuses on the following four comparisons of the scenarios described in the temporal scope (see **Section 8.6**):
- comparison of the noise levels for the 2021 18 mppa scenario, against the existing Condition 10 limits for 2021 - 2027, using the assessment year 2021 only, showing the short-term change in noise levels prior to the increase to 19 mppa (the change in Condition 8);
 - comparison of the noise levels for the 2022 18 mppa scenario, against the worst-case year in terms of population affected (assessment year 2022), with the existing Condition 10 limits for 2021 - 2027, using the assessment year 2022 only, showing the short-term change in noise levels prior to the increase to 19 mppa (change in Condition 8);
 - comparison of the noise levels for the 2028 19 mppa scenario, against the 2028 future baseline ('do nothing') scenario using the 12.5 mppa revised fleet baseline noise estimate showing the long-term effects as would have been expected for the 2014 Planning Permission as assessed in the 2012 ES; and
 - comparison of the noise levels for the 2028 19 mppa scenario, with the future existing Condition 10 limits for 2028 onwards showing the long-term effects.

Change in noise exposure across the affected residential population

- 9.9.5 As set out in **Chapter 8: Noise**, the proposed variation to Condition 10 is expected to increase noise levels overall in the following ways:
- When comparing the 2021 18 mppa **daytime noise levels** with the existing Condition 10, for 2021, the noise assessment shows that almost all of the affected dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB_{LAeq 16hr}. No dwellings, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. No dwellings, with noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
 - When comparing the 2021 18 mppa **night-time noise levels** with the existing Condition 10, for 2021, the noise assessment shows that the majority of affected dwellings are expected to experience a small change in noise levels, either an increase in noise or decrease, of between 0.9 to -0.9 dB_{LAeq 8hr}. No dwellings, with noise levels between the night-time LOAEL (45 dB) and

the SOAEL (55 dB), are expected to experience a 3 dB or more increase in noise. Some dwellings (144), with noise levels above the SOAEL, are expected to experience a 1.0 to 1.9 dB increase in noise.

- When comparing the 2022 18 mppa **daytime noise levels** with the existing Condition 10, **the worst case scenario**, for 2022, the noise assessment shows that all the affected dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB $L_{Aeq\ 16hr}$. No dwellings, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. No dwellings, with noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- When comparing the 2022 18 mppa **night-time noise levels** with the existing Condition 10, **the worst case scenario**, for 2022, the noise assessment shows that approximately half of affected dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB $L_{Aeq\ 8hr}$. No dwellings, with noise levels between the night-time LOAEL (45 dB) and the SOAEL (55 dB), are expected to experience a 3 dB or more increase in noise. Some dwellings (1,877), with noise levels above the SOAEL, are expected to experience a 1.0 to 1.9 dB increase in noise.
- When comparing the 2028 19 mppa **daytime noise levels** with the future scenario for the original 12.5 mppa, the '**do nothing option**', for 2028, the noise assessment shows that all affected dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB $L_{Aeq\ 16hr}$ only. No dwellings, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. No dwellings, with noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- When comparing the 2028 19 mppa **night-time noise levels** with the future scenario for the 12.5 mppa updated 2028 future baseline, the '**do nothing option**', for 2028, the noise assessment shows that the majority of dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB $L_{Aeq\ 8hr}$. No dwellings, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. No dwellings, with noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- When comparing the 2028 19 mppa **daytime noise levels** with the existing future Condition 10, for 2028, the noise assessment shows that all affected dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB $L_{Aeq\ 16hr}$. No dwellings, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. No dwellings, with noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- When comparing the 2028 19 mppa **night-time noise levels** with the existing future Condition 10, for 2028, the noise assessment shows that all affected dwellings are expected to experience a small change in noise levels, either an increase or decrease, of between 0.9 to -0.9 dB $L_{Aeq\ 8hr}$ only. No dwellings, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. No dwellings, with noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- There would be changes of 1 dB or more above the noise assessment threshold effect criteria for the non-residential receptors at Caddington, Park Town, Breachwood Green, St Pauls Walden, Slip End and at Stevenage Station. These significant effects are mainly predicted in 2022, except for ongoing significant effects in Park Town, Luton (until 2024) and at Slip End (until 2023).

Health effects due to the change in noise exposure across the affected residential population

- 9.9.6 As discussed in paragraphs 8.6.16 - 8.6.26, research evidence from other airports shows that an increase in noise exposure at the population level is likely to have some physical health effects leading to some additional cases of hypertension, stroke, ischaemic heart disease, and dementia. In addition, the increased noise exposure is also likely to lead to additional annoyance and sleep disturbance within the exposed population reducing mental health and wellbeing. These additional cases are likely to represent a small fraction of the existing baseline rates for these health outcomes.
- 9.9.7 A summary of the results of the assessment of the health effects from changes in noise exposure is provided in **Table 9.7**.
- 9.9.8 Percentages have been rounded up (0.5 - 0.9) or down (0.1 - 0.4) to the nearest whole number.

Affected population

Sensitivity of the affected residential population

- 9.9.9 Taking account of the existing health status of communities affected by the increase in noise, residents are judged to have a sensitivity that varies between low and high during both daytime and night-time. The health baseline shows that residents in LBC experience a range of existing health burdens. This means they have a shorter life expectancy and higher levels of mortality and morbidity from non-communicable diseases, and slightly lower levels of mental health and wellbeing. Sensitivity is therefore low for some residents, and medium, or high for others.

Change in the number of people affected in the 2021 18 mppa scenario, with the existing Condition 10 limits for 2021 - 2027, using the year 2021 only (short term effects)

- 9.9.10 More residents are affected during the night-time period than the daytime period. This is due to the lower noise thresholds for the night-time.
- 9.9.11 For the **daytime**, the comparison of the 2021 18 mppa scenario, with the existing Condition 10 limits for 2021 - 2027, shows that for 2021, for residents currently experiencing noise levels between 51 - 62.9 dB $L_{Aeq\ 16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 37,345 residents, while five residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 63 dB $L_{Aeq\ 16hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 2,036 residents. No residents, experiencing noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- 9.9.12 For the **night-time**, the comparison of the 2021 18 mppa scenario, with the existing Condition 10 limits for 2021 - 2027, shows that for 2021, for residents currently experiencing noise levels between 45 - 54.9 dB $L_{Aeq\ 16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 45,101 residents, while 9,969 residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the night-time LOAEL (45 dB) and the SOAEL (55 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 55dB $L_{Aeq\ 8hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 4,339 residents, while 277 residents are expected to experience an increase in noise of between 1.0 to 1.9 dB.

Change in the number of people affected in the 2022 18 mppa scenario, the worst-case year in terms of population affected, with the existing Condition 10 limits for 2021 - 2027, using the year 2022 only

- 9.9.13 More residents are affected during the night-time period than the daytime period. This is due to the lower noise thresholds for the night-time.
- 9.9.14 For the **daytime**, the comparison of the 2022 18 mppa scenario, with the existing Condition 10 limits for 2021 - 2027, **the worst case scenario**, shows that for 2022, for residents currently experiencing noise levels between 51 - 62.9 dB $L_{Aeq\ 16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 36,500 residents, while no residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 63 dB $L_{Aeq\ 16hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 2,187 residents. No residents, experiencing noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- 9.9.15 For the **night-time**, the comparison of the 2022 18 mppa scenario, with the existing Condition 10 limits for 2021 - 2027, **the worst case scenario**, shows that for 2022, for residents currently experiencing noise levels between 45 - 54.9 dB $L_{Aeq\ 16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 27,489 residents, while 26,268 residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the night-time LOAEL (45 dB) and the SOAEL (55 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 55dB $L_{Aeq\ 8hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 80 residents, while 4,829 residents are expected to experience an increase in noise of between 1.0 to 1.9 dB.

Change in the number of people affected in the 2028 19 mppa scenario, with the 2028 future baseline ('do nothing') scenario using the 12.5 mppa revised fleet baseline noise estimate showing long term effects as would have been expected for the 2014 Planning Permission (as assessed in the 2012 ES)

- 9.9.16 More residents are affected during the night-time period than the daytime period. This is due to the lower noise thresholds for the night-time.
- 9.9.17 For the **daytime**, the comparison of 2028 19 mppa scenario, with the 2028 future baseline scenario using the 12.5 mppa revised fleet baseline, **the 'do nothing' scenario**, shows that for 2028, for residents currently experiencing noise levels between 51 - 62.9 dB $L_{Aeq\ 16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 22,994 residents, while no residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 63 dB $L_{Aeq\ 16hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 1,201 residents. No residents, experiencing noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- 9.9.18 For the **night-time**, the comparison of comparison of 2028 19 mppa scenario, with the 2028 future baseline scenario using the 12.5 mppa revised fleet baseline, **the 'do nothing' scenario**, shows that for 2028, for residents currently experiencing noise levels between 45 - 54.9 dB $L_{Aeq\ 16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 32,164 residents, while 9,138 residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the night-time LOAEL (45 dB) and the SOAEL (55 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 55dB $L_{Aeq\ 8hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9

to -0.9 dB for 3,656 residents. No residents, experiencing noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.

Change in the number of people affected in the 2028 19 mppa scenario, with the existing Condition 10 limits for 2028 onwards showing the long-term effects

- 9.9.19 More residents are affected during the night-time period than the daytime period. This is due to the lower noise thresholds for the night-time.
- 9.9.20 For the **daytime**, the comparison of 2028 19 mppa scenario, with the Condition 10 limits for 2028 onwards, shows that for 2028, for residents currently experiencing noise levels between 51 - 62.9 dB $L_{Aeq,16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 22,994 residents, while no residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the daytime LOAEL (51 dB) and the SOAEL (63 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 63 dB $L_{Aeq,16hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 1,201 residents. No residents, experiencing noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.
- 9.9.21 For the **night-time**, the comparison of 2028 19 mppa scenario, with the Condition 10 limits for 2028 onwards, shows that for 2028, for residents currently experiencing noise levels between 45 - 54.9 dB $L_{Aeq,16hr}$, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 42,256 residents, while no residents are expected to experience an increase in noise of between 1.0 to 1.9 dB. No residents, with noise levels between the night-time LOAEL (45 dB) and the SOAEL (55 dB), are expected to experience a 3 dB or more increase in noise. For residents currently experiencing noise levels 55dB $L_{Aeq,8hr}$ or more, there is expected to be an increase or decrease in noise of between 0.9 to -0.9 dB for 3,656 residents. No residents, experiencing noise levels above the SOAEL, are expected to experience a 1 dB or more increase in noise.

Significance of 2021 and 2022 18 mppa compared with existing Condition 10 short term health effects

Significance of the 2021 and 2022 18 mppa short-term health effects across the affected residential population: daytime 51 - 62 dB $L_{Aeq,16hr}$ and night-time 45 - 54 dB $L_{Aeq,8hr}$

- 9.9.22 In both scenarios, for those residents experiencing an increase in noise levels between 51 – 62 dB $L_{Aeq,16hr}$ (daytime) and between 45 – 54 dB $L_{Aeq,8hr}$ (night-time), the residents' **sensitivity** is judged to be **low to high** during the daytime and **medium to high** during the night-time. While at the individual level the change in exposure is small (<1 dB and in some scenarios between 1.0 to 1.9 dB), across the whole affected population and considering the additional population that is affected, the magnitude of change is judged to be **low to medium adverse**. This takes into account an increase in noise exposure indoors and associated health effects (including with windows open and closed) and outdoors (changing the amenity value of public spaces); a minor magnitude of change on children's learning and cognition outdoors (outdoor play is an important part of children's learning), and a minor magnitude of change on social capital through a small reduction in social interaction and helpful behaviours. Those residents experiencing changes at the lower level of the range e.g. 51 – 53 dB $L_{Aeq,16hr}$ may experience a lower magnitude of change.
- 9.9.23 Therefore, taking into account the range of sensitivity in residents, the large number of additional people affected at these noise levels, and the larger aggregate population health effect that is likely to be experienced, for those residents experiencing daytime noise levels between 51 – 62 dB $L_{Aeq,16hr}$, and night-time noise levels between 45 – 54 dB $L_{Aeq,8hr}$, **the health effect is judged to be of potentially significance (moderate)**.

Significance of the 2021 and 2022 18 mppa short term health effects across the affected residential population: daytime at or above 63 dB $_{LAeq,16hr}$ and night-time at or above 55 dB $_{LAeq,8hr}$

- 9.9.24 In both scenarios, for those residents experiencing an increase in daytime noise levels at or above 63 dB $_{LAeq,16hr}$ and night-time noise levels at or above 55 dB $_{LAeq,8hr}$, the residents' sensitivity is judged to be **medium to high**. While at the individual level the change in exposure is small (<1 dB and in some scenarios between 1.0 to 1.9 dB), across the whole affected population and considering the additional population that is affected, the magnitude of change is judged to be **medium adverse**. This takes account of the more disruptive effect of noise during sleep and consequent effects on wellbeing, work performance and learning because of lower quality sleep and the higher occurrence of health effects at these higher exposure levels.
- 9.9.25 Therefore, taking into account the range of sensitivity in residents, for those residents experiencing daytime noise levels at or above 63 dB $_{LAeq,16hr}$ and night-time noise levels at or above 55 dB $_{LAeq,8hr}$, **the health effect is judged to be of moderate significance**.
- 9.9.26 Measures to mitigate some or most of these effects for residents who are exposed to noise at or above the daytime and night-time SOAEL levels (63 and 55 dB $_{LAeq}$) will be provided. This is expected to minimise the increase in noise when windows and patio doors are closed and therefore the potential adverse health effects. They will not be able to mitigate the increase in noise indoors when windows and patio doors are open. There is therefore expected to continue to be a **potentially significant (minor to moderate)** residual health effect on some residents experiencing noise above the daytime and night-time SOAEL levels, e.g. highly sensitive residents with pre-existing cardiovascular conditions and some children and older people with learning or other disabilities or chronic health conditions that may be exacerbated by increases in noise.

Significance of the 2021 and 2022 18 mppa short term health effects across the affected worker and visitor population

- 9.9.27 In both scenarios, for those workers and visitors experiencing an increase in daytime noise levels between 51 – 62 dB $_{LAeq,16hr}$ and night-time noise levels between 45 – 54 dB $_{LAeq,8hr}$, the two groups' sensitivity is judged to be **low**. As workers and, particularly, visitors are affected for relatively short periods of times (usually 8 hours or less), though there is no estimate of the numbers of workers or visitors affected, it is judged that the magnitude of change is **low adverse** for workers and visitors. This is because they have a specific reason to be in the area with immediate short-term benefits e.g. workers get paid for the work they do, visitors come to visit a site or meet family or friends. This is likely to make it easier for them to adapt to, or not discern, small increases in noise.
- 9.9.28 Therefore, for those workers and visitors experiencing daytime noise levels between 51 – 62 dB $_{LAeq,16hr}$ and night-time noise levels between 45 – 53 dB $_{LAeq,8hr}$ **the health effect is judged to be not significant**.
- 9.9.29 For those workers and visitors experiencing an increase in daytime noise levels at or above 63 dB $_{LAeq,16hr}$ and night-time noise levels at or above 55 dB $_{LAeq,8hr}$, as workers and visitors are affected for relatively short periods of times (usually 8 hours or less), the higher level of noise experienced means that the two groups' sensitivity is **medium**. Though there is no estimate of the numbers of workers or visitors affected, it is judged that the magnitude of change is **low adverse** for workers and visitors.
- 9.9.30 Therefore, for those workers and visitors experiencing daytime noise levels at or above 63 dB $_{LAeq,16hr}$ and night-time noise levels at or above 55 dB $_{LAeq,8hr}$ the health effect is judged to be **not significant**.

Significance of the 2021 and 2022 18 mppa short term health effects across noise-sensitive facilities

- 9.9.31 Noise sensitive non-residential facilities such as schools, nursing homes and hospitals are judged to have **high** sensitivity. The estimated increase in noise for the majority of non-residential noise sensitive facilities is less than 1 dB. There would be changes of 1 dB or more above the noise assessment threshold effect criteria at Caddington (Caddington Village School, Heathfield Lower School), Park Town, Breachwood Green (Breachwood Green JMI School), St Pauls Walden (All Saints Church), Slip End (Slip End Lower School) and at Stevenage Station (North Hertfordshire College). These significant effects are mainly predicted in 2022, except for ongoing significant effects in Park Town, Luton (until 2024) and at Slip End (until 2023).
- 9.9.32 From a public health perspective, noise sensitive non-residential facilities include nurseries, schools, nursing homes, hospitals, health centres and places of worship. Some schools could experience a greater magnitude of change when taking account of children's activities outdoors in school playgrounds and playing fields.
- 9.9.33 The magnitude of change Caddington, Park Town, Breachwood Green, St Pauls Walden, Slip End and at Stevenage Station is judged to be **medium to high adverse** overall.
- 9.9.34 Therefore, the health effect on noise-sensitive non-residential facilities is judged to be **significant (moderate to high)**.

Significance of the 2021 and 2022 mppa short term health effects across public open spaces and recreational green spaces

- 9.9.35 Public open spaces and recreational green spaces are judged to have **medium to high** sensitivity. Taking into account that the estimated increase in noise for the majority of these spaces is between 1 - 3 dB, the magnitude of change is judged to be **low to medium adverse**. When taking children and older people into account, public open spaces, and recreational green spaces nearer to the airport could experience a magnitude of change that is **medium adverse**.
- 9.9.36 Therefore, **the health effect on public open spaces and recreational green spaces is judged to be potentially significant (minor-moderate)**.

Significance of 2028 19 mppa compared to 12.5 mppa revised baseline, the 'do nothing' scenario, and future existing Condition 10 long term health effects

- 9.9.37 The overall numbers of residents affected between the two scenarios is very similar. The only difference is that the existing Condition 10 scenario is expected to have no residents experience a 1.0 to 1.9 dB increase compared to the 'do nothing scenario' during the night-time. The increases in noise affect a similar number of residents however residents experience lower increases in noise in the future existing Condition 10 scenario.

Significance of the 2028 long-term health effects across the affected residential population: daytime 51 - 62 dB $L_{Aeq,16hr}$ and night-time 45 - 54 dB $L_{Aeq,8hr}$

- 9.9.38 In both scenarios, for those residents experiencing an increase in noise levels between 51 – 62 dB $L_{Aeq,16hr}$ (daytime) and 45 – 54 dB $L_{Aeq,8hr}$ (night-time), the residents' sensitivity is judged to be **low to high** during the daytime and **medium to high** during the night-time. While at the individual level the change in exposure is small (<1 dB and in some scenarios 1 - 1.9 dB), across the whole affected population and considering the additional population that is affected, the magnitude of change is judged to be **low to medium adverse**. This takes into account an increase in noise exposure indoors and associated health effects (including with windows open and closed) and outdoors (changing the amenity value of public spaces); a minor magnitude of change on children's learning and cognition outdoors (outdoor play is an important part of children's learning) and a minor

magnitude of change on social capital through a small reduction in social interaction and helpful behaviours. Those residents experiencing changes at the lower level of the range e.g. 51 – 53 dB $L_{Aeq,16hr}$ may experience a lower magnitude of change.

- 9.9.39 For those residents experiencing daytime noise levels between 51 - 62 dB $L_{Aeq,16hr}$ and night-time noise levels between 45 - 54 dB $L_{Aeq,8hr}$ **the effect is judged to be of significance (moderate)**. This conclusion takes into account the long-term nature of the exposure, the range of sensitivity in residents, the large number of people affected at these noise levels, and the larger aggregate population health effect that is likely to be experienced.

Significance of the 2028 long-term health effects across the affected residential population: daytime at or above 63 dB $L_{Aeq,16hr}$ and night-time at or above 55 dB $L_{Aeq,8hr}$

- 9.9.40 In both scenarios, for those residents experiencing an increase in daytime noise levels at or above 63 dB $L_{Aeq,16hr}$ and night-time noise levels at or above 55 dB $L_{Aeq,8hr}$, the residents' sensitivity is judged to be **medium to high**. While at the individual level the change in exposure is small (<1 dB and in some scenarios 1 - 1.9 dB), across the whole affected population and considering the additional population that is affected, the magnitude of change is judged to be **medium adverse**. This takes account of the more disruptive effect of noise during sleep and consequent effects on wellbeing, work performance and learning because of lower quality sleep, and the higher occurrence of health effects at these higher exposure levels.
- 9.9.41 Therefore, taking into account, the range of sensitivity in residents, for those residents experiencing daytime noise levels at or above 63 dB $L_{Aeq,16hr}$ and night-time noise levels at or above 55 dB $L_{Aeq,8hr}$, **the health effect is judged to be of significance (moderate)**.
- 9.9.42 Measures to mitigate some or most of these effects for residents who are exposed to noise at or above the daytime and night-time SOAEL levels (63 and 55 dB L_{Aeq}) will be provided. This is expected to minimise the increase in noise when windows and patio doors are closed and therefore the potential adverse health effects. They will not be able to mitigate the increase in noise indoors when windows and patio doors are open. There is therefore expected to continue to be a **potentially significant (minor to moderate)** residual health effect on some residents experiencing noise above the daytime and night-time SOAEL levels, e.g. highly sensitive residents with pre-existing cardiovascular conditions and some children and older people with learning or other disabilities or chronic health conditions that may be exacerbated by increases in noise.

Significance of the 2028 long-term health effects across the affected worker and visitor population

- 9.9.43 Workers and visitors, in both scenarios, experiencing an increase in daytime noise levels between 51 - 62 dB $L_{Aeq,16hr}$ and night-time noise levels 45 - 54 dB $L_{Aeq,8hr}$, the two groups' sensitivity is judged to be **low**. As they are affected for relatively short periods of time (usually 8 hours or less). Though there is no estimate of the numbers of workers or visitors affected, it is judged that the magnitude of change is **low adverse** for workers and visitors. This is because they have a specific reason to be in the area with immediate short-term benefits e.g. workers get paid for the work they do, and visitors come to visit a site or meet family or friends. This is likely to make it easier for them to adapt to, or not discern, small increases in noise.
- 9.9.44 Therefore, for those workers and visitors experiencing daytime noise levels between 51 - 62 dB $L_{Aeq,16hr}$ and night-time noise levels between 45 - 53 dB $L_{Aeq,8hr}$ **the health effect is judged to be not significant**.
- 9.9.45 Workers and visitors experiencing an increase in daytime noise levels at or above 63 dB $L_{Aeq,16hr}$, and night-time noise levels at or above 55 dB $L_{Aeq,8hr}$, are affected for relatively short periods of times (usually 8 hours or less). The higher level of noise experienced means that the sensitivity of these

two groups is therefore medium. Though there is no estimate of the numbers of workers or visitors affected, it is judged that the magnitude of change is **low adverse** for workers and visitors.

- 9.9.46 Therefore, for those workers and visitors experiencing daytime noise levels at or above 63 dB $L_{Aeq,16hr}$, and night-time noise levels at or above 55 dB $L_{Aeq,8hr}$ **the health effect is judged to be not significant.**

Significance of the 2028 long term health effects across noise-sensitive facilities

- 9.9.47 Noise sensitive non-residential facilities such as schools, nursing homes and hospitals are judged to have **high** sensitivity. The estimated increase in noise for all the non-residential noise sensitive facilities is less than 1 dB (between 0.1 - 0.7 dB for the existing future Condition 10 scenario).
- 9.9.48 From a public health perspective, noise sensitive non-residential facilities include nurseries, schools, nursing homes, hospitals, health centres and places of worship. Some schools could experience a greater magnitude of change when taking account of children's activities outdoors in school playgrounds and playing fields.
- 9.9.49 The magnitude of is judged to be **very low** overall.
- 9.9.50 Therefore, the health effect on noise-sensitive non-residential facilities is judged to be **not significant.**

Significance of the 2028 long term health effects across public open spaces and recreational green spaces

- 9.9.51 Public open spaces and recreational green spaces are judged to have **medium sensitivity**. Taking into account that the estimated increase in noise for the majority of these spaces is between 1 – 3 dB, the magnitude of change is judged to be **low-medium adverse**. When taking children and older people into account, public open spaces, and recreational green spaces nearer to the airport could experience a magnitude of change that is **medium adverse**.
- 9.9.52 Therefore, **the effect on public open spaces and recreational green spaces is judged to be of significance (minor-moderate).**

Table 9.6 Summary of significance of adverse and beneficial health effects

| Receptor and summary of predicted effects | Sensitivity/ importance/ value of receptor ¹ | Magnitude of change ² | Significance ³ | Summary rationale |
|--|---|----------------------------------|---|---|
| Significance of 2021 and 2022 18 mppa compared with existing Condition 10 short term health effects 51 - 62 dB _{Laeq,16hr} (DAYTIME) and 45 - 54 dB _{Laeq,8hr} (NIGHT-TIME) exposure | | | | |
| Residents affected by an increase in noise between 51 - 62 dB LAeq 16hr (DAYTIME) | Low - High | Low - Medium Adverse | Moderate (Potentially Significant) | <p>The health baseline shows that residents in LBC experience a range of existing health burdens which mean they have a shorter life expectancy and higher levels of mortality and morbidity from non-communicable diseases and slightly lower levels of mental health and wellbeing. Sensitivity is therefore low for some residents and medium - high for others.</p> <p>While the individual level increase in noise is small, a 1-2 dB change, across the whole affected population, the change in magnitude is judged to be minor to moderate adverse. The significance of effect is moderate as it includes both an increase in noise exposure indoors (including with windows open and closed) as well as outdoors (amenity value of public open and recreational green spaces).</p> |
| Residents affected by an increase in noise between 45 - 54 dB LAeq 8hr (NIGHT-TIME) | Medium - High | Low - Medium Adverse | Moderate (Potentially Significant) | Same as above except that sensitivity is medium as noise at night has greater effects than the same level of noise during the day. |
| Workers and visitors affected by an increase in noise between 51 - 62 dB LAeq 16hr (DAYTIME) | Low | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less the sensitivity of these two groups is low. There are no estimates of the numbers of workers or visitors affected. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to, or not discern, small increases in noise. |
| Workers and visitors affected by an increase in noise between 45 - 54 dB LAeq 8hr (NIGHT-TIME) | Low | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less the sensitivity of these two groups is low. There are no estimates of the numbers of workers or visitors affected. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with |

| Receptor and summary of predicted effects | Sensitivity/ importance/ value of receptor ¹ | Magnitude of change ² | Significance ³ | Summary rationale |
|--|---|----------------------------------|--------------------------------|---|
| | | | | immediate short-term benefits which make it easier for them to adapt to, or not discern, small increases in noise. |
| Significance of 2021 and 2022 18 mppa compared with existing Condition 10 short term health effects 63-68 dB LAeq 16hr (DAYTIME) and 55-62 dB LAeq 8hr (NIGHT-TIME) exposure | | | | |
| Residents affected by an increase in noise between 63 - 68 dB LAeq 16hr (DAYTIME) | Medium - High | Medium Adverse | Moderate (Significant) | As for residents above. The judgment on the magnitude of change takes account of the proposed mitigation. However, there is a potential for moderate significance residual effects. LLA will provide noise insulation to reduce noise exposure indoors though this insulation will not reduce the noise exposure indoors with windows open and noise exposure outdoors, of residents exposed to noise at or above 63 dB LAeq 16hr daytime and 55 dB LAeq 8 hr night-time. |
| Residents affected by an increase in noise between 55 - 62 dB LAeq 8hr (NIGHT-TIME) | Medium - High | Medium Adverse | Moderate (Significant) | As for residents above. The judgment on the magnitude of change takes account of the proposed mitigation. However, there is a potential for moderate significance residual effects. LLA will provide noise insulation to reduce noise exposure indoors though this insulation will not reduce the noise exposure indoors with windows open and noise exposure outdoors, of residents exposed to noise at or above 63 dB LAeq 16hr daytime and 55 dB LAeq 8 hr night-time. |
| Workers and visitors affected by an increase in noise between 63 - 68 dB LAeq 16hr (DAYTIME) | Medium | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less, the sensitivity of these two groups is low. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to small increases in noise. |
| Workers and visitors affected by an increase in noise between 55 - 62 dB LAeq 8hr (NIGHT-TIME) | Medium | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less, the sensitivity of these two groups is low. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to small increases in noise. |

| Receptor and summary of predicted effects | Sensitivity/ importance/ value of receptor ¹ | Magnitude of change ² | Significance ³ | Summary rationale |
|---|---|----------------------------------|--|---|
| Significance of 2021 and 2022 18 mppa compared with existing Condition 10 short term health effects 51 - 62 dB $L_{Aeq, 16hr}$ (DAYTIME) and 45 - 54 dB $L_{Aeq, 8hr}$ (NIGHT-TIME) exposure and 63 - 68 dB $L_{Aeq, 16hr}$ (DAYTIME) and 55 - 62 dB $L_{Aeq, 8hr}$ (NIGHT-TIME) exposure | | | | |
| Noise-sensitive non-residential facilities (at each facility) | High | Medium to High Adverse | Major (Significant) | The estimated increase in noise for the majority of non-residential noise sensitive facilities is less than 1 dB. This would have a high sensitivity when taking into account children and older people and those with pre-existing health conditions and disabilities who may use these spaces. There would be changes of 1 dB or more above the noise assessment threshold effect criteria at Caddington (Caddington Village School, Heathfield Lower School), Park Town, Breachwood Green (Breachwood Green JMI School), St Pauls Walden (All Saints Church), Slip End (Slip End Lower School) and at Stevenage Station (North Hertfordshire College). These significant effects are mainly predicted in 2022, except for ongoing significant effects in Park Town, Luton to 2024 and at Slip End to 2023. From a public health perspective, noise sensitive non-residential facilities include nurseries, schools, nursing homes, hospitals, health centres and places of worship. Some schools could experience a greater magnitude of change when taking account of children's activities outdoors in school playgrounds and playing fields. |
| Public open spaces and recreational green spaces | Medium - High | Low - Medium Adverse | Minor – Moderate (Potentially significant) | Public open spaces and recreational green spaces have a moderate to high sensitivity when taking into account children and older people and those with pre-existing health conditions and disabilities who may use these spaces. The magnitude of effect for the 1 - 2 dB increase in noise is judged to be minor to moderate adverse. When taking children and older people into account, public open spaces and recreational green spaces nearer to the airport could experience a magnitude of change that is moderate adverse. |
| Significance of 2028 19 mppa compared to 12.5 mppa revised baseline and future Condition 10 long term health effects 51 - 62 dB $L_{Aeq, 16hr}$ (DAYTIME) and 45 - 54 dB $L_{Aeq, 8hr}$ (NIGHT-TIME) exposure | | | | |
| Residents affected by an increase in noise between 51 - 62 dB $L_{Aeq, 16hr}$ (DAYTIME) | Low - High | Low - Medium Adverse | Moderate (Significant) | While the individual level increase in noise is small (a 1 - 2 dB change), across the whole affected population, the change in magnitude is judged to be minor to moderate adverse. The significance of effect is moderate as it includes both an increase in noise exposure indoors |

| Receptor and summary of predicted effects | Sensitivity/ importance/ value of receptor ¹ | Magnitude of change ² | Significance ³ | Summary rationale |
|---|---|----------------------------------|--------------------------------|---|
| | | | | (including with windows open and closed) as well as outdoors (amenity value of public open and recreational green spaces). |
| Residents affected by an increase in noise between 45 - 54 dB LAeq 8hr (NIGHT-TIME) | Medium - High | Low - Medium Adverse | Moderate (Significant) | Same as above except that sensitivity is medium as noise at night has greater effects than the same level of noise during the day. |
| Workers and visitors affected by an increase in noise between 51 - 62 dB LAeq 16hr (DAYTIME) | Low | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less the sensitivity of these two groups is low. There are no estimates of the numbers of workers or visitors affected. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to, or not discern, small increases in noise. |
| Workers and visitors affected by an increase in noise between 45 - 54 dB LAeq 8hr (NIGHT-TIME) | Low | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less the sensitivity of these two groups is low. There are no estimates of the numbers of workers or visitors affected. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to, or not discern, small increases in noise. |
| Significance of 2028 19 mppa compared to 12.5 mppa revised baseline and future Condition 10 long term health effects 63 - 68 dB LAeq 16hr (DAYTIME) and 55 - 62 dB LAeq 8hr (NIGHT-TIME) exposure | | | | |
| Residents affected by an increase in noise between 63 - 68 dB LAeq 16hr (DAYTIME) | Medium - High | Medium Adverse | Moderate (Significant) | As for residents above. The judgment on the magnitude of change takes account of the proposed mitigation. However, there is a potential for moderate significance residual effects. LLA will provide noise insulation to reduce noise exposure indoors though this insulation will not reduce the noise exposure outdoors, of residents exposed to noise at or above 63 dB LAeq 16hr daytime and 55 dB LAeq 8 hr night-time. |
| Residents affected by an increase in noise between 55 - 62 dB LAeq 8hr (NIGHT-TIME) | Medium - High | Medium Adverse | Moderate (Significant) | As for residents above. The judgment on the magnitude of change takes account of the proposed mitigation. However, there is a potential for moderate significance residual effects. |

| Receptor and summary of predicted effects | Sensitivity/ importance/ value of receptor ¹ | Magnitude of change ² | Significance ³ | Summary rationale |
|--|---|----------------------------------|----------------------------------|---|
| | | | | LLA will provide noise insulation to reduce noise exposure indoors though this insulation will not reduce the noise exposure indoors with windows open and noise exposure outdoors, of residents exposed to noise at or above 63 dB LAeq 16hr daytime and 55 dB LAeq 8 hr night-time. |
| Workers and visitors affected by an increase in noise between 63 - 68 dB LAeq 16hr (DAYTIME) | Medium | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less the sensitivity of these two groups is low. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to small increases in noise. |
| Workers and visitors affected by an increase in noise between 55 - 62 dB LAeq 8hr (NIGHT-TIME) | Medium | Low Adverse | Minor (Not significant) | As workers and especially visitors are affected for relatively short periods of times usually 8 hours or less the sensitivity of these two groups is low. Magnitude is judged to be minor for workers and visitors because they have a specific reason to be in the area with immediate short-term benefits which make it easier for them to adapt to small increases in noise. |
| Significance of 2028 19 mppa compared to 12.5 mppa revised baseline and future Condition 10 long term health effects 51 - 62 dB LAeq 16hr (DAYTIME) and 45 - 54 dB LAeq 8hr (NIGHT-TIME) exposure and 63 - 68 dB LAeq 16hr (DAYTIME) and 55 - 62 dB LAeq 8hr (NIGHT-TIME) exposure | | | | |
| Noise-sensitive non-residential facilities (at each facility) | High | Very Low Adverse | Minor (Not significant) | The estimated increase in noise for all the non-residential noise sensitive facilities is less than 1 dB (between 0.1 - 0.7 dB for the existing future Condition 10 scenario). This would have a high sensitivity when taking into account children and older people and those with pre-existing health conditions and disabilities who may use these spaces. From a public health perspective, noise sensitive non-residential facilities include nurseries, schools, nursing homes, hospitals, health centres and places of worship. Some schools could experience a greater magnitude of change when taking account of children's activities outdoors in school playgrounds and playing fields. |
| Public open spaces and recreational green spaces | Medium - High | Low - Medium Adverse | Minor – Moderate | Public open spaces and recreational green spaces have a moderate to high sensitivity when taking into account children and older people |

| Receptor and summary of predicted effects | Sensitivity/ importance/ value of receptor ¹ | Magnitude of change ² | Significance ³ | Summary rationale |
|---|--|-------------------------------------|--------------------------------------|--|
| | | | (Potentially significant) | and those with pre-existing health conditions and disabilities who may use these spaces. The magnitude of effect for the 1 - 3dB increase in noise is judged to be a minor to moderate adverse. When taking children and older people into account, public open spaces, and recreational green spaces nearer to the airport could experience a magnitude of change that is moderate adverse. |

1. The sensitivity / importance / value of a receptor is defined using the criteria set out in **Section 9.8** above and is defined as low, medium, high, and very high.
2. The magnitude of change on a receptor resulting from activities relating to the development is defined using the criteria set out in **Section 9.8** above and is defined as major, moderate, minor, and negligible.
3. The significance of the environmental effects is based on the combination of the sensitivity / importance / value of a receptor and the magnitude of change and is expressed as major (significant), moderate (probably significant) or minor / negligible (not significant), subject to the evaluation methodology outlined in **Section 9.8**.

9.10 Assessment of cumulative effects

- 9.10.1 As outlined in **Section 4.8**, consideration has been given as to whether any of the health receptors that have been taken forward for assessment in this chapter are likely to be subject to cumulative health effects because of the noise effects generated by 'other developments'. However, no 'other developments' have been identified within the study area of this assessment that would contribute to a cumulative health impact. **No likely significant inter-project effects** are predicted to occur from the Proposed Scheme together with 'other developments'.
- 9.10.2 The potential for inter-related effects has been identified at receptors that could experience health and noise effects, and these are reported in **Section 9.9**. This is because the Health assessment is by its nature cumulative, as it assesses the effects on a variety of determinants of health, such as exposure to noise, and changes in air quality and climatic effects.
- 9.10.3 The air quality, climate, and transport assessments have identified that no likely significant effects are predicted to occur. **No likely significant intra-project effects** involving cumulative health interactions with these aspects are therefore predicted to occur from the Proposed Scheme.

9.11 Conclusions of significance evaluation

- 9.11.1 The 2012 ES of the 2014 Planning Permission described and assessed a range of beneficial as well as adverse health effects and associated mitigation and enhancement measures which continue to apply.
- 9.11.2 This health assessment has focused solely on the health effects of the change in noise exposure. Therefore, the findings of this chapter should be read alongside the health-related findings of the 2012 ES of the 2014 Planning Permission.
- 9.11.3 While at the individual-level the change in noise exposure is estimated to be small and not result in individual-level measurable health effects, at the population level, the health effects are measurable because of the larger size of the exposed population subject to small changes in noise exposure.
- 9.11.4 The health effects related to the change in noise exposure linked to the proposed Condition 10 variation is judged overall, to continue to have an adverse health effect at the population level that is of **moderate significance** in the assessment years 2021, 2022, and 2028.
- 9.11.5 Measures to mitigate some or most of these effects for residents who are exposed to noise at or above the daytime and night-time SOAEL levels (63 and 55 dB LAeq) will be provided. This is expected to minimise the increase in noise when windows and patio doors are closed and therefore the potential adverse health effects. They will not be able to mitigate the increase in noise indoors when windows and patio doors are open. There is therefore expected to continue to be a **potentially significant (minor to moderate)** residual health effect on some residents experiencing noise above the daytime and night-time SOAEL levels, e.g. highly sensitive residents with pre-existing cardiovascular conditions and some children and older people with learning or other disabilities or chronic health conditions that may be exacerbated by increases in noise.

9.12 Implementation of environmental measures

- 9.12.1 **Table 9.7** describes the environmental measures proposed to mitigate the health impacts of the Proposed Scheme and the means by which they will be implemented.

Table 9.7 Summary of environmental measures to be implemented – relating to noise

| Environmental measure | Responsibility for implementation | ES section reference |
|---|-----------------------------------|-----------------------------------|
| LLAOL will contribute to the Noise Insulation Fund with an initial budget of £400,000 in 2021, £900,000 in 2022, £700,000 in 2023 and £100,000 each year afterwards to 2028 inclusive. | LLAOL | Noise Chapter Section 8.14 |