HEALTH IMPACT ANALYSIS

SHORTLISTED SCHEMES FOR DRAFT AIRPORTS NATIONAL POLICY STATEMENT

FEBRUARY 2017

WSP | PARSONS BRINCKERHOFF

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Provided separately:

ABBREVIATIONS

AC	Airports Commission
AMI	Acute Myocardial Infarction

AONB	Areas of Outstanding Natural Beauty
AoS	Appraisal of Sustainability
AQMAs	Air Quality Management Areas
AQO	Air Quality Objectives
BAME	Black, Asian and Minority Ethnic people
CPRE	Campaign for the Protection of Rural England
DALY	Disability-Adjusted Life Year
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EqIA	Equalities Impact Assessment
ESA	Ecosystem Services Assessment
HIA	Health Impact Assessment
HSE	Health Survey for England
IOM	Institute of Occupational Medicine
LA	Local Authority
$L_{Aeq\ 0700\text{-}2300hrs}$	level of A-weighted noise detected between 0700hr to 2300hrs
LGW-2R	London Gatwick Second Runway
LHR-ENR	London Heathrow Extended Runway
LHR-NWR	London Heathrow Northwest Runway
LNR	Local Nature Reserves
NAEI	National Atmospheric Emissions Inventory
NCD	Non-Communicable disease
NPS	National Policy Statement
ONS	Office of National Statistics
PAH	Poly Aromatic Hydrocarbons
PHE	Public Health England
PM	Particulate Matter
SAC	Special Areas of Conservation
SINC	Site of Importance to Nature Conservation
SNCI	Site of Nature Conservation Interest
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SWLW	South West London Waterbodies
ToR	Terms of Reference
VOC	Volatile Organic Compounds
WFD	Water Framework Directive

WHO	World Health Organisation
YLD	Years Lost due to Disability

1 EXECUTIVE SUMMARY

1.1.1 The Department for Transport (DfT) has prepared an Appraisal of Sustainability (AoS) to inform Government of the economic, social and environmental effects of the three shortlisted schemes (as outlined at 1.1.4 below) to expand UK aviation capacity.

1.1.2 The AoS provides an impact analysis of three policy alternatives for the Airports National Policy Statement (NPS). The AoS includes an assessment of the potential impacts of increasing aviation capacity on quality of life for the communities surrounding the airports involved in the three policy alternatives.

1.1.3 The three policy alternatives under consideration for the Airports NPS are subject to a health impact analysis, scheduled to be published alongside the Airports NPS as a stand-alone document (this report).

1.1.4 The purpose of the health impact analysis is to assist decision makers in judging the impact of airport expansion and its broader legacy to the population's health. The health impact analysis has considered the following three policy alternatives:

- Gatwick Airport Second Runway (LGW-2R) for a new full length runway to the south of and parallel to the existing runway at Gatwick Airport;
- Heathrow Extended Northern Runway (LHR-ENR) for an extension of the existing northern runway at Heathrow Airport to the west; and
- Heathrow Northwest Runway (LHR-NWR) for a new full length runway to the northwest of the current northern runway at Heathrow Airport.

1.1.5 This health impact analysis has explored the health impacts, both beneficial and negative, upon the local population. As part of the study each of the scheme area community baselines were assessed and relevant evidence was considered.

1.1.6 As the shortlisted scheme plans and baseline information supplied by the Airport Commission were limited in their detail, this assessment has been limited to consider the impacts of each shortlisted scheme at a policy level. Collection and review of additional baseline data to identify vulnerable groups, and supporting information has been limited to the District level or above.

1.1.7 A steering group was established to oversee the health impact analysis and included members of the DfT project management team, the consultant's management team, representatives of Public Health England, Department for Communities and Local Government, and the Environment Agency.

1.1.8 Due to the confidential nature of elements of this study, no targeted stakeholder consultation has taken place at this stage.

1.1.9 The key issues identified as significant by this health impact analysis in terms of their potential impact upon the health of people living close to each of the shortlisted schemes under consideration were:

- Significance of any changes in employment, employment type and quality, as well as training and skills demands resulting from each of the shortlisted schemes;
- Changes in income levels locally resulting from each of the shortlisted schemes;

- Loss of housing as a result of each shortlisted scheme;
- Impacts on educational facilities and young people;
- Pollution from additional road transport;
- Additional noise from airport and aircraft activities;
- Lack of access to leisure facilities and outdoor space.

1.2 KEY FINDINGS

1.2.1 This health impact analysis seeks to support the DfT in determining broader impacts upon health of each shortlisted scheme.

1.2.2 This health impact analysis study has found commonality between key health issues and those recognised within previous HIA studies on airports. These included:

- Noise Impacts – from additional aircraft flights and ground movement, leading to significant health impacts
- Air Quality Impacts – health impacts resulting from degradation of local air quality from additional aircraft emissions, and road traffic could impact on compliance with limit values, with a risk of future non-compliance of air quality objectives in the Greater London area.
- Socio-economic – beneficial impacts on local employment opportunities; and potentially adverse impacts on dwellings or established businesses.

1.2.3 Other impacts identified included community severance, reduced access to recreation facilities, greenspace, flood risk and potential loss of tranquillity. These impacts are common to all three shortlisted schemes, although the severity of the impact varies slightly. Further detail is provided in the summaries below.

1.2.4 Despite its lower beneficial health impacts arising from economic effects, overall LGW-2R was judged to have a lower detrimental impact upon health; this was in part due to LGW-2R requiring fewer residential properties to be demolished. This would result in a fewer groups being subjected to moderately adverse health effects from the risk to both their housing tenure and housing conditions. In addition, it would result in fewer older people being subjected to potential major adverse health effects, once again, from the risk to both their housing tenure and housing conditions.

1.2.5 Noise impacts arising from LGW-2R were predicted to be of a lower magnitude and affect a smaller population, than either of the unmitigated Heathrow shortlisted schemes. The changes in the metric Disability-Adjusted Life Years (DALYs) lost, attributed solely to total environmental noise as a consequence of LGW-2R were lower for LGW-2R than for either Heathrow shortlisted scheme. Over the 60-year design life period DALYs associated with changes in total environmental noise attributed to LGW-2R were significantly lower for LGW-2R than either LHR-ENR or LHR-NWR.

1.3 INEQUALITY

1.3.1 LGW-2R is likely to further increase inequalities between a number of vulnerable groups and the general population (Table 6-1) with regard to:

- Adverse health impacts upon children and young people as well as people living in areas with poor health status through a reduction in the opportunities to undertake exercise / access physical activity;
- Adverse health impacts upon 'children and young people' as well as 'people living in areas with poor health status' through changes in the level of family incomes;
- Adverse health impacts upon 'Different Faith groups', 'Older people', 'Black and ethnic minority groups' and 'Shift workers' through changes in the security of housing tenure;
- Adverse health impact upon 'older people' through risks to housing conditions;
- Adverse health impacts upon 'children and young people' through a reduction in their ability to access leisure, recreation services, facilities and utilities;
- Adverse indirect health impacts upon a number of vulnerable groups, including 'different faith groups', 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people in areas of poor health status' through a reduction in the opportunities and facilities to participation in the community;
- Adverse indirect health impacts upon a number of vulnerable groups, including 'children and young people', 'older people', 'disabled people with a physical or mental impairment' and 'people living in geographical/social isolation' through a potential increase in community severance for these groups;
- Adverse health impacts upon 'children and young people' and 'people living in areas with poor health status' through a potential reduction in the 'Air Quality' in and around the LGW-2R study area.

1.3.2 LHR-ENR is likely to further increase inequalities between a number of vulnerable groups and the general population (Table 6-2) with regard to:

- Level of income of families of including 'children and young people' as well as 'people living in areas with poor health status';
- Housing tenure amongst 'Different Faith groups', 'Older people', 'Black and ethnic minority groups' and 'Shift workers';
- Housing conditions of 'older people';
- Access to leisure, recreation services, facilities and utilities' for 'children and young people';
- Participation in the community for 'different faith groups', 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people in areas of poor health status';
- Community severance for 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people living in geographical/social isolation';
- 'Air Quality' for including 'children and young people', 'people living in areas with poor health status'.

1.3.3 LHR-NWR is likely to further increase inequalities between a number of vulnerable groups and the general population (Table 6-3) with regard to:

- Level of income of families of including ‘children and young people’ as well as ‘people living in areas with poor health status’;
- Housing tenure amongst ‘Different Faith groups’, ‘Older people’, ‘Black and ethnic minority groups’ and ‘Shift workers’;
- Housing conditions of ‘older people’;
- Access to leisure, recreation services, facilities and utilities’ for ‘children and young people’ for the health;
- Participation in the community for ‘different faith groups’, ‘children and young people’, ‘older people’; ‘disabled people with a physical or mental impairment’ and ‘people in areas of poor health status’;
- Community severance for ‘children and young people’, ‘older people’; ‘disabled people with a physical or mental impairment’ and ‘people living in geographical/social isolation’;
- ‘Air Quality’ for including ‘children and young people’, ‘people living in areas with poor health status’.

1.3.4 Of the shortlisted schemes, LGW-2R is considered to have the least negative impacts upon vulnerable groups, as its detrimental impact on health as a consequence of loss of housing is the lowest.

1.3.5 It is likely that a large number of those most affected by the expansion schemes are unlikely to benefit from the opportunities provided. This issue of equity will need to be considered further in the development of mitigation for each shortlisted scheme to reduce the overall impact on health and wellbeing.

1.3.6 A project specific Health Impact Assessment should be undertaken in relation to a scheme that is the subject of an application for development consent. A central output of the project level Health Impact Assessment should include health mitigations, which would be designed to maximise the health benefits of the scheme and mitigate against any detrimental health impacts.

2 PROJECT BACKGROUND

2.1 INTRODUCTION

2.1.1 To ensure increased productivity, sustainable economic growth and employment opportunities within the UK economy, the Airports Commission (AC) has considered it necessary to increase capacity at a London based airport. The position of the UK within the global aviation market is critical to its economy, and delivering sufficient capacity within the aviation sector is crucial to support UK markets.

2.1.2 The AC examined the need for additional UK airport capacity and published a report to the Secretary of State for Transport on 1 July 2015. The aim of this report was to examine the scale and timing of any requirement for additional capacity to maintain the UK's position as Europe's most important aviation hub, and to identify and evaluate how any need for additional capacity should be met in the short, medium and long term.

2.1.3 During this process, three potential policy schemes were shortlisted:

- Gatwick Airport Second Runway (LGW-2R) for new full length runway to the south of and parallel to the existing runway at Gatwick Airport. The space between the runways would be set at 1,045m, which would provide room for the required supporting airport infrastructure – a new terminal building, main pier and satellite. It would also permit simultaneous independent mixed mode operations on each runway, as proposed by the scheme promoter, which would enable the proposed operating capacity of 560,000 air transport movements per annum (currently 280,000);
- Heathrow Extended Northern Runway (LHR-ENR) for an extension of the existing northern runway at Heathrow Airport to the west. This would effectively create two separate runways, each 3,000m in length, with a 650m safety area in between, enabling them to be operated independently. The scheme would provide an operating capacity of 700,000 air transport movements per year (currently 480,000);
- Heathrow Northwest Runway (LHR-NWR) for a new full length runway to the northwest of the current northern runway at Heathrow Airport. It would also be needed to permit simultaneous independent, mixed mode operations on each runway, as proposed by the shortlisted scheme promoter, which would enable the proposed operating capacity of 740,000 air transport movements per annum (currently 480,000).

2.1.4 Each of the three shortlisted schemes are considered to be credible for expansion, capable of delivering valuable enhancements to the UK's aviation capacity. More information on the alternatives considered is given in the Health Impact Analysis Scoping Report (refer Appendix A).

2.1.5 As the project involves development of infrastructure which is significant on a national scale, a National Policy Statement (NPS) will be produced by the Department for Transport (DfT). The NPS will set out the new policy to be introduced based upon the final decision, and will provide an explanation as to how the policy takes account of Government policy and legislation. The NPS will also outline other relevant policies and will provide the framework from which recommendations will be made to the Secretary of State.

2.1.6 The Airports NPS sets out:

- The Government's policy on the need for new capacity; and
- The Government's preferred scheme to deliver this.

2.2 BACKGROUND TO THE ASSESSMENT

2.2.1 As part of the NPS process, the DfT has commissioned WSP | Parsons Brinckerhoff to provide an Appraisal of Sustainability (AoS) for the expansion of airport capacity in the UK.

2.2.2 As part of this AoS a Health Impact Assessment was commissioned. According to 'Health Impact Assessment: A Practical Guide'[1] (Harris *et al* 2007) an Health Impact Assessment (HIA) is defined as;

"*Both a health protection and health promotion tool. In HIA, health is broadly defined to include assessment of both health hazards and health benefits of a proposal and the potential ways in which health and well-being can be both protected and promoted."*

2.2.3 As noted in Harris *et al*, the health sector typically adopts two approaches to health;

- The quantitative[2] approach; focusing on disease categorisation and a reliance on quantitative evidence of health impacts within the traditional biomedical model; and
- The broad or qualitative[3] approach; based upon the social or wellness model of health, attaching significance to the socio-environmental 'health and wellbeing' aspects of health.

2.2.4 HIAs assess the impact of a proposed scheme using both quantitative and qualitative evidence. They can also assist in examining broader health impacts of a scheme or proposal at its planning and implementation stage.

2.2.5 The health status of a population can be adversely affected by exposure to risks and conditions such as noise, vibration and air pollution, and beneficially affected by conditions such as social support and improvements in state infrastructure:

- Health Determinants are the personal, social, cultural, economic and environmental factors that influence the health of individuals or a population. In addition to physical health, these include a range of other factors such as income, employment, housing and education;
- Health Impact is the direct (e.g. release of pollutant) or indirect cumulative effect (e.g. loss of jobs or income) of a proposal on the health of individuals or a wider population. The impact may be either short or long term.
- Health Inequality can be defined as the difference in either health status, or the distribution of health determinants, between different population groups. Some health inequalities are unavoidable, others are not so and may well be unjust and unfair.

2.3 HEALTH AND INEQUALITY

2.3.1 Health and health inequalities are influenced by interactions between a spectrum of health determinants which include: income and poverty, housing, employment, the environment, transport, education, access to health services and the broader influence of wellbeing[4]. These are shown in Figure 2.1 below.

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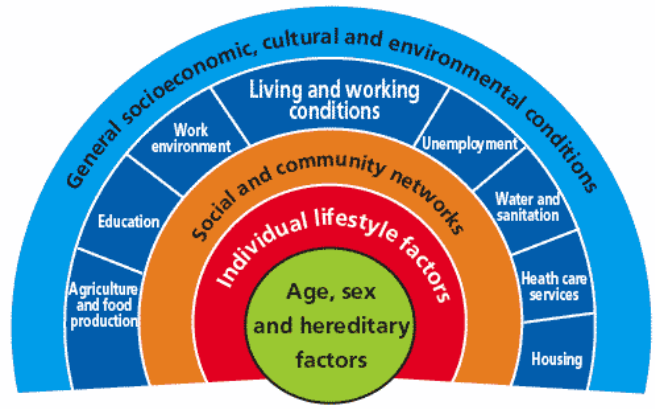
[1] Harris, P., Harris-Roxas, B., Harris, E., & Kemp, L. 2007 *Health Impact Assessment: A Practical Guide, Sydney: Centre for Health Equity Training, Research and Evaluation* (CHETRE).

[2] **Quantitative:** relating to quantity**-** concerning, or based on the amount or number of something.

[3] **Qualitative:** relating to quality- based on the quality or character of something, often as opposed to its size or quantity.

Figure 2-1 Socio-Environmental Model of Wellbeing



2.4 HEALTH IMPACT ANALYSIS

2.4.1 During discussion at the Health Impact Analysis Steering Group, the study was amended from a HIA to a health impact analysis. The main drivers behind the rationale for undertaking an health impact analysis instead of a HIA are:

- **Policy-making**: A package of mitigation measures for each scheme is being developed in discussion between DfT and each of the scheme promoters and a HIA has the potential to cut across this process and make suggestions that are outside negotiated packages;
- **Methodological**: Interpretation of results – the difference between what is appraised during the AoS and that during a HIA (i.e. scheme with mitigation and scheme without mitigation, respectively) could lead to apparent inconsistencies between the outputs of the AoS and those of the HIA. A health impact analysis which excludes additional mitigations and recommendations, reducing the potential for confusion in terms of agreed measures for mitigation;
- **Decision-taking**: Health is only one of several domains that decision-makers need to consider when weighing potential trade-offs to achieve policy objectives. A health impact analysis presents the potential adverse and beneficial impacts of each scheme so that they can be aligned with the outputs from other appraisals allowing decision-makers to take decisions about the schemes and any packages for mitigation based on an overall balance of benefits and harms.

2.4.2 This health impact analysis includes mitigation measures put forward by the different shortlisted scheme promoters as they are an assumed part of the design, rather than as mitigation measures. Mitigation applied after the assessment (e.g. through the NPS) is not included in this health impact analysis, whereas in a HIA mitigation applied after the assessment can be proposed.

AIM OF THE HEALTH IMPACT ANALYSIS

- To identify the aspects of each shortlisted scheme for increasing aviation capacity which have the potential to affect people's health and wellbeing, both directly and indirectly.

OBJECTIVES FOR THE HEALTH IMPACT ANALYSIS

- To assess the potential health impacts, both beneficial and adverse, of each of the policy schemes for increasing aviation capacity.
- To assess the direct/indirect[5] and cumulative[6] health impacts including health inequalities associated with each of the shortlisted schemes for increasing aviation capacity.

[5] Direct / Indirect Distinguishes between effects that are a direct result of the policy (e.g. land loss) or are secondary, they occur away from the original effect or as a result of a complex pathway.

[6] Cumulative effects arise, for instance, where several developments each have insignificant effects but together have a significant effect; or where several individual effects of the plan (e.g. noise, dust and visual) have a combined effect. Includes synergistic effects where interactions produce a total effect greater than the sum of the individual effects. Cumulative effects are also taken to mean 'in-combination effects' under the Habitats Directive, where other plans or projects in combination with the Project might affect European sites.

3 SCOPE AND METHODOLOGY

3.1.1 A Scoping Report for this health impact analysis was produced by WSP | Parsons Brinckerhoff with a template provided by Public Health England (PHE), under guidance from the DfT Health Impact Analysis Steering Group. An outline of the Scope and Methodology for this health impact analysis can be found below; the full Scoping Report is available in Appendix A.

3.2 GEOGRAPHICAL AREA

3.2.1 This is a desk-based assessment of the direct and indirect effects which are likely to be experienced by those communities (wards and districts) closest to each airport, (i.e. into which, and close to which, the extended airports would physically impact). Specific technical assessments, for example; noise or air quality, have their own study areas.

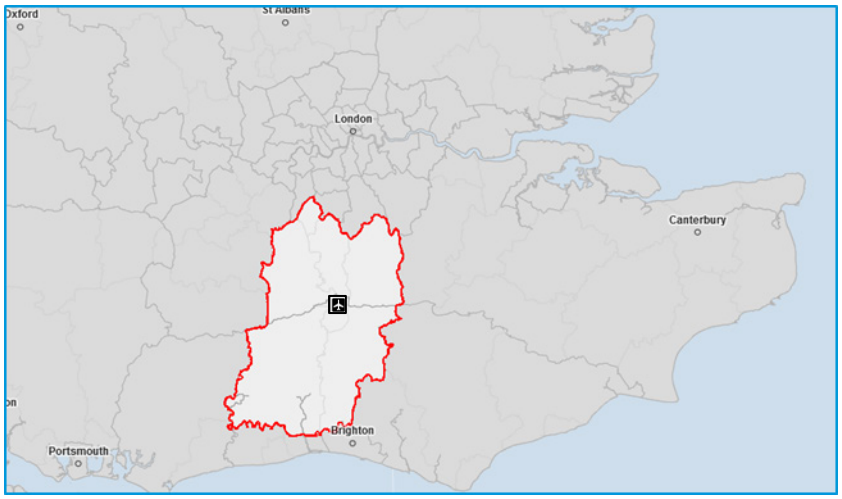
3.2.2 Two principal study areas are considered within this health impact analysis, and were determined by identifying areas where indirect and direct effects may be experienced as a result of each shortlisted scheme for airport expansion. It is noted that at the strategic level these are selected by administrative boundary as set out above rather than distance from the airports. The asymmetrical nature of these administrative study areas results in some populations not being represented within the study areas, and is a limitation of this strategic level Health Impact Analysis. In addition to these principal study areas, two additional distinct study areas solely related to noise impacts were employed. Therefore two study areas were relevant to the single shortlisted scheme at Gatwick, and two are relevant to both Heathrow shortlisted schemes.

3.2.3 The study areas include the following administrative areas:

GATWICK

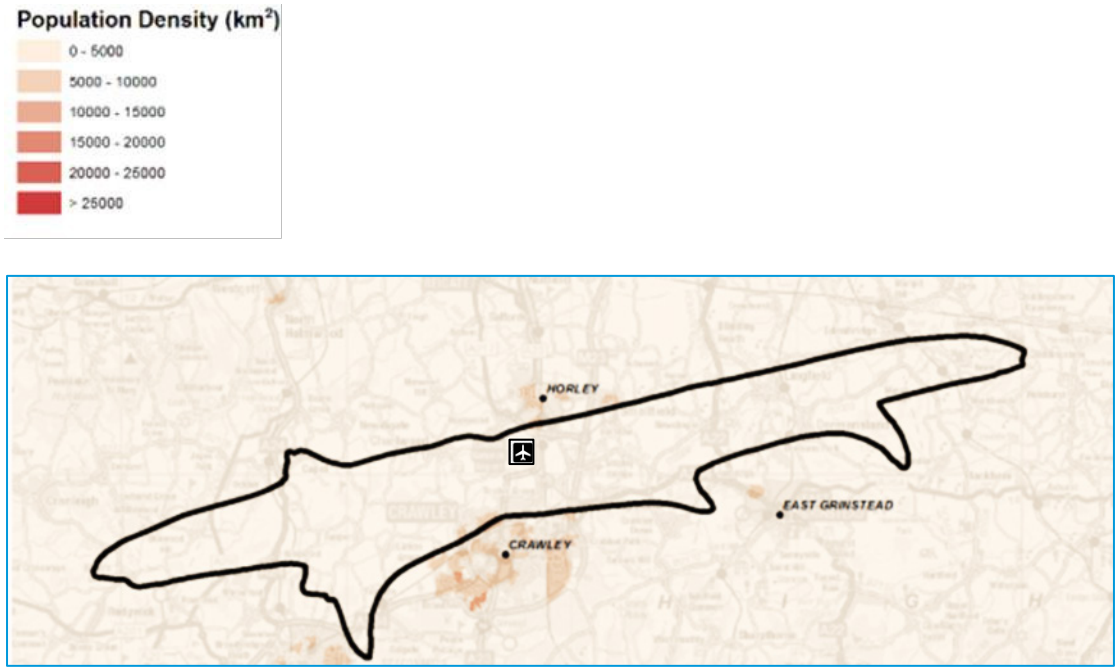
- District of Crawley
- District of Horsham
- District of Reigate and Banstead
- Mole Valley District
- Tandridge District
- District of West Sussex

Figure 3-1 Gatwick Health Impact Analysis Principal Study Area



3.2.4 The noise study area for the Gatwick Second Runway shortlisted scheme is derived from the total area covered by the do minimum and do something noise[7] contours that have been calculated by the Environmental Research and Consultancy Department on behalf of the AC, and is shown in Figure 3.2 below.

Figure 3-2 Gatwick Health Impact Analysis Noise Study Area

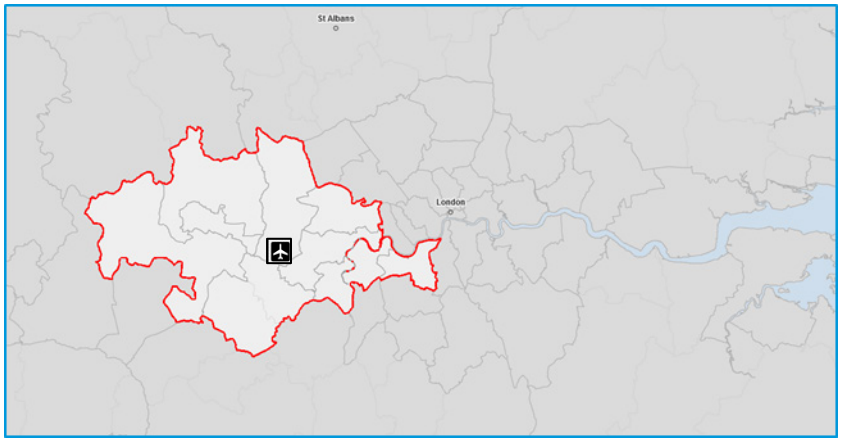


[7] Appraisal of Sustainability – Noise

HEATHROW

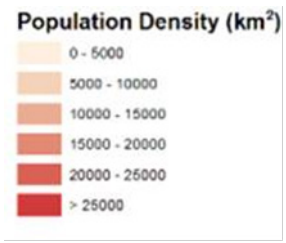
- District of Slough
- District of Spelthorne
- London Borough of Hounslow
- London Borough of Hillingdon
- London Borough of Richmond upon Thames
- The Royal Borough of Windsor and Maidenhead
- South Bucks District Council
- Runnymede Borough Council
- London Borough of Ealing
- London Borough of Wandsworth

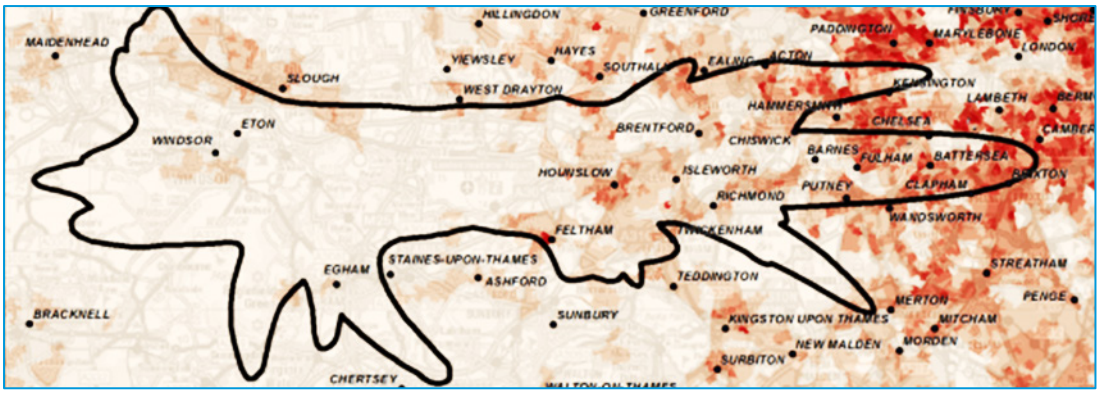
Figure 3-3 Heathrow Health Impact Analysis Principal Study Area



The noise study area for LHR-NWR is derived from the total area covered by the do minimum and do something noise contours that have been calculated by the Environmental Research and Consultancy Department on behalf of the AC and are shown in Figure 3.4 below.

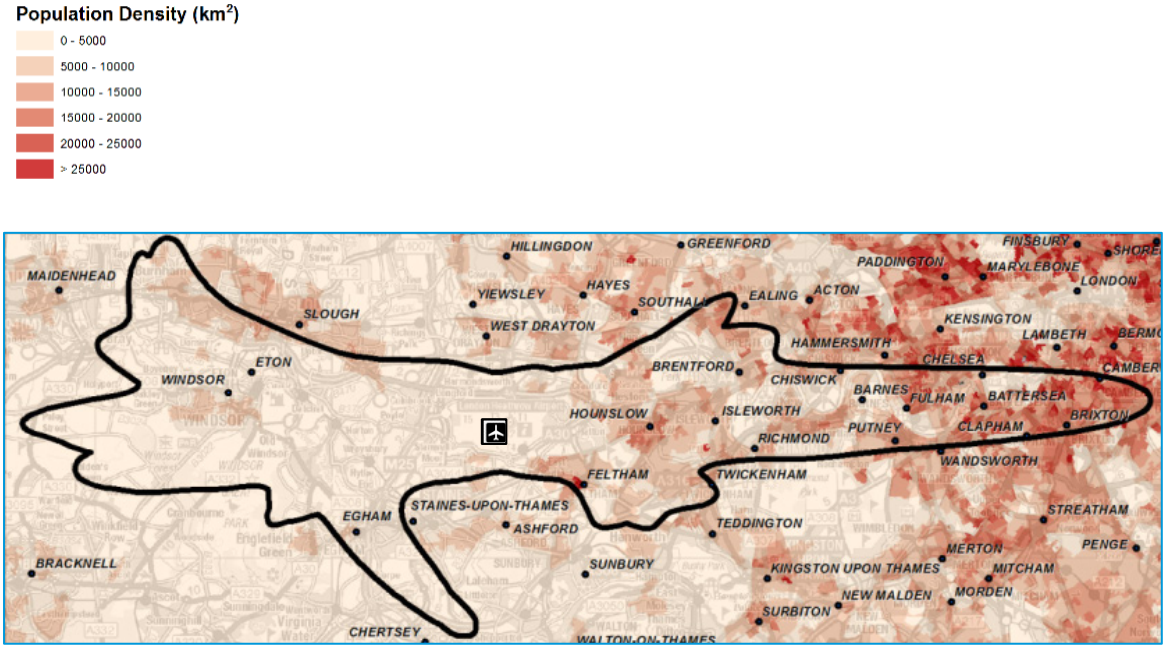
Figure 3-4 Heathrow Northwest Runway Health Impact Analysis Noise Study Area





The noise study area for LHR-ENR is derived from the total area covered by the do minimum and do something noise contours that have been calculated by the Environmental Research and Consultancy Department on behalf of the AC, and are shown in Figure 3.5 below.

Figure 3-5 Heathrow Extended Northern Runway Health Impact Analysis Noise Study Area



3.3 COMMUNITIES AND VULNERABLE GROUPS DIRECTLY AFFECTED

3.3.1 For LGW-R2, people living in:

- Tandridge
- Mole Valley
- Mid Sussex
- Horsham
- Reigate and Banstead
- Epsom and Ewell
- Crawley

3.3.2 For either of the Heathrow shortlisted schemes, people living in:

- London Borough of Hillingdon
- London Borough of Hounslow
- London Borough of Ealing
- London Borough of Richmond upon Thames
- London Borough of Wandsworth
- Slough Borough Council
- Royal Borough of Windsor and Maidenhead
- South Bucks District Council
- Runnymede Borough Council
- Spelthorne Borough Council

3.3.3 The priority groups identified within the Equalities Impact Assessment (EqIA) are detailed below (Table 3.1). The groups in the EqIA were determined through the AC's screening process, where potential impacts were also identified.

Table 3-1 Priority Groups identified within the EqIA

EQUALITY STRAND	EQUALITY PRIORITY GROUP
Gender, pregnancy and maternity	Women
Religion or Belief	People belonging to faith and belief groups
Ethnicity and Race	Black, Asian and Minority Ethnic people (BAME)
Age grouping	Children (0-16 years) Young People (17-25 years) Working age people (15-64 years) Older people (≥60 years)
Disability	Disabled people with a physical or mental impairment which has a long term effect on their ability to undertake day to day activities
Low Income Groups	Most deprived local authorities using Indices of Deprivation – Income Domain[8]

3.3.4 Additional vulnerable groups identified and included in the health impact analysis are;

- People who are economically inactive/unemployed
- People living in areas with poor health status
- People living in geographical and or social isolation
- Non-motorised users[9]

[8] Department for Communities and Local Government, 2015. *England indices of deprivation*. [online] Accessed 09/01/2017.

[9] Non-motorised users (NMU) are considered to be pedestrians, cyclists and equestrians by the Design Manual for Roads and Bridges, Volume 5, Section 2, Part 5, HD42/05.

- People with poor access to services, facilities and amenities
- People with poor access to greenspace
- Shift workers

3.4 HEALTH IMPACTS OF CONCERN

3.4.1 The following health determinants are proposed to be assessed as part of the desk top appraisal (see Table 3.2 below). These were selected as a result of health impacts identified in the Airport Commission report, identified in responses to the AC's consultation, included in previous airport expansion HIAs and raised by steering group members of this health impact analysis. Further information on how the determinants were selected is provided in Appendix A.

Table 3-2 Health Determinants

LIFESTYLE	PERSONAL CIRCUMSTANCES	ACCESS TO SERVICES, FACILITIES AND AMENITIES
→ Exercise and physical activity	→ Childhood development → Employment status → Level of income, → Housing tenure → Housing conditions	→ Access to greenspace or bluespace → Access to leisure and recreation services and facilities
Social Factors	**Economic Factors**	**Environmental Factors**
→ Participation in the community, social inclusion/exclusion, social contact/support → Community severance	→ Distribution of wealth → Job creation → Availability of employment opportunities → Quality of employment opportunities → Training and skills development → Amount of traffic congestion → Creation of wealth and retention of wealth	→ Air quality → Water quality → Soil quality, including agricultural soil/level of contamination → Noise → Land use → Natural habitats → Landscape, including green and open spaces → Townscape, including civic areas and public realm → Tranquillity → Flood risk → Resilience to global climate change

3.4.2 As a result of the literature review undertaken, it was concluded that for some determinants identified in the Scoping Report, there was insufficient available information for an assessment at a strategic level. As a result there was insufficient evidence to link the following determinants to Airport expansion; smoking, crime, anti-social behaviour, public safety and emergency planning, business activity, technological development, and waste management.

3.4.3 In addition the limited information available for each shortlisted scheme meant that the health effects of some determinants could not be evaluated at this stage. These included; smoking, crime, anti-social behaviour, public safety and emergency planning, personal safety, working conditions, educational attainment, business activity, technological development, and road collisions.

3.5 METHODS FOR THE APPRAISAL OF IMPACTS

3.5.1 The three airport expansion schemes are assessed against each of the above determinants, looking first at the baseline conditions of the determinant category within each of the study areas, evidence of how each determinant effects health and then the effect that each of the shortlisted schemes has on the health of the target population (short-term, temporary and permanent) via the determinant category.

3.5.2 A seven point assessment scale that classifies the significance of the identified impacts (Table 3.3) is used to categorise the effects for the assessment. This approach has been adapted from that used by the Institute of Occupational Medicine (IOM), for the North Staffordshire 'Streetcar' Bus Rapid Transport Scheme HIA, IOM, 2009. Significance incorporates the intensity of the impact and its potential duration, shown in Table 3.3 below.

3.5.3 The threshold values for number of people affected have been scaled to the expansion plan health outcomes. The largest known direct health outcome is linked to the number of properties to be demolished, which is approximately 1,000. Therefore the upper population threshold was been set as greater than 500.

Table 3-3 Assessment Scale and Definition of Significance

Significance of Impact	Definition	Intensity [+/-]	Duration (SML) (TIP)
Major Adverse	Health effects are categorised as a major adverse if they could lead directly to deaths, acute or chronic diseases or mental ill health. They can affect either or both physical and mental health either directly or through the wider determinants of health and wellbeing. These effects can be important local, district, regional and national considerations. Mitigation measures and detailed design work can reduce the level of negative effect though residual effects are likely to remain.	The exposures tend to be of high intensity. Over a large geographical area or affect a large number of people or impact vulnerable groups. (- - -/+ + +)	Long term duration (L) Intermittent (I) Temporary (T) or Permanent (P) in nature
Major beneficial	Health effects are categorised as a major positive if they prevent deaths/prolong lives, reduce/prevent the occurrence of acute or chronic diseases or significantly enhance mental wellbeing.		
Moderate Adverse	Health effects are categorised as a moderate negative if the effects are long term nuisance impacts, e.g. odours and noise, or may lead to exacerbations of existing illness. The negative impacts may be nuisance/quality of life impacts which may affect physical and mental health either directly or through the wider determinants of health. The cumulative effect of a set of moderate effects can lead to a major effect. These effects can be important local, district and regional considerations. Mitigation measures and detailed design work can reduce and in some/many cases remove the negative and enhance the positive effects though residual effects are likely to remain	The exposures tend to be of moderate intensity and/or over a relatively localised area and/or likely to affect a moderate-large number of people e.g. between 100-500 and/or sensitive groups (- -/+ +)	Medium term duration (M) Intermittent (I) Temporary (T) or permanent (P) in nature.

Significance of Impact	Definition	Intensity [+/-]	Duration (SML) (TIP)
Moderate Beneficial	Health effects are categorised as a moderate positive if they enhance mental wellbeing significantly and/or reduce exacerbations to existing illness and reduce the occurrence of acute or chronic diseases.		
Minor Adverse	Health effects are categorised as minor positive or negative, if they are generally lower level quality of life or wellbeing impacts. Increases or reductions in noise, odour, visual amenity, etc. are examples of such effects. These effects can be important local considerations. Mitigation measures and detailed design work can reduce the negative and enhance the positive effects such that there are only some residual effects remaining.	The exposures tend to be of low intensity and/or over a small area and/or affect a small number of people e.g. less than 100 (-/+)	Short term duration (S) Intermittent (I) Temporary (T) or permanent (P) in nature.
Minor Beneficial			
Neutral/No Effect	No health effect or effects within the bounds of normal/accepted variation.	N/A	N/A

3.5.4 Definitions for duration of effect have been adopted from the AoS:

- Short-term: 0 – 5 years (e.g. Construction period)
- Medium-term: 5 - 10 years (e.g. beyond construction or for part of operational period)
- Long term: 10+ years (e.g. Operation period, 60 year design life)

3.6 EXISTING INFORMATION

CURRENT AIRPORT COMMISSION REPORTS

3.6.1 As part of the promoters' submissions to the AC, various quality of life assessments have been undertaken on the three policy schemes, which have been described in several AC reports including:

PROMOTERS' QUALITY OF LIFE REPORTS

- Gatwick Second Runway - Appendix A14 Quality of Life A second Runway for Gatwick;
- Heathrow Northwest Runway - Quality of Life Chapter Volume 1 - Technical submission Heathrow Airport Limited; and
- Heathrow Extended Northern Runway - Submission to Airports Commission – Long Term Options, Chapter 7: People. Heathrow Hub Ltd[10].

[10] Submission to Airports Commission – Long Term Options By Heathrow Hub Ltd and Runway Innovations Ltd (http://www.heathrowhub.com/UploadedImages/c18c1334-74cc-4c80-ba27-c60c564d3662report_190713_rev_a.pdf) Accessed 20/01/2017 [online]

QUALITY OF LIFE REPORTS

- Aircraft noise effects on health, Prepared for the Airports Commission, Queen Mary University of London, 2015;
- Quality of Life: Equalities Impacts Report , Airports Commission;
- Quality of Life: Leisure impacts , Airports Commission;
- Quality of Life Health and Equalities Assessment Review, Prepared for the Airports Commission;
- Community: Impact Assessment, Airports Commission.

LITERATURE REVIEW

3.6.2 In order to identify health evidence for this health impact analysis, a literature review of health and inequality evidence, using a number of relevant databases from published literature and publically available reports, was undertaken. The methods used for the Literature Review are set out in the Scoping Report attached at Appendix A.

3.7 AIRPORT EXPANSION COMPONENTS THAT COULD INFLUENCE HEALTH

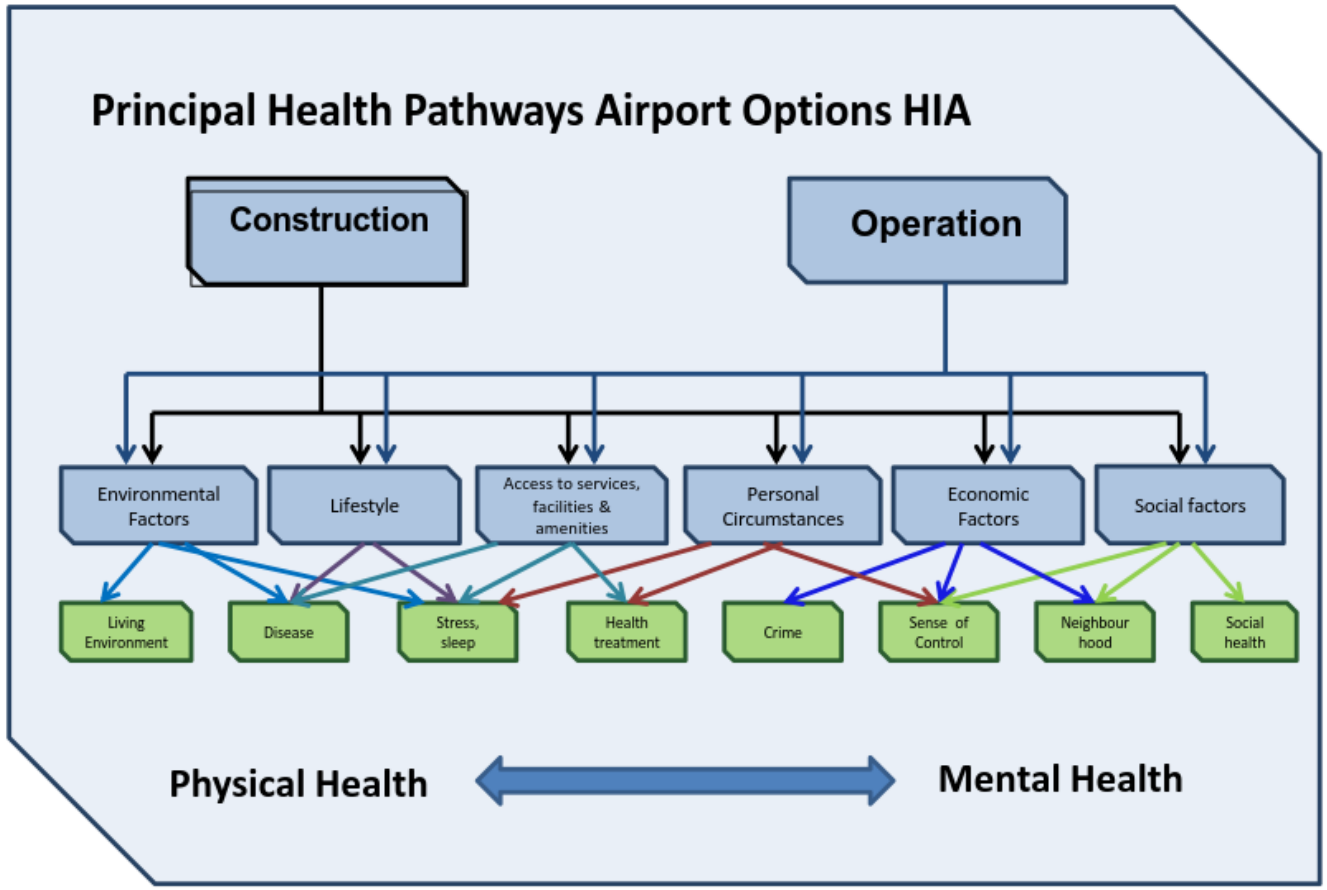
3.7.1 The identification of links between airport expansion and health, covering key issues, impact source and potential health effects are presented in Table 3.4. This initial high level analysis is an output of the literature review and review of HIAs undertaken upon other airport expansion plans. This was undertaken as part of the analysis process, informing the identification of potential health impacts and the key issues upon which to focus this Health Impact Analysis during construction and operation of the shortlisted schemes.

Table 3-4 Potential Health Effects arising from the shortlisted schemes

Expansion Phase	Key Issue		Impact Source	Potential Health Effect
Construction		Noise	Noise from construction activities. Changes in spatial distribution of aircraft noise due to construction. Changes in noise from road closure/re-routing.	Health effects from sleep deprivation and annoyance, hearing loss, educational attainment, hospital recovery rates, morbidity, adverse coronary impacts.
		Air quality	Spatial variation in aircraft emissions due to construction; Increased exposure to vehicle emissions due to changes/disruption in road transport.	Direct Health effects on both respiratory and cardiovascular system. Indirect long-term effects on immune system and cancer risk.
		Visual Amenity	Adverse changes in visual amenity within construction envelope.	Health effect on wellbeing associated with stress and anxiety.
	Access to services, facilities and amenities Lifestyle **Social factors**		Road closures, increased road capacity, short-term loss of public transport services.	Adverse health effect on wellbeing associated with stress and anxiety. Indirect adverse health effect from lack of access to essential services.
	Lifestyle **Personal circumstances** **Economic Factors**		Relocation of residents. Stress on existing public services due to changes in population density. Creation of new employment.	Indirect adverse health effect from lack of access to essential services and employment. Indirect health effect from a reduction in unemployment and household stress.
Operation	**Environmental Factors**	Noise	Changes in aircraft noise intensity, frequency and spatial distribution. Changes in noise from additional road capacity/closure/realignment.	Health effects from sleep deprivation and annoyance, hearing loss, educational attainment, hospital recovery rates, morbidity, adverse coronary impacts.
		Air Quality	Spatial variation in aircraft emissions. Increased exposure to vehicle emissions due to changes/ disruption in road transport.	Direct health effects on both respiratory and cardiovascular system. Indirect long-term effects on immune system and cancer risk.
		Visual Amenity	Significant changes in the visual amenity.	Health effect on wellbeing associated with stress and anxiety.
	Access to services, facilities and amenities **Lifestyle** **Social factors**		Road closures, increased road capacity. Additional public transport services.	Adverse health effect on wellbeing associated with stress and anxiety. Indirect health effect from impact on access to essential services and employment.
	Lifestyle		Relocation of residents	Health effect on wellbeing associated with stress and anxiety.

Expansion Phase	Key Issue	Impact Source	Potential Health Effect
	Personal circumstances **Economic Factors**	Stress on existing public services due to changes in population density. Creation of new employment	Indirect adverse health effect from lack of access to essential services and employment. Indirect health effect from a reduction in unemployment and household stress.

Figure 3-6 Principal Health Determinants Pathways of Aviation Expansion



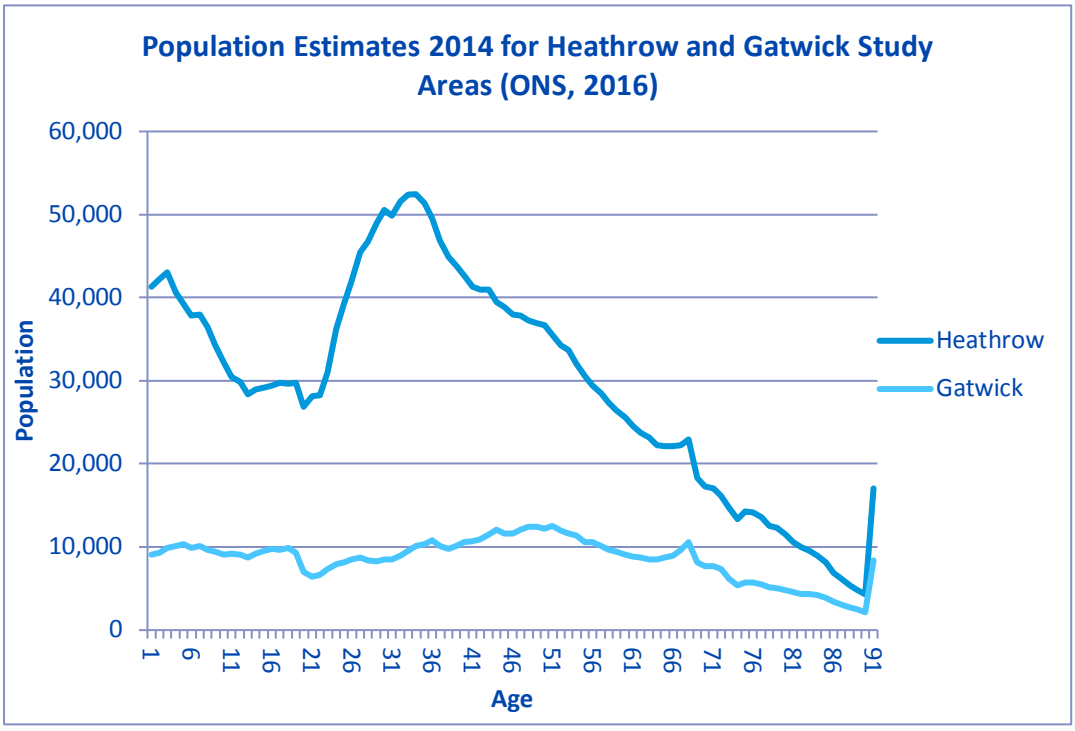
4 COMMUNITY PROFILE

4.1 COMMUNITY PROFILE

4.1.1 Amongst the communities living close to both airports and directly affected by any changes brought about by airport expansion, the proportion and profile of vulnerable groups, identified in sections 3.3.3 and 3.3.4 above, have been described within each of the study area local authorities (LA) using publically available data. Community profile data has been used to express the status of vulnerable groups with respect to their vulnerable health status and/or derivation. In some cases where Health Profile Indicators that are directly relevant are not readily available, proxies have been used. This data is retrospective and can only be assumed to be representative of the community profile in 2030.

4.1.2 From ONS 2014 population projections of each study area (Figure 4-1) it can be seen that Heathrow has proportionally a far younger resident population than Gatwick.

Figure 4-1 Demographic Profile of Heathrow and Gatwick Study Areas



4.1.3 Health Profile Indicators relating to children and young people who are vulnerable or deprived between the two study areas are contained in Table 4.1. It is clear in Table 4.1 conveys that for three out of the four child health indicators, the Heathrow study area is worse than Gatwick study area.

Table 4-1 Child Health Indicators Districts close to Heathrow, Districts close to Gatwick & England

INDICATOR	HEATHROW	GATWICK	ENGLAND
Low birth weight (%)	7.4	6.9	7.4
Child Development at age 5 (% of children who has achieved school readiness)	64.8	66.8	63.5
*Obese Children (reception year) %	9.5	7.1	9.4
*Obese Children (year 6) %	18.8	14.2	19.1

*Source PHE 2010-2014

4.1.4 Additional Health Profile Indicators relating to children and young people across the local authorities making up each study area for Heathrow and Gatwick are shown in Figures 4.2 and 4.3. These imply that with the exception of Crawley, a number of districts within the area surrounding Heathrow are more deprived with respect to health indicator relating to children and young people than areas surrounding Gatwick. Four of the ten areas surrounding Heathrow have greater levels of children living in poverty than the national average.

Figure 4-2 Gatwick Community Profile: Office of National Statistics (ONS) Health Indicator for Children and Young People (2011 to 2014)

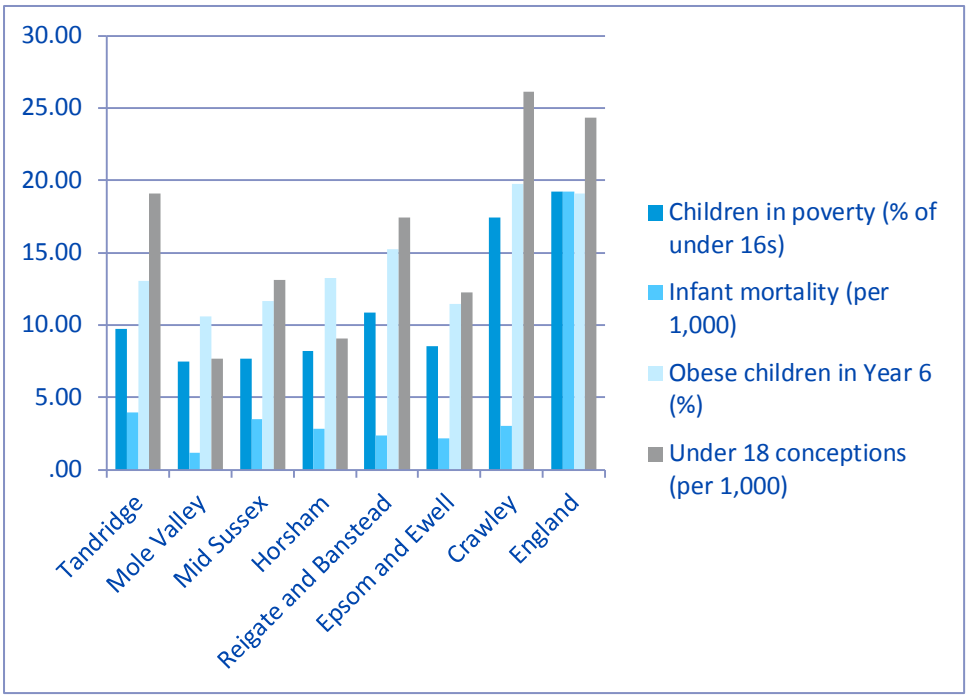
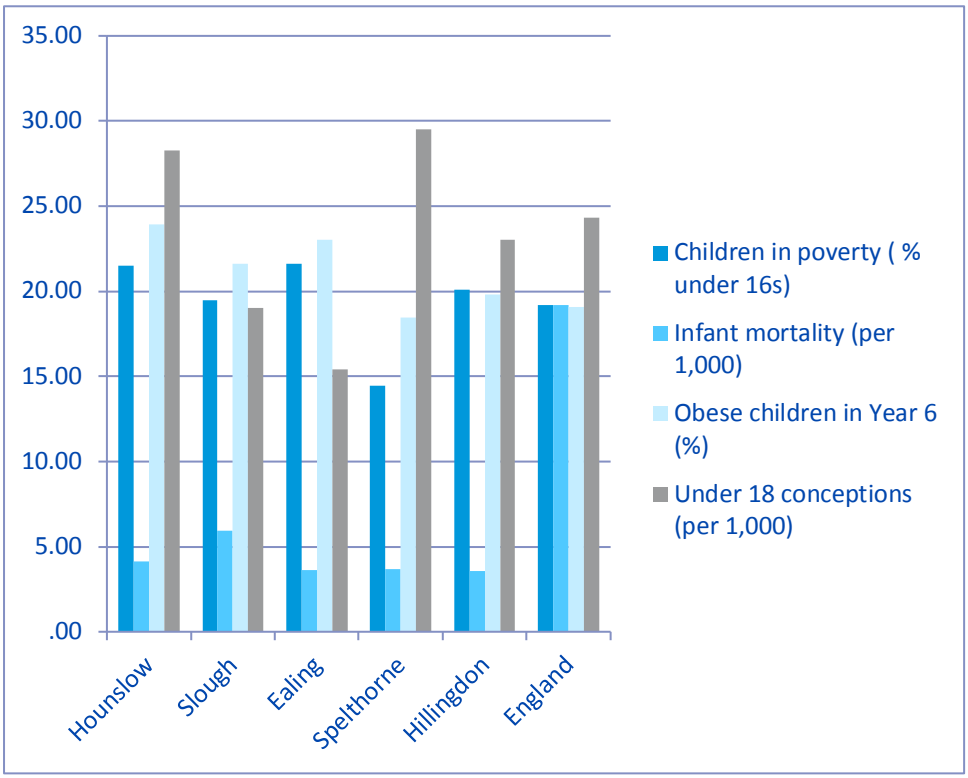


Figure 4-3 Heathrow Community Profile: Office of National Statistics (ONS) Health Indicator for Children and Young People (2011 to 2014)



4.1.5 Three Health Profile Indicators relating to levels of deprivation between the two study areas include 'income deprivation', 'child poverty' and 'older people in deprivation', indices for all three indicators for both study areas and averages for England are contained in Table 4.2 below. It is clear in Table 4.2 that for all indicators of deprivation, the Heathrow study area is significantly worse than the Gatwick study area.

Table 4-2 Deprivation[11] Indicators for Districts close to Heathrow and Gatwick, and for England

INDICATOR	HEATHROW	GATWICK	ENGLAND
Income Deprivation (%)	12.8	7.4	14.7
Child Poverty (%)	21.3	10.5	21.8
Older People in deprivation (%)	17	9.7	18.9

4.1.6 A different set of Health Profile Indicators relating to deprivation were available at local authority level, these were 'long-term unemployment' and 'indices for multiple deprivation'. Figures 4.4 and 4.5 contain these for the local authorities within the study areas of Heathrow and Gatwick. These indicators imply that five of the ten districts surrounding Heathrow are more deprived with respect to health indicators relating to indices for multiple deprivation and long-term unemployment than in areas close to Gatwick. Parts of the area surrounding Heathrow are also more deprived than

[11] Public Health England, 2014. *Local Health*. [online] Accessed 09/01/2017. (http://www.localhealth.org.uk/#l=en;v=map11)

the national average for these health indicators.

Figure 4-4 Gatwick Community Profile: ONS Health Indicator for long-term unemployment and indices for multiple deprivation (IMD) (2011 to 2014)

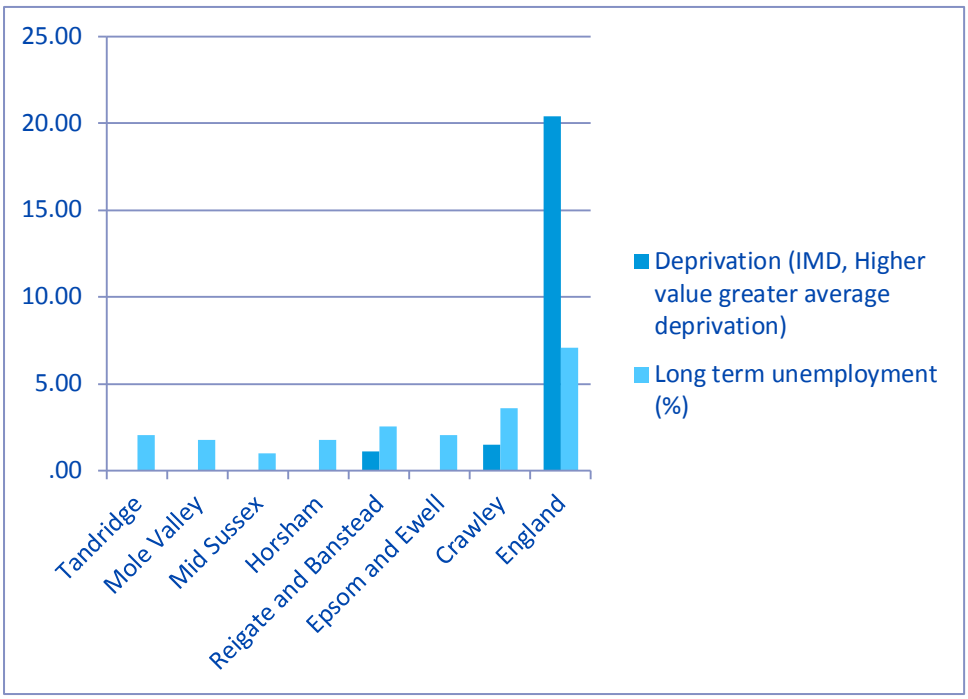
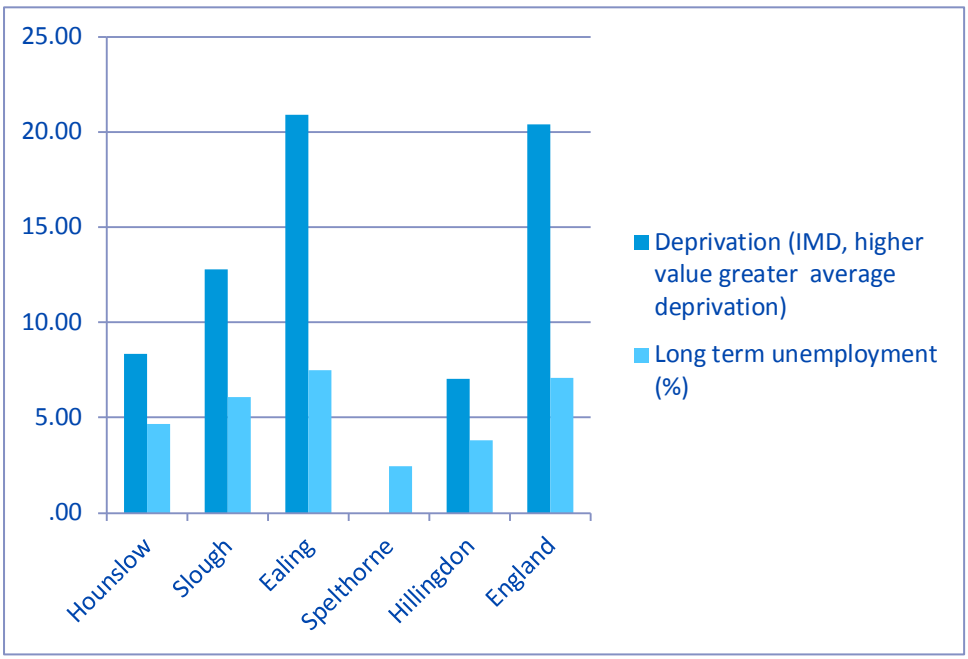


Figure 4-5 Heathrow Community Profile: ONS Health Indicator for long-term unemployment and indices for multiple deprivation (IMD) (2011 to 2014)



4.1.7 Seven Health Profile Indicators relating to both mortality and premature mortality rates between the two study areas, 'all cancer', 'all cancer under 75', 'coronary heart disease', 'coronary heart disease under 75', 'all circulatory disease', 'all circulatory disease under 75' and 'respiratory diseases', are contained in Table 4.3 below, where mortality rates have been standardised against national (England) rates. It is clear from Table 4.3 that for all mortality and premature mortality indicators, the Heathrow study area is worse than Gatwick study area, particularly with respect to mortality and premature mortality rates for those under 75. The standard mortality and premature mortality rates for people living around Heathrow is better than the national average (lower than those for England) and lower still for those living around Gatwick.

Table 4-3 Mortality[12] and Premature mortality rates for Districts close to Heathrow, Districts close to Gatwick & England (Standardised Mortality Rates[13])

INDICATOR	HEATHROW	GATWICK	ENGLAND
All Cancer	92.1	87.5	100
All Cancer under 75	89.6	84.5	100
Coronary Heart Disease	90.6	77.8	100
Coronary Heart Disease under 75	89.7	63.5	100
All circulatory Disease	93.1	90.2	100
All circulatory Disease under 75	92.8	70.5	100
Respiratory Diseases	95.7	95.1	100

4.1.8 A separate set of Health Profile Indicators relating to health status, mortality and premature mortality rates were available across the local authorities within the Heathrow and Gatwick study areas, Figures 4.6 and 4.7. These imply that with the exception of Crawley, there is greater health inequality across areas close to Heathrow than those close to Gatwick. A limited number of districts surrounding Heathrow have a poorer health status than the national average for these indicators.

[12] Public Health England /Office National Statistics, 2014. *Local Health*. [online] Accessed 09/01/2017. (http://www.localhealth.org.uk/#l=en;v=map11)
[13] Office National Statistics, 2015. *Deaths register*. [online] Accessed 09/01/2017. (https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths)

Figure 4-6 Gatwick Community Profile: ONS Health Indicators for obese adults, those diabetes, cancer and cardiovascular mortality rate for those under 75 (2011 to 2014)

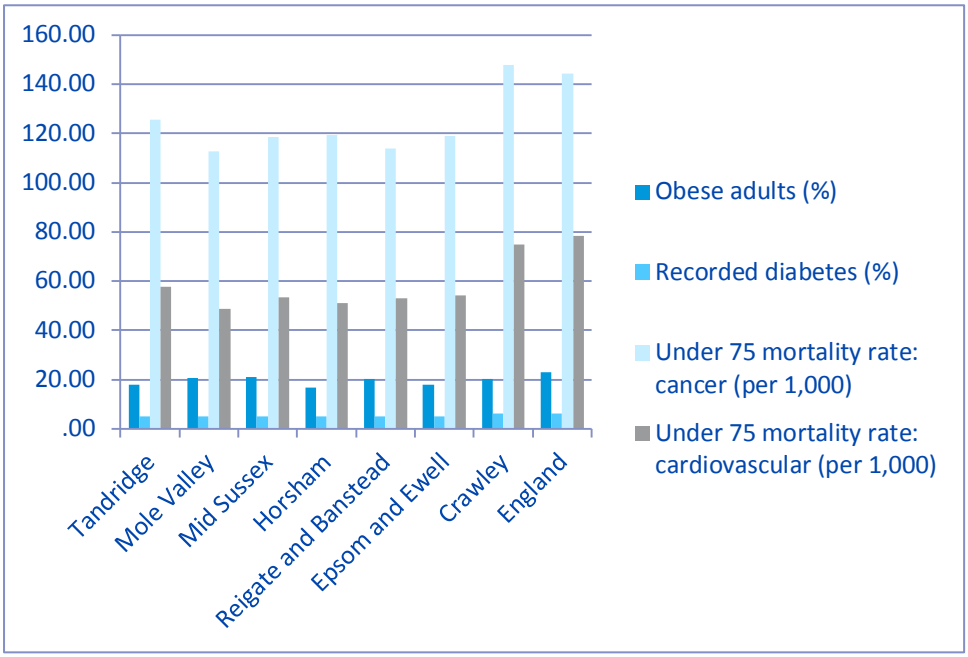
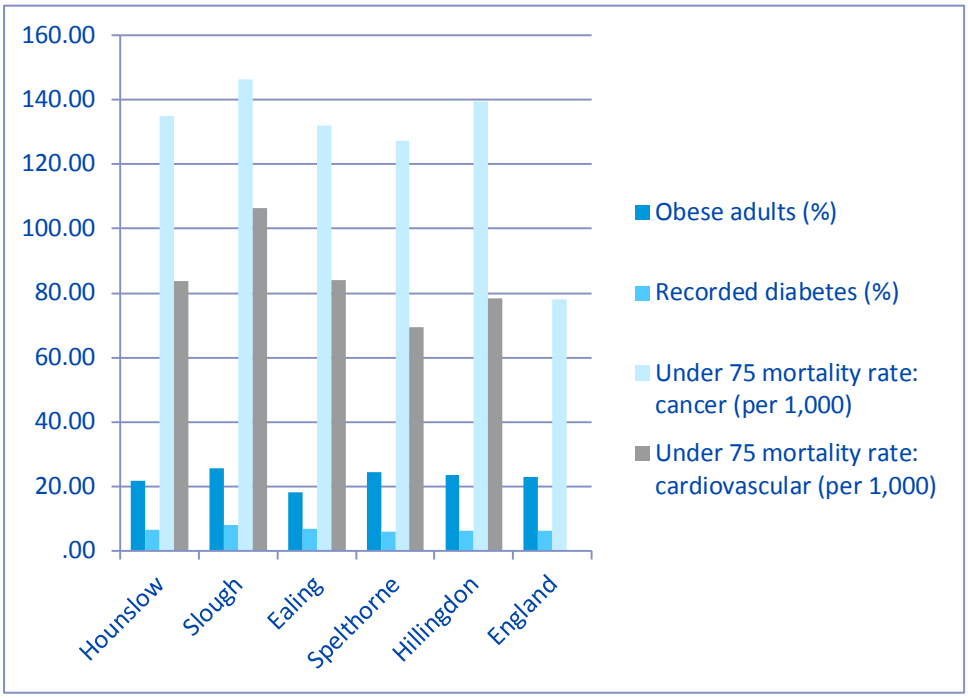


Figure 4-7 Heathrow Community Profile: ONS Health Indicators for People for obese adults, those diabetes, cancer and cardiovascular mortality rate for those under 75 (2011 to 2014)



4.1.9 Health Profile Indicators relating to older people who are vulnerable across the local authorities neighbouring Heathrow and Gatwick are shown in Figures 4.8 and 4.9 (deprivation is shown in Table 4.2 above). These imply that older people within the Gatwick study area are slightly more vulnerable than in the Heathrow study area. This could be a consequence of the demographic profile of the area close to Gatwick being biased towards an older population (see Figure 4-1).

Figure 4-8 Gatwick Community Profile: ONS Health Indicators for Older People (2011 to 2014)

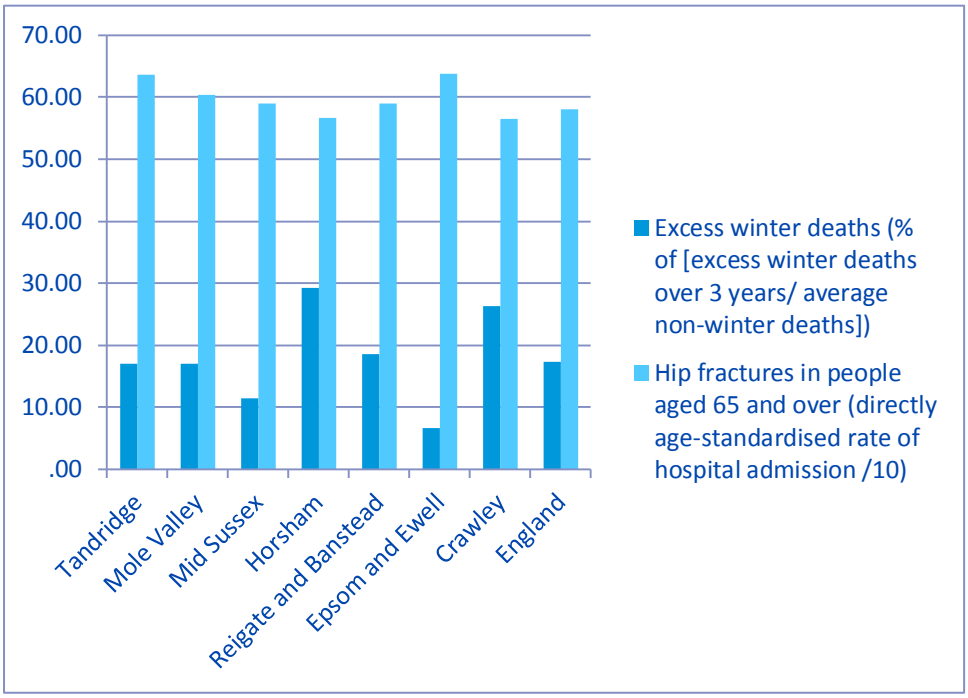
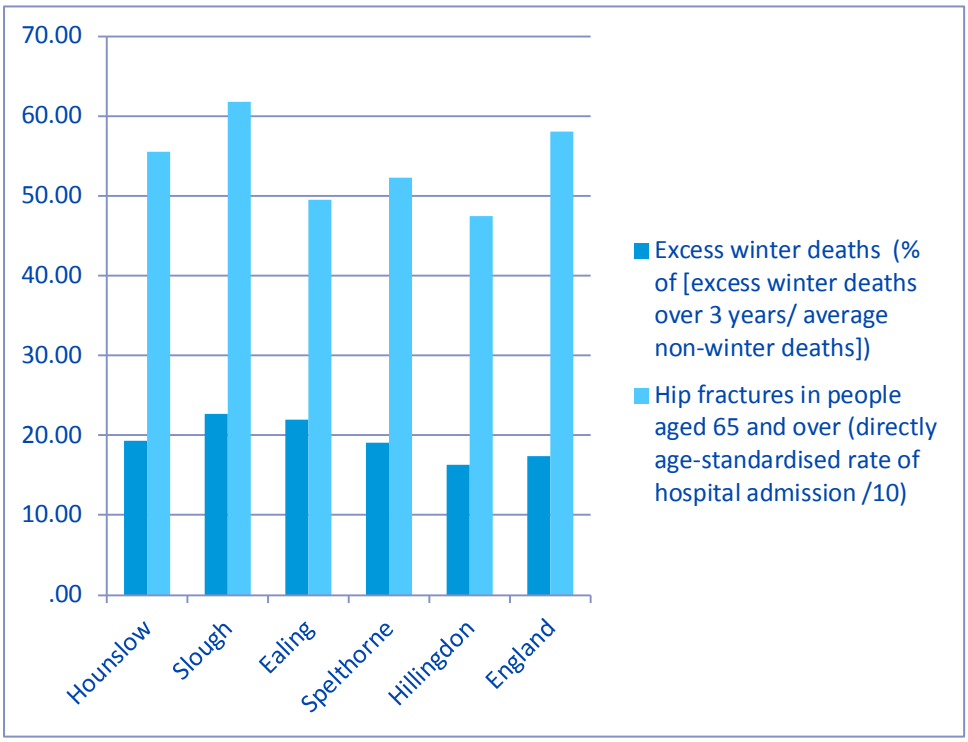


Figure 4-9 Heathrow Community Profile: ONS Health Indicators for Older People (2011 to 2014)



5 ASSESSMENT OF EFFECTS

5.1 INTRODUCTION

5.1.1 The analysis of health impact has focussed on the determinants identified in Section 3.4 which fall into the following categories:

- Lifestyle;
- Personal Circumstances;
- Access to Services, Facilities and Amenities;
- Social Factors;
- Economic Factors; and
- Environmental Factors.

5.1.2 The three shortlisted airport expansion schemes have been assessed against each of the above determinant categories, looking first at the baseline conditions of the determinant category within each of the study areas, then at evidence of how each determinant effects health, and then the effect that each of the shortlisted schemes has on the health of the target population (short-term, temporary and permanent) via the determinant category.

5.2 LIFESTYLE

EXERCISE AND PHYSICAL ACTIVITY: EVIDENCE

5.2.1 Being physically active plays an essential role in ensuring health and wellbeing. It is known that physical activity benefits many parts of the body; the heart, skeletal muscles, bones, blood (for example, cholesterol levels), the immune system and the nervous system. Exercise and physical activity can reduce some of the risk factors for non-communicable diseases (NCDs), including reducing blood pressure, improving blood cholesterol levels, and lowering body mass index (BMI)[14].

5.2.2 Physical activity plays an important part in a number of diseases, such as type 2 diabetes, heart disease and some cancers. The World Health Organization (WHO) estimates that physical inactivity is the fourth leading risk factor for global mortality[15] and physical inactivity is responsible for 6% of deaths globally – around 3.2 million deaths per year, including 2.6 million in low and middle-income countries, and 670,000 of these deaths are premature.[16] Symptoms of depression

[14] World Health Organization, date unknown. *Global Health Risks*: Selected figures and tables. [online] Accessed 09/01/2017. (http://www.who.int/entity/healthinfo/global_burden_disease/global_health_risks_report_figures.ppt)
[15] World Health Organization, date unknown. *Global Health Risks*: Selected figures and tables. [online] Accessed 09/01/2017. (http://www.who.int/entity/healthinfo/global_burden_disease/global_health_risks_report_figures.ppt)
[16] World Health Organization, 2011. *Global Recommendations on Physical Activity for Health*. [online] Accessed 09/01/2017. (http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf)

in adolescents have also been linked to higher BMI and low levels of physical activity,[17] particularly among young women.[18]

5.2.3 It has been stated that the impact of physical inactivity on mortality could even rival tobacco use as a cause of death.[19]

5.2.4 Walkable environments assist a population to achieve their physical activity targets, compared with residents in less walkable areas. Populations meet physical activity targets where safe places to walk exist within ten minutes of home. The presence or absence of walkable streets is related to longevity, even after adjustment for demographic and socioeconomic factors and baseline health status.[20]

EXERCISE AND PHYSICAL ACTIVITY BASELINE: GATWICK

5.2.5 The percentage of physically active adults across the 6 local authorities within the Gatwick study area varies as Horsham, Mole Valley, Reigate, Tandridge all have high levels of adult activity and are all above the 75th percentile for England, whereas Crawley and Mid Sussex both have adult activity levels below the regional average, though at or close to the England average (Appendix B Local Authority Health Profiles).

5.2.6 Incidence of obesity in adults across the 6 local authorities within the Gatwick study area was generally close to the England average though, with the exception of Tandridge (Appendix B Local Authority Health Profiles).

5.2.7 Incidence of excess weight in adults across the 6 local authorities within the Gatwick study area were at or below the England and regional average, with exception to Crawley which was greater than both the England and regional average, though well within the 25th percentile of incidence of excess weight in England local authorities (Appendix B Local Authority Health Profiles).

5.2.8 Incidence of obesity in children across the 6 local authorities within the Gatwick study area varied, with Crawley having slightly higher incidence of obesity in children than the England average. Reigate and Tandridge had a low incidence, with Horsham, Mole Valley and Mid Sussex all having an exceptionally low incidence of obesity in children (Appendix B Local Authority Health Profiles).

5.2.9 At a national level the Health Survey for England (HSE) in 2012 provided a representative sample of the population at both national and regional levels. The HSE found that the average sedentary time per weekday decreased from 5.0 hours in 2008 to 4.9 hours in 2012 in men and from 5.0 to 4.7 hours in women. On weekend days, the average sedentary time decreased from 5.6 hours in 2008 to 5.4 hours in 2012 in men and from 5.3 to 5.1 hours in women[21].

5.2.10 A higher proportion of boys than girls aged 5 to 15 (21% and 16% respectively) were classified as meeting current guidelines for children and young people of at least one hour of moderately

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17 Hill AJ, Draper E, Stack J., 1994 A weight on children's minds: body shape dissatisfactions at 9-years old. *International Journal of Obesity*, 18, 383-389.

18 Ball K, Burton NW, Brown WJ., 2009 A prospective study of overweight, physical activity, and depressive symptoms in young women. *Obesity*., 1791, 66-71.

19 I.-M. Lee et al., 2012. Effect of physical activity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy, *The Lancet* , 380, 219:, p. 227.

20 Takano T, Nakamura H, Watanabe N., 2002. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *J Epidem Community Health*, 56,12,913–918. doi: 10.1136/jech.56.12.913.

21 Craig R, Mindell J (eds), 2013. *Health Survey for England 2012.* London: The Health and Social Care Information Centre.

intensive physical activity per day. Among both sexes, the proportion meeting guidelines was lower in older children. The proportion of boys meeting guidelines decreased from 24% in those aged 5 to 7 to 14% in those aged 13 to 15. Among girls the decrease was from 23% to 8% respectively.[22]

5.2.11 The surrounding land around Gatwick Airport includes several areas of recreational value, which are likely to contribute to human health. These include several areas of Open Access land, Registered Parks and Gardens and the North Downs Way National Trail which lie within 5km of Gatwick Airport.

5.2.12 Other recreational features include Country Parks, Tandridge Border Path, Crawley Rugby Club, Rowley Wood and Sussex Border Path recreational routes, public footpaths and golf courses. Metropolitan Green Belt, woodlands, the River Mole and a number of sites protected for biodiversity, including four Local Nature Reserves (LNRs) and 46 Sites of Nature Conservation Importance (SNCIs) within 5km which are also likely to support health benefits associated with exercise and physical activity. The recreational value of some of these sites may be linked to tranquillity or landscape. Greenspace areas to the east and west of Gatwick have been recognised as having moderate tranquillity, with tranquillity diminishing closer to Gatwick Airport.[23] Horley, Crawley and the M23.

EXERCISE AND PHYSICAL ACTIVITY BASELINE: HEATHROW

5.2.13 The percentage of physically active adults across the 9 local authorities within the Heathrow study area varies. Both Slough and Hounslow had the lowest number of physically active adults falling into the 25th lowest percentile in England. Ealing had a significantly lower number of physically active adults than the England average. Both Spelthorne and Hillingdon had slightly higher numbers of physically active adults than the England average. South Bucks and Runnymede had high numbers of physically active adults, with both Wandsworth and Richmond had an exceptionally high number (Appendix B Local Authority Health Profiles),

5.2.14 Incidence of obesity in adults across the 9 local authorities within the Heathrow study area varied. Hounslow had slightly lower incidence of obesity in adults and Ealing was significantly better than the England average, Spelthorne and Hillingdon slightly worse than, though still close to the England average. Slough had greater incidence of obesity in adults than the England average, close to the 25th percentile of worst authorities in England. South Bucks and Runnymede were slightly better than national average. Windsor, Wandsworth and Richmond all recorded exceptionally low incidence of obesity in adults (Appendix B Local Authority Health Profiles).

5.2.15 Incidence of excess weight in adults across the 9 local authorities within the Heathrow study area varied. The number of incidence in Ealing was significantly lower, and Spelthorne and Hounslow marginally lower than the England average. The number of incidence of excess weight in adults in South Bucks was slightly higher, and Hillingdon were higher than the national average. Incidence of excess weight in adults in Slough and Runnymede were close to England averages, though Runnymede was slightly lower and Windsor even lower. Both Wandsworth and Richmond had an exceptionally low incidence of excess weight in adults (see Appendix B).

5.2.16 Incidence of obesity in children across the 9 local authorities within the Heathrow study area varied. Hounslow and Ealing had significantly higher incidents of obesity in children than the England average. Spelthorne was slightly better, with Wandsworth and Hillingdon slightly worse

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[22] Craig R, Mindell J (eds), 2013. *Health Survey for England 2012*. London: The Health and Social Care Information Centre.

[23] Campaign to Protect Rural England Tranquillity Mapping presented in Jacobs, 2014. *10. Place: Baseline*. [online] Accessed 23/12/2015.

than the national average. The incidence of obesity in children in Slough was significantly worse than the England average. Windsor, South Bucks and Runnymede all had a low incidence, and Richmond an exceptionally low incidence, of obesity in children (see Appendix B).

5.2.17 Nationally, sedentary times per weekday are assumed to be declining as set out above for Gatwick.

5.2.18 There are a number of areas and routes of recreational value within the study area, such as the River Thames corridor and Colne Valley Regional Park, including the Colne Valley Way. Four Registered Parks and Gardens lie within 5km of Heathrow Airport, in addition to areas of open access, the Thames Path National Trail to the south, footpaths and cycleways. There are also a number of sites protected for biodiversity within 5km, such as LNR's and statutory Green Belt that are likely to provide some value to exercise and physical activity. The recreational value of some of these sites may be linked to tranquillity or landscape.

EXERCISE AND PHYSICAL ACTIVITY ASSESSMENT: LGW-2R

5.2.19 LGW-2R is likely to contribute to the further urbanisation of the area during construction and operation. The expansion would involve the loss of Crawley Rugby club, with its sporting and social facilities, the northern part of Rowley Wood, and other formal and informal recreation sites including rights of way and cycle routes. These losses are confined to the construction phase, as the promoter has proposed to relocate the Rugby Club and provide new links to maintain connectivity of footpaths and cycle routes. Therefore, affects associated with these assets may be disrupted in the short term but it is assumed use would continue/be resumed in the long term.

5.2.20 The loss of greenspace including open access areas and woodland could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas, offering both opportunities for physical activity and wellbeing[24]. Furthermore, this loss of access can reduce social contact, social cohesion and lessen the benefits that greenspace can provide to psychophysiological stress[25].

5.2.21 Any effects would apply to the general population and all vulnerable groups both during construction and operation phases of the expanded airport. Without further information on levels of use of recreational amenities assessed it is not possible to specify the areas or populations affected. The health outcomes resulting from any changes in exercise and physical activity associated with LGW-2R have been assessed as minor adverse, of large intensity and long term in nature, due in part to the current high rate of physical activity across the Gatwick study area. However it is estimated that these health outcomes could have a moderate adverse impact on health, which is of moderate intensity and long term for vulnerable groups including children and young people, and people living in areas with poor health status.

5.2.22 In areas with current moderate levels of tranquillity[26], the potential increase in over-flight will reduce tranquillity levels due to increased noise. This may cause annoyance and reduce the perceived overall recreational quality of the area[27] leading to minor adverse, large intensity and

[24] Seaman P, et al., 2010. It's not just about the park, it's about integration too: Why people choose to use or not use urban greenspaces. *International Journal of Behavioural Nutrition and Physical Activity*, 7, 78.
[25] Van den Berg, A. E., et al. 2010. Green space as a buffer between stressful life events and health. *Social Science & Medicine,* 70. 1203–1210.
[26] Natural England, 2015. National Character Area profile. [online] Accessed 24/12/2015. (https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles)
[27] Thwaites, K. *et al*., 2005. Restorative urban open space: Exploring the spatial configuration of human emotional fulfilment is urban open space. *Landscape Research*, 30, 525-547

long term impacts upon all groups.

EXERCISE AND PHYSICAL ACTIVITY ASSESSMENT: LHR-ENR

5.2.23 LHR-ENR is likely to contribute to the further urbanisation of the area. Some of the Colne Valley Regional Park would be lost to accommodate the new runway and views from other potentially valued recreational areas, such as Public Rights of Way, would be impacted. To mitigate effects on the Colne Valley Regional Park the promoter has proposed to accommodate an extension to the park within the green belt to the east and provide screening to reduce impact on other amenity areas. New links to maintain connectivity of footpaths and cycle routes would also be provided. Therefore, affects associated with these assets may be disrupted in the short term during the construction phase, but it is assumed would continue in the long term, during the operational phase.

5.2.24 LHR-ENR would result in land take of other greenspaces which could affect their amenity and recreational value and could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas.[24]

5.2.25 In areas currently showing moderate tranquillity, the anticipated increase in over-flight will reduce tranquillity levels due to increased noise. This may cause annoyance and reduce the perceived overall recreational quality of the areas[27] leading to minor adverse, high intensity and long term impacts upon all groups.

5.2.26 Effects would apply to the general population and all vulnerable groups both during construction and operational phases of the expanded airport. Without further information on levels of use of recreational amenities assessed, it is not possible to specify the areas or populations affected. The health outcomes associated with any changes in exercise and physical activity associated with LHR-ENR have been assessed as moderately adverse, high intensity and long term, due to the high level of physical inactivity across the Heathrow study area and health indicators, such as obesity and being overweight in adults, for the study area being poor.

EXERCISE AND PHYSICAL ACTIVITY ASSESSMENT: LHR-NWR

5.2.27 LHR-NWR is likely to contribute to the further urbanisation of the area. Some of the Colne Valley Regional Park would be lost to accommodate the new runway and views from other potentially valued recreational areas, such as Public Rights of Way, would be impacted. Mitigation is proposed within and around the Colne Valley Regional Park to offset adverse effects from construction of the new runway. They include habitat creation areas, a diversion of the Colne Valley Way and improvements to recreational areas. Sipson recreation ground would be relocated. New links to maintain connectivity of footpaths and cycle routes would also be provided. Therefore, affects associated with these assets may be disrupted in the short term but it is assumed use would continue in the long term.

5.2.28 The loss of other greenspace could affect their amenity and recreational value and could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas.[24] The health outcomes associated with any changes in exercise and physical activity associated with LHR-NWR upon completion have been assessed as moderately adverse, high intensity and long term across the Heathrow study area.

5.2.29 The effect would apply to the general population and all vulnerable groups, both during construction and operational phases of the expanded airport. Without further information on levels of use of recreational amenities assessed it is not possible to specify the areas or populations affected.

5.2.30 In areas currently showing moderate tranquillity, the anticipated increase in over-flight will reduce tranquillity levels due to increased noise. This may cause annoyance and reduce the perceived

overall recreational quality of the areas[27], leading to minor adverse, high intensity and long term impacts upon all groups.

5.3 PERSONAL CIRCUMSTANCES

CHILDHOOD DEVELOPMENT: EVIDENCE

5.3.1 Early childhood experiences shape a child's development and can affect lifelong health and learning. Children require safe and stable housing, adequate and nutritious food, access to medical care, secure relationships, nurturing and responsive parenting, and high-quality learning opportunities at home, in child care settings and in school. Where children face instability in their lives all of the above can be undermined, causing disruption to childhood development and their ability to thrive[28].

5.3.2 Family income, parental employment, family structure, housing, and school or childcare provision are a number of key pathways through which instability may affect development.

5.3.3 In addition to care and support, childhood development is also linked to the environment in which they are reared. There is evidence to show the beneficial effect on birth weight in lower socioeconomic groups among pregnant women residing in greener areas.[29] Forms of physical activity taken by young children can differ; play brings many benefits to physical, mental and social development. Epidemiological evidence shows that children are more active outdoors.[30] Children who are not allowed to play outdoors have been found to have reduced motor development.[31]

5.3.4 There is no clear-cut, causal link between poverty and parenting. However, poverty can contribute to parental stress, depression and irritability leading to disrupted parenting and to poorer long-term outcomes for children.

5.3.5 The link between poverty, parental stress and negative outcomes for children, is not so clear when attempting to identify any improved outcomes for children when families have been lifted out of poverty. But even where there is evidence of improved outcomes, it is not certain how much this is a factor of improved parenting capacity or better access to resources such as housing or childcare or, a combination of all of them.[32] [33]

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28 Sandstrom, H. *et al*. 2013. *The Negative Effects of Instability on Child Development: A Research Synthesis, Low-Income Working Families Discussion Paper 3*. The Urban Institute.

29 Dadvand, P., Audrey de Nazelle, Francesc Figueras *et al*, 2012. *Green space, health inequality and pregnancy* Original Research Article Environment International, 40, , 110-115.

30 Davison KK, Lawson CT, Davison KK, Lawson CT.2006 *Do attributes in the physical environment influence children's physical activity?* A review of the literature. Int J Behav Nutr Phys Act. 2006;3:19.

31 Hüttenmoser, M, 1995. *Children and their living surroundings: empirical investigations into the significance of living surroundings for the everyday life and development of children.* Children's Environ;12(4):403–413.

32 La Placa, V., et al.2016 *Unpacking the Relationship between Parenting and Poverty: Theory, Evidence and Policy, Social Policy and Society* /Volume 15 /Issue 01 / pp 11-28

33 The relationship between parenting and poverty Ilan Katz (University of New South Wales) Judy Corlyon, Vincent La Placa and Sarah Hunter (Policy Research Bureau)

5.3.6 Small children and babies can be disturbed by loud noise, and noisy environments can inhibit sleep of small children. Environmental noise can be a significant cause of sleep disturbance (see para 5.7.94) and poor sleep causes endocrine and metabolic measurable perturbations and is associated with a number of cardio metabolic, psychiatric and social adverse outcomes both in adults and children.[34] There is also a strong association between duration of sleep in early childhood and obesity.[35] [36] [37]

5.3.7 There is considerable evidence linking obesity with numerous long-term and immediate physiological health risks which highlights the importance of preventing children from becoming overweight early in their development and preventing obesity.[38],[39] [40],[41],[42]Childhood and adolescent obesity can persist into adulthood, where the direct health risks of obesity are severe and well-established. In addition to the increased risk for health problems in later life, children face immediate health consequences of obesity, including increased risks for an abnormal lipids (fats in blood) profile and elevated blood pressure.[43]

5.3.8 Associations between childhood obesity and increased asthma prevalence[44] and the incidence of Type 2 diabetes mellitus[45] have also been reported. As well as the physiological health risks that arise as a result of obesity, the psychological effects of obesity are also being increasingly recognised, these include high levels of dissatisfaction with body size and shape amongst adolescents as well as a desire to be thinner, low self-esteem or self-image[46] and depression.[47]

CHILDHOOD DEVELOPMENT BASELINE: GATWICK

5.3.9 Indicators of childhood development baseline data within the Gatwick Study area included:

- → Child Mortality Rate
- → Good level of development at reception
- → Children in poverty

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[34] Demian Halperin *Environmental noise and sleep disturbances: A threat to health?* Sleep Science. Volume 7, Issue 4, December 2014, Pages 209–212

[35] Hart CN, Jelalian E, Hart CN, Jelalian E. *Shortened sleep duration is associated with pediatric overweight. Behav Sleep Med.* 2008;6(4):251-267.

[36] Marshall NS, Glozier N, Grunstein RR, Marshall NS, Glozier N, Grunstein RR. *Is sleep duration related to obesity? A critical review of the epidemiological evidence.*[see comment]. Sleep Med Rev. Aug 2008;12(4):289-298

[37] Snell EK, Adam EK, Duncan GJ, Snell EK, Adam EK, Duncan GJ. *Sleep and the body mass index and overweight status of children and adolescents*. Child Development. Jan-Feb 2007;78(1):309-323.

[38] Lew EA, Garfinkel L. *Variations in mortality by weight among 750,000 men and women*. Journal of Chronic Disease 1978;32:563-565

[39] Rhoads GG, Kagan A. *The relation of coronary-disease, stroke, and mortality to weight in youth and in middle-age*. Lancet 1983;1:492-495

[40] Gunnell D, Frankel S, Nanchahal K, Peters TJ, Smith GD. *Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort*. American Journal of Clinical Nutrition 1998;67:1111-18

[41] Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. *Long-term morbidity and mortality of overweight adolescents – a follow-up of the Harvard growth study of 1922 to 1935*. New England Journal of Medicine 1992;327:1350-55

[42] England A, Bjorge T, Sogaard AJ, Tverdal A. *Body mass index in adolescence in relation to total mortality: 32-year follow-up of 227,000 Norwegian boys and girls*. American Journal of Epidemiology 2003;157:517-523

[43] Freedman D, Dietz WH, Srinivasan S, Berenson GS. *The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study*. Pediatrics, 1999;103:1175-1182.

[44] Von Mutius E, Schwartz J, Neas LM, Dockery D, Weiss ST. *Relation of body mass index to asthma and atopy in children: the National Health and Nutrition Examination Study III*. Thorax 2001;56:835-838.

[45] Fagot-Campagna A, Pettitt DJ, Engelgau MM, Burrows NR et al. *Type 2 diabetes among North American children and adolescents: an epidemiological review and a public health perspective*. Journal of Pediatrics 2000;136:664-672

[46] Cornette R. *The emotional impact of obesity on children*. Worldviews on Evidence-Based Nursing 2008;5(3):136-41.

[47] Sjoberg RL. *Obesity, Shame, and Depression in School-Aged Children: A Population-Based Study*. Paediatrics 2005;116(3):389-92

- Children in care
- Hospital admission due to substance misuse
- Hospital Admissions for Asthma under 19 years

5.3.10 These indicators were only available at County and Unitary level (West Sussex and Surrey). All the baseline indicators were good in relation to England averages, with the exception of the 'Good Level of Development at Reception', which was low for West Sussex, in relation to the England average. See Table 5.1 below.

5.3.11 Impacts on childhood development due to sleep loss are expected to decrease, particularly in the medium term.

Table 5-1 Childhood Development Baseline Indicators for the Gatwick Study Area (England Average in brackets) [48]

CHILDHOOD DEVELOPMENT BASELINE INDICATORS	WEST SUSSEX				SURREY
	Crawley	Horsham	Reigate and Banstead	Mid Sussex	Mole Valley & Tandridge
Child Mortality Rate (12.0)	8.1				10.9
Good level of development at reception (66.3)	63.5				68.4
Children in poverty (18.6)	12.1				9.6
Children in care (60)	38				37
Hospital admission due to substance misuse (88.8)	80.9				33.2
Hospital Admissions for Asthma under 19 years (216.1)	160.4				153.1

CHILDHOOD DEVELOPMENT BASELINE: HEATHROW

5.3.12 Childhood development baseline data for the study area surrounding Heathrow was only available at County and Unitary level (Bucks & Surrey). All the baseline indicators were good or close to England averages, with the exception of child mortality rate in Hounslow and Slough, and Children in Poverty in Hounslow and Ealing which were higher than the England average. The 'Good Level of Development at Reception', which was low for Hounslow, in relation to the England average. Slough had a very high incidence for Hospital Admissions for Asthma under 19 years, at 331.6, as opposed to the England average of 216.1 admissions. All other authorities

[48] Child Health Profiles, Public Health England, 2017 (accessed 20/01/2017). (http://fingertips.phe.org.uk/profile/child-health-profiles/data#page/0/gid/1938132948/pat/42/ati/102/are/E10000032)

were below the England average. See Table 5.2 below.

5.3.13 Impacts on childhood development due to sleep loss are expected to decrease, particularly in the medium term.

Table 5-2 Childhood Development Baseline Indicators for the Heathrow Study Area (England Average in brackets) [49]

CHILDHOOD DEVELOPMENT INDICATOR	HILLINGDON	HOUNSLOW	EALING	RICHMOND	WANDSWORTH	SLOUGH	WINDSOR	SOUTH BUCKS (BUCKS)	RUNNYMEDE & SPELTHORNE (SURREY)
Child Mortality Rate (12.0)	10.9	17.1	6.9	12.0	12.6	18.2	5.0	10.9	8.2
Good level of development at reception (66.3)	65.2	64.5	69.6	71.3	69.6	64.9	73.9	68.4	72.4
Children in poverty (18.6)	17.9	19.7	19.2	8.3	18.6	18.4	8.6	9.6	9.4
Children in care (60)	48	48	44	22	37	49	30	37	31.0
Hospital admission due to substance misuse (88.8)	52.0	54.0	58.1	76.0	70.2	46.8	80.2	33.2	79.0
Hospital Admissions for Asthma under 19 years (216.1)	202.1	153.6	210	125.1	180.6	331.6	79.7	153.1	154.1

5.3.14 **Nationally:** Estimates in the past have suggested that by 2050, 55% of boys and 70% of girls aged under 20 could be overweight or obese[50]. However, a more recent update on these trends from 2000 to 2007, although not directly comparable, indicated a healthier picture; these suggested that by 2020 13% of boys and 10% of girls aged 2-11 might be obese.[51]

CHILDHOOD DEVELOPMENT ASSESSMENT: LGW-2R

5.3.15 The threat of the loss of 205 residential properties as a consequence of expansion of Gatwick Airport could contribute directly to the feeling of instability of property occupants. This instability could have a direct detrimental impact upon the family environment which in turn could impact upon the development of the occupant children through denying them safe and stable housing, and high-quality learning opportunities at home. Due to the relatively healthy indicators of childhood development and scale of relocation within the study area, potential health impacts would be moderately adverse amongst children in the general population, leading to minor adverse as the impacts from night-time noise reduce with time, of moderate intensity and long

[49] Child Health Profiles, West Sussex. Public Health England. http://fingertips.phe.org.uk/profile/child-health-profiles/data#page/0/gid/1938132948/pat/42/ati/102/are/E10000032

[50] Foresight. *Tackling Obesities: Future Choices* – Project report. Government Office for Science, 2007. http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publichealth/Healthimprovement/Obesity/DH_079713

[51] McPherson K, Brown M, Marsh T, Byatt T. *Obesity: Recent Trends in Children Aged 2-11y and 12-19y*. Analysis from the Health Survey for England 1993 – 2007. National Heart Forum, 2009.

term in scale within the Gatwick study area and would apply during both the construction and operational phases of the expanded airport. Adverse impacts upon childhood development relating to sleep disturbance are expected to be slightly lower in 2040 and 2050 compared with 2030 as a result of expansion at Gatwick.

5.3.16 The loss of four pre-schools or nurseries as a consequence of expansion of Gatwick Airport would impact directly upon access to local children's ability to access high quality learning opportunities. The current low attainment of 'Good level of development at reception' within west Sussex compounds the detrimental impact of any school closures. Though replacement school places would be secured for all of the children affected, a change of school can be severely disruptive for a child[52] with loss of friendships and secure relationships with carer adults. Due to the number of schools involved the potential health outcomes would be of moderate intensity in scale within the Gatwick study area and would apply during both the construction and operational phases of the expanded airport.

5.3.17 Any loss of access to leisure facilities, including associated sporting facilities, could result in a reduction in child activity levels within the study area. Importantly loss of informal recreation opportunities, including part of Rowley Wood, public rights of way and cycle routes all reduce access to outdoor play to both children and young people within the study area. As children are known to be more active outdoors and outdoor play has been associated with good motor development, such a loss could have a direct and indirect detrimental impact upon childhood physical and mental development, contributing to lowering physical activity amongst children and increasing risk of childhood obesity, and potentially type 2 diabetes, within the study area.

5.3.18 Due to the specific loss of sporting facilities and key outdoor leisure facilities the potential health outcomes would be moderate adverse amongst children from the general population, high intensity and long term in scale within the Gatwick study area and would apply during both the construction and operational phases of the expanded airport. These health outcomes would disproportionately affect children and young people. No information is available on the secondary impacts of development, where displaced households[53] will be relocated, and the effect this will have on existing communities. Proposed sites for relocation of amenities are not yet known and what impact there will be in terms of journey times to the new pre-schools and nurseries (for staff and for parents), to places of worship.

CHILDHOOD DEVELOPMENT ASSESSMENT: LHR-ENR

5.3.19 The threat of loss of up to 407[54] houses as a consequence of LHR-ENR could contribute directly to the feeling of instability of property occupants, including families. This instability would have a direct detrimental impact upon the family environment, which in turn could impact upon the development of the occupant children through denying them safe and stable housing and high-quality learning opportunities at home.

5.3.20 This could have a disproportionate effect upon children in both Hounslow and Slough, due to the higher than average levels of childhood mortality, childhood poverty, high incidence of hospital admissions for asthma in Slough and slightly below average levels of 'Good level of Development at reception' in both Hounslow and Slough. Due to the relatively high number of properties

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[52] Adam, Emma K., and P. Lindsay Chase-Lansdale. 2002. "*Home Sweet Home(s): Parental Separations, Residential Moves, and Adjustment in Low-Income Adolescent Girls.*" Developmental Psychology 8:792–805

[53] It has been assumed that household population density is 2.36 people per household (http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/articles/householdsandhouseholdcompositioninenglandandwales/2014-05-29)

[54] 242 residential properties likely to be demolished for airport expansion and up to 165 residential properties could be demolished for surface access, since they fall within the buffer zone for construction works

proposed to be demolished, the high number of residents under threat of being relocated to other properties and the current poor childhood development health indicators of in parts of the study area. The potential health outcomes would be moderately adverse, high intensity and long term in scale within the Heathrow study area and would apply during both the construction and operational phases of the expanded airport to children in the general population. Beneficial impacts upon childhood development relating to sleep disturbance may be expected due to potential relative reductions in sleep disturbance over all of the assessment years, compared with the do minimum[55].

5.3.21 The predicted increase in aircraft noise levels at the Pippins Primary School would have a direct impact upon childhood development in terms of learning potential, and would reduce the children's' ability to access high quality learning opportunities. This is explored within the noise section of this report.

5.3.22 Loss of access to informal as well as formal leisure opportunities such as loss part of the Colne Valley regional park, severance of a section of the Colne Valley Way may result in a temporary reduction in child activity levels within the study area until mitigation for the Park and severance is in place. There is potential for reduced access to outdoor play for both children and young people within the study area. As children are known to be more active outdoors and outdoor play has been associated with good motor development, such a loss could have a direct and indirect detrimental impact upon childhood physical and mental development. This could contribute to lowering physical activity amongst children and increase risk of childhood obesity, and potentially type 2 diabetes, within the study area. The potential health outcomes have been assessed as being minor adverse, high intensity and long term in scale within the Heathrow study area and are likely to apply to the construction phase of the expanded airport and to children in the general population.

CHILDHOOD DEVELOPMENT ASSESSMENT: LHR-NWR

5.3.23 The threat of loss of up to 1072[56] houses as a consequence of LHR-NWR would contribute directly to the feeling of instability of property occupants, including families. This instability would have a direct detrimental impact upon the family environment, which in turn could impact upon the development of the occupant children through denying them safe and stable housing, and high-quality learning opportunities at home.

5.3.24 This could have a disproportionate effect upon children in both Hounslow and Slough, due to the higher than average levels of childhood mortality, childhood poverty, high incidence of hospital admissions for asthma in Slough and slightly below average levels of 'Good level of Development at reception' in both Hounslow and Slough. Due to the very high number of properties proposed to be demolished, the very high number of residents under threat of being 'relocated to other properties and the current poor childhood development health indicators in parts of the study area. The potential health outcomes would be moderately adverse, of high intensity and long term in scale within the Heathrow study area and would apply during both the construction and operational phases of the expanded airport to children in the general population. Adverse impacts upon childhood development relating to sleep disturbance are expected for all assessment years other than 2050, compared with the do minimum.

5.3.25 The loss of Harmondsworth Primary School as a consequence of LHR-NWR would impact directly upon access to local children's' ability to access high quality learning opportunities. The

[55] Do Minimum scenario is where no expansion takes place at either Heathrow or Gatwick.
[56] 783 residential properties likely to be demolished for airport expansion and up to 289 residential properties could be demolished for surface access, since they fall within the buffer zone for construction works.

slightly below average levels of 'Good level of Development at reception' in both Hounslow and Slough will compound the detrimental impact of the school closures. Though replacement school places would be secured for all of the children affected, a change of school is severely disruptive for a child[57] with loss of both friendships and secure relationships with carer adults. Due to the low number of schools involved the potential health outcomes would be minor in scale within the Heathrow study area, and of low intensity and would apply during both the construction and operational phase of the expanded airport.

5.3.26 Loss of access to informal, as well as formal, leisure opportunities such as loss part of the Sipson Recreation ground and facilities loss of part of Colne Valley Regional Park may result in a temporary reduction in child activity levels within the study area, until mitigation for severance, the Park extension and relocated facilities are in place. There is potential for reduced access to outdoor play to both children and young people within the study area. As children are known to be more active outdoors and outdoor play has been associated with good motor development, such a loss could have a direct and indirect detrimental impact upon childhood physical and mental development. This could contribute to lowering physical activity amongst children and increase risk of childhood obesity, and potentially type 2 diabetes, within the study area. The potential health outcomes would be minor adverse, of high intensity and long term in scale within the Heathrow study area and would apply during the construction phase of the expanded airport to children in the general population.

EMPLOYMENT STATUS: EVIDENCE

5.3.27 Employment is an important determinant of health; having a job or an occupation provides a vital link between an individual and society, and enables people to contribute to society and achieve personal fulfilment.[58]

5.3.28 The WHO identifies a number of ways in which employment benefits mental health.[59] These include the provision of structured time, social contact and satisfaction arising from involvement in a collective effort. Therefore the loss of a job or the threat of losing a job is considered detrimental to health.[60]

5.3.29 The Marmot Review was commissioned by the Department of Health to look into health inequalities in England. The Review identifies six policy objectives for reducing health inequalities, one of which is to 'Create fair employment and good work for all'. The Review identifies the importance of work for health: 'being in good employment is protective of health. Conversely, unemployment contributes to poor health'.[61]

5.3.30 A study commissioned by the Department of Work and Pensions found that 'work meets important psychosocial needs in societies where employment is the norm' and that *'work is central to individual identity, social roles and social status'*. [62]

5.3.31 The London Health Commission's report Health in London: Review of the London Health Strategy High Level Indicators describes unemployment as: '*a significant risk factor for poor physical and*

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57 Adam, Emma K., and P. Lindsay Chase-Lansdale. 2002. "*Home Sweet Home(s): Parental Separations, Residential Moves, and Adjustment in Low-Income Adolescent Girls*." Developmental Psychology 8:792–805

58 Doyle C, Kavanagh P, Metcalfe O, and T Lavin. 2005. *Health Impacts of Employment: A Review.* The Institute of Public Health in Ireland. [online]

59 World Health Organisation. Mental Health. Available at: http://www.who.int/mentalhealth/en.

60 Marmot M, Wilkinson R, editors. *The solid facts.* 2nd ed. Geneva: World Health Organisation; 2003

61 Marmot, M., Allen, J., Goldblatt, P., Boyce, T., McNeish D., Grady, M. and Geddes, I., 2010, *Fair society, healthy lives: Strategic review of health inequalities in England post-2010*, The Marmot Review. Page 26, para 1.

62 Waddell, G., Burton, A. K., 2007. *Is work good for your health and well-being?* The Stationery Office.

mental health and a major determinant of health inequalities. It is associated with morbidity, injuries and premature mortality, especially through increased risk of coronary heart disease. It is also related to depression, anxiety, self-harm and suicide'.[63]

5.3.32 The type of job a person has and the working conditions he or she is exposed to will also affect health. It is also important to consider the impact that employment has on other aspects of people's lives that are important for health – for example, family life, social life and caring responsibilities for family members.

EMPLOYMENT STATUS BASELINE: GATWICK

5.3.33 The proportion of the population in full-time employment in the Gatwick study area is higher than the national average of 38.6%, ranging from 39.2% of the population in Mole Valley District to 47.2% in Crawley District. The percentage of the population unemployed in Crawley District is close to the national average (4.5% in Crawley, 4.4% in England). Unemployment in the remaining local authorities surrounding Gatwick is lower than the English average.

5.3.34 In Crawley, 10% of the working age population claim benefits, of which, 1.1% are classified as disabled claimants. In Reigate and Banstead, of 7% of the working age population claiming benefits, 0.9% of these are classified as disabled, and in Horsham, of 6.4% the working population claiming benefits, 0.9% of these are classified as disabled. This is compared to 1% in the south east regionally.

5.3.35 Gatwick Airport supported 24,900 direct employees in 2011[64]. Airport employees are located predominantly (35%) in Crawley postcode districts, compared to 7% of employees in Horley, 6% in Brighton and 6% in Horsham. The share of total local authority employment at the airport varies between 0% and 2.6%, and airport employees make up a less significant proportion of the workforce. In 2013, the average rate of unemployment across the neighbouring local authorities (5.1%) was lower than the national average (6.4%)[65].

EMPLOYMENT STATUS BASELINE: HEATHROW

5.3.36 The proportion of the population in full-time employment in the Heathrow study area is higher than the English average of 38.6%. The proportion of the population that is unemployed in the study area varies: some local authorities have higher unemployment than the English average of 4.4% (Hounslow 4.6%, Ealing 5.2%, and Slough 5.4%). Unemployment in the remaining local authorities is lower than the English average.

5.3.37 In Slough, 10% of the working age population claim benefits, of this 0.8% are classified as disabled claimants. In Hillingdon, of 9.5% of the working age population claiming benefits, 0.8% of these are classified as disabled, and in Hounslow, of 9.9% the working population claiming benefits, 0.8% of these are classified as disabled. This is compared to 0.8% in the London region.

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[63] Greater London Authority, 2005*, Health in London: Review of the London Health Strategy High Level Indicators*, London Health Commission

[64] PwC,2014. *Airports Commission Local Economic Impacts Literature Review*, p. 13

[65] Jacobs, 2014. *Local Economy Impacts: Assessment,* p. 23, Table 12 .*(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/373487/AC09-local-economy-assessment.pdf)*. Accessed 18/02/2016.

5.3.38 Heathrow Airport supported 84,400 jobs in 2011[66]. Airport employees are drawn relatively evenly from Hounslow, Ealing, Slough, Hillingdon and Spelthorne. 42% of Heathrow's workforce lives in the five surrounding local authorities, including Hillingdon, Ealing, Hounslow, Slough and Spelthorne.

EMPLOYMENT STATUS ASSESSMENT: LGW-2R

5.3.39 Additional employment opportunities will arise as a direct consequence of expansion of Gatwick airport. In the short-term these will be temporary construction jobs, though relatively long-term, as construction is expected to take place over several years.

5.3.40 Airport expansion is expected to have direct, indirect and cumulative beneficial effects on local employment, as it is likely to attract businesses to locate to be closer to the airport, once expansion has taken place.

5.3.41 The number of local jobs supported by LGW-2R depends on many factors, including the type of airport, size of the airport passenger and employment catchment areas as well as the size of these areas compared to the country as a whole. Reflecting these uncertainties, the DfT developed a range of local employment estimates for LGW-2R. These indicated that between 5,290 and 12,500 additional local jobs would be generated by 2030 with between 18,700 and 44,190 generated by 2050[67]. It has not been estimated at this stage what proportion of these jobs will be taken up by 523,000 residents of working age population estimated to be in the 7 local authorities surrounding Gatwick. The quantity and distribution of high skilled jobs has not been determined at this stage of the assessment.

5.3.42 Such employment gains will largely result in beneficial health outcomes such as improved mental health, a reduction in both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These employment opportunities would also attract an improvement in social status, and improvement in the mental health of those who gain employment as a result of expansion. These health outcomes would be moderate, though would have a disproportionately beneficial impact in Crawley, as it has the highest unemployment within the Gatwick Study area. These health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, and people who are economically inactive/unemployed. These health outcomes will be moderately beneficial to most vulnerable groups, excluding older people as well as the general population, of high intensity and long-term in duration.

5.3.43 Contrary to beneficial health outcomes associated with employment status, the expansion of Gatwick Airport will also involve relocation of residents from an estimated 168 residential properties as a consequence of the scheme and up to 37 additional residential properties being demolished for surface access. Thereby indirectly placing their employment status at risk. Placing employment status at risk brings with it the risk of detrimental health outcomes, due to changes in proximity to their place of employment and changes to their accessibility to suitable transport options. The potential health outcome upon employment status arising from housing loss would be moderately adverse, of moderate intensity and long term in duration within the Gatwick study area and would apply during both the construction and operational phases of the expanded airport.

[66] PwC,2014. *Airports Commission Local Economic Impacts Literature Review*, p. 13.
[67] Department for Transport, 2016. *Airport Capacity in the South East: Further Review and Sensitivities Report*. (https://www.gov.uk/government/publications/airport-expansion-further-review-and-sensitivities-report) (Accessed 25/11/2016).

5.3.44 Several workplaces will be closed/relocated as a consequence of expansion of LGW-2R, including four local schools/nurseries, Trent Care Home, Outreach 3 Way Charity and Crawley Rugby club. All of these closures/relocations bring with them significant changes to employment status, once again raising the risk of detrimental health outcomes upon those directly and indirectly affected. The potential health outcome would be moderately adverse, of low intensity and long term in scale within the Gatwick study area.

EMPLOYMENT STATUS ASSESSMENT: LHR-ENR

5.3.45 Additional employment opportunities will arise as a direct consequence of LHR-ENR. In the short-term these will be temporary construction jobs, though relatively long-term, as construction is expected to take place over several years.

5.3.46 Airport expansion is expected to have direct, indirect and cumulative beneficial effects on local employment, as it is likely to attract businesses to locate to be closer to the airport, once expansion has taken place.

5.3.47 The number of local jobs supported by the shortlisted scheme depends on many factors, including the type of airport, size of the airport passenger and employment catchment areas as well as the size of these areas compared to the country as a whole. Reflecting these uncertainties, the DfT developed a range of local employment estimates. These indicated that between 37,830 and 76,650 additional local jobs would be generated by 2030 with between 32,750 and 65,610 generated by 2050[67]. The quantity and distribution of high skilled jobs has not been determined at this stage of the assessment.

5.3.48 Such employment gains will largely result in beneficial health outcomes such as improved mental health, a reduction in both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These employment opportunities would also attract an improvement in social status, and improvement in the mental health of those who gain employment as a result of expansion. These health outcomes would be moderately beneficial, of high intensity, long-term in duration, and occur across both the construction and operational phases, though would have a disproportionately beneficial impact upon a low income, people living in areas of deprivation, and people who are economically inactive/unemployed. This would be particularly beneficial in Slough Ealing and Hounslow, as they have the highest unemployment levels within the Heathrow Study area.

5.3.49 Contrary to beneficial health outcomes associated with employment status, LHR-ENR will also involve relocation of residents from an estimated 242 residential properties as a consequence of the airport land take with the potential loss of an additional 165 residential properties as a result of improvements to surface access. Relocation, due to housing loss, could indirectly place residents' employment status at risk through changes in proximity to their place of employment and accessibility to suitable transport options. The potential health outcome upon employment status arising from housing loss would be moderately adverse, moderate intensity and long term in scale within the Heathrow study area and would apply during both the construction and operational phases of the expanded airport.

5.3.50 Several workplaces will be closed or relocated as a consequence of expansion of LHR-ENR, including the Punch Bowl Pub and loss on industrial/employment land. All of these closures and relocations bring with them significant changes to employment status, raising the risk of detrimental health outcomes upon those directly and indirectly affected. The potential health outcome upon employment status from workplace closure arising from workplace loss would be minor adversely in scale within the Heathrow study area and would apply during both the construction and operational phases of the expanded airport.

EMPLOYMENT STATUS ASSESSMENT: LHR-NWR

5.3.51 Additional employment opportunities will arise as a direct consequence of LHR-NWR. In the short-term these will be temporary construction jobs, though relatively long-term, as construction is expected to take place over several years.

5.3.52 Airport expansion is expected to have direct, indirect and cumulative beneficial effects on local employment, as it is likely to attract businesses to locate closer to the airport, once expansion has taken place.

5.3.53 The number of local jobs supported by LHR-NWR depends on many factors, including the type of airport, size of the airport passenger and employment catchment areas as well as the size of these areas compared to the country as a whole. Reflecting these uncertainties, the DfT developed a range of local employment estimates. These indicated that between 37,740 and 76,650 additional local jobs would be generated by 2030 with between 39,100 and 78,360 jobs generated by 2050[67]. The quantity and distribution of high skilled jobs has not been determined at this stage of the assessment.

5.3.54 Such employment gains will largely result in beneficial health outcomes such as improved mental health, a reduction in both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These employment opportunities would also attract an improvement in social status, and improvement in the mental health of those who gain employment as a result of expansion. These health outcomes would be moderately beneficial of high intensity, long-term in duration and occur across both the construction and operational phases, though would have a disproportionately beneficial impact upon a low income, people living in areas of deprivation, and people who are economically inactive or unemployed. This would be particularly beneficial in Slough Ealing and Hounslow, as they have the highest unemployment levels within the Heathrow Study area.

5.3.55 Contrary to beneficial health outcomes associated with employment status, LHR-NWR will also involve relocation of residents from an estimated 783 properties, with changes in surface access potentially requiring an additional 289 properties to be demolished.

5.3.56 Several workplaces will be closed or relocated as a consequence of expansion of LHR-NWR, including Harmondsworth Primary School, Sipson Community Centre, Heathrow Special Needs Centre, Longford and Sipson nursery Schools, the Wonderland day nursery and the White Horse Pub. All of these closures and relocations bring with them changes to employment status, raising the risk of detrimental health outcomes upon those directly and indirectly affected. The potential health outcome upon closure of places of employment status arising from housing loss would be minor adverse, low intensity and long term in scale within the Heathrow study area and would apply during both the construction and operational phases of the expanded airport.

LEVEL OF INCOME: EVIDENCE

5.3.57 Several historical studies (1980s and 1990s) provided strong evidence for a causal relationship between unemployment and increased mortality, linking unemployment with a number of different diseases[68,69,70,71,72,73].

5.3.58 Though some disease evidence is conflicting, some of the earlier studies detected confounding associations of individual risk factors. A Swedish[74] and a Finnish[75] study, investigated health effects of unemployment in times of generally high unemployment and thus decreasing selection bias among the unemployed), only found weak associations between unemployment and increased mortality.

5.3.59 Despite the uncertainties around some of the disease areas the Swedish (Lundin et al. (2009)) still found a beneficial association with unemployment and mortality (57% increase in the unemployed), violent death (116% increase in the unemployed), suicide (76% increase in the unemployed) and violent death other than suicide (346% increase in the unemployed) after adjusting for 12 competing risk factors.

5.3.60 Links between unemployment with poor health outcomes have mainly been focussed on health effects of becoming unemployed, with those that become unemployed or enter less secure employment having worse health than those that remain in secure employment.

5.3.61 The type of employment that a person enters will also have an effect on health; research suggests that jobs with low personal control or low income are associated with poorer health status compared with high control/high income jobs.[76]

5.3.62 The evidence therefore shows that becoming unemployed, or entering into either low paid or low control employment, is bad for health.

5.3.63 Income is a key factor through which employment status affects health and wellbeing. The Department of Work and Pensions study found that "employment is generally the most important means of obtaining adequate economic resources, which are essential for material wellbeing and full participation in today's society … employment and socio-economic status are the main drivers of social gradients in physical and mental health and mortality".[77]

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68 Moser KA, Fox AJ and Jones DR, 1984: *Unemployment and mortality in the OPCS longitudinal study*. The Lancet: 1324-1328.

69 Iversen L, Andersen O, Andersen PK, Christoffersen K and Keiding N, 1987: *Unemployment and mortality in Denmark, 1970-80*. British Medical Journal; 295: 879-884

70 Iversen L, Sabroe S and Damsgard MT, 1989: *Hospital admissions before and after shipyard closure*. British Medical Journal; 299: 1073-1076.

71 Martikainen PT, 1990: *Unemployment and mortality among Finnish men*, 1981-5. British Medical Journal, 301: 407-411.

72 Stefanson CG,1991: *Long term unemployment and mortality in Sweden*, 1980-1986. Social Science Medicine; 32, 4: 419-423.

73 Morris JK, Cook DG and Shaper GA, 1994: *Loss of employment and mortality*. British Medical Journal; 308: 1135-1139.

74 Lundin A, Lundberg L, Hallstern L, Ottosson J and Henningsson T, 2009: *Unemployment and mortality - a longitudinal prospective study on selection and causation in 49321 Swedish middle aged men*. Journal of Epidemiology and community health; 64: 22-28.

75 Martikainen PT and Valkonen T, 1996: *Excess mortality of unemployed men and women during a period of rapidly increasing unemployment*. Lancet; 348, 9032: 909-913

76 Kuper H1, Marmot M., *Job strain, job demands, decision latitude, and risk of coronary heart disease within the Whitehall II study*. J Epidemiol Community Health. 2003 Feb;57(2):147-53.

77 Waddell, G., Burton, A. K., 2007. *Is work good for your health and well-being?* The Stationery Office.

5.3.64 Children, particularly from low-income families, are more sensitive than adults to air pollution, noise and other environmental factors. Pregnant women in poverty and deprivation can lead to adverse health effects on unborn babies'.[78]

LEVEL OF INCOME BASELINE: GATWICK

5.3.65 For this health determinant, deprivation and unemployment rates within the study areas have been used as proxies for Level of Income, and no data on level of income are presented. In this study area, deprivation is lower than the national average, and the unemployment rate is noticeably lower than the national rate, although the rate for Crawley is approximately the same.

5.3.66 Approximately 17.4% (3,900) children still live in poverty in Crawley,[79] 10.8% (2,900) in Reigate and Banstead,[80] and 8.2% (1,900) in Horsham.[81]

LEVEL OF INCOME BASELINE: HEATHROW

5.3.67 For this health determinant, deprivation and unemployment rates within the study areas have been used as proxies for Level of Income, and no data on level of income are presented. In this study area, deprivation is lower than the national average, and unemployment within the Slough, Ealing and Hounslow are noticeably above the national rate.

5.3.68 Approximately 19.5% (6,600) children still live in poverty in Slough,[82] 20.1% (11,800) in Hillingdon,[83] and 21.5% (11,300) in Hounslow.[84]

LEVEL OF INCOME ASSESSMENT: LGW-2R

5.3.69 LGW-2R will provide additional employment opportunities but also improve levels of income. Both of these are associated with both the direct and indirect employment opportunities that airport expansion attracts. Employment and improved income level opportunities will arise from the new construction jobs, and once expansion has taken place, from direct airport employment and new businesses attracted to the area to be closer to the airport.

5.3.70 The quantity and distribution of the income level associated with new employment opportunities has not been determined at this stage of the assessment. However as airport expansion has been predicted to result in Gatwick Airport employing 1.25% of the working age population in the 7 local authorities surrounding Gatwick.[85] A proportion of these posts will require management and technical skills and provide an opportunity for increase in salary levels, with some posts involving

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78 Xu Xiaohui; Sharma Ravi K.; Talbott Evelyn O.; et al: 2011, *PM_{10} air pollution exposure during pregnancy and term low birth weight in Allegheny County*, PA, 1994-2000 International archives of occupational and environmental health Volume: 84 Issue: 3 Pages: 251-257

79 Public Health England, Health Profile 2015, Crawley District

80 Public Health England, Health Profile 2015, Reigate and Banstead District

81 Public Health England, Health Profile 2015, Horsham District

82 Public Health England, Health Profile 2015, Slough District

83 Public Health England, Health Profile 2015, Hillingdon District

84 Public Health England, Health Profile 2015, Hounslow District

85 Airports Commission, 2015. *Local Economy: Impacts Assessment Post Consultation Updates*. P. 17 (https://www.gov.uk/government/publications/airports-commission-final-report-local-economy-impacts) Accessed 17.02.2016

higher medium to high salaries.

5.3.71 Improvements to income levels and security of income have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These health outcomes would be minor beneficial, of high intensity and long term. Though outcomes are likely to be moderately beneficial in Crawley, as it has the highest unemployment within the Gatwick Study area, which is often associated with low household income. Health outcomes would be of moderately beneficial to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed and minor beneficial to remaining vulnerable groups, excluding older people and would apply during both the construction and operational phase of the expanded airport.

LEVEL OF INCOME ASSESSMENT: LHR-ENR

5.3.72 Expansion at LHR-ENR is likely to provide additional employment opportunities, but also improve levels of income. This is associated with the direct and indirect employment opportunities that airport expansion attracts. Employment and improved income level opportunities will arise from the new construction jobs, and once expansion has taken place, from direct airport employment and new businesses attracted to the area to be closer to the airport.

5.3.73 The quantity and distribution of the income level associated with new employment opportunities has not been determined at this stage of the assessment. However as airport expansion has been predicted to result in increases in employment which are highly likely to be drawn from the same authorities as the current airport staff, as 42% of Heathrow's current workforce lives in the five surrounding local authorities, including Hillingdon, Ealing, Hounslow, Slough and Spelthorne. A proportion of these posts will require management and technical skills and provide an opportunity for increase in salary levels, with some posts involving higher medium to high salaries.

5.3.74 Improvements to income levels and security of income have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These health outcomes would be of minor benefit to the general population and most vulnerable groups, though are likely to be of moderate benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/unemployed, and moderately beneficial within Slough, Hounslow and Ealing, as these have significantly higher unemployment than the England average, which is often associated with low household income. Health outcomes are likely to apply during both the construction and operational phases of the expanded airport.

LEVEL OF INCOME ASSESSMENT: LHR-NWR

5.3.75 Expansion at LHR-NWR is likely to provide additional employment opportunities, but also improve levels of income. This is associated with the direct and indirect employment opportunities that airport expansion attracts. Employment and improved income level opportunities will arise from the new construction jobs, and once expansion has taken place, from direct airport employment and new businesses attracted to the area to be closer to the airport.

5.3.76 The quantity and distribution of the income level associated with new employment opportunities has not been determined at this stage of the assessment. However as airport expansion has been predicted to result in increases in employment which are highly likely to be drawn from the same authorities as the current airport staff, as 42% of Heathrow's current workforce lives in the five surrounding local authorities, including Hillingdon, Ealing, Hounslow, Slough and Spelthorne. A proportion of these posts will require management and technical skills and provide an opportunity for increase in salary levels, with some posts involving higher medium to high salaries.

5.3.77 Improvements to income levels and security of income have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These health outcomes would be of minor benefit to the general population and most vulnerable groups, though are likely to be of moderate benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/unemployed, and moderately beneficial within Slough, Hounslow and Ealing, as these have significantly higher unemployment than the England average, which is often associated with low household income. Health outcomes are likely to apply during both the construction and operational phases of the expanded airport.

HOUSING TENURE: EVIDENCE

5.3.78 Housing tenure has been strongly associated with health, where tenants appear to have poorer health than those who own their houses even after controlling for age, gender, and education.[86] There is clear difference between homes that are owned and those that are rented, especially in relation to problems of condensation, lack of adequate heating and damp, with proportions in the rented sector around twice as high.[87] Evidence on the relationship between housing and poor health identified key stressors including insecurity and tenure concerns, difficulties with landlords and repairs, frequent relocations, limited control over social interactions, and the stigma of poor housing.[88]

5.3.79 Home-ownership has become the dominant form of tenure in England. Since 1971 home ownership has increased from 50% to 70% of all homes. Average (median) gross income of households is lowest in the social rented sector by tenure and households in the private rented sector have median around half the level for those buying with a mortgage.[89]

5.3.80 Home-owners are more likely to be satisfied with their accommodation than those households who are renting. In 2006/07 95% of home-owners were satisfied (see footnote 6) with their accommodation compared with only 82% of households who were renting.[89]

5.3.81 People's lives are affected by changes to them and neighbourhoods will be through regeneration and relocation. These changes bring both opportunities and risks, which potential to significantly impact upon the health and wellbeing of those involved.

HOUSING TENURE BASELINE: GATWICK

5.3.82 The provision and distribution of social housing across the Gatwick study area is outlined in Table 5.3 below, alongside the total number of properties in each Local Authority in the study area. With both Crawley and Tandridge hosting 7,840 and 2,631 social housing residential premises respectively. Outside of these two Local Authorities, the provision of social housing was minimal across the study area.

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86 Macintyre S, Hiscock R, Kearns A, et al. Housing tenure and health inequalities: a three-dimensional perspective on people, homes and neighbourhoods. In: Graham H, ed. *Understanding health inequalities*. Buckingham: Open University Press, 2001.

87 Pevalin, D J, Taylor M P, Todd J, 2009: '*The dynamics of unhealthy housing in the UK: A panel data analysis*' Housing Studies, Vol 23, Issue 5, Sep 2008. pp. 679-695.

88 Evans, G., Wells, N., & Moch, A. 2003. *Housing and mental health: A review of the evidence and a methodological and conceptual critique.* Journal of Social Issues, *59*(3), 475–500.

89 Housing in England 2006/07, Communities and Local Government, 2008

Table 5-3 Housing Tenure in Gatwick Study Area[90]

CHILDHOOD DEVELOPMENT INDICATOR	CRAWLEY	HORSHAM	REIGATE AND BANSTEAD	MID SUSSEX	TANDRIDGE	MOLE VALLEY
Local Authority and Housing Association (Total Social Housing Residential Premises)	7,840	58	15	17	2,631	29
Total stock of properties[91]	43,390	58,470	59,050	60,650	35,740	37,390

HOUSING TENURE BASELINE: HEATHROW

5.3.83 The provision and distribution of social housing across the Heathrow study area is outlined in Table 5.4 below alongside the total number of properties in each Local Authority in the study area. With all of the four London Local Authorities hosting in excess of 52,000 social housing residential properties. The remaining six local authorities only host 9,500 between them, with 9,200 of these hosted by Slough and Runnymede. None were hosted by Richmond.

Table 5-4 Housing Tenure in Heathrow Study Area[92]

CHILDHOOD DEVELOPMENT INDICATOR	HILLINGDON	HOUNSLOW	EALING	RICHMOND	WANDSWORTH	SLOUGH	WINDSOR	SOUTH BUCKS	SPELTHORNE	RUNNYMEDE
Local Authority and Housing Association (Total Social Housing Residential Premises)	10,051	13,086	12,533	0	16,895	6,233	18	18	180	2,986
Total stock of properties[93]	108,510	99,120	132,240	83,080	138,820	51,720	62,580	28,360	41,650	34,840

HOUSING TENURE ASSESSMENT: LGW-2R

5.3.84 The 205 residential properties which are likely to be demolished for airport expansion and surface access would place occupants into uncertain housing tenure. Assuming a housing occupancy of 2.36[94], this would amount to a total population of 484 residents being placed into uncertain housing tenure. Health outcomes such as increased respiratory disease, episodes of depression, limited social networks, income, poverty and unemployment, poor local transport and access to services, low educational attainment and drug and alcohol misuse are all associated with poor

[90] Local Authority Housing Statistics data returns, England 2014-15
[91] ONS, June 2015, Council Tax Stock of Properties, England and Wales [online]
[92] Local Authority Housing Statistics data returns, England 2014-15
[93] ONS, June 2015, Council Tax Stock of Properties, England and Wales (https://www.gov.uk/government/statistics/council-tax-stock-of-properties-2015)
[94] Average household size in England in 2011 (https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/articles/householdsandhouseholdcompositioninenglandandwales/2014-05-29)

housing could all arise as a consequence of loss of residential properties associated with the expansion of Gatwick.[95, 96, 97, 98, 99,100] Due to the scale of threat to housing tenure within LGW-R2, these health outcomes would be moderately adverse, of moderate intensity upon all to the following vulnerable groups: Black, Asian and Minority Ethnic (BAME) groups, people belonging to different faith and belief groups and shift workers and minor adverse to all remaining vulnerable groups and the general population, of moderate intensity and long-term in duration.

5.3.85 Growth of jobs and businesses associated with each of shortlisted schemes has the potential to put pressure on housing in the local area. Workforce modelling of the additional households required for each shortlisted scheme suggests that (depending on scenario) expansion at Gatwick by 2030 will have attracted up to 18,400 additional residents into the area.

5.3.86 Unless housing is introduced in a phased manner and dispersed, demands on any individual local authority could be significant. Jobs growth could, in part, be met by people who live in local areas with current high unemployment, such as Crawley for Gatwick thereby requiring fewer new homes.

5.3.87 Local authorities in the areas neighbouring Gatwick are taking steps to increase housing provision to 2030 given already existing pressures, and in particular Crawley, the authority most dependent on the airport for local employment, has already identified its town centre as a location for long-term residential developments. As such, the scale of change associated with development at the airport has been assessed as unlikely to significantly increase housing pressures on the local authorities' plans.

5.3.88 Improvements in employment and income levels as a consequence of airport expansion would increase the potential of occupants within rental properties to become home owners, thereby securing or improving tenure on their home. Health outcomes from such improved tenure would be a reduction in respiratory disease, reduced number of episodes of depression, improved social networks. Due to the scale of improvement to employment and income levels the gains in housing tenure within LGW-2R these health outcomes would be moderately beneficial, of moderate intensity, long-term in duration and could be felt throughout both construction and operational phases.

HOUSING TENURE ASSESSMENT: LHR-ENR

5.3.89 There is the potential for up to 407 residential properties to be demolished for airport expansion and surface access. Assuming a housing occupancy of 2.36[101], this would amount to a total population of 961 residents being placed into uncertain housing tenure. Health outcomes such as increased respiratory disease, episodes of depression, limited social networks, income, poverty and unemployment, poor local transport and access to services, low educational attainment and drug and alcohol misuse are all associated with poor housing could all arise as a potential consequence of loss of residential properties associated with the expansion of either Heathrow

[95] Acheson, D.1998 *Independent Inquiry into Inequalities in Health: Report* The Stationery Office , London.
[96] Evans, G. W. 2003 *The built environment and mental health.* Journal of Urban Health 80 , pp. 536-555.
[97] Ineichen, B. 1993 *Homes and Health: How Housing and Health Interact* E & FN Spon , London
[98] Marsh, A., Gordon, D., Heslop, P. and Pantazis, C. 2000 *Housing deprivation and health: a longitudinal analysis. Housing Studies* 15 , pp. 411-428.
[99] Shaw, M. 2004 Housing and Public Health. *Annual Review of Public Health* 25 , pp. 397-418.
[100] Taske, N; Taylor, L; Mulvihill, C and Doyle, N. 2005 *'Housing and public health: a review of reviews of interventions for improving health*'. Evidence Briefing NICE.
[101] Average household size in England in 2011 (https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/articles/householdsandhouseholdcompositioninenglandandwales/2014-05-29)

shortlisted scheme only if no appropriate mitigation is taken.[95] [102] [103] [104] [105] [106] Due to LHR-ENR expansion the scale of the threat to housing tenure these health outcomes would be considered to be potentially moderately adverse, of high intensity and long-term in duration.

5.3.90 Improvements in employment and income levels as a consequence of airport expansion would increase the potential of occupants within rental properties to become home owners, thereby securing or improving tenure on their home. Health outcomes from such improved tenure would be a reduction in respiratory disease, reduced number of episodes of depression, improved social networks.

HOUSING TENURE ASSESSMENT: LHR-ENR BENEFICIAL IMPACTS

5.3.91 Due to the scale of improvement to employment and income levels the gains in housing tenure within the LHR-ENR health outcomes would be moderately beneficial, of moderate intensity, long-term and would be felt throughout both construction and operational phases in all groups.

HOUSING TENURE ASSESSMENT: LHR-NWR

5.3.92 There is a potential for up to 1072 residential properties to be demolished for airport expansion and surface access. Assuming a housing occupancy of 2.36[107], this would amount to a total population of 2,530 residents being placed into uncertain housing tenure. Health outcomes such as increased respiratory disease, episodes of depression, limited social networks, income, poverty and worklessness, poor local transport and access to services, low educational attainment and drug and alcohol misuse are all associated with poor housing could all arise as a potential consequence of loss of residential properties associated with the expansion of either Heathrow shortlisted scheme only if no appropriate mitigation is taken.[95] [108] [109] [104] [110] [111] Due to LHR-NWR expansion the scale of the threat to housing tenure these health outcomes would be considered to be potentially moderately adverse, of high intensity and long-term in duration. Both Heathrow shortlisted schemes' health outcomes would be felt throughout both construction and operational phases.

Improvements in employment and income levels as a consequence of airport expansion would increase the potential of occupants within rental properties to become home owner, thereby securing or improving tenure on their home. Health outcomes from such improved tenure would be a reduction in respiratory disease, reduced number of episodes of depression, improved social networks. Due to the scale of improvement to employment and income levels the gains in housing tenure within LHR-NWR these health outcomes would be moderately beneficial and could be felt throughout both construction and operational phases.

HOUSING CONDITIONS: EVIDENCE

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[102] Evans, G. W, 2003. *The built environment and mental health*. Journal of Urban Health 80 , pp. 536-555.
[103] Ineichen, B, 1993 *Homes and Health: How Housing and Health Interact* E & FN Spon , London
[104] Marsh, A., Gordon, D., Heslop, P. and Pantazis, C, 2000 *Housing deprivation and health: a longitudinal analysis. Housing Studies* 15 , pp. 411-428.
[105] Shaw, M, 2004 *Housing and Public Health*. Annual Review of Public Health 25 , pp. 397-418.
[106] Taske, N; Taylor, L; Mulvihill, C and Doyle, N. 2005 *'Housing and public health: a review of reviews of interventions for improving health*'. Evidence Briefing NICE.
[107] Average household size in England in 2011[online]
[108] Evans, G. W, 2003 *The built environment and mental health*. Journal of Urban Health 80, pp. 536-555.
[109] Ineichen, B, 1993 *Homes and Health: How Housing and Health Interact* E & FN Spon , London
[110] Shaw, M. 2004 *Housing and Public Health*. Annual Review of Public Health 25, pp. 397-418.
[111] Taske, N; Taylor, L; Mulvihill, C and Doyle, N. (2005) *'Housing and public health: a review of reviews of interventions for improving health*'. Evidence Briefing NICE.

5.3.93 Housing quality has been shown to affect both physical and mental health. WHO research[112] found that 'increased housing satisfaction following housing improvement is strongly linked to improvements in mental health' and 'housing satisfaction may be linked to life satisfaction and mental health'.

5.3.94 There is direct evidence linking housing and neighbourhood characteristics to health and wellbeing. [113] [114] [115] [116] There are also a number of theories that link the physical environment to health, wellbeing and other factors such as crime.

5.3.95 Physical characteristics of a living environment, such as cleanliness and the quality of the housing, low housing density and distance to shopping facilities have all been found to have an impact upon neighbourhood satisfaction, which in turn is associated with higher general quality of life.[117]

5.3.96 Non-physical aspects of the environment are important as they often highlight the value of social networks and social capital for one's health and wellbeing.

5.3.97 Regeneration has generally been linked to measurable improvements in health, with two studies reporting a reduction in mortality following regeneration, though mortality increased within one of the case study areas. This is not always a universal improvement, as some health indicators may decline, whilst the majority are enhanced.[118] [119] [120] Residents of high-rise dwellings planned for demolition were recorded as feeling anxious, among them, reasons given included not knowing who one's neighbours would be, a lack of familiarity in the new area, enhanced risk of burglary from living in a house rather than a flat, and the possibility of having more social contact with people when living on a street at ground level.[121]

5.3.98 Underlying indicators relevant to the health impact of land take and housing loss upon vulnerable groups have been reviewed for the two districts surrounding Heathrow and Gatwick. These indicators were common indicators which were linked to deprivation or housing standards;

- Older People in Deprivation;
- Pensioners living alone;
- Overcrowding;

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[113] Bernard, P., et al. *Health inequalities and place: A theoretical conception of neighbourhood*. Social Science & Medicine (2007) doi:10.1016/j.socscimed.2007.05.037

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- Households with Central Heating; and
- Population with bad or very bad general health.

HOUSING CONDITIONS BASELINE: GATWICK

5.3.99 Overcrowding of properties is widespread in 6 of the 10 districts surrounding Heathrow than all 7 of those districts surrounding Gatwick, and is exceptionally prevalent in 5 of the districts.

Table 5-5 Underlying Health and Housing Conditions in Districts Surrounding Gatwick[122]

Local Authority (England)	Older People in Deprivation, % (16.2)	Pensioners living alone, % (31.5)	Overcrowding, % (8.7)	Households with central heating, % (97.3)	General Health - bad or very bad, % (5.5)
Epsom and Ewell, Surrey	8.4	29.8	6.8	98.3	3.4
Mole Valley, Surrey	8.2	29.7	6.6	98.2	3.6
Reigate and Banstead, Surrey	9.6	29.6	6.6	98.6	3.6
Tandridge, Surrey	8.8	28.5	5.5	98.3	3.8
Crawley, West Sussex	15.1	33.2	9.8	98.3	4.4
Horsham, West Sussex	8.8	29.2	5.3	98	3.5
Mid Sussex, West Sussex	8.9	29.3	5.6	98.4	3.5

HOUSING CONDITIONS BASELINE: HEATHROW

5.3.100 Districts surrounding Heathrow Airport record higher levels of older people in deprivation than all districts surrounding Gatwick, with exception to Crawley. Overcrowding of properties is widespread in 6 of the 10 districts surrounding Heathrow than all 7 of those Districts surrounding Gatwick, and is exceptionally prevalent in 5 of the districts.

Table 5-6 Underlying Health and Housing Conditions in Districts Surrounding Heathrow[122]

Local Authority (England)	Older People in Deprivation, % (16.2)	Pensioners living alone, % (31.5)	Overcrowding, % (8.7)	Households with central heating, % (97.3)	General Health - bad or very bad, % (5.5)
Slough	22.7	31.3	20.8	97.3	4.5
Windsor and Maidenhead	10.6	28.8	6.7	98.3	3.4

[122] Communities Local Government 2010, ONS 2011 *Census Data via Public Health England Local Health Profiles* (http://www.localhealth.org.uk)

Local Authority (England)	Older People in Deprivation, % (16.2)	Pensioners living alone, % (31.5)	Overcrowding, % (8.7)	Households with central heating, % (97.3)	General Health - bad or very bad, % (5.5)
South Bucks, Buckinghamshire	8.8	28.6	4.2	98.8	3.8
Runnymede, Surrey	10.9	32.3	8.3	98	3.7
Spelthorne, Surrey	10	30.2	9	98	4.1
Ealing	26.2	31.3	23.6	97.4	5
Hillingdon	16.7	31.1	15.9	98	4.4
Hounslow	24.1	32.2	21.8	97.4	4.7
Richmond upon Thames	12.4	37.3	10	97.4	3.2
Wandsworth	26.4	38.6	20.1	97.1	3.8

5.3.101 There were no significant differences between households with central heating in either district groups. Bad or very bad general health was more frequently recorded amongst the residents of districts surrounding Heathrow than surrounding Gatwick, with 7 of the 10 districts surrounding Heathrow having recorded greater incidents of bad or very bad poorer health than 6 of the 7 districts surrounding Gatwick (the exception being Crawley).

HOUSING CONDITIONS ASSESSMENT: LGW-2R

5.3.102 The potential loss of 205 residential properties which are likely to be demolished for airport expansion and surface access would place occupants into uncertain conditions. Health outcomes such as increased respiratory disease, episodes of depression, limited social networks, income, poverty and worklessness, poor local transport and access to services, low educational attainment and drug and alcohol misuse which are all associated with poor housing could all arise as a consequence of loss of residential properties associated with the expansion of Gatwick.[95] [123] [124] [125] [126] [127] Should there be any secondary effects across the study area as a whole on housing availability and housing quality, then Crawley would be at the greatest risk, as it has the highest incidence of overcrowding, highest number of pensioners living in poverty and poorest general health across the Gatwick study area. Due to the scale of threat to housing conditions within LGW-R2 these health outcomes would be moderately adverse, of moderate intensity and long-term in duration, though would have a major adverse impact of low intensity upon older people and would be relevant to both the construction and operational phases.

HOUSING CONDITIONS ASSESSMENT: LHR-ENR

5.3.103 The potential demolition of 407 residential properties for airport expansion and surface access would place occupants into uncertain conditions. Health outcomes such as increased respiratory disease, episodes of depression, limited social networks, income, poverty and worklessness, poor local transport and access to services, low educational attainment and drug and alcohol misuse

[123] Evans, G. W. 2003. *The built environment and mental health.* Journal of Urban Health 80, pp. 536-555.
[124] Ineichen, B. 1993 *Homes and Health: How Housing and Health Interact* E & FN Spon , London
[125] Marsh, A., Gordon, D., Heslop, P. and Pantazis, C. 2000 *Housing deprivation and health: a longitudinal analysis. Housing Studies* 15, pp. 411-428.
[126] Shaw, M. 2004. *Housing and Public Health*. Annual Review of Public Health 25, pp. 397-418.
[127] Taske, N; Taylor, L; Mulvihill, C and Doyle, N. 2005 '*Housing and public health: a review of reviews of interventions for improving health*'. Evidence Briefing NICE.

are all associated with poor housing could all arise as a consequence of loss of residential properties associated with LHR-ENR.[95] [128] [129] [130] [131] [132] Should there be any secondary effects across the study area as a whole on housing availability and housing quality, then Ealing would be at the greatest risk, as it has the highest incidence of overcrowding, highest number of pensioners living in poverty and poorest general health across the Heathrow study area. Due to the scale of threat to housing tenure for LHR-ENR these health outcomes would be moderately adverse, of moderate intensity and long-term in duration, though would have a major adverse impact of low intensity upon older people and would be relevant to both the construction and operational phases.

HOUSING CONDITIONS ASSESSMENT: LHR-NWR

5.3.104 The potential demolition of 1072 residential properties for airport expansion and surface access would place occupants into uncertain housing conditions. Health outcomes such as increased respiratory disease, episodes of depression, limited social networks, income, poverty and worklessness, poor local transport and access to services, low educational attainment and drug and alcohol misuse are all associated with poor housing could all arise as a consequence of loss of residential properties.[95, 133, 134, 135, 136, 137] Should there be any secondary effects across the study area as a whole on housing availability and housing quality, then Ealing would be at the greatest risk, as it has the highest incidence of overcrowding, highest number of pensioners living in poverty and poorest general health across the Heathrow study area. Due to the scale of threat to housing within LHR-NWR these health outcomes would be moderately adverse, of major intensity and long-term in duration, though would have a major adverse impact of potentially moderate intensity upon older people and would be relevant to both the construction and operational phases.

SUMMARY OF PERSONAL CIRCUMSTANCES EFFECTS: LGW-2R

5.3.105 Effects of LGW-2R upon housing loss could potentially result in a detrimental impact upon childhood development, including loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home.

5.3.106 Loss of four pre-schools/nurseries would detrimental impact upon childhood development in terms of access to high quality learning opportunities and loss of friendships and secure relationships with carer adults. This could be compounded by the current low attainment of Good level of development at reception' within parts of the Gatwick Study area.

5.3.107 Opportunities for high quality outdoor play would be severely disrupted, potentially resulting in a lowering of physical activity among children, with a detrimental impact upon mental and physical development, increasing risk of obesity and type 2 diabetes.

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[128] Evans, G. W. 2003 *The built environment and mental health*. Journal of Urban Health 80, pp. 536-555.
[129] Ineichen, B. 1993 *Homes and Health: How Housing and Health Interact* E & FN Spon , London
[130] Marsh, A., Gordon, D., Heslop, P. and Pantazis, C. 2000 *Housing deprivation and health: a longitudinal analysis. Housing Studies* 15, pp. 411-428.
[131] Shaw, M. 2004 *Housing and Public Health*. Annual Review of Public Health 25, pp. 397-418.
[132] Taske, N; Taylor, L; Mulvihill, C and Doyle, N. 2005 '*Housing and public health: a review of reviews of interventions for improving health*'. Evidence Briefing NICE.
[133] Evans, G. W. (2003) *The built environment and mental health*. Journal of Urban Health 80, pp. 536-555.
[134] Ineichen, B. (1993) *Homes and Health: How Housing and Health Interact* E & FN Spon , London
[135] Marsh, A., Gordon, D., Heslop, P. and Pantazis, C. 2000 *Housing deprivation and health: a longitudinal analysis. Housing Studies* 15, pp. 411-428.
[136] Shaw, M. 2004 *Housing and Public Health*. Annual Review of Public Health 25, pp. 397-418.
[137] Taske, N; Taylor, L; Mulvihill, C and Doyle, N. 2005 *'Housing and public health: a review of reviews of interventions for improving health*'. Evidence Briefing NICE.

5.3.108 Gains in employment status have been predicted as a consequence of LGW-2R, including beneficial health outcomes such as improved mental health, a reduction in episodes of depression and reduction in risk of coronary heart disease in for those directly and indirectly involved in new or improved employment. Although these beneficial health outcomes would be moderate, they could have a disproportionately beneficial impact in Crawley, as it has the highest unemployment within the Gatwick Study area.

5.3.109 Risk to the employment status of those residents at threat of relocation and work premises facing closure could have a detrimental impact upon health, due to risk that relocation has upon to secure employment. This could include such health outcomes as effect on mental health, an increase in episodes of depression and risk of coronary heart disease. The potential health outcome upon employment status arising from housing and workplace loss would be moderate in scale within the Gatwick study area.

5.3.110 Improvements to income levels and security of income as a consequence of LGW-2R have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These health outcomes would be minor beneficial, though are likely to be moderately beneficial in Crawley, as it has the highest unemployment within the Gatwick study area.

5.3.111 It is anticipated that loss of community facilities may disproportionately impact some of the vulnerable groups, depending on the extent to which alternative accessible facilities can be provided.

5.3.112 The effect on health of LGW-2R from housing loss and displacement/lack of provision of community facilities was assessed as being potentially detrimental to the health of the local population through its impacts on wellbeing, anxiety, distress and annoyance during both the construction and operational phase.

EFFECTS: LHR-ENR

5.3.113 Effects of LHR-ENR upon housing loss could potentially result in a detrimental impact upon childhood development, including loss of safe and stable housing, as well as reduction in access to high-quality learning opportunities at home.

5.3.114 Loss of a primary school would detrimental impact upon childhood development in terms of access to high quality learning opportunities and loss of friendships and secure relationships with carer adults. This could be compounded by the current low attainment of Good level of development at reception' within parts of the Heathrow study area.

5.3.115 Loss of access to leisure opportunities and high quality outdoor play could be severely disruptive to childhood development, potentially resulting in a lowering of physical activity among children, with a detrimental impact upon mental and physical development, increasing risk of obesity and type 2 diabetes.

5.3.116 Gains in employment status have been predicted as a consequence of LHR-ENR, including beneficial health outcomes such as improved mental health, a reduction in episodes of depression and reduction in risk of coronary heart disease in for those directly and indirectly involved in new or improved employment. Although these beneficial health outcomes would be moderate, they could have a disproportionately beneficial impact in Hounslow and Slough, as they have the highest unemployment within the Heathrow study area.

5.3.117 Risk to the employment status of those residents at threat of relocation and work premises facing closure could have a detrimental impact upon health, due to risk that relocation has upon to secure employment. This could include such health outcomes as effect on mental health, an

increase in episodes of depression and risk of coronary heart disease. The potential health outcome upon employment status arising from housing and workplace loss would be moderate adverse scale within the Heathrow study area.

5.3.118 Improvements to income levels and security of income as a consequence of LHR-ENR have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These health outcomes would be minor beneficial, though are likely to be moderately beneficial in Hounslow and Slough, as they has the highest unemployment within the Heathrow study area.

5.3.119 It is anticipated that loss of community facilities may disproportionately impact some of the vulnerable groups, depending on the extent to which alternative accessible facilities can be provided.

5.3.120 The effect on health of LHR-ENR from housing loss and displacement/lack of provision of community facilities was assessed as being potentially adverse to the health of the local population through its impacts on wellbeing, anxiety, distress and annoyance during both the construction and operational phase.

EFFECTS: LHR-NWR

5.3.121 Effects of LHR-NWR upon housing loss could potentially result in a detrimental impact upon childhood development, including loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home.

5.3.122 Loss of Harmondsworth primary school would have a detrimental impact upon childhood development in terms of access to high quality learning opportunities and loss of friendships and secure relationships with carer adults. This could be compounded by the current low attainment of a good level of 'development at reception' within parts of the Heathrow study area.

5.3.123 Loss of access to leisure opportunities and high quality outdoor play could be severely disruptive to childhood development, potentially resulting in a lowering of physical activity among children, with a detrimental impact upon mental and physical development, increasing risk of obesity and type 2 diabetes.

5.3.124 Gains in employment status have been predicted as a consequence of LHR-NWR, including beneficial health outcomes such as improved mental health, a reduction in episodes of depression and reduction in risk of coronary heart disease in for those directly and indirectly involved in new or improved employment. Though, these beneficial health outcomes would be moderate, they could have a disproportionately beneficial impact in Hounslow and Slough, as they have the highest unemployment within the Heathrow study area.

5.3.125 Risk to the employment status of those residents at threat of relocation and work premises facing closure could have a detrimental impact upon health, due to risk that relocation has upon to secure employment. This could include such health outcomes as effect on mental health, an increase in episodes of depression and risk of coronary heart disease. The potential health outcome upon employment status arising from housing and workplace closure and potential relocation would be moderate adverse scale within the Heathrow study area.

5.3.126 Improvements to income levels and security of income as a consequence of LHR-NWR have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty both episodes of depression and risk of coronary heart disease in for those directly and indirectly involved. These health outcomes would be minor beneficial, though are likely to be moderately beneficial in Hounslow and Slough, as they has the highest unemployment within the Heathrow study area.

5.3.127 It is anticipated that loss of community facilities may disproportionately impact some of the vulnerable groups, depending on the extent to which alternative accessible facilities can be provided.

5.3.128 The effect on health of LHR-NWR from housing loss and displacement/lack of provision of community facilities was assessed as being potentially adverse to the health of the local population through its impacts on wellbeing, anxiety, distress and annoyance during both the construction and operational phase.

5.4 ACCESS TO SERVICES, FACILITIES AND AMENITIES

ACCESS TO GREENSPACE/BLUESPACE: EVIDENCE

5.4.1 Green and open space has been suggested to improve physical and mental health and wellbeing by increasing physical activity, reducing air pollution, noise, and ambient temperature, increasing social contacts and relieving psychophysiological stress[138].

5.4.2 Greenspace is a valuable resource for physical activity and has the potential to contribute to reducing obesity and improving health[139]. Greenspace has been observed to have a stronger positive relationship with lower socioeconomic groups, older people and children and young people.[140] Findings have identified that women in lower greenspace areas showing higher levels of stress.[141]

5.4.3 A literature review of peer reviewed papers undertaken by the Forestry Commission[142] found evidence that proximity, size and amount of greenspace available to people in urban environments influences physical and mental health outcomes. Beneficial effects of greenspace included 'providing a space that promotes social interaction and inclusion, reducing social annoyances and crime' and 'reducing stress and restoring cognitive function and capacity to function with the demands of life'. Furthermore, greenspace Scotland[143] found a positive relationship between greenspace and general health, identifying that 'the attractiveness or quality of greenspace is an important determination of greenspace use'. The accessibility of greenspace will also affect its use and determinants such as age, gender, ethnicity, socioeconomic status and the perception of safety are important.[144,145]

5.4.4 Other studies have identified that individuals living closer to urban greenspace have lower mental distress and higher wellbeing[146] and self-reported mental health of people in densely urbanised areas has been report to be poorer than those living near nature or greenspaces[147]. Studies have

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[138] Dadvand, P. et al., 2012. *Greenspace, health inequality and pregnancy*. Environment International, 40, 110-115.
[139] Lachowycz, K. and Jones, A. P., 2011. *Greenspace and obesity: a systematic review of the evidence*. Obesity Reviews, 12, 183-9.
[140] Mass, J. et al., 2006. *Greenspace, urbanity, and health: how strong is the relation?* Journal of Epidemiology & Community Health, 60, 587-592.
[141] Roe, J.J., et al., 2013. *Greenspace and Stress: Evidence from Cortisol Measures in Deprived Urban Communities*. International Journal of Environmental Research and Public Health, *10*, 4086-4103.
[142] O'Brien, L., Williams, K., Stewart, A., 2010. *Urban health and health inequalities and the role of urban forestry in Britain: A review*, The Research Agency of the Forest Commission.
[143] Croucher, K., et al., 2007, *The links between Green space and health: a critical literature review*. Green space Scotland
[144] Lachowycz, K. and Jones, A. P., 2011. *Greenspace and obesity: a systematic review of the evidence*. Obesity Reviews, 12, 183-9.
[145] Lee, A. C. K. and Maheswaran, R., 2013. *The Health Benefits of Urban Green Spaces: A Review of the Evidence*. Journal of Public Health, 33, 212-222.
[146] White, M.P. et al., 2013. *Would You Be Happier Living in a Greener Urban Area? A Fixed-Effects Analysis of Panel Data*. Psychological Science, 24, doi: 10.1177/0956797612464659.
[147] De Vries, S., et al., 2003 *Natural environments–healthy environments? An exploratory analysis of the relationship between greenspace and health*. Environment and Planning A, 35, 1717–1731.

found that the presence of greenery in a neighbourhood has a positive relationship with resident's wellbeing, and social safety.[148,149] Restricted access to natural areas may well be associated with poor psychological wellbeing.[150]

5.4.5 Access to green and open space has been suggested encompassed the idea of walkability, which includes perceptions of social cohesion and felt integration/inclusion by individuals in their communities.[24] This social cohesion is a key cultural component of areas and neighbourhoods that has the potential to reinforce existing health inequalities through differentiated greenspace access[Error! Bookmark not defined.]. Mitchell and Popham (2008)[151] found that populations exposed to the reenest environments also have lowest levels of income-related inequality in health. Health inequalities related to income deprivation in all-cause mortality and mortality from circulatory diseases were lower in populations living in the greenest areas. Possible mechanisms include physical activity, stress buffering and the direct relationship between contact with nature and reduced blood pressure.

5.4.6 Many studies carried out observing the relationship between greenspace and human wellbeing considered water as an element of greenspace[152]. Bluespaces in urban and natural contexts can reduce stress and enhance mood[153]. Bluespace may also provide the basis for recreational activities[152]. The direct health benefits of blue space have mainly been recognised by researchers within the concept of therapeutic landscapes, with views of water being potentially beneficial for health.[152,154]

5.4.7 Access to greenspace has been linked to reducing adverse mental health symptoms and improving wellbeing of local populations. Individuals exposed to less green areas displayed significantly worse mental health in the preceding years.[155] Where a shortlisted scheme is likely to contribute to the further urbanisation of the area, this could have an impact of reducing wellbeing, which has been shown to be a particularly stronger response in lower socioeconomic groups, older people, children and young people[156] and women, where higher levels of stress have been displayed in areas with less accessible greenspace.[152]

ACCESS TO GREENSPACE/BLUESPACE BASELINE: GATWICK

[148] Kaplan, R, 2001. *The Nature of the View from Home Psychological Benefits*. Environment and Behaviour, 33, 507-542.
[149] Kuo, F. and Sullivan, W., 2001. *Environment and Crime in the Inner City Does Vegetation Reduce Crime?* Environment and Behaviour, 33, 343-367.
[150] Wells, N. and Evans, G., 2003. *Nearby Nature A Buffer of Life Stress Among Rural Children. Environment and Behaviour*, 35, 3, 311-330.
[151] Mitchell R and Popham F, 2008. *Effect of exposure to natural environment on health inequalities: an observational population study*. The Lancet: 372:9650; 1655 – 1660.
[152] Volker, S. and Kistemann, T., 2014. *The impact of blue space on human and well-being – Salutogenetic health effect of inland surface water: A review. International Journal of Hygiene and Environmental Health*, 214, 449-460.
[153] Karmanov, D.,Hamel, R., 2008. *Assessing the restorative potential of contemporary urban environment(s): beyond the nature versus urban dichotomy*. Landscape Urban Plan. 86, 115–125.
[154] Burmil, S., Daniel, T.C., Hetherington, J.D., 1999. *Human values and perceptions of water in arid landscapes.* Landscape Urban Plan, 4, 99–109.
[155] Alcock,I. et al., 2014. *Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas*. Environmental Science & Technology, 48,1247–1255.
[156] Mass, J. et al., 2006. *Greenspace, urbanity, and health: how strong is the relation?* Journal of Epidemiology & Community Health, 60, 587-592.

5.4.8 Much of the surrounding land around Gatwick Airport is in mixed agricultural use, and includes several areas of recreational value, which are likely to contribute to human health. Within the footprint of Gatwick airport and the 250m area around it, 44% of the land is under agriculture and forestry use, primarily to the north of the airport. Woodlands are abundant and provide a sense of enclosure. The most significant hydrological feature locally is the River Mole. There are several smaller streams within and in close proximity to the airport boundary, many of which are demarcated by narrow bands of vegetation.

5.4.9 Many of the greenspaces in the Crawley borough, the borough Gatwick is situated within, are designated of conservation importance or used for recreation. Within the footprint of Gatwick Airport and the 250m area around it, 0.6% (7ha) of land is used for recreation and leisure use mainly to the south and the northeast.

5.4.10 The majority of land to the north west of Gatwick in Mole Valley District and north east of Gatwick in Reigate and Banstead District are within the Metropolitan Green Belt. The land further west is an Area of Outstanding Natural Beauty (AONB).

5.4.11 Within 15 km of the LGW-2R footprint there are a number of designated site. This includes three European sites of importance for biodiversity and 35 Sites of Special Scientific Interests (SSSI), as well as four LNRs and 46 SNCIs within 5km. Three of the SNCIs and a significant amount of ancient semi-natural woodland falls within the shortlisted scheme footprint.

ACCESS TO GREENSPACE/BLUESPACE BASELINE: HEATHROW

5.4.12 Heathrow sits within an area of predominantly urban/industrial nature. Within the footprint of the Heathrow Airport and the 250m area around it a large proportion (32%) of the land is under agriculture and forestry use, primarily to north and west of the airport. There are a number of areas and routes of recreational value and statutory Green Belt within 5 km of the airport which are likely to contribute to human health. The nearby River Thames corridor and the Colne Valley Regional Park are a focus for recreational space and tranquillity. The significant waterbodies of the area comprises the River Colne and River Crane and the Spelthorne Borough is on the south western edge of Heathrow contains three large reservoirs.

5.4.13 Large areas of the Hillingdon Borough, which contains Heathrow Airport, are within the Metropolitan Green Belt. Within the footprint of Heathrow Airport and the 250m area around it, 0.3% (4ha) of land is used for recreation and leisure.

5.4.14 There are eight European sites of importance for biodiversity and more than 30 SSSIs within 15km of the Heathrow Airport. There are a number of LNRs within 5km.

ACCESS TO GREENSPACE/BLUESPACE ASSESSMENT: LGW-2R

5.4.15 The resultant further urbanisation as part of LGW-2R is likely to lead to a reduction in accessible greenspace (as discussed in paragraphs 5.4.1- 5.4.6) henceforth a reduction in wellbeing, particularly amongst some vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, and people who are economically inactive/unemployed. Aspects of this urbanisation is not expected to be significantly visible from a number of greenspaces, including AONBs and some recreational sites, due to the intervening distance and current screening by existing built up areas. This could help to maintain the visual amenity and recreational value of these sites.

5.4.16 Furthermore, it is anticipated that there will be involuntary relocation of 168 residential dwellings and a further 37 dwellings depending on surface access. If the residents relocate to an area with reduced green and blue space, these people could be at risk of increased mental distress and

lower wellbeing.[157,158] The potential health outcome of mental distress from loss or removal of greenspace and bluespace has been assessed as being minor adverse, of high intensity and long-term in duration in terms with respect to LGW-2R.

5.4.17 The use of large areas of previously undeveloped land will affect land resources meaning these areas will no longer be suitable for other uses. The recreational value of some sites would be affected, such as Ancient Woodland which would need to be removed. The loss of these sites could result in the loss of potentially vital resource for promoting healthy living for people in urban areas, offering both opportunities for physical activity and wellbeing. There will also be a loss of a number of habitats including woodland, hedgerow, rivers and brooks. The recreational value of some sites would therefore be affected.Error! Bookmark not defined. Furthermore, the loss of access to hese natural habitats can reduce social exchanges and interactions. The potential health outcome of loss of sites has been assessed as being minor adverse of high intensity and long-term in duration, and would potentially occur during both the construction and operational phases, principally impacting upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active/unemployed.

ACCESS TO GREENSPACE/BLUESPACE ASSESSMENT: HEATHROW

5.4.18 The resultant further urbanisation as part of both LHR-ENR and LHR-NWR are likely to lead to a reduction in accessible greenspace and (as discussed in paragraphs 5.4.1 -5.4.6) henceforth a reduction in wellbeing, particularly amongst some vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active/unemployed. The impact may be significant, as the local authorities within the Heathrow study area have higher percentages of young and older people than the UK average.

5.4.19 LHR-ENR has been predicted to result in the compulsory purchase of nearly 242 homes for expansion and 165 homes for surface access, whereas LHR-NWR has been predicted to result in the compulsory purchase of nearly 783 homes for expansion and 289 homes for surface access. In either case, should residents relocate to an area with reduced green and blue space, these people could be at risk of increased mental distress and lower wellbeing. Involuntary relocation and loss of community facilities, such as the loss of Sipson recreation ground and facilities and other formal and informal recreation sites, have the potential to disrupt social support and networks. The potential health outcome of loss/removal from greenspace/bluespace has been assessed as minor adverse of high intensity and long-term in duration in terms of mental distress and higher wellbeing and would potentially occur during both the construction and operational phases. Those impacts would be principally vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active/unemployed.

ACCESS TO GREENSPACE/BLUESPACE ASSESSMENT: LHR-ENR

5.4.20 Land take as part of the LHR-ENR expansion would reduce greenspace such as woodland and lowland meadows. The diversion of several rivers and streams and the incorporation significant culverts would also impact on bluespace. The recreational value of some sites would therefore be affected. Views from and to greenspace could be impacted particularly from the construction

[157] White, M.P. et al., 2013. *Would You Be Happier Living in a Greener Urban Area? A Fixed-Effects Analysis of Panel Data.* Psychological Science, 24, doi: 10.1177/0956797612464659.

[158] De Vries, S., et al., 2003 *Natural environments.–.healthy environments? An exploratory analysis of the relationship between greenspace and health*. Environment and Planning A, 35, 1717–1731.

works affecting their visual amenity and recreational value. Furthermore, a section of the Colne Valley Regional Park will be removed. This site is a focus for recreational space and tranquillity and its loss could have adverse physical and mental health impact through reduced active and social contact, and increased pollution. There may be further loss of green and blue space cause by the expected increased demand for an additional 400 homes per year[159]. Therefore the potential health outcome of loss of sites with respect to LHR-ENR has been assessed as minor adverse of high intensity and long-term in duration and would potentially occur during both the construction and operational phases. . Those likely to be disproportionately impacted would include vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active/unemployed.

ACCESS TO GREENSPACE/BLUESPACE ASSESSMENT: LHR-NWR

5.4.21 Land take would reduce greenspace such as woodland and lowland meadows. The diversion of several rivers and streams and the incorporation significant culverts would impact on bluespace. The recreational value of some sites would therefore be affected. Furthermore, the loss of access to these sites can reduce social exchanges and interactions. Views from and too greenspace could be impacted affecting their visual amenity and recreational value. Some potential visibility of LHR-NWR would be constrained by existing built form to the north, east and south, and by vegetation and reservoir embankments to the west. Furthermore, part of the Colne Valley Regional Park will be removed. This site is a focus for recreational space and tranquillity and its loss could have adverse physical and mental health impact through reduced active and increased pollutions. The loss of access to these sites can also reduce social contact and cohesion. The potential health outcome of loss of sites has been assessed as being minor adverse, of high intensity and of long term in duration. Those likely to be disproportionately impacted include upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active/unemployed.

ACCESS TO LEISURE AND RECREATION SERVICES AND FACILITIES: EVIDENCE

5.4.22 The health benefits of local leisure facilities can go beyond those gained from physical exercise (as assessed under the Exercise and Physical Activity determinant) and extend to social contact, providing a safe and supervised facility for young children.[160]

5.4.23 In addition to accessibility to greenspace (as assessed under the Access to greenspace or bluespace determinant), evidence suggests that access to leisure facilities can determine levels of physical activity and reduce the risks of obesity[161].

5.4.24 A review of literature has shown that leisure can contribute to physical, social, emotional and cognitive health through prevention, coping (adjustment, remediation, diversion), and transcendence.[162]

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[159] Airports Commission, 2015. *Final Report*. [online] Accessed 30/03/2016.
[160] Thomson H, Kearns A, Petticrew M. Assessing the health impact of local amenities; a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow. J Epidemiol Community Health. 2003: 57(9): 663-667.
[161] Greenspace Scotland, 2009, *Health Impact Assessment of greenspace* - A Guide.
[162] Caldwell, L.L., 2005, *Leisure and health: Why is leisure therapeutic?*

5.4.25 According to the 2008 Place Survey, 44% of adults in England reported access to health services as one of the key contributors to how good somewhere was to live[163].

5.4.26 According to the DfT, 'over the course of a year over 1.4 million people miss, turn down or simply choose not to seek healthcare because of transport problems'[164]. Capacity to reach healthcare services is affected by the accessibility of transport modes, availability of financial support for those on low incomes and the location of healthcare services[165]. Groups impacted by disability and of certain ages may experience even greater barriers to health and social care services.[166]

5.4.27 According to the Department of Health, some ethnic minority groups experience poorer health than others (health inequalities) and also experience poorer access to services and poorer quality of services (inequalities in access)[167].

ACCESS TO LEISURE AND RECREATION SERVICES AND FACILITIES BASELINE: GATWICK

5.4.28 There are a range of formal and informal, public and privately owned sports and fitness facilities available within a 15km radius of Gatwick airport, catering to the local population. These 227 facilities include recreational fields, sport-specific clubs (including football, tennis, bowling, and cricket), leisure centres and gyms[168].

5.4.29 Recreation facilities are generally well spread across the study area, with concentrations found in the areas of Crawley and Horsham.

5.4.30 There are 49 GP practices within a 15km radius of Gatwick airport, with a greater number found in the more populous Crawley and Horsham areas[169].

ACCESS TO LEISURE AND RECREATION SERVICES AND FACILITIES BASELINE: HEATHROW

5.4.31 There are a range of formal and informal, public and privately owned sports and fitness facilities with a 15km radius of Heathrow airport, catering to the local population. These 671 Sports facilities include playing fields, leisure centres, sports clubs (including tennis, football, bowls, and hockey), golf clubs, gyms and recreational fields.

5.4.32 Recreational facilities are generally evenly spread across the study area.

5.4.33 There are 343 GP practices with a 15km radius of Heathrow airport, with a greater number found in the more populous areas to the east of the study area.

ACCESS TO LEISURE AND RECREATION SERVICES AND FACILITIES ASSESSMENT: LGW-2R

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[163] Department for Communities and Local Government, 2008, *Place survey*, UK Government.
[164] Social Exclusion Unit, 2003, *Making the Connections: Final Report on Transport and Social Exclusion.*
[165] Randall, C., 2012, *Measuring National Well-being - Where we Live* – 2012, Office for National Statistics.
[166] Hamer, L., 2004, *Improving patient access to health services: a national review and case studies of current approaches*, Health Development Agency.
[167] King's Fund, 2006. *Briefing: Access to health care and minority ethnic groups*. (http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/access-to-health-care-minority-ethnic-groups-briefing-kings-fund-february-2006.pdf)
[168] NHS Choices, 2015. *Sports and Fitness Metadata*
[169] NHS Choices, 2015. *GP Practice Metadata*

5.4.34 LGW-2R will lead to the loss of Crawley Rugby Club, along with its sporting and social facilities. Additionally, the northern part of Rowley Wood and other formal and informal recreation sites, public rights of way, and cycle routes in the study area will be lost. This will have a moderately adverse health outcome on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children and young people of high intensity and medium term in duration.

5.4.35 The AC's assessment suggests that provision of additional housing will need to be supported by the provision of two additional GPs per local authority up to 2030. If additional healthcare services are provided, there may be benefits for the local community in terms of reduced waiting times at GP surgeries.

5.4.36 It is predicted that loss of leisure and recreational services and facilities will have a minor adverse health outcome on the general population, of low intensity and medium term in scale during both construction and operation, though a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users.

5.4.37 Effects are likely to reduce in significance by re-provision of facilities and provision of additional facilities to support additional housing.

ACCESS TO LEISURE AND RECREATION SERVICES AND FACILITIES ASSESSMENT: LHR-ENR

5.4.38 LHR-ENR will lead to the loss of Punch Bowl pub during the construction phase. Additionally the shortlisted scheme will cause the loss of part of the Colne Valley regional park, as well as other formal and informal recreation sites.

5.4.39 The project will involve a loss of recreational facilities that cannot be reversed, however the facilities affected should only be significant in a local context, and the effects restricted to the local vicinity of the airport.

5.4.40 Provision of additional housing is likely to require support by the provision of two additional health centres (14 GPs) and two primary care centres per local authority to 2030. If additional healthcare services are provided, there may be benefits for the local community in terms of reduced waiting times at GP surgeries.

5.4.41 It is predicted that loss of leisure and recreational services and facilities will have a minor adverse health outcome on the general population, of low intensity and medium term in scale during both construction and operation, though a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users.

5.4.42 Effects on the general population will occur both during construction and operation. However, effects are estimated to be reduced in significance over time by re-provision facilities, and provision of additional facilities to support additional housing.

ACCESS TO LEISURE AND RECREATION SERVICES AND FACILITIES ASSESSMENT: LHR-NWR

5.4.43 LHR-NWR will result in the loss of Harmondworth Community Hall, Sipson Community Centre, the White Horse pub at Longford, Sipson recreation ground and facilities, other formal and informal recreation sites, and part of the Colne Valley Regional Park.

5.4.44 The project will involve a loss of recreational facilities that cannot be reversed, however the facilities affected should only be significant in a local context, and the effects restricted to the local

vicinity of the airport.

5.4.45 Provision of additional housing is likely to require support by the provision of two additional health centres and two primary care centres per local authority to 2030. If additional healthcare services are provided, there may be benefits for the local community in terms of reduced waiting times at GP surgeries.

5.4.46 It is predicted that loss of leisure and recreational services and facilities will have a minor adverse health outcome on the general population, of low intensity and medium term in scale during both construction and operation, though a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users.

5.4.47 Effects on the general population will occur both during construction and operation. However, effects are estimated to be reduced in significance over time by re-provision facilities, and provision of additional facilities to support additional housing.

5.5 SOCIAL FACTORS

PARTICIPATION IN THE COMMUNITY, SOCIAL INCLUSION/EXCLUSION, SOCIAL CONTACT/SUPPORT: EVIDENCE

5.5.1 Transportation access promotes social inclusion. Social exclusion can occur as a result of a community not being able to easily access transport options.

5.5.2 A long term regeneration study looking at community and neighbourhood outcomes over time[170] [171] reported on four indicators of social cohesion: informal social control, perceptions of honesty, feelings of safety and the extent to which people feel part of their community. Residents reported that previous high levels of support and contact with friends and family were sustained after regeneration. Though wider community cohesion findings were less positive, as loss of elements of social cohesion were reported post-regeneration. Contrary to this was evidence that within the areas of regeneration residents felt safer and part of the community.

5.5.3 Outcomes were observed as less positive for residents of areas periphery to regeneration areas, (as these residents needs may not have been as targeted[123]), as those within the regeneration area itself. However most of the residents within the periphery area felt that their neighbourhoods were improving, particularly in relation to their perception of the local environment, local shops, resident empowerment, as well as reduced levels of antisocial behaviour[124].

5.5.4 Given the scale of the effect on mortality of high social integration, which is of similar magnitude to stopping smoking.[172]

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[170] Bond, L., Kearns, A., Tannahill, C., Egan, M. and Mason, P. 2013a. *Community outcomes over time: A comparison across the 2006, 2008 and 2011* GoWell community surveys.

[171] Bond, L., Kearns, A., Tannahill, C., Egan, M. and Mason, P. 2013b. *Neighbourhood outcomes over time: A comparison across the 2006, 2008 and 2011* GoWell community surveys. Glasgow: Go Well.

[172] Holt-Lunstad J, Smith TB, Layton JB. *Social relationships and mortality risk: a meta-analytic review*. PLoS Med. 2010;7(7):e1000316. doi: 10.1371/journal.pmed.1000316.

5.5.5 The Social Exclusion Unit states that 'participation in social, cultural and leisure activities is very important to people's quality of life and can play a major part in meeting policy goals like improving health, reducing crime and building cohesive communities'. Problems with transport and the location and delivery of services contribute to social exclusion by preventing people from participating in work or learning and from accessing healthcare, food shopping and other local activities. People in deprived communities also suffer the worst effects of road traffic through pollution and pedestrian accidents.[173]

5.5.6 A report by the Cabinet Office, 'Wellbeing and Civil Society' stated that "Volunteering is vital to charities and civil society, helps to strengthen local communities, and improves the wellbeing of individuals who participate.[174]

PARTICIPATION IN THE COMMUNITY, SOCIAL INCLUSION/EXCLUSION, SOCIAL CONTACT/SUPPORT BASELINE: GATWICK

5.5.7 Strength of participation in the community baseline has been assembled from data available within the last national 'Place Survey' (2008) consultation survey conducted.

5.5.8 Some of the population in the Gatwick study area responded more positively than the England average (58.7%) when asked what strength of belonging to immediate neighbourhood, with those living in Mole Valley District Council reported feeling the most belonging (66.2%), though those living in Reigate and Bansted District (54.9%) and Crawley (53.5%) having lower than the England average feeling of belonging.

5.5.9 Results indicated that residents of Crawley had the lowest rates of volunteering, at 21.4% (England average 58.7%), lowest confidence in local public services, at 68.5% (England average 74.6%), lowest influence of decisions affecting their local area, at 26.2% (England average 28.9%) and lowest conviction that Crawley is a place where people from different backgrounds get on well together at 73.1% (76.4%). Crawley has the highest proportion of pensioners living alone (33.2%),

5.5.10 When asked whether they felt their local public services treated all types of people fairly, residents in all areas apart from Crawley (68.5%) responded more positively than the English average (70.8%), with respondents in Horsham District Council responding the most positively (78.9%).

5.5.11 When asked whether they felt older people in their area were able to get services and support to live in their own homes for as long as they wanted, only Horsham (30.4%) and Mid Sussex (30.6%) were above the national average (30.0%). All other areas in the Gatwick study area reported below the national average, with Reigate and Banstead (27.1%) reporting the lowest.

5.5.12 The highest levels of statutory homelessness within the Gatwick study area were within Horsham (0.43%) and Crawley (0.35%) with levels higher than the English average (0.23%). Epsom and Ewell (0.02%) and Tandridge (0.02%) both have the lowest levels of statutory homelessness in the study area.

PARTICIPATION IN THE COMMUNITY, SOCIAL INCLUSION/EXCLUSION,

[173] Social Exclusion Unit, 2003. *Making the connections: Final report of Transport and Social Exclusion*. (http://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_policy/@invest/documents/publication/wcms_asist_8210.pdf)

[174] Fujiwara, D. et al. *Wellbeing and civil society Estimating the value of volunteering using subjective wellbeing data*. Cabinet Office. 2013

SOCIAL CONTACT/SUPPORT BASELINE: HEATHROW

5.5.13 Strength of participation in the community baseline has been assembled from data available within the last national 'Place Survey' (2008) consultation survey conducted.

5.5.14 Some of the population in the Heathrow Study Area responded more positively than the England average (58.7%) when asked what strength of belonging to immediate neighbourhood, with those living in London Borough of Richmond upon Thames reported feeling the most belonging (64.1%), though those living in Slough (47.4%) having lower than the England average feeling of belonging.

5.5.15 When asked about volunteering in the past year (unpaid help to any group, club or organisation), most residents in the Heathrow study area reported lower than the national average (23.2%). Results indicated that residents of Wandsworth had the lowest rates of volunteering, at 15.4% (England average 58.7%), Ealing (66.1%), Hillingdon (67.8%) and Slough (63.3%) all reported lower confidence in local public services than the England average (74.6%), Spelthorne had the lowest influence of decisions affecting their local area, at 22.1% (England average 28.9%). Hounslow (73.2%) and Hillingdon (73.2%) had the lowest conviction that their area was where people from different backgrounds get on well together. Wandsworth has the highest proportion of pensioners living on their own (38.6%).

5.5.16 When asked whether they felt their local public services treated all types of people fairly, residents in Ealing (66.1%), Hillingdon (67.8%) and Slough (63.3%) all reported lower than the English average (70.8%). In contrast, Runnymede (77.1%) reported the most positively in the Heathrow study area.

5.5.17 When asked whether they felt older people in their area were able to get services and support to live in their own homes for as long as they wanted, none of the areas within the Heathrow study area reported equal to or above the national average response (30.0%). The lowest response came from Richmond upon Thames (20.2%) and the highest from Hillingdon (27.3%).

5.5.18 When asked whether they felt they could influence decisions affecting their local area, residents in Spelthorne reported the lowest in the Heathrow study area (22.1%), as well as residents of Windsor and Maidenhead (28.7%), Runnymede (26.8%) and South Bucks (26.5%) who were also below the English average (28.9%). Ealing (38.4%) reported the highest feeling of influence in the Heathrow study area.

5.5.19 In the Heathrow study area, Hounslow (0.48%), Wandsworth (0.47%) and Ealing (0.34%) all have higher than national average (0.23%) levels of statutory homelessness. Spelthorne has the lowest level of statutory homelessness in the Heathrow study area (0.02%). Wandsworth has the highest proportion of pensioners living on their own (38.6%), with South Bucks having the lowest proportion (28.6%).

PARTICIPATION IN THE COMMUNITY, SOCIAL INCLUSION/EXCLUSION, SOCIAL CONTACT/SUPPORT ASSESSMENT: LGW-2R

5.5.20 An additional runway at Gatwick would result in a likely 168 residential properties being demolished and up to 37 additional residential properties demolished for surface access. Loss of housing and community facilities has the potential to disrupt social support and networks, as well as cause potential social isolation.

5.5.21 Access to transport promotes social inclusion, however, social exclusion can occur as a result of a community not being able to easily access transport options. This is caused by preventing people from participating in work or learning and from accessing healthcare, food shopping and other local activities. Additionally, the relocation of residents could increase the distance to work or recreational facilities, reduced leisure time available for health-promoting activities and social

interactions. The construction period would cause community severance reducing the quality of living in the area.

5.5.22 Following runway construction, there may be a loss of elements of social cohesion through parts of the community being geographically dispersed. However, as elsewhere, residents in areas of regeneration have reported feeling safer and part of the community post regeneration. Additionally, areas surrounding Gatwick are expected to have a high level of community support because of its more rural natural, and are more likely to sustain this after regeneration.

5.5.23 There will be the loss of a residential care home, nursery facilities, places of worship as well as greenspace and recreational sites. Evidence suggests that social contact, as well as improved physical and mental health, is promoted through access to community and recreational sites. Their loss is likely to reduce social contacts, which may have a moderate adverse impact on some vulnerable groups, including the different faith groups, older people, disabled people, those with other health problems and children; and for residents of areas periphery to regeneration areas. Furthermore, the disruption to local place and social activities could decrease the feeling of 'place', which could affect wellbeing and social integration.[175]

5.5.24 These changes are likely to have a minor adverse impact upon wellbeing and social integration, of moderate intensity and long-term in duration. There may be some moderately beneficial impacts of low intensity and permanent in duration from health improvements as a consequence of improved standard of living from new housing and improved social networks, and new community facilities.

PARTICIPATION IN THE COMMUNITY, SOCIAL INCLUSION/EXCLUSION, SOCIAL CONTACT/SUPPORT ASSESSMENT: LHR-ENR

5.5.25 The Heathrow shortlisted schemes are in a more densely populated area than the Gatwick area leading to more homes being affected. This shortlisted scheme will result in the compulsory purchase of nearly 242 homes for airport expansion and of 165 homes for surface access during the construction phase. Involuntary relocation and loss of community facilities have the potential to disrupt social support and networks which is likely to have a disruptive impact within these communities, as well as cause potential social isolation. Loss of the Punch Bowl public house, informally used as a community meeting facility, may reduce the social cohesion of local communities and the loss of community facilities could disproportionately affect older people, children and young people as well as the disabled. Potentially a secondary negative impact upon local communities and social inclusion could be the demand for an additional 400 homes per year to be constructed within the Heathrow study area as a consequence of LHR-ENR.

5.5.26 A positive impact associated with the loss of housing could arise, through the improvements in standard of living from new housing and improved social networks, new community facilities and public transport. There could also be positive impacts on social inclusion as new jobs associated with expansion could support increased employment in local areas, which would be particularly valuable in the areas surrounding Heathrow that suffer from higher levels of unemployment.

5.5.27 Transportation access promotes social inclusion, however, social exclusion can occur as a result a community not being able to easily access transport options. This is caused by preventing people from participating in work or learning and from accessing healthcare, food shopping and other local activities. Additionally, the relocation of residents could increase the distance to work or recreational facilities, reduced leisure time available for health-promoting activities and social interactions. The construction period may cause community severance reducing the quality of

[175] Madanipour, A., 1999. *Why Are the Design and Development of Public Spaces Significant for Cities*. Environment and Planning B: Planning and Design, 26, 879-891

living in the area.

5.5.28 Following runway construction, there may be loss of elements of social cohesion though wider community. However, residents in areas of regeneration have reported feeling safer and part of the community post regeneration.

5.5.29 There will be the loss of Greenspace and recreational sites, which promote social contact, and physical and mental health. This loss is likely to reduce social contacts, which may have a particularly adverse impact on a cross section of the population including older people those with other health problems and children; and for residents of areas periphery to regeneration areas. Furthermore, the disruption to local place and social activities could decrease the feeling of 'place', which could affect wellbeingand social integration.

5.5.30 Mixed minor beneficial/adverse impact on social integration of high intensity, and long-term in duration from loss/relocation of community facilities and relocation of some of the local population.

PARTICIPATION IN THE COMMUNITY, SOCIAL INCLUSION/EXCLUSION, SOCIAL CONTACT/SUPPORT ASSESSMENT: LHR-NWR

5.5.31 Housing loss is expected to be larger for the Heathrow shortlisted schemes, due to the more densely populated area and the more extensive surface access works required. This is expected to be higher for the LHR-NWR than for LHR-ENR. LHR-NWR will result in the compulsory purchase of nearly 783 homes for expansion and 289 homes for surface access resulting in a significant adverse impact on Quality of Life. Involuntary relocation and loss of community facilities have the potential to disrupt social support and networks which is likely to have an adverse impact within these communities. Involuntary relocation and loss of community facilities, such as the loss of Sipson Community Centre and other formal and informal recreation sites, have the potential to disrupt social support and networks.

5.5.32 There may be some beneficial impact associated with the loss of housing, result in some greater standard of living from new housing and improved social networks, new community facilities and public transport. There could also be beneficial impacts on social inclusion as new jobs associated with expansion could support increased employment in local areas, which would be particularly valuable in the Heathrow which its higher levels of unemployment. Therefore changes to community facilities once the airport is operations are likely to be beneficial on Quality of Life.

5.5.33 Transportation access promotes social inclusion, however, social exclusion can occur as a result a community not being able to easily access transport options. This is caused by preventing people from participating in work or learning and from accessing healthcare, food shopping and other local activities. Additionally, the relocation of residents could increase the distance to work or recreational facilities, reduced leisure time available for health-promoting activities and social interactions. The construction period would cause community severance reducing the quality of living in the area.

5.5.34 Following runway construction, there may be loss of elements of social cohesion though wider community. However, residents in areas of regeneration have reported feeling safer and part of the community post regeneration.

5.5.35 There will be the loss of greenspace and recreational sites, which promote social contact, and physical and mental health. This loss is likely to reduce social contacts, which may have a particularly adverse impact on a cross section of the population including the older people those with other health problems and children; and for residents of areas periphery to regeneration areas. Furthermore, the disruption to local place and social activities could decrease the feeling of 'place', which could affect wellbeing and social integration.

5.5.36 Mixed minor beneficial/adverse impact on social integration of high intensity, and long-term in duration from loss/relocation of community facilities and relocation of some of the local population.

COMMUNITY SEVERANCE: EVIDENCE

5.5.37 Community severance can occur as a consequence of a community being segregated by the barrier of traffic flow (speed or volume). This can also occur when new rail corridors or airport runways are built and which alter community interaction by placing a physical barrier within existing communities.

5.5.38 Following a literature review, the UCL Street Mobility and Network Accessibility research project proposed the following definition of community severance[176];

Transport-related community severance is the variable and cumulative negative impact of the presence of transport infrastructure or motorised traffic on the perceptions, behaviour, and wellbeing of people who use the surrounding areas or need to make trips along or crossing that infrastructure or traffic.

5.5.39 High volume traffic alone can act as a barrier with health consequences. People living on lightly trafficked roads have been shown to have three times more friends and twice as many acquaintances on their street compared with those living on similar streets with heavy motor traffic. This is important for health because low levels of social support are linked to increased death rates, social support is needed to promote health and protect people from negative stressors in their lives. The young, older people or disabled are at particular risk of suffering the negative consequences of community severance.[177]

5.5.40 Although community severance diminishes social contacts, the implications of community severance for morbidity and mortality have not been empirically established. Following a systematic literature review, it seems likely that the effects of community severance do indeed impact on health, with negative health consequences of reduced social contacts also occurring when this social disruption is due to road traffic.[178]

COMMUNITY SEVERANCE BASELINE: LGW-2R

5.5.41 There is no concise or conclusive baseline data available that adequately describes existing levels of community severance in the Gatwick study area. As community severance has been defined as:

"the reduction in the number of being taken journeys on foot due to their impact on the nature of

[176] Anciaes, PR, 2015. *What do we mean by "community severance"?* Street Mobility and Network Accessibility Series: Working Paper 04. (https://www.ucl.ac.uk/street-mobility/docs/ucl_streetmobility_paper04)
[177] Roads Task Force - Technical Note 20 What are the main health impacts of roads in London? TfL, 2012
[178] Jennifer S. Mindell, Saffron Karlsen. (2012) *Community Severance and Health: What do we actually know?* J Urban Health. 2012 April; 89(2): 232–246.

the journey itself and the local environment[179]"

5.5.42 Therefore the proxy baseline for Community Severance could be interpreted as the proportion of number of non-motorised journeys undertaken within the Study Area. By inference, the largely rural nature of the Gatwick Study Area would result in journeys by motorised transport would represent a high proportion of trips, thereby implying a relatively low community severance potential within the Gatwick Study Area.

COMMUNITY SEVERANCE BASELINE: HEATHROW

5.5.43 There is no concise or conclusive baseline data available that adequately describes existing levels of community severance in the Heathrow study area. As community severance has been defined as:

"the reduction in the number of being taken journeys on foot, due to their (negative) impact on the nature of the journey itself and the local environment"[180]

5.5.44 Therefore the proxy baseline for Community Severance could be interpreted as the proportion of number of non-motorised journeys undertaken within the Study Area. By inference, the partly urban/suburban nature of the Heathrow Study Area would result in journeys by motorised transport representing a lower proportion of trips, thereby implying a relatively high community severance potential within the Heathrow Study Area.

COMMUNITY SEVERANCE ASSESSMENT: LGW-2R

5.5.45 LGW-2R will cause additional traffic movements during construction and operation which may lead to severance, loss of sense of place, breakdown in community cohesion and reduction in the quality of amenity within the study area.

5.5.46 With the loss and relocation of housing and of some community facilities such as day-care and nurseries, Trent House Care Home, and the Outreach 3 Way facility, it is considered that the additional journey times may disproportionately affect mothers travelling to nurseries with their children, older people and their families, and could lead to disruption and additional journey times for those with disabilities. There are likely to be impact on local journey times, either from severance or increased traffic. This may also lead to severance impacts for disabled people, and potentially impact on mother's employment due to changes in care service access. The LGW-2R impacts upon community severance have been estimated as being minor adverse health outcomes of increased general risk to health associated with social isolation and moderate adverse health outcomes on children and young people, older people, people living in isolation, people living in area with poor health status, and those with a long-term condition. Both of the above would be of moderate intensity and long-term in duration.

COMMUNITY SEVERANCE ASSESSMENT: LHR-ENR

5.5.47 LHR-ENR will cause additional traffic movements which may lead to more traffic and increased journey times. This may also lead to issues of severance, loss of sense of place, breakdown in community cohesion, and a reduction in the quality of amenity within the community.

5.5.48 Young people, those with disabilities, mothers and older people could be particularly impacted by

[179] Jones L. *Putting transport on the social policy agenda*. In: May M, Brunsdon E, Craig G, editors. Social Policy Review 8.London: Social Policy Association; 1996: 247-264.
[180] Jones L. *Putting transport on the social policy agenda*. In: May M, Brunsdon E, Craig G, editors. Social Policy Review 8.London: Social Policy Association; 1996: 247-264.

the loss of community facilities. For example, the Punch Bowl Pub, which is informally used as a community meeting facility by these groups, would be lost which may cause disproportionate effects upon this group as they may have to travel further to find similar facilities.

5.5.49 This shortlisted scheme will also cause severance of a section of the Colne Valley Way running from Colnbrooke to Horton, severance of Pyle Rd, which currently Poyle and Colnbrooke with Wraysbury and Horton, and severance of route to Pyle from the west along Bath Road.

5.5.50 The LHR-ENR impacts upon community severance have been estimated as being minor adverse health outcomes of increased general risk to health associated with social isolation and moderate adverse health outcomes on children and young people, older people, people living in isolation, people living in areas with poor health status, and those with a long-term condition. Both of the above would be of moderate intensity and long-term in duration.

COMMUNITY SEVERANCE ASSESSMENT: LHR-NWR

5.5.51 LHR-NWR will see the relocation of a range of community facilities (including housing, a primary school, three nursery schools (in Harmondsworth, Longford and Sipson)) which is likely lead to significant disruption, and cause difficulties for parents finding appropriate child-care, potentially impacting on the mother's employment, and/or additional journey times to relocated/new nurseries. The relocation of the Heathrow Special Needs Centre in Longford, could lead to disruption and additional journey times for those with disabilities, as well as severance impacts.

5.5.52 There are likely to be impacts on local journey times and severance, particularly from A4/M25/Southern Rail Access works.

5.5.53 The LHR-NWR impacts upon community severance have been estimated as being minor adverse health outcomes of increased general risk to health associated with social isolation and moderate adverse health outcomes on children and young people, older people, people living in isolation, people living in areas with poor health status, and those with a long-term condition. Both of the above would be of moderate intensity and long-term in duration.

5.6 ECONOMIC FACTORS

DISTRIBUTION OF WEALTH: EVIDENCE

5.6.1 Since the 1980s there has been a dramatic growth in income inequality in the UK.[181] Studies[182] have drawn a direct relationship between income inequality and health. The scale of the impact is significant, and one study has suggested that the loss of life from income inequality in the US in 1990 was the equivalent of the combined loss of life due to lung cancer, diabetes, motor-vehicle accidents, HIV-related causes, suicide and homicide.[183] However, contrary to this, other studies have maintained that the evidence supporting a direct causal relationship between income inequality and health is weak, and that the correlation does not prove the cause.[184] [185]

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[181] National Equality Panel 2010 *An Anatomy of Economic Inequality in the UK*. London: Government Equalities Office. Available at: http://www.equalities.gov.uk/pdf/NEP%20Report%20bookmarked.pdf.

[182] Wilkinson, R. and Pickett, K. 2009a *The Spirit Level: Why More Equal Societies Almost Always Do Better*. London: Penguin

[183] Lynch, J., Kaplan, G., Pamuk, E., Cohen, R., Heck, J., Balfour, J., Yen R. 1998 '*Income Inequality and Mortality in Metropolitan Areas of the United States*', American Journal of Public Health, 88(7), 1074–80

[184] Saunders, P. 2010 *Beware False Prophets: Equality, the Good Society and The Spirit Level*. London: Policy Exchange

[185] Snowdon, C. 2010 *The Spirit Level Delusion*. Ripon: Little Dice

5.6.2 Status anxiety has been put forward as one of the mechanisms (Wilkinson and Pickett (2009a)) behind the adverse impact of income inequality on health. This suggests that income inequality is harmful because by placing people into an increased status competition hierarchy, it causes stress, leads to poor health and other adverse outcomes. Though, this theory has been challenge on a number of concepts, including the definition of 'status' (Saunders, 2010 and Snowdon, 2010).

5.6.3 Not all research studies have shown an independent effect of income inequality on health. Some studies show that other factors have an independent effect including material circumstances (individual income), culture/history, ethnicity and welfare state institutions/social policies.[186,187]

5.6.4 However a comprehensive, independent review of evidence surrounding income distribution and health found that evidence suggested that there is a correlation between income inequality and a range of health problems.[188]

5.6.5 Inequality of wealth is far more unequally distributed than income in the UK. The wealthiest 1% of households hold about 20% of household wealth, the top 5% of hold approximately 40%, and the top 10% hold over 50% of wealth.[189] The rate of increase in real wealth over the period 2006 to 2012 suggests that younger cohorts are on course to have lower real wealth on average at each age than earlier generations.[190]

5.6.6 Over the long-term, the UK labour market has become increasingly polarised into high and low wage employment, and wage inequality has also increased. This is now seen as having harmful social consequences such as potentially reducing social mobility.[191]

DISTRIBUTION OF WEALTH BASELINE: GATWICK

5.6.7 The south east is considered to be the region of the UK with the greatest income inequality.[192] In the absence of a defined metric of income distribution at the LA level, a comparison between average weekly pay and % of benefit claimants was been made for the local authorities across the Gatwick study area.

Table 5-7 Proportion of Claimants and Level of Weekly Pay in the Gatwick Study Area

GATWICK STUDY AREA	CLAIMANT COUNT	% CLAIMANTS OF ECONOMIC ACTIVE POPULATION	AVERAGE WEEKLY PAY (£)
Tandridge	285	0.6	636.5
Reigate and Banstead	575	0.8	634.6
Horsham	505	0.7	627.9
Mid Sussex	385	0.5	615.8
Mole Valley	240	0.6	597.5

186 Gravelle, H. 1998 '*How Much of the Relation Between Population Mortality and Unequal Distribution of Income is a Statistical Artefact?*', British Medical Journal, 316(7128), pp. 382–5

187 Jen, M., Jones, K. and Johnston, R. 2009a '*Compositional and Contextual Approaches to the Study of Health Behaviour and Outcomes*', Health and Place, 15, pp. 198–203

188 *Does income inequality cause health and social problems?* Karen Rowlingson. Joseph Rowntree Foundation. 2011

189 '*Household Wealth in Great Britain: Distribution, Composition and Changes 2006–12*' by Crawford, Innes & O'Dea

190 *Household Wealth in Great Britain: Distribution, Composition and Changes 2006–12*†, Crawford, R. et al Fiscal Studies, Wealth Data and Public Policy Volume 37, Issue 1, pages 35–54, March 2016

191 *Wage inequality and employment polarisation in British cities*, Neil Lee, Paul Sissons and Katy Jones. The Work Foundation. May 2013

192 Stewart, M.B. '*The Changing picture of earnings inequality in Britain and the role of regional and sectoral differences*'. National Institute Economic Review, 218 (1) R20-32.

GATWICK STUDY AREA	CLAIMANT COUNT	% CLAIMANTS OF ECONOMIC ACTIVE POPULATION	AVERAGE WEEKLY PAY (£)
Crawley	945	1.6	544.7

5.6.8 Average weekly pay ranged from £544.7 to £636.5, and the percentage of economically active population who were claimants ranged from 0.5 to 1.6%. Tandridge residents had the highest weekly average pay and one of the lowest proportions of claimants, though Crawley residents had the lowest weekly average pay and the highest proportion of claimants.

DISTRIBUTION OF WEALTH BASELINE: HEATHROW

5.6.9 In the absence of a defined metric of income distribution at the LA level, a comparison between average weekly pay and % of benefit claimants was been made for the local authorities across the Heathrow study area.

Table 5-8 Proportion of Claimants and Level of Weekly Pay in the Heathrow Study Area

HEATHROW STUDY AREA	CLAIMANT COUNT	% CLAIMANTS OF ECONOMIC ACTIVE POPULATION	AVERAGE WEEKLY PAY (£)
Richmond upon Thames	1,260	1.2	744.2
Wandsworth	3,100	1.6	718.5
Runnymede	285	0.6	597.9
Windsor and Maidenhead	605	0.8	694.5
South Bucks	245	0.7	670.1
Spelthorne	500	0.9	658.0
Hillingdon	2,620	1.7	605.5
Hounslow	1,610	1.1	565.7
Ealing	4,895	2.7	562.2
Slough	1,310	1.7	540.2

5.6.10 Average weekly pay ranged from £540.2 to £744.2, and the percentage of economically active population who were claimants ranged from 0.6 to 2.7%. Richmond upon Thames residents had the highest weekly average pay, though not one of the lowest proportions of claimants, Slough residents had the lowest weekly average pay and Ealing the highest proportion of claimants. The London Borough of Wandsworth was observed as having one of the highest proportions of benefit claimants (1.6%) yet the average weekly wage was second highest for the study area at £718.5. This implies there is a degree of income inequality within the London Borough of Wandsworth.

DISTRIBUTION OF WEALTH ASSESSMENT

5.6.11 Airport expansion could result in an increase clustering of businesses near to the airport. If this occur, it would improve productivity as the creation of business agglomerations around the airport would facilitate both knowledge and technology industry spillovers as well as provide access to larger input markets and labour markets. These increases in productivity (i.e. workers moving to more productive jobs) could result in an increase in the scale of salaries available within the study area.

5.6.12 Two types of productivity-related impacts are expected to arise from airport development: enhanced productivity through increased trade and associated spin-off benefits; and increased

productivity through creating strengthening agglomerations and clusters.

5.6.13 For the former, expansion in airport capacity provides better access to foreign markets, facilitates gains from trade and encourages greater exchange of knowledge and technology, thus improving the overall level of productivity in trade-related sectors of the economy.

5.6.14 For the latter, airport expansion would also attract more businesses requiring better international links to cluster around the airport, together with their supply chains, leading to growing agglomeration impacts around the airport and additional productivity increases in these sectors.

5.6.15 Income inequality may decrease as a consequence of airport expansion, should the secondary effect of airport expansion be an increase in productivity of the existing workforce via access to larger input markets. However with agglomeration and clustering comes access to larger labour markets. This could result in higher skilled labour from the wider labour market displacing or superseding the existing workforce for the higher skilled roles. This could in effect result in a widening of income inequality and a reduction in the distribution of wealth as an indirect consequence of airport expansion.

DISTRIBUTION OF WEALTH ASSESSMENT: LGW-2R

5.6.16 Additional employment as a consequence of LGW-R2, does not guarantee a reduction in income inequality. The majority of direct and indirect airport employment is within the service and retail roles, neither of which are high salary industries. However increased employment opportunities at Gatwick would benefit the local economy, particularly that of Crawley, which has the highest unemployment and lowest weekly pay of any of the 6 local authorities within the Gatwick study area.

5.6.17 Health outcomes as a consequence of a reduction in income inequality are indirect and can only be stated that it would result in a reduction of health problems and stress potentially caused by status anxiety. Due to the weak evidence between income inequality and wealth distribution and heath, LGW-R2 for these health outcomes would be of marginal positive.

5.6.18 Overall the LHR-2R impacts upon distribution of wealth have been estimated as being minor beneficial on all groups, of high intensity and permanent in duration.

DISTRIBUTION OF WEALTH ASSESSMENT: LHR-ENR

5.6.19 Additional employment as a consequence of LHR-ENR, does not guarantee a reduction in income inequality. The majority of direct and indirect airport employment is within the service and retail roles, neither of which are high salary industries. However increased employment opportunities at Heathrow would benefit the local economy, particularly that of Ealing, Slough and Hillingdon, which have the highest unemployment, as well as Hounslow which has one of the lowest weekly pay of any of the 9 local authorities within the Heathrow study area.

5.6.20 Health outcomes as a consequence of a reduction in income inequality are indirect and can only be stated that it would result in a reduction of health problems and stress potentially caused by status anxiety. Due to the weak evidence between income inequality and wealth distribution and heath, LHR-ENR for these health outcomes would be minor beneficial, though a neutral impact for the elderly.

DISTRIBUTION OF WEALTH ASSESSMENT: LHR-NWR

5.6.21 Additional employment as a consequence of LHR-NWR, does not guarantee a reduction in income inequality. The majority of direct and indirect airport employment is within the service and retail roles, neither of which are high salary industries. However increased employment opportunities at Heathrow would benefit the local economy, particularly that of Ealing , Slough and

Hillingdon, which have the highest unemployment, as well as Hounslow which as one of the lowest weekly pay of any of the 9 local authorities within the Heathrow study area.

5.6.22 Health outcomes as a consequence of a reduction in income inequality are indirect and can only be stated that it would result in a reduction of health problems and stress potentially caused by status anxiety. Due to the weak evidence between income inequality and wealth distribution and heath, LHR-NWR for these health outcomes would be minor beneficial, though a neutral impact for the elderly.

JOB CREATION, AVAILABILITY OF EMPLOYMENT OPPORTUNITIES, TRAINING AND SKILLS DEVELOPMENT: EVIDENCE

5.6.23 Socio-economic effects such as employment and income are potential health effects during both the construction and operational resulting from airport expansion.

5.6.24 Employment, and its related income, provides the means to gain access to services, somewhere to live, buy food and make use of leisure facilities. There is a growing body of evidence which suggests that changes in employment status and/or income influence health outcomes, including

depression, limiting long term illnesses, and mortality.

5.6.25 Work is generally good for the physical and mental health and wellbeing of healthy people, many disabled people and most people with common health problems.[193]

5.6.26 There is strong evidence that unemployment is generally harmful to health, including association between unemployment and many adverse health outcomes including rates of overall mortality, cardiovascular disease mortality, and suicide[194] Unemployment has been associated with prevalence of long-standing illness[195], poorer mental health, psychological distress, minor psychological/psychiatric morbidity[196] and higher medical consultation[197], [198].

5.6.27 Re-employment may partially or completely reverse adverse effects of worklessness.[199],[200]

JOB CREATION, AVAILABILITY OF EMPLOYMENT OPPORTUNITIES, TRAINING AND SKILLS DEVELOPMENT BASELINE: GATWICK

5.6.28 Amongst the local authorities within the Gatwick study the current job creation and availability of employment opportunities potential has been assessed using the ONS indicator of existing VAT Based Enterprises within the study area. This is an indication of the areas suitability and provision for small businesses (less than 250 employees), from which the largest proportion of employment is held. In the South East in 2014, 51,000 new businesses were formed and in London the figure was 89,000 in the same year.[201]

5.6.29 In the study area surrounding Gatwick a total of 235,980 VAT Based Enterprises were reported to be in business, with Property & Business sector with the greatest number of registered businesses and the construction sector with the second largest number of enterprises.[202]

5.6.30 As Crawley accounts for approximately one third of current airport staff and a high proportion of staff in the area are employed in airport related businesses, Crawley is a strong focus of direct, indirect and induced jobs associated with Gatwick airport.

JOB CREATION, AVAILABILITY OF EMPLOYMENT OPPORTUNITIES, TRAINING AND SKILLS DEVELOPMENT BASELINE: HEATHROW

5.6.31 In the study area surrounding Heathrow a total of 837,678 VAT Based Enterprises were reported to be in business, with the Real Estate & Business sector with the greatest number of registered businesses,[203] and the wholesale and trading was the sector with the second largest number or enterprises, and transport storage and communication was the sector with the next highest of enterprises.

5.6.32 There is comparatively low skills level amongst the population local to Heathrow, with 5 local boroughs having a lower than average level of skills, and high unemployment rate in the area, provides a good match with the relatively low skill of the new jobs and those for the associated transport industry.

JOB CREATION, AVAILABILITY OF EMPLOYMENT OPPORTUNITIES, TRAINING AND SKILLS DEVELOPMENT ASSESSMENT: LGW-2R

[193] Waddell G, Burton AK. 2004. *Concepts of rehabilitation for the management of common health problems*. The Stationery Office, London
[194] Jin RL, Shah CP, Svoboda TJ. 1995. *The impact of unemployment on health: a review of the evidence*. Can Med Assoc J 153: 529-540.
[195] Mathers CD, Schofield DJ. 1998. *The health consequences of unemployment: the evidence*. Med J Aust 168: 178-182
[196] Vuori J,Vesalainen J. 1999. *Labour market interventions as predictors of re-employment, job seeking activity and psychological distress among the unemployed*. Journal of Occupational and Organizational Psychology 72: 523-538.
[197] Hammarström A. 1994b. *Health consequences of youth unemployment - review from a gender perspective*. Soc Sci Med 38: 699-709.
[198] Lakey J. 2001. *Youth unemployment, labour market programmes and health*. Policy Studies Institute, London.
[199] Ferrie JE. 1999. *Health consequences of job insecurity*. In Labour market changes and job insecurity: a challenge for social welfare and health promotion (WHO Regional Publications, European Series, No. 81) (Ed. Ferrie JE, Marmot MG, Griffiths J, Ziglio E) WHO, Copenhagen.
[200] Ferrie JE. 2001. *Is job insecurity harmful to health?* J R Soc Med 94: 71-76.
[201] Business Statistics. Briefing Paper, Number 06152, 7 December 2015 House of Commons Library.
[202] ONS http://www.neighbourhood.statistics.gov.uk/dissemination/UpdateTable.do
[203] ONS http://www.neighbourhood.statistics.gov.uk/dissemination/UpdateTable.do

5.6.33 The construction phase of LGW-2R will result in job creation as well as training and skills development opportunities.

5.6.34 Expansion of Gatwick airport could provide additional local employment opportunities, wider benefits of increased productivity arising from more trade (estimated at either £6.9bn, £13.1bn, or £43.0bn depending on the approach taken) and benefits of business agglomeration into the area surrounding Gatwick (£0.3 - £1.6bn). Total economic benefits of LGW-2R, excluding trade and producer impacts, are estimated between £52.4-53.7bn. Positive benefits would arise to the local economy through the significant increase in the availability of jobs, including the creation of jobs, re-location of businesses, requiring a skilled workforce. Staff training and skills development would form part of the successful growth of the local economy.

5.6.35 Creation of new local employment, increasing the availability of local employment, and training and skills development opportunities have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for those directly and indirectly involved. These health outcomes would be moderately beneficial, though are likely to be of major benefit in Crawley, as it has the highest unemployment within the Gatwick Study area, which is often associated with poor health, of high intensity and long-term for all groups, with exception to the elderly, who will experience a neutral impact.

JOB CREATION, AVAILABILITY OF EMPLOYMENT OPPORTUNITIES, TRAINING AND SKILLS DEVELOPMENT ASSESSMENT: LHR-ENR

5.6.36 The construction phase of both Heathrow shortlisted schemes will result in job creation as well as training and skills development opportunities.

5.6.37 Expansion of Heathrow Airport could provide additional local employment opportunities, but also wider benefits of increased productivity arising from more trade (estimated at either £5.5bn, £10.0bn or £85.8bn depending on the approach taken). There would also be benefits from business agglomeration in the range of £0.5 - £2.1bn into the area surrounding Heathrow. Total economic benefits of LHR-ENR, excluding trade and producer impacts, are expected to range from £50.1 - 51.7bn. Positive benefits would arise to the local economy through the significant increase in the availability of jobs, including the creation of jobs, re-location of businesses, requiring a skilled workforce. Staff training and skills development would form part of the successful growth of the local economy.

5.6.38 Creation of new local employment, increasing the availability of local employment, and training and skills development opportunities have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for those directly and indirectly involved. These health outcomes would of minor benefit, though may are likely to be moderately beneficial in Ealing, Slough and Hounslow, as it they have the highest unemployment within the Heathrow study area, which is often associated with poor health, of high intensity and long-term for all groups, with exception to the elderly, who will experience a neutral impact.

JOB CREATION, AVAILABILITY OF EMPLOYMENT OPPORTUNITIES, TRAINING AND SKILLS DEVELOPMENT ASSESSMENT: LHR-NWR

5.6.39 The construction phase of both Heathrow shortlisted schemes will result in job creation as well as training and skills development opportunities.

5.6.40 Expansion of Heathrow Airport will provide additional local employment opportunities, but also wider benefits of increased productivity arising from more trade (estimated at either £6.6bn, 11.9bn or £108.3bn depending on the approach taken). Benefits from business agglomeration into the area surrounding Heathrow are expected to be between £0.7 - 2.5bn. Total economic

benefits of LHR-NWR, excluding trade and producer impacts, are expected to range from £59.2 - 61.1bn. Positive benefits would arise to the local economy through the significant increase in the availability of jobs, including the creation of jobs, re-location of businesses, requiring a skilled workforce. Staff training and skills development would form part of the successful growth of the local economy.

5.6.41 Creation of new local employment, increasing the availability of local employment, and training and skills development opportunities have the potential to result in beneficial health outcomes such as improved mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for those directly and indirectly involved. These health outcomes would be of minor benefit, though may are likely to be moderately beneficial in Ealing, Slough and Hounslow, as it they have the highest unemployment within the Heathrow study area, which is often associated with poor health, of high intensity and long-term for all groups, with exception to the elderly, who will experience a neutral impact.

AMOUNT OF TRAFFIC CONGESTION BASELINE: GATWICK

5.6.42 The area surrounding Gatwick Airport is connected by to the national network by the M23, and is approximately 11 km from junction 7 of the M25. Both the south and north terminals are only accessible via the A23 to the east of the airport.

5.6.43 The cargo terminal is accessible via the northern perimeter road which connects to the A23 to the north of the airport. Direct access to London for is via the M23 for all airport users, while the local road network provides access in the immediate vicinity, via the A23 to the south or the A217 immediately to the north.

5.6.44 Junctions upon major routes surrounding and approaching Gatwick airport are under pressure from traffic congestion. Traffic flow on almost the whole of the M23, except for two short sections exceeds the design capacity of the road. On the A23, traffic flow south of Crawley exceeds the capacity in both directions. Congestion occurs during peak hours, outside the peak hours, and at weekends and holidays on parts of the A23/M23.[204]

5.6.45 West Sussex has reported that travel patterns dominated by the private car and low usage of sustainable modes of transport, where households are reliant upon private vehicle use to daily travel needs,[204] adding to traffic congestion locally. Therefore any congestion issues impact upon a great number of residents within study area, as public transport use is relatively low in comparison to other parts of the South East.

AMOUNT OF TRAFFIC CONGESTION BASELINE: HEATHROW

5.6.46 The area surrounding Heathrow Airport is well served by the existing road network with direct motorway links to Terminals 1, 2 and 3 from the M4 and from the M25 to Terminal 5. Terminal 4 is accessible via the A30 and also the southern perimeter road running south of the airport east/west from the A3113. The A3113 also provides easy access to the cargo terminal from both London and the rest of the UK. Both the M4 and A4 provide direct access to London for all airport users, while the local road network provides for access in the immediate vicinity.

5.6.47 Parts of the surrounding road network experience stress owing to high levels of traffic compared with the capacity available, this includes parts of the M25 and M4 at times operating at between 85% and 99% of capacity. It is estimated that direct airport-related traffic is a relatively small

[204] West Sussex Transport Plan: 2011 – 2016, February 2011.

proportion of total traffic in the area as a whole.

5.6.48 Slough has reported that residents rely heavily on cars for their daily travel adding to traffic congestion locally. Large number of people in Slough travel out to jobs, mainly using private car, with low usage of public transport.[205] Therefore any congestion issues impact upon a great number of residents within study area, as public transport use is relatively low in comparison to other parts of the South East.

5.6.49 Congestion is a problem throughout the South East of England, as well as across the study area surrounding Heathrow. The London Borough of Hillingdon reports that congestion is a problem on many parts of its road network[206], and this issue is reflected across the study area.

AMOUNT OF TRAFFIC CONGESTION ASSESSMENT: LGW-2R

5.6.50 Impacts upon traffic congestion as a result of the expansion of Gatwick Road could comprise of disruption during construction, as well as changes to traffic volumes and road capacity throughout the airport operation.

5.6.51 Impacts during the construction period, though largely an unknown at this stage would add to disruption and traffic congestion, due partly to the addition of heavy goods vehicles associated with construction, though mainly due to the disruption caused by diversions and road closures required to create a construction buffer zone, though also as part of construction of the surface access enhancements (Table 5.9).

Table 5-9 LGW-2R Related Surface Access Enhancements

CATEGORY	LOCATION	REQUIREMENT
Local road enhancement	M23 J9	Slip road widening
		Grade-separated flyover for southbound slip
	M23 J9 to J9a road widening	Widening of existing section to four and five lanes as appropriate
	Airport Way	Widening of existing section of four lanes in each direction
	A23 re-alignment	Provision of new section of A23
		Grade-separated section of A23 re-alignment
	Long-term parking	New high capacity roundabout and approaches
	Industrial zone	New roundabout and approaches
	North Terminal access	New high capacity roundabout and approaches
		A23 to Airport Way grade-separated flyover
	New Terminal access	Provision of new section connecting M23 to new terminal
		Grade-separated section of new access to new terminal
	South Terminal access	New high capacity roundabout and approaches
	Longbridge Roundabout	Capacity enhancements
	Gatwick Road	New roundabout and approaches

[205] Slough's Third Local Transport Plan, 2011 to 2016. 2011.
[206] London Borough of Hillingdon Local Implementation Plan Report, April 2011

CATEGORY	LOCATION	REQUIREMENT
	Balcombe Road	Re-provision of existing road (standard 7.5m width one lane in either direction)

5.6.52 Impacts of traffic congestion within the study area during operation are uncertain, though the plans to provide additional capacity on the local road network around Gatwick may off-set increases in the number of road vehicles using the airport as a consequence of expansion.

5.6.53 Direct impacts upon both household and the local economy due to traffic congestion as a consequence of the Gatwick expansion shortlisted scheme for these health outcomes are estimated to be minor adverse, of moderate intensity in scale and temporary over the construction period. Health outcomes as a consequence of changes to both household and the local economy due to traffic during operation of the LGW-2R expansion scheme have been estimated to be neutral.

AMOUNT OF TRAFFIC CONGESTION ASSESSMENT: LHR-ENR

5.6.54 Impacts upon traffic congestion as a result of the expansion of LHR-ENR could comprise of disruption during construction, as well as changes to traffic volumes and road capacity throughout the airport operation.

5.6.55 Impacts during the construction period, though largely an unknown at this stage would add to disruption and traffic congestion, due partly to the addition of heavy goods vehicles associated with construction, though mainly due to the disruption caused by diversions and road closures required to create a construction buffer zone, though also as part of construction of the surface access enhancements (Table 5.10).

Table 5-10 LHR-ENR Related Surface Access Enhancements

CATEGORY	LOCATION	REQUIREMENT
Strategic road	M4 J3 to J4	Road widening
	M4 Airport Spur	Road widening
	M4 J2 to J3	Road widening
	M4 J4 and J4B	Road widening
	M4	Large M4 Junction 4b replacement
	M4	Higher capacity @ M4 J4a
	M4	Capacity improvements to existing main airport tunnel
	M25	M25 tunnelling costs (south of junction 15)
Local road network	M25 J13 (A13) D2	Grade-separated junction and flyover/bridge structures
	Tunnel From A4 to T5	
	A4 Access	Tunnel running parallel to M25 – expected to have light traffic
	New roundabouts on access roads	Southern Road Tunnel/Southern Perimeter Road Interchange
	Airport Roads	New link from junction 13
	Heathrow Road Tunnel	Providing new spur access
	Airport One Way	One way system for western campus

5.6.56 Impacts of traffic congestion within the study area during operation are uncertain, though the plans to provide additional capacity on the road network may off-set some increases in the number of road vehicles using the airport as a consequence of expansion. Changes to traffic any flows along the M4 can cause significant disruption to the wider road network, thereby having a detrimental impact upon households and the local economy.

5.6.57 Direct impacts upon both household and the local economy due to traffic congestion as a consequence of the LHR-ENR expansion scheme for these health outcomes would be estimated to be minor adverse, of moderate intensity and would be confined temporary over the construction period. Health outcomes as a consequence of changes to both household and the local economy due to traffic during operation of the LHR-ENR expansion scheme have been estimated to be minor adverse, of high intensity and permanent in duration.

AMOUNT OF TRAFFIC CONGESTION ASSESSMENT: LHR-NWR

5.6.58 Impacts upon traffic congestion as a result of the LHR-NWR scheme could comprise of disruption during construction, as well as changes to traffic volumes and road capacity throughout the airport operation.

5.6.59 Impacts during the construction period, though largely an unknown at this stage would add to disruption and traffic congestion, due partly to the addition of heavy goods vehicles associated with construction, though mainly due to the disruption caused by diversions and road closures required to create a construction buffer zone, though also as part of construction of the surface access enhancements (Table 5.11).

Table 5-11 LHR–NWR Related Surface Access Enhancements

CATEGORY	LOCATION	REQUIREMENT
Strategic road	M4 J3 to J4	Road widening
	M4 Airport Spur	Road widening
	M4 J2 to J3	Road widening
	M4 J4 and J4B	Road widening
	M4	Large M4 Junction 4b replacement
	M4	Higher capacity @ M4 J4a
	M4	Capacity improvements to existing main airport tunnel
	M25	M25 tunnelling costs (south of junction 15)
Local road network	A4	Diversion of A4 road alignment, dual carriageway
	A3044	Diversion of A3044 road alignment, dual carriageway
	Airport Roads	Airport Way/Southern Perimeter Road Interchange, grade-separated junction and flyover/bridge structures
	Heathrow Road Tunnel	Southern Road Tunnel/Southern Perimeter Road Interchange
	Airport One Way	One way system for western campus

5.6.60 Impacts of traffic congestion within the study area during operation are uncertain, though the plans to provide additional capacity on the road network may off-set some increases in the number of road vehicles using the airport as a consequence of expansion. Changes to traffic any flows along the M4 may cause significant disruption to the wider road network, thereby having a detrimental impact upon households and the local economy.

5.6.61 Direct impacts upon both household and the local economy due to traffic congestion as a consequence of the LHR-NWR expansion scheme for these health outcomes would be estimated to be minor adverse, of moderate intensity and would be confined temporary over the construction period. Health outcomes as a consequence of changes to both household and the local economy due to traffic during operation of the LHR-NWR expansion scheme have been estimated to be minor adverse, of high intensity and permanent in duration.

5.7 ENVIRONMENTAL FACTORS

AIR QUALITY: EVIDENCE

5.7.1 The association between health effects and exposure to air pollutants is now well established, with distinct health risks associated with exposure to particulates available at a local level[207], [208].

5.7.2 The impact of long term human exposure to particulate matter (PM) anthropogenic pollution is estimated to have an effect on mortality equivalent to nearly 29,000 deaths in the UK[209]. There is no known threshold concentration below which NO_2 or PM_{10} have no effect on a population's health.

5.7.3 Many of the sources of PM are also sources of NO_2. Links between the occurrence of NO_2 and health effects has strengthened substantially in recent years, though some of these are co-incident with PM, as noted by the Committee on the Medical Effects of Air Pollutants[210], some could be attributed to other co-existing pollutants, such as Poly Aromatic Hydrocarbons (PAH) and Volatile Organic Compounds (VOC).

5.7.4 Defra have estimated that the effect of NO2 on mortality is equivalent to 23,500 deaths in the UK annually, though this estimate has not been endorsed by COMEAP.[211] Any increases in mortality are likely to be either as a result of cardiovascular and/or respiratory mortality, particularly with regards to an elevated short-term exposure to NO_2[212].

5.7.5 Due to the correlation between differing airborne pollutants and similar health effects, one pollutant can often mask the effects of another and it is not always possible to discreetly isolate the health effects of a single pollutant. The causal mechanism, primarily cardiovascular and respiratory, leading to increased mortality with increased exposure to particulate matter is well-founded, though processes behind NO_2 contributing to cardiovascular damage, respiratory disease or cancer are less understood.

5.7.6 Currently there is no threshold concentration below which a certain air pollutant has no effect on a population's health.

5.7.7 Studies have reported statistically significant associations between long-term exposure to NO_2 and lung function in children, respiratory infections in early childhood and effects on adult lung function. Though mortality, lung cancer, and cardiovascular and cerebrovascular effects in adults are predominately weighted towards PM mass and not NO_2 (studies cited in COMEAP/2014/06 Annex B[213]). Similar rates of mortality per 10 $\mu g/m^3$ of $PM_{2.5}$ and NO_2 have been found in some studies.[214] Though a greater effect of NO_2 (6%) than $PM_{2.5}$ (3%) was found on total mortality when

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207 COMEAP 2010 *The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom*. A report prepared by the Committee on the Medical Effects of Air Pollutants. Available at: http://www.comeap.org.uk/

208 COMEAP 2012 *Statement on Estimating the Mortality Burden of Particulate Air Pollution at a Local Level*. Available at: http://www.comeap.org.uk/

209 *The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom*, COMEAP, 2010

210 *Committee on the Medical Effects of Air Pollutants, Statement on the Evidence of the Effects of Nitrogen Dioxide on Health*, COMEAP, March 2015

211 Defra analysis using interim recommendations from COMEAP's working group on NO

212 Quantitative systematic review of the associations between short-term exposure to nitrogen dioxide and mortality and hospital admissions. BMJ Open 2015;5:e006946 doi:10.1136/bmjopen-2014-006946

213 COMEAP/2014/06 Working paper: Evidence for the effects of NO_2 on health Visit https://www.gov.uk/government/groups/committee-on-the-medical-effects-of-air-pollutants-comeap and click on COMEAP discussion papers [Accessed Jan 2016]

214 Faustini A, Rapp R, Forastiere F 2014 *Nitrogen dioxide and mortality: review and meta-analysis of long-term studies*. Eur Respir J 44(3): 744-753

the broader range of NO_2 concentrations over $PM_{2.5}$ concentrations were taken into account. The US Environmental Protection Agency[215] found that there was consistent evidence in single-city studies in diverse locations but inconsistent evidence among other large cohorts of multiple US locations.

5.7.8 A meta-analysis of available long term studies on NO_2 data by Faustini et al[214] concluded that the magnitude of the effect of long-term exposure to NO_2 on mortality is at least as important as that of $PM_{2.5}$

5.7.9 Airports and their associated surface transport are clearly sources of both PM and NO_2. Studies of air pollution in the vicinity of airports have been weighted towards PM, and show strong evidence of increased concentrations both in the vicinity (<1km) and extending downwind (>1km) of airports and an association with aircraft movements[216,217]. Other studies also show the significant impact of airport activity on NO_2[218,219] and the potentially significant contributions of local traffic and ground support equipment.

5.7.10 With specific reference to health effects of air pollution in the vicinity of airports, many studies have drawn on existing relationships between air pollution and health outcomes (such as those described above) to infer health impacts in the vicinity of airports. There are fewer direct studies of health impacts. Lin et al (2008) [220] indicate potentially increased risk of hospital admissions for residents living in proximity (<5km) to airports, although they note that effects are likely to be dependent on airport-specific factors. In contrast, Lavicoli et al (2014)[221] suggest that the direct evidence of association between air pollution and health effects on workers and residents is still limited. Notwithstanding this, evidence is emerging of the impact of aviation emissions at multiple scales, from near-airport to regional scales[222].

AIR QUALITY BASELINE: NATIONAL

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

5.7.12 Data presented by Defra[223] indicate that there has been no significant increase or reduction in NO_2 concentrations at roadside monitoring sites across the UK between 1998 and 2010. NO_2 concentrations at non-roadside sites decreased until around 2002, after which there is no discernible trend. Total emissions of NO_x (from the NAEI) show reductions year-on-year.

5.7.13 Emerging evidence on the real-world performance of the latest passenger cars and heavy duty vehicles (Euro 6/VI vehicles) strongly indicates that NO_x emissions, and as a result roadside NO_2

[215] US EPA, Integrated Science Assessment for Oxides of Nitrogen – Health Criteria (First External Review Draft). United States Environmental Protection Agency, 2013. http://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=259167

[216] Zhu, Y. et al 2011. Aircraft emissions and local air quality impacts from takeoff activities at a large International Airport. Atmospheric Environment 45(36):6526-6533

[217] Hudda, N et al. 2014. *Emissions from an international airport increase particulate number concentrations 4-fold at 10km downwind*. Environmental Science and Technology 48(12): 6628-6635.

[218] Carslaw, D.C. et al 2012. *A Short term intervention study* – Impact of airport closure due to the eruption of eyjafjallajokull on near-field air quality. Atmospheric Environment 54: 328 – 336.

[219] Carslaw, D.C. et al 2006. Detecting and quantifying aircraft and other on-airport contributions to ambient nitrogen oxides in the vicinity of a large international airport. Atmospheric Environment 40(28): 5424-5434.

[220] Lin, S. et al 2008. *Residential proximity to large airports and potential health impacts in New York State*. International Archives of Occupational and Environmental Health 81(7): 797-804.

[221] Iavicoli, I et al. 2014. *Airport related air pollution and health effects*. Epidemiologia e Prevenzione 38(3-4):237-243.

[222] Yim, S.H.L. et al 2015. *Global, regional and local health impacts of civil aviation emissions*. Environmental Research Letters 10(3): 034001.

[223] Defra, 2015. *Air Pollution in the UK 2014*. (https://uk-air.defra.gov.uk/library/annualreport/) Accessed 06/01/2016.

concentrations, are likely to decrease in the future[224].

5.7.14 PM_{10} concentrations also show a decreasing trend, but year-on-year variability is higher than for NO_2 due to the influence of meteorological conditions and transboundary transport into the UK. There is no clear trend evident in available $PM_{2.5}$ concentrations or emissions; however limited data are available prior to 2009.

5.7.15 As of 2013, emissions of all pollutants covered by the Gothenburg Protocol showed a decreasing trend over time and were within the target levels set for 2010.[225] Moreover, progress has been made towards meeting the more stringent targets for 2020 and beyond.

5.7.16 From Defra forecasts of local air quality for the assessment of compliance with EU Directive limit values significant improvements in local air quality are predicted over time. The most recent Plan[226] prepared by Defra concludes that compliance is predicted to be achieved in all Zones by 2025, with the Greater London Zone as the only Zone in the UK where compliance is not predicted to be achieved by 2020.

5.7.17 Projected UK pollutant emissions of NO_x and $PM_{2.5}$ were predicted to meet the 2020 target values of the Gothenburg Protocol[227]. However, compliance with the targets was marginal for $PM_{2.5}$. Moreover, the latest emissions and target levels published by Defra indicate that $PM_{2.5}$ emissions are likely to exceed their 2020 target[228]. Whilst this is partly a result of methodological changes relating to emissions from domestic wood burning, it serves to demonstrate that there is a significant risk that the UK will exceed its Gothenburg Protocol 2020 emissions target for $PM_{2.5}$, although NO_X emissions remain on course to meet the targets. However, this assessment has focussed on compliance for the pollutants NO_2 and PM_{10}.

AIR QUALITY BASELINE: GATWICK

5.7.18 Of the six local authorities within the Gatwick study area, three have areas where air quality concentrations exceed national Air Quality Objective (AQO) limits for nitrogen dioxide.

5.7.19 Modelling of roadside pollutant concentrations, undertaken by Defra, indicates that air quality alongside the A23 near Gatwick, currently exceeds EU Directive limits values for annual mean NO_2[229]. However concentrations of air pollutants are predicted to reduce in the future, falling below EU Directive limit values by 2020.

5.7.20 Annual mean concentrations of NO_2 in the vicinity of Gatwick are predicted to be compliant by 2020.

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[224] https://www.gov.uk/government/publications/vehicle-emissions-testing-programme-conclusions, accessed, 18/07/2016
[225] Ricardo-AEA, 2015. *UK Informative Inventory Report (1990 to 2013)*. [online] Accessed 06/01/2016.
[226] Defra, 2015. *Improving air quality in the UK - Tackling nitrogen dioxide in our towns and cities, UK overview document*. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486636/aq-plan-2015-overview-document.pdf)Accessed 06/01/2016.
[227] AEA Group, 2012. *UK Emission Projections of Air Quality Pollutants to 2030*. (http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjC1q_wjpXKAhXCGB4KHQ6TAcEQFggmMAE&url=http%3A%2F%2Fuk-air.defra.gov.uk%2Fassets%2Fdocuments%2Freports%2Fcat07%2F1211071420_UEP43_(2009)_Projections_Final.pdf&usg=AFQjCNHrU0fvcVAsYtlTJZcxs7CgWGLoaw&bvm=bv.110151844,d.dmo) Accessed 06/01/2016.
[228] Defra, 2015. *National Statistics Release: Emissions of air pollutants in the UK, 1970 to 2014.* (https://www.gov.uk/government/statistics/emissions-of-air-pollutants) Accessed 16/06/2016
[229] Defra, 2016, https://uk-air.defra.gov.uk/data/gis-mapping, Accessed 25/07/2016

AIR QUALITY BASELINE: HEATHROW

5.7.21 Of the ten local authorities within the Heathrow study area, all ten have areas where air quality concentrations exceed national AQO limits for nitrogen dioxide and PM_{10}.

5.7.22 Modelling of roadside pollutant concentrations, undertaken by Defra, indicates that air quality alongside numerous roads in the vicinity of Heathrow, notably the A4, M4, A312, A30 and A3113, currently exceeds EU Directive limits values for annual mean NO_2 by some considerable margin.

5.7.23 The most recent Plan prepared by Defra concludes that, the Greater London Zone is the only Zone in the UK where NO_2 annual mean compliance is not predicted to be achieved by 2020.

AIR QUALITY ASSESSMENT: LGW-2R

5.7.24 A re-analysis of compliance[230] with the EU Air Quality Directive taking into account the government's 2015 Air Quality Plan and considering the start of operation of LGW-2R in 2025 or 2030 indicates that LGW-2R is at a very low risk of affecting the UKs compliance to limit values. Furthermore, with the shortlisted scheme in operation, the maximum predicted annual mean NO_2 concentration with the shortlisted scheme in operation at any receptor is 38.6µg/m^3 (i.e. at residential properties or other location where long term exposure to air pollution is likely within 2km of the airport). This is within the annual mean AQO (40µg/m^3 annual mean).

5.7.25 At any receptor, the maximum predicted change in annual mean NO_2 concentrations brought about by the shortlisted scheme at any receptor is 13.1µg/m^3. Predicted PM_{10} concentrations are all below the annual mean AQO values (50µg/m^3 averaged over 24 hrs and 40µg/m^3 annual mean). The predicted incremental changes in PM_{10} concentrations are all less than 4µg/m^3.

5.7.26 There is unlikely to be any risk of both PM_{10} and $PM_{2.5}$ AQOs being exceeded in the assessment years, 2030, 2040 and 2050 within the LGW-2R study area. Therefore a low public exposure close to the airport was predicted due to the relatively low concentration of both PM_{10} and $PM_{2.5}$ around Gatwick airport, resulting in a minor adverse impact on health[207, 208].

5.7.27 Owing to the low population density around Gatwick airport, increased exposure of sensitive receptors to NO_2 as a result of direct emissions from aircraft is limited, resulting in a minor negative impact on health during operation. However there are 20,985 properties where annual mean NO_2 concentrations within the study area have been predicted to increase by greater than 2.1µg/m^3, affecting 51,328 residents. There are 62 properties likely to have an annual mean NO_2 concentration greater than 80% of the AQO concentration value of 40µg/m^3 (>32µg/m^3), placing them into an "at risk" status , which have been assessed as experiencing an increase in NO_2 concentrations.

5.7.28 Increases in exposure to air pollutants as a result of expansion at Gatwick airport are not predicted to be significant due to small changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations. This will have a negative effect on the Quality of Life for several thousand local residents.

5.7.29 Health outcomes as a consequence of changes in air quality associated with LGW-2R were estimated to result in major adverse effects for people living in areas with poor health status, children and young people of moderate intensity and medium term in duration, due to the pronounced risk of increased mortality and morbidity for these vulnerable groups, as well as a risk of increase in respiratory effects and cardiovascular disease. Whereas the health outcomes for study area population, as a consequence of changes in air quality associated with LGW-2R were

[230] WSP | Parsons Brinckerhoff, February 2017, *Updated Air Quality Re-Analysis, published as part of the draft Airports NPS Consultation documentation.*

estimated to be moderately adverse for the remaining population, of high intensity and medium term in duration.

5.7.30 The shortlisted scheme would not cause any new exceedances of the lower or upper bounds of the Critical Loads, and no new exceedances of the Critical Level are predicted; an improvement is predicted at the Buchan Hill Ponds SSSI.

5.7.31 Cumulative effects on air quality may arise from the airport expansion in combination with other major infrastructure development delivered in support of the National Networks NPS, or residential, commercial or infrastructure development associated with nearby local authority's plans for growth, delivered in support of local development plans. The health outcomes associated with habitat impacts associated with LGW-2R were assessed as neutral.

AIR QUALITY ASSESSMENT: LHR-ENR

5.7.32 Large areas including the airport site and nearby major roads have annual mean NO_2 levels in excess of the EU Directive limit value of 40µg/m^3. Therefore existing air quality at and surrounding Heathrow is poor. Four of the adjacent local authorities to Heathrow have declared Air Quality Management Areas (AQMAs) for exceedances of the annual mean NO_2 AQO, mainly due to emissions from road transport.

5.7.33 A re-analysis[231] of the AC's air quality impact assessment[232] has been undertaken taking into account the Government's 2015 Air Quality Plan, emerging evidence on vehicle emissions and revised surface access strategies for LHR-ENR. The re-analysis indicates that the LHR-ENR scheme impacts on compliance with limit values alongside some roads within Greater London. However, the maximum predicted annual mean NO_2 concentration with the shortlisted scheme at any residential property or other location where long term exposure to air pollution is likely within 2km of the airport with the shortlisted scheme in operation is 37.2µg/m^3. This is within the annual mean AQO. The maximum predicted change in concentrations brought about by the shortlisted scheme at any receptor is 14.0µg/m^3 (with the proposed LHR-ENR).

5.7.34 Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network, could potentially mitigate the risks of impacts on compliance further.

5.7.35 Applying the Institute of Air Quality Management significance criteria[233] to air quality impacts, health outcomes as a consequence of changes in air quality associated with LHR-ENR have been assessed as potentially moderately adverse effect, due to an increase in mortality and morbidity as well as an increase in respiratory effects and cardiovascular risk within the study area population.

5.7.36 Predicted PM_{10} concentrations are all well below the annual mean AQO. The predicted incremental changes in PM_{10} concentrations are all less than 6µg/m^3, which is of minor negative effect upon Health.

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

[231] WSP|Parsons Brinckerhoff, February 2017, *Updated Air Quality Re-Analysis, published as part of the draft Airports NPS Consultation documentation.*

[232] https://www.gov.uk/government/publications/airport-expansion-further-analysis-of-air-quality-data.

[233] Moorcroft and Barrowcliffe. et al.,2015. *Land-use Planning & Development Control: Planning for Air Quality*. Institute of Air Quality Management, London

concentrations.

5.7.38 Expansion of Heathrow would result in an increase in emissions from aircraft and road traffic associated with the airport. Vehicle emissions reductions predicted to occur over time independent of airport expansion will offset this partly. However due to the densely populated urban area surrounding Heathrow an increase in emissions of air pollutants as a result of its expansion will result in several thousand local residents as well as sensitive receptors being affected by poorer air quality, resulting in a reversal of air quality improvements predicted to occur as a consequence of improved emissions reduction over time. This will have a significant negative effect on the Health for those several thousand local residents.

5.7.39 Health outcomes as a consequence of changes in air quality associated with LHR-ENR were estimated to result in major adverse effects for people living in areas with poor health status, children and young people of moderate intensity and medium term in duration, due to the pronounced risk of increased mortality and morbidity for these vulnerable groups, as well as a risk of increase in respiratory effects and cardiovascular disease. Whereas the health outcomes for study area population, as a consequence of changes in air quality associated with LHR-ENR were estimated to be moderately adverse for the remaining population, of high intensity and medium term in duration.

5.7.40 Cumulative effects on air quality may arise from the airport expansion in combination with other major infrastructure development delivered in support of the National Networks NPS, or residential, commercial or infrastructure development associated with nearby local authority's plans for growth, delivered in support of local development plans. The health outcomes associated with habitat impacts associated with LHR-ENR were assessed as neutral.

AIR QUALITY ASSESSMENT: LHR-NWR

5.7.41 Large areas including the airport site and nearby major roads have annual mean NO_2 levels in excess of the EU Directive limit value[40] of 40µg/m^3. Therefore existing air quality at and surrounding Heathrow is poor. Four of adjacent local authorities to Heathrow have declared AQMAs for exceedances of the annual mean NO_2 AQO, mainly due to emissions from road transport.

5.7.42 A reanalysis[234] of the AC's air quality impact assessment[235] has been undertaken taking into account the Government's 2015 Air Quality Plan and emerging evidence on vehicle emissions. The re-analysis indicates that there is a risk that the LHR-NWR scheme will impact on compliance with limit values alongside some roads within Greater London.

5.7.43 However, the maximum predicted concentration at any residential property or other location where long term exposure to air pollution is likely within 2km of the airport with the shortlisted scheme in operation is 34.7µg/m^3. This is within the annual mean AQO. The maximum predicted change in concentrations brought about by the shortlisted scheme at any receptor is 10.8µg/m^3 (with the proposed LHR-NWR).

[234] WSP | Parsons Brinckerhoff, February 2017, *Updated Air Quality Re-Analysis, published as part of the draft Airports NPS Consultation documentation.*

[235] https://www.gov.uk/government/publications/airport-expansion-further-analysis-of-air-quality-data.

5.7.44 Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network, could potentially mitigate the risks of impacts on compliance further.

5.7.45 Applying the Institute of Air Quality Management significance criteria[236] to air quality impacts, health outcomes as a consequence of changes in air quality associated with LHR-NWR have been assessed as a potentially moderate adverse effect, due to an increase in mortality and morbidity as well as an increase in respiratory effects and cardiovascular risk within the study area population.

5.7.46 Predicted PM_{10} concentrations are all below the annual mean AQO. The predicted incremental changes in PM_{10} concentrations are all less than 6µg/m^3, which would result in minor adverse impact upon health.

5.7.47 There are 47,063 properties where annual mean NO_2 concentrations within the Principal Study Area are predicted to be higher (on average by 0.9 µg/m^3), with 121,377 people affected. There are 14 "at risk" properties (>32 µg/m^3) that would experience an increase in annual mean NO_2 concentrations.[40]

5.7.48 The scheme for a northwest runway at Heathrow would result in an increase in emissions from aircraft and road traffic associated with the airport. Vehicle emissions reductions predicted to occur over time independent of airport expansion will offset this partly. However due to the densely populated urban area surrounding Heathrow an increase in emissions of air pollutants as a result of the northwest runway would affect several thousand local residents as well as sensitive receptors being affected by poorer air quality, resulting in a reversal of the baseline air quality improvements. This will have a significant negative effect on the Quality of Life of those several thousand local residents.

5.7.49 Health outcomes as a consequence of changes in air quality associated with LHR-NWR were estimated to result in major adverse effects for people living in areas with poor health status, children and young people of moderate intensity and medium term in duration, due to the pronounced risk of increased mortality and morbidity for these vulnerable groups, as well as a risk of increase in respiratory effects and cardiovascular disease. Whereas the health outcomes for study area population, as a consequence of changes in air quality associated with LHR-NWR were estimated to be moderately adverse for the remaining population, of high intensity and medium term in duration.

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

[236] Moorcroft and Barrowcliffe. et al..,2015. *Land-use Planning & Development Control: Planning for Air Quality*. Institute of Air Quality Management: London.

WATER QUALITY: EVIDENCE

5.7.51 Airports typically host activities that can generate discharges of potential contaminants[237]. Water has interactions with communities including issues relating to water resources (quality and availability), waterscape, and amenity value. Airport expansion has the potential to impact the surface water and groundwater quality during construction and operation from pollutants leached into groundwater or run-off to local waterbodies. These pollutants can include sediment (construction) and fuel, oil, grease, detergents, de-/anti-icing chemical wastes, metals[238], alkalis, acids, and organic solvents (operation); which can be toxic[239].

5.7.52 Pollutants from airport activities may contaminate groundwater and surface water supplies if allowed to flow to storm drains or waterways[240].

5.7.53 During periods of low temperatures, it is standard practice at airports to use de-/anti-icing substances. After use, the fluid typically mixes with stormwater runoff and may enter waterbodies. There principal environmental impacts include reduced dissolved oxygen in receiving waters, potential toxicity and impaired fishery within the watershed[241,242,243]. Additionally, nitrogen compounds may be formed as a result of the biodegradation of urea (often used in de-/anti-icing fluid) and are responsible for accelerated eutrophication of waters[244]. This environmental damage may reduce the amenity/recreational value and aesthetic appreciation of a water body or waterscape.

5.7.54 Fire training facilities are also an airport pollutant source releasing aqueous fire-fighting foams which contaminate entire watercourses[245], potentially binding with particles and accumulating in the food chain[246]. Aqueous fire-fighting foams can therefore pose a potential threat to human drinking water reservoirs[247].

5.7.55 Typically an airport development will not be allowed to go ahead unless it puts measures in place to treat the chemicals and other pollutants from surface water or rainwater run-off[248]. However, during hard rains the drains and their controls can be overwhelmed, and pollution of waterbodies can occur[248].

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[237] Davis, R. et al., 2014. *Critical Issues in Aviation and the Environment 2014, Water Quality*. [online] Accessed 06/07/2016.
[238] Gnecco, I. et al., 2008. Speciation of Zinc and Copper in Stromwater Pavement Runoff from Airside and Landside Aviation Land Uses. *Water, Air, and Soil Pollution*, **192**, 321-336.
[239] Sulej, A. M. et al, 2012. Pollutants in airport runoff waters. *Critical Reviews in Environmental Science and Technology*, **42**, 1691-1734.
[240] United States Government Accountability Office, 2010. *Aviation and the Environment: Systematically Addressing Environmental Impacts and Community Concerns Can Help Airports Reduce Project Delays*, p. 9. [online] Accessed 06/07/2016.
[241] Siedlecka, E.M. and Downar, D., 2004. *Quality of water from airport Gdansk-Trojmiasto region*. Ecological Chemistry and Engineering, 11, 557.
[242] Koryak, M. et al., 1998. *The Impact of Airport De-icing Runoff on Water Quality and Aquatic life in a Pennsylvania Stream*. Journal of Freshwater Ecology, **13**, 287-298.
[243] Switzenbaum, M. S. et al., 2001. *Best management practices for airport de-icing stormwater. Chemosphere*, **43**, 1051-1062.
[244] Siedlecka, E.M. and Downar, D., 2004. *Quality of water from airport Gdansk-Trojmiasto region*. Ecological Chemistry and Engineering, 11, 557.
[245] Ahrens, L. et al., 2015. *Stockholm Arlanda Airport as a source of per- and polyfluoroalkyl substances to water, sediment and fish*. Chemosphere 129: 33-38.
[246] Ahrens, L. et al., 2010. *Distribution of polyfluoroalkyl compounds in water, suspended particulate matter and sediment from Tokyo Bay, Japan*. Chemosphere, 79, 266–272.
[247] Ahrens, L. et al., 2015. *Stockholm Arlanda Airport as a source of per- and polyfluoroalkyl substances to water, sediment and fish*. Chemosphere 129: 33-38.
[248] Aviation Environment Federation, Unknown. Planning – *What are an airport's impacts?*. [online] Accessed 07/07/2016.

WATER QUALITY BASELINE: GATWICK

5.7.56 The Water Framework Directive (WFD) status of water bodies within the Gatwick study area, which include seven watercourses and one groundwater body, have been identified in the Water and Flood Risk Baseline Report[249]. Biological elements of assessed water bodies in the Gatwick study area, located across 10 km from the shortlisted scheme boundary, were mainly classified as 'Moderate' or 'Poor' under the WFD.[249] Three of the four assessed rivers were classified as having poor status for fish whilst five out of six were classified as having moderate or poor status for invertebrates.[249]

5.7.57 Within the Gatwick study area two rivers and one groundwater body have been assigned an overall chemical quality, with all achieving Good Status. Two of the seven water bodies within the study area are classified as 'Heavily Modified Water Bodies' and flow around the outskirts of Gatwick Airport.[250].

5.7.58 The Ecosystem Services Assessment (ESA) undertaken by the AC[251] identified benefits obtained from the regulating services function of ecosystem processes, such as the regulation of water quality and water flow. This is important for reservoirs, rivers and ground water.

5.7.59 Water bodies are likely to be put under considerable pressure over the next century through increased water demand and discharge from the existing airport and surrounding infrastructure.[252]

WATER QUALITY BASELINE: HEATHROW

5.7.60 In the area around LHR-NWR there a number of water bodies, comprising of eight watercourses, five lakes, and one groundwater identified as WFD water bodies for LHR-NWR and 15 watercourses, six lakes and one groundwater for LHR-ENR.[253] The majority of these are classified as Artificial/Heavily Modified Water Bodies.[254]

5.7.61 For the LHR-NWR, three out of four waterbodies were assessed to have a Moderate or higher status for fish, and five out of six were classified as Moderate status or higher for invertebrates.[255] All five of the lake water bodies in the study area have been assessed for phytoplankton, of which one is achieving high, two are good, one is moderate and one is poor.[255] The groundwater is the Lower Thames Gravels which currently is assessed to be achieving good Ecological Status. More detailed analysis of water quality in discharges from the Airport are not available at the strategic level.

5.7.62 A further six watercourses and one lake were assessed within LHR-ENR. Five out of the six watercourse waterbodies were assessed to have a Moderate or higher status for fish, and six out

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[249] Jacobs, 2014. *9. Water and Flood Risk: Baseline,* p. 12. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372156/9-water-and-flood-risk--baseline.pdf) Accessed 05/01/2016.

[250] Jacobs, 2014, *Water and Flood Risk: Baseline*, p. 13. [online] Accessed 05/01/2016

[251] Jacobs 2014, *7. Biodiversity: Ecosystem Services*. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372448/7-biodiversity--ecosystem-services.pdf) Accessed 20/06/2016.

[252] WSP | Parsons Brinckerhoff, 2016. Appendix A7 AoS Water. Accessed 30/06/2016.

[253] Jacobs, 2014. *9. Water and Flood Risk: Baseline.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372156/9-water-and-flood-risk--baseline.pdf) Accessed 05/01/2016.

[254] Jacobs, 2014. *9. Water and Flood Risk: Baseline,* p. 38. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372156/9-water-and-flood-risk--baseline.pdf) Accessed 05/01/2016.

[255] Jacobs, 2014. *9. Water and Flood Risk: Baseline,* p. 40. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372156/9-water-and-flood-risk--baseline.pdf) Accessed 05/01/2016.

of seven were classified as Moderate status or higher for invertebrates'. No changes to the other waterbodies were reported.

5.7.63 The ESA undertaken by the AC251 identified benefits obtained from the regulating services function of ecosystem processes, such as the regulation of water quality and water flow. This is important for reservoirs, rivers and ground water.

5.7.64 Water bodies are likely to be put under considerable pressure over the next century through increased water demand and discharge from the existing airport and surrounding infrastructure.

WATER QUALITY ASSESSMENT: LGW-2R

5.7.65 LGW-2R could impact surface water and groundwater quality from polluted runoff during construction and operation. This could result in health impacts and loss of recreation resource (reduction in fish stocks or aesthetic appeal). The development would lead to a decrease in pesticides and herbicides applied to the land due to change from agricultural use, which could have a beneficial impact on water quality and hence on overall health. It is assumed that measure proposed by the promoter as part of their proposal to reduce the risks to water quality during construction and operation would be implemented, however, there will be some residual pollution at times.

5.7.66 Risk during construction is posed if contaminants are mobilised from the historic landfill within the proposed footprint of this shortlisted schemes development.

5.7.67 Direct human health effects resulting from changes in water quality as a consequence of LGW-2R would be isolated to contamination of the food-chain locally. Due to the remote nature of this occurrence, the health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.

5.7.68 An active wetland would be considered to improve water quality at the discharge point, which has been included in the promoter's shortlisted scheme design together with other measures. All runoff flows would be pumped to a balancing tank and treated via an active wetland treatment system. In addition, centralised de-icing facilities would be used to limit contaminated runoff; and, de-icer contaminated runoff would be managed through a positive drainage system and storage lagoon. This is expected to be effective at typically eliminating the risk of runoff pollution causing effects on human health.

5.7.69 Discharges could affect Glovers Wood SSSI which is hydrologically connected via minor watercourses to Gatwick although it is unlikely given its location upstream of the airport. If this was to be affected, people's ability to enjoy this woodland may be reduced.

5.7.70 Indirect adverse human health effects resulting from changes in water quality as a consequence of LGW-2R would include loss of habitat, or loss of fishing assets locally. Due to the remote nature of this occurrence and low impact upon human health, the health outcome has been assessed as being moderately adverse, moderate intensity and temporary in duration during construction and neutral during the operational phase of the expanded airport.

WATER QUALITY ASSESSMENT: LHR-ENR

5.7.71 LHR-ENR could impact surface water and groundwater quality from polluted runoff during construction and operation, including sediment (construction) and de-icers, cleaning agents and cadmium (operation). This would also lead to a decrease in pesticides and herbicides applied to the land. It is assumed that measure proposed by the promoter as part of their proposal to reduce the risks to water quality during construction and operation would be implemented however, there will be some residual pollution at times.

5.7.72 Currently two of the WFD waterbodies in the LHR-ENR area are classified as having a 'Failing' chemical status, so a potential increase in pollutants could have a more magnified impact on these water bodies. Although water quality standards set by the WFD are not prescribed directly for the protection of human health, the higher levels of pollutants could have an adverse effect on human health, causing illness or reduced ability to enjoy the water body/waterscape recreationally.

5.7.73 Mitigation measures identified within the promoters proposal, including surface water quality monitoring and water treatment should ensure that if adverse impacts on water quality during construction are acted upon to ensure human health is not affected.

5.7.74 Direct human health effects resulting from changes in water quality as a consequence of LHR-ENR would be isolated to contamination of the food-chain locally. Due to the remote nature of this occurrence, the health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.

5.7.75 There is potential for hydrological conditions to be altered on Staines Moor SSSI and Southwest London Waterbodies Special Protection Area (SWLW SPA). There would also be works directly adjacent to King George VI Reservoir, which forms part of Staines Moor SSSI and SWLW SPA and nearby Wraysbury Reservoir (also part of the SWLW SPA). This could have adverse or beneficial effects on water quality, depending on design, and hence an impact on health if these site are used recreationally.

5.7.76 Indirect adverse human health effects resulting from changes in water quality as a consequence of LHR-ENR would include loss of habitat, or loss of fishing assets locally. Due to the remote nature of this occurrence and low impact upon human health, the health outcome has been assessed as being moderately adverse, moderate intensity and temporary in duration during construction and neutral during the operational phase of the expanded airport.

WATER QUALITY ASSESSMENT: LHR-NWR

5.7.77 LHR-NWR could impact surface water and groundwater quality from polluted runoff during construction and operation, including sediment (construction) and de-icers, cleaning agents and cadmium (operation). This would also lead to a decrease in pesticides and herbicides applied to the land. It is assumed that measure proposed by the promoter as part of their proposal to reduce the risks to water quality during construction and operation would be implemented, however, there will be some residual pollution at times. Mitigation measures identified within the promoter's design, including dedicated areas for de-icing aircraft, glycol recovery procedure and monitoring, are expected to be effective at typically eliminating the risk of runoff pollution causing effects on human health. This would therefore result in no increase impacts on sensitive subgroups, such as the young, older people and pregnant women.

5.7.78 Direct human health effects resulting from changes in water quality as a consequence of LHR-NWR would be isolated to contamination of the food-chain locally. Due to the remote nature of this occurrence, the health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.

5.7.79 There is potential for hydrological conditions to be altered on Staines Moor SSSI from diversion of the River Colne and this would need to be addressed during detailed design. There are also a number of reservoirs and gravel pits which make up the SWLW SPA further downstream from the Airport. If these locations were to be effected, people ability to enjoy them may be reduced.

5.7.80 Indirect adverse human health effects resulting from changes in water quality as a consequence of LHR-NWR would include loss of habitat, or loss of fishing assets locally. Due to the remote nature of this occurrence and low impact upon human health, the health outcome has been

assessed as being moderately adverse, moderate intensity and temporary in duration during construction and neutral during the operational phase of the expanded airport.

SOIL QUALITY: EVIDENCE

5.7.81 Soils significantly influence a variety of functions, such as plant growth and the cycling of water, that sustains the human population and affect human health[256]. Environmental impacts of airports on soils are similar to those of many industries, though their operations expand over a very large area[257].

5.7.82 Two main impacts on soil are likely to be soil loss and soil contamination[258], both of which can have associated human health impacts. Typically urban development and agriculture are competing for the same land[259,260]. Airport developments have led to important loss of fertile and productive soils and cause large areas of impervious surface[261]. This causes partial or total loss of soils for plant production and habitats, as well as an increase in floods and health and social costs[262]. The direct loss of land is address within the Land Use topic. A reduction in soil quality may reduce the lands ability to produce crops, for example crop yields may deteriorate from urban smog, theft, and vandalism[263].

5.7.83 Hazards materials and heavy metals have been found in soils within, or contiguous to, airports. Sources of soil pollution at airports include fuel and chemical storage, leaking, spillage, washing of aircraft and vehicles, atmospheric deposition, winter operation and fire-training[264]. This may damage soil and water ecosystems and affect agricultural production, drinking water quality and recreational value[265]. This will have an adverse impact on public health, although it is not easy to assess its significance and intensity.

5.7.84 The use of de-/anti-icing fluid at airports contaminates soils and has environmental and health impacts[266]. The reported effects at lower inhalatory exposures are headaches and irritation of eyes and upper respiratory tract[267] and ingestion leads to kidney damage.

5.7.85 Polycyclic aromatic hydrocarbons (PAHs) airport soil contamination due to jet turbine exhaust has been reported[268,269]. Many PAHs have toxic, mutagenic and/or carcinogenic (cancer causing)

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256 Abrahams, P. W., 2002. *Soils: their implications to human health*. Science of The Total Environment, 291, 1-32.
257 Nunes, et al., 2011. *Environmental impacts on soil and groundwater at airports: Origin, contaminants of concern and environmental risks*. Journal of Environmental Monitoring, 13, 3026-3039.
258 Rodrigue, J-P. et al., 2009. *The Geography Transport System*. Routledge: Oxon.
259 Doygun, H. et al., 2007. *Environmental Monitoring and Assessment*, 145, 387-395.
260 Morello, J. et al., 2000. *Urbanisation and the consumption of fertile land and other ecological changes: the case of Buenos Aires*. Environment & Urbanisation. 12, 119-131.
261 Davis, R. et al., 2014. *Critical Issues in Aviation and the Environment 2014, Water Quality*. (http://onlinepubs.trb.org/onlinepubs/circulars/ec184.pdf) Accessed 06/07/2016.
262 Burghardt, W., 2006. *Soil sealing and soil properties related to sealing*. Geological Society, London Special Publications, 266, 117-124.
263 Heimlich, R. E. and Anderson, W. D., 2001. *Development at the Urban Fringe and Beyond: Impact on Agriculture and Rural Land*. US Department of Agriculture: Washington DC.
264 National Resources Defence Council, 1996. *Flying off course*. Environmental impacts of America's airports. New York: NRDC.
265 Health Council of the Netherland, 1999. *Public health impact of large airports*. Health Council of the Netherland: The Hague.
266 Ramakrishna, D. N. and Viraraghavan, T., 2005. *Environmental Impact of Chemical De-icers* – A review. Water, Air, and Soil Pollution, 166, 49-63.
267 Health Council of the Netherland, 1999. *Public health impact of large airports*. Health Council of the Netherland: The Hague.
268 Ray, S. et al., 2008. *Assessment of PAHs in soil around the International Airport in Delhi, India*. Journal of Hazardous Materials. 156, 9-16.
269 Crepineau-Ducoulombier, C. and Rychen, G., 2003. Assessment of soil and grass Polycyclic Aromatic Hydrocarbon (PAH) contamination levels in agricultural fields located near a motorway and an airport. Agronomie, 23, 345-348.

properties[270]. There is therefore a risk to airport workers and other people that may come into contact with contaminated airport soil. It has also been acknowledged as a potential risk to the food chain via the ruminant[271]. Soils surrounding airports have also been found to be contaminated with Cadmium and Lead[272], which are both classified as human carcinogens by several regulatory agencies[273]. Other chemicals with carcinogenic, endocrine disrupting and toxic effects have also been found at, or near to, airports.[269]

5.7.86 Overall, the risk to human health posed by contaminated soil depends on the potential extent of exposure to soil and on the toxic properties of the contaminants. Children's physiology and behaviour may put them at higher risk from environmental exposures[274]. However, they are highly unlikely to be in contact with airport contaminated soils; however airport and constructions workers could become exposed to contaminated airport soils, if proper precautions are not taken.
Soil quality baseline: LGW-2R, LHR-ENR and LHR-NWR

5.7.87 Soil is a non-renewable resource and urban development and construction of transport infrastructure are the main causes of almost irreversible net soil loss and sealing. Soil sealing prevents the soil from performing other functions such as food and fibre production, water infiltration and drainage. The ESA undertaken on behalf of the AC acknowledges the value of agricultural land for food provision, particularly food crops.[251]

5.7.88 A range of sources and pathways for contamination have been identified within all three site boundaries.[275] These include a historical landfill, licensed waste management facility, registered pollution incidents, agriculture on adjacent land and various industrial and military uses.

SOIL QUALITY: BASELINE

5.7.89 No "substantial" soil contamination at LGW-2R was identified or predicted by Jacobs Engineering UK Ltd. in a contaminated land assessment of the Pier 1 and Pier 2 areas of the site (the existing southern and central aircraft stands attached to the South Terminal building) undertaken in 2010[276]. A further five registered pollution incidents are identified within 250 m of the site (one of which is classed as significant).

5.7.90 The baseline conditions at LHR-ENR are considered to be broadly comparable to LHR-NWR with both situated in a similar location.[277] Sources of contamination have been identified and include Historical landfills and industrial activity, and a fuel support pipeline leak in 2010.

5.7.91 Various other historic on- and off-site land uses have been identified as potential contamination sources, including a fire engine house, a road research laboratory, gravel pits, a sand and ballast works, an energy from waste plant, a disused railway, various fuel stations and several large distribution warehouses. A press report dated September 2010 indicates a fuel support pipeline leak in which at least 139,000 litres of aviation fuel entered the ground affecting the groundwater

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[270] Abdel-Shafy, H. I. and Mansour, M. S. M., 2016. A review on polycyclic aromatic hydrocarbons: Source, environmental impact, effect on human health and remediation. Egyptian Journal of Petroleum, 25, 107-123.
[271] Crepineau-Ducoulombier, C. and Rychen, G., 2003. Assessment of soil and grass Polycyclic Aromatic Hydrocarbon (PAH) contamination levels in agricultural fields located near a motorway and an airport. Agronomie, 23, 345-348.
[272] Ray, S. et al., 2012. The Effect of Aircraft Traffic Emissions on the Soil Surface Contamination Analysis around the International Airport in Delhi, India. Asian Journal of Atmospheric Environment, 6, 118-126.
[273] Mohajer, R. et al., 2013. The status of lead and cadmium in soils of high prevalence gastrointestinal cancer region of Isfaham. Journal of Research in Medical Sciences, 18, 210-214.
rics, 113, 996-1006
[275] Jacobs, 2014. *10. Place: Assessment,* p. 113. [online] Accessed 24/12/2015.
[275] Jacobs, 2014. *10. Place: Assessment,* p. 113. [online] Accessed 24/12/2015.
[276] Jacobs, 2010. *Gatwick Airport – Pier 1 and Pier 2 Developments – Contaminated Land Site Investigation Interpretative Report*. [online] Accessed 08/09/2016.
[277] Jacobs, 2014. *10. Place: Assessment*, p. 152. [online] Accessed 24/12/2015.

at Heathrow.

SOIL QUALITY: ASSESSMENT

5.7.92 Expansion has the potential to effect soil quality through erosion, contamination and degradation, may pose a risk to human health. Construction and operation activities have the potential to pollute soils. The resulting contaminated soil poses a risk to the health of humans that may have contact with this soil. This is likely to be most significant for airport or construction workers. The soil may also have a reduced agricultural use, effecting human health through possible local food security issues in the long term.

5.7.93 During the construction phase, it is anticipated that risks to human health may arise if construction workers are exposed to soils or Made Ground affected by land contamination, particularly in areas of excavation, tunnelling, or levelling. For example, there is a potential for previously unidentified underground structures which pose a risk to human, particularly accumulation of ground gases is occurring. Dusts and odours may also be produced during construction and off-site disposal, particularly in association with the disturbance of historical landfill or industrial materials, which could have health impacts, surface water contamination and effect the enjoyment associated with the use of surrounding land/property. Construction activities have the potential to create pathways allowing contaminated materials to migrate to groundwater or surface water. This could result in the health impacts identified in for the water topic.

SOIL QUALITY ASSESSMENT: LGW-2R, LHR-ENR AND LHR-NWR

5.7.94 Likely human health outcomes resulting from contamination from airport soils resulting from LGW-2R, LHR-ENR and LHR-NWR would include increased cancer risk, headaches, respiratory symptoms and kidney damage. The potential impact from these health outcomes occurring have been assessed as minor adverse during construction and neutral during airport operation. Airport and constructions workers are likely to be vulnerable groups due to the increased potential to become exposed to contaminated airport soils.

SOIL QUALITY ASSESSMENT: LGW-2R, LHR-ENR AND LHR NWR

5.7.95 Human health outcomes resulting from contamination from airport soils resulting from all three scheme proposals are anticipated to be the same, and could include; increased cancer risk, headaches, respiratory symptoms and kidney damage. Airport and constructions workers are the population likely to be affected, due to the increased potential to become exposed to contaminated airport soils. The potential impact from these health outcomes occurring have been assessed as major adverse, low intensity and short-term in duration during construction and neutral during airport operation.

NOISE: EVIDENCE

5.7.96 The health impacts of environmental noise are widely acknowledged. A number of reviews of impacts have been published (for example, WHO 2011[278],) which highlight potential impacts on cardio-vascular disease, cognitive impairment and sleep disturbance and annoyance.

[278] WHO, 2011. *Burden of disease from environmental noise: Quantification of healthy life years lost in Europe. [online]*

5.7.97 WHO consider the health burden of environmental noise in terms of Disability-Adjusted Life Years (DALYs). One DALY can be thought of as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability.

5.7.98 Therefore any noise impacts resulting in one DALY lost can be thought of as one lost year of 'healthy life'. DALYs considers life expectancy and the incidence of disease, weighted by the severity of the disease (from zero to 1, where 0 is perfect health and 1 is year of life lost).

5.7.1 Years Lost due to Disability (YLD) are calculated by multiplying the incident cases by duration and disability weight for the condition. The assessment of health effects is based on the existing monetisation analysis[279], which includes an assumed range of values for the 'disability weighting'[280] for annoyance, sleep disturbance and AMI effects, reflecting the expected uncertainty with regards to population health outcomes. The disability weighting values used for sleep disturbance were 0.04 (low), 0.07 (mid) and 0.1 (high). The weightings applied for annoyance were 0.01 (low), 0.02 (mid) and 0.12 (high). The weighting used for AMI was 0.405.

5.7.2 WHO estimate that, in EU Member States and other western European countries, DALYs lost are 61,000 years for ischaemic heart disease, 45,000 years for cognitive impairment of children, 903,000 years for sleep disturbance and 654,000 years for annoyance. Swift [281] provided a review of impacts in the vicinity of airports, focussing on sleep disturbance and stress as pathways leading to eventual cardiovascular outcomes and the potential mis-attribution of certain conditions, e.g. obesity and diabetes, as confounding factors whereas these conditions themselves may have resulted from sleep disturbance.

5.7.3 An N70 contour has been used to define the loss of tranquillity (where N70 is the number of noise events above 70 dB(A) per day) has, where possible, been applied as an indication of audible disturbance and loss of tranquillity. The 70 dB(A) level was chosen as an external single noise event will be attenuated by approximately 10 dB(A) by the fabric of a house with open windows. The resulting internal noise level of 60 dB(A) is the noise level which is likely to interfere with conversation or with listening to the radio or the television.

5.7.4 The range of potential impacts is described in more detail below and with reference to specific studies.

SLEEP DISTURBANCE

5.7.5 Environmental noise can be a significant cause of sleep disturbance. Poor sleep causes endocrine and metabolic measurable perturbations and is associated with a number of cardiovascular, psychiatric and social negative outcomes both in adults and children. Nocturnal environmental noise also provokes measurable biological changes in the form of a stress response, and clearly affects sleep architecture, as well as subjective sleep quality.

[279] Jacobs, 2014. *5. Noise: Local Assessment.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372488/noise--local-assessment.pdf) Accessed 21/12/2015.
[280] World Health Organisation, 2011. *Burden of disease from environmental noise.* (http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf) Accessed 03/05/2016.
[281] *A Review of the Literature Related to Potential Health Effects of Aircraft Noise*, Hales Swift, Purdue University, 2010.

5.7.6 Noise imposed sleep perturbations are similar in their nature to those observed from other sleep disorders associated with ill health. Apart from these measurable effects and the subjective feeling of disturbed sleep, people who struggle with nocturnal environmental noise often also suffer the next day from daytime sleepiness and tiredness, annoyance, mood changes as well as decreased wellbeing and cognitive performance.

5.7.7 There is emerging evidence that these short-term effects of environmental noise, particularly when the exposure is nocturnal, may be followed by long-term poor cardiometabolic outcomes. Nocturnal environmental noise may be the most worrying form of noise pollution in terms of its health consequences because of its synergistic direct and indirect (through sleep disturbances acting as a mediator) influence on biological systems.

5.7.8 Duration and quality of sleep needs to be regarded as risk factors or markers significantly influenced by the environment and possibly amenable to modification through both education and counselling as well as through measures of public health. One of the means that should be proposed is avoidance at all costs of sleep disruptions caused by environmental noise.

CARDIOVASCULAR HEALTH

5.7.9 Aircraft noise exposure has been linked to increased risk of poor cardiovascular health. Occurrences of hypertension (high blood pressure), heart attack, and stroke, increase by 7 to 17%[282] with every 10dB increase in either aircraft or road traffic noise exposure. A study of exposure to aircraft noise around Heathrow found that people exposed to high levels of aircraft noise had a 24% higher chance of stroke, 21% higher chance of heart disease, and 14% higher chance of cardiovascular diseases compared to those exposed to low levels of aircraft noise.

PSYCHOLOGICAL HEALTH

5.7.10 Long term noise exposure is believed to have an influence on psychological health, although, with the exception of annoyance, there is not as strong a link as for other health outcomes.

5.7.11 Annoyance[283], rather than aircraft noise levels, has been reported as being more closely associated with lower quality of life in some studies of residents' responses to aircraft noise.[284]

5.7.12 Within studies of the effect of aircraft noise on children around London Heathrow, there was no detected effect of aircraft noise on children's psychological health or cortisol levels (which can be raised in children with depression).[285,286] Though study results have suggested that chronic aircraft noise exposure is associated with impaired reading comprehension.[287]

5.7.13 A recent review of the health effects of noise exposure in children[287], suggested generic school noise exposure can have a detrimental effect on children's cognitive skills such as reading and memory, and other studies have suggested exposure of children to noise is associated with

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[282] Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., et al.,2014. *Auditory and non-auditory effects of noise on health*. Lancet, 383, 1325-1332.

[283] http://publicapps.caa.co.uk/docs/33/ERCD1006.pdf

[284] Schreckenberg, D., Meis, M., Kahl, C., Peschel, C., & Eikmann, T. 2010. *Aircraft noise and quality of life around Frankfurt Airport*. International journal of environmental research and public health, 7, 3382-3405.

[285] Haines, M.M., Stansfeld, S.A., Brentnall, S., Head, J., Berry, B., Jiggins, M., et al. 2001a. *The West London Schools Study: the effects of chronic aircraft noise exposure on child health*. Psychological Medicine, 31, 1385-1396.

[286] Haines, M.M., Stansfeld, S.A., Job, R.F., Berglund, B., & Head, J. (2001b). *Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children* Psychological Medicine, 31, 265-277.

[287] Stansfeld, S., & Clark, C. (2015). *Health effects of noise exposure in children*. Current Environmental Health Reports.

increased hyperactivity symptoms.[288]

5.7.14 From the few studies on the effects of aircraft noise on adult psychological health, one found that there was a 28% increase in anxiety medication use corresponding with a 10dB increase in day-time noise (measured as L_{Aeq} 16 hour) and a 27% increase with 10dB increase in night-time aircraft noise.[289]

5.7.15 There was no association between sleep medication or anti-depressant medication use and day or night-time exposure to aircraft noise.[290]

NOISE IMPACTS ON EDUCATIONAL ATTAINMENT

5.7.16 Several studies have demonstrated that aircraft noise exposure, at school[291], has detrimental impacts on children's reading comprehension or memory skills.[292] Though one study suggested that the main focus of effects of aircraft noise upon children should be at school rather than at home.[293]

5.7.17 The exposure-response relationship between aircraft noise at school and reading comprehension has indicated that, as aircraft noise exposure increases, performance on reading tests decreases[294]. In the UK study, reading age was delayed by up to 2 months for a 5dB increase in aircraft noise exposure.

NOISE BASELINE

5.7.18 The noise baseline in the AC work was considered in relation to the current potential population exposure in the vicinity of the airports and, in addition, for future conditions in the base year (2030), intermediate year (2040), and end year (2050) without airport expansion[295]. This data is available for this determinant as was part of the work undertaken by the AC.

5.7.19 Future baseline noise levels took into account changes to the type of aircraft to be operated over the period which, by 2050, will comprise an increased percentage of new or re-engined aircraft. These are likely to be quieter than current aircraft. It is anticipated that locally these fleet changes would lead to a reduction in the size of areas subjected to the current noise levels in the future assessment. An increase in ground noise is expected in the future, due to increases in traffic flows (not associated with airport expansion schemes).

5.7.20 Additional noise benefits are expected from the increased use of quieter operating procedures such as steeper approaches, continuous climb and delayed deployment of landing gear.

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[288] Stansfeld, S.A., Clark, C., Cameron, R.M., Alfred, T., Head, J., Haines, M.M., et al. (2009). *Aircraft and road traffic noise exposure and children's mental health* Journal of Environmental Psychology, 29, 203-207.

[289] Babisch, W., Houthuijs, D., Pershagen, G., Cadum, E., Katsouyanni, K., Velonakis, M., et al. (2009). Annoyance due to aircraft noise has increased over the years--results of the HYENA study. Environment International, 35, 1169-1176

[290] 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*. Environmental Health Perspectives, 116, 329-333.

[291] Stansfeld, S.A., Berglund, B., Clark, C., Lopez-Barrio, I., Fischer, P., Ohrstrom, E., et al. (2005). *Aircraft and road traffic noise and children's cognition and health: a cross-national study*. Lancet, 365, 1942-1949.

[292] Evans, G.W., & Hygge, S. (2007). *Noise and performance in children and adults*. In Noise and its effects. In L. Luxon, & D. Prasher (Eds.), Noise and its effects. London: Whurr Publishers.

[293] Stansfeld, S.A., Hygge, S., Clark, C., & Alfred, T. (2010). *Night time aircraft noise exposure and children's cognitive performance*. Noise and Health, 12, 255-262.

[294] Clark et al., 2006 Clark, C., Martin, R., van Kempen, E., Alfred, T., Head, J., Davies, H.W., et al. (2006). *Exposure-effect relations between aircraft and road traffic noise exposure at school and reading comprehension* - The RANCH project. American Journal of Epidemiology, 163, 27-37.

[295] Airport Commissions Noise Baseline, November 2014

NOISE BASELINE: GATWICK

5.7.21 The population density of the area surrounding Gatwick is less than 5,000 people/km^2 with exceptions in the more densely populated towns of Horley, Crawley, East Grinstead and Horsham (The UK's highest population density of 14,517 people/km^2 can be found in Islington, the UK's highest population density outside of London is 5,141 people/km^2 in Portsmouth[296]). The study area for the AC noise assessment (previously Figure 3.2), was set with reference to the future year do minimum and with airport expansion scenario modelling and, therefore, can be considered an initial indication of the population potentially exposed to changed noise climate with the airport expansion.

5.7.22 Surface noise arising from the operation of Gatwick airport includes airside support vehicles, traffic movements (e.g. A23) and movements of trains both entering and departing Gatwick station.

5.7.23 Due to its relatively rural location and sparsely populated wider local area, the population exposed to any measure of noise, whether originating from airspace or ground, around Gatwick is likely to be less than that immediately surrounding Heathrow. This is illustrated in Table 5-12 which sets out the population current exposed (2013) and likely to be exposed in the future (2030) to noise above 57dB $L_{Aeq\ 0700\text{-}2300hrs}$ (level of A-weighted noise detected between 0700hr to 2300hrs).[297] This is the level at which there is the onset of significant community annoyance. Other noise exposure measures shown similar trends.

Table 5-12 Baseline local population exposure for 2013 and 2030 within >57 dB $L_{Aeq\ 0700\text{-}2300hrs}$ (level of A-weighted noise detected between 0700hr to 2300hrs) from airspace noise and ground noise

Noise Origin	Gatwick Population Noise Exposure (≥ 57 dB $L_{Aeq,0700\text{-}2300hrs}$)		Heathrow Population Noise Exposure (≥57 dB $L_{Aeq,0700\text{-}2300hrs}$)	
	Current (2013)	2030	Current (2013)	2030
Airspace	3,550	2,700	266,100	217,300
Ground	900	3,150	30,650	30,750

5.7.24 The current impacts on health (expressed as DALYs lost as a result of health outcomes including annoyance, sleep disturbance, AMI/heart attack, hypertension triggered strokes, hypertension triggered dementia, at a threshold 45dB$_{(A)}$)[298] of noise at Gatwick are dominated by impacts due to annoyance and, to a lesser degree, sleep disturbance. In the future, DALYs lost due to annoyance are expected to increase, but those due to sleep disturbance are expected to decrease in the medium term. By 2050, DALYs lost due to cardio-vascular disease become increasingly important.

[296] http://www.neighbourhood.statistics.gov.uk/HTMLDocs/dvc134_c/index.html
[297] Department for Transport, 2013. *Aviation Policy Framework*. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf) Accessed 21/12/2015. APF[297] Threshold Noise for the approximate onset of significant community annoyance
[298] Discussion Paper 05: Aviation Noise, July 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223764/airports-commission-noise.pdf

NOISE BASELINE: HEATHROW

5.7.25 The population density to the south and east of Heathrow is generally below 5,000 people/km^2, with the exception of Windsor and Slough (see previous Figure 3.4). Population densities increase to the north of Heathrow and, more substantially, to the east as you approach central London.

5.7.26 Surface noise arising from the operation of Heathrow airport will include airside support vehicles, traffic movements (e.g. M4, M25, A4, A30, A3044), rail and underground and movements of trains both approaching and moving away from departing Heathrow station. Surface noise immediately to the west and north of Heathrow airport is likely to be a particular issue, due to the close proximity of Motorways, trunk roads and to east due to the frequency and of both rail and underground trains making the journey to Heathrow throughout its hours of operation.

5.7.27 The current impacts on health (expressed as DALYs lost) of noise at Heathrow are dominated by impacts due to annoyance and sleep disturbance. In the future, DALYs lost due to annoyance are expected to increase, but those due to sleep disturbance are expected to decrease, particularly in the medium term. By 2050, DALYs lost due to cardio-vascular disease become increasingly important.[299]

5.7.28 The majority of additional surface noise impacts for all three shortlisted schemes are considered to be as a consequence of committed improvements to surface access provision, rather than airport expansion, which have not been included within this assessment. Therefore its impacts on health have not been included with this assessment.

NOISE ASSESSMENT FOR ALL THREE AIRPORT EXPANSION SCHEMES

5.7.29 Aircraft noise for the base year (2030), intermediate year (2040), and end year (2050) without airport expansion considered, in addition to the current noise situations at each airport were assessed.[300]

5.7.30 Changes to the type of aircraft to be operated over the period, and by 2050 will be significant, with an increased percentage of new or re-engined aircraft. These are likely to be quieter than current aircraft. It is anticipated that locally these fleet changes would lead to a reduction in the size of areas subjected to the current noise levels in the future assessment.

5.7.31 Additional noise benefits are expected from the increased use of quieter operating procedures such as steeper approaches, continuous climb and delayed deployment of landing gear.

[299] Airport Commissions Noise Baseline, November 2014 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372770/5._Noise-Baseline.pdf

[300] Airport Commissions Noise Baseline, November 2014 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372770/5._Noise-Baseline.pdf

5.7.32 In all the noise impact assessment scenarios, it was assumed that noise will be mitigated to an extent by the future development of quieter aircraft technologies, and the gradual incorporation of newer aircraft into the fleet mixes. Details on the fleet mixes used in the assessment have been published[301],[302].

5.7.33 In assessing the noise effects of each shortlisted scheme for the AoS, it was considered that greater weight should be placed on the assessments for the medium term (i.e. in the base year 2030), and lesser weight placed on the assessments for the long term (i.e. the intermediate and end years 2040 and 2050). This is because the long term assessments increasingly rely on the assumed improvements in technology and anticipated operational changes, with corresponding increases in associated uncertainty.

NOISE ASSESSMENT: LGW-2R

5.7.34 The local ground noise assessment for LGW-2R indicates that the total population exposure to the >57 dB $L_{Aeq, 0700-2300}$ [303] contour in 2030 is expected to remain very similar to the baseline current situation, and reduced compared with the do minimum in the medium term (2030), since, in the do minimum case, exposure to ground noise is expected to increase. Nonetheless, a residual population exposed to the >57 dB $L_{Aeq, 0700-2300}$ contour is expected for LGW-2R.

5.7.35 Local effects of ground noise for LGW-2R are considered to be mixed minor beneficial/moderate adverse, of medium intensity and long-term in duration. Since a residual population would remain exposed to ground >57 dB $L_{Aeq, 0700-2300}$ with the LGW-2R scheme, but this is expected to be a smaller number than exposed in the do minimum.

Table 5-13 Estimated Changes as a consequence of LGW-2R in Disability Adjusted Life Years Lost (DALYs) Compared with Do Minimum, by Health Effect (Assessment of Need Carbon Traded)

HEALTH EFFECTS	2030			2040			2050		
	Disability Weightings								
	Low	**Medium**	**High**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Annoyance	41	83	494	54	109	651	60	119	713
Sleep Disturbance	29	51	73	26	45	64	32	55	78
AMI	17	17	17	22	22	22	29	29	29
HT Strokes	1	1	1	1	1	1	1	1	1
HT Dementia	1	1	1	1	1	1	3	3	3
Total	90	154	587	105	179	739	125	208	825

NOTE: Decreases indicated by values in parentheses.
Total DALYs are calculated from the total health cost values, not from summation of the separate effects, which are based on rounded data.

5.7.36 The changes in the total DALYs lost over a 60-year design life period were estimated at 3486 (for

[301] Appendix A.3, Jacobs, 2015. *5. Noise: Local Assessment Addendum. Prepared for the Airports Commission. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437265/noise-local-assessment-addendum-heathrow-airport-extended-northern-runway-offset-route-and-single-exposure-level-contours.pdf)* Accessed 21/12/2015.

[302] Jacobs, 2014. *5. Noise: Baseline and Local Assessment Methodology Addendum. Prepared for the Airports Commission.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/389579/noise_methodology_addendum.pdf) Accessed 21/12/2015.

[303] >57 dB $L_{Aeq, 0700-2300\,r}$ – greater than 57 decibels over 16 hrs

the low disability weighting), 5810 (for the mid disability weighting), and 23239 (for the high disability weighting) for the 45 dB(A) threshold case.

5.7.37 The health effects assessment from aircraft noise as result of LGW-2R (Table 5-13) indicates:

- All assessed health effects are expected to result in additional DALYs lost compared with the do minimum;
- Annoyance, sleep disturbance and AMI effects dominate total estimated differences in DALYs lost for all disability weightings;
- Annoyance increasingly dominates the differences in total estimated DALYs lost as the disability weightings are increased;
- DALYs lost due to annoyance are expected to increase over the assessment period for all weightings;
- The difference in DALYs lost due to sleep disturbance are expected to be slightly lower in 2040 and 2050 compared with 2030; and
- AMI effects generate similar DALYs difference estimations in the 2030 and 2040 assessment years, are expected to be increased for the 2050 assessment.

5.7.38 It has been noted[304] that the LGW-2R scheme is expected to result in increases in exposure of schools to the >54 dB $L_{Aeq,0700-2300}$ daytime average noise level contour, and the N70>20 contour (where N70 is the number of noise events above 70 dB(A) per day), and some increases for exposure >57 dB $LAeq_{,0700-2300}$ (in 2050) and for N70>50 (2040 and 2050). Reductions in exposure are also expected for >57 dB (2030 and 2040), >60 dB and >63 dB $LAeq_{,0700-2300}$, and for N70>50 (2030), N70>100 and N70>200. These results can be interpreted as having mixed beneficial and adverse effects for children's cognitive development.

5.7.39 The effects of the LGW-2R scheme on the aircraft noise related health outcomes assessed are estimated to be moderate adverse[305] of moderate intensity and long-term in duration.

5.7.40 The combination of airspace and ground noise could lead to cumulative adverse effects for some areas. For example:

- For receptors exposed to airspace noise levels of at least 62 dB $L_{Aeq,\ 0700-2300}$, the addition of ground noise of 57 dB $L_{Aeq,\ 0700-2300}$ or more could push those areas above the significant observed adverse effect level; and
- For receptors exposed to airspace noise at levels of 68 dB $L_{Aeq,\ 0700-2300}$, ground noise would need to be at least 63 dB $L_{Aeq,\ 0700-2300}$ to push these areas above the upper adverse effect level.

5.7.41 It is estimated based on the available information that there are areas that could be brought above the thresholds by the combination of ground and airspace noise. For some areas, reductions in exposure to ground noise may to some extent be counteracted by increases in airspace noise; conversely some areas (particularly in close proximity to the north of the existing runway) may experience some reductions in both ground and airspace noise.

[304] Pages 21-22, Clark,C, 2015. Aircraft noise effects on health. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446311/noise-aircraft-noise-effects-on-health.pdf) Accessed 21/12/2015.
[305] There is no established guidance for describing the significance of lost DALYs in non-monetised terms.

5.7.42 The local cumulative effects of LGW-2R are considered to be minor beneficial/moderately adverse, of moderate intensity and long-term in duration.

NOISE ASSESSMENT: LHR-ENR

5.7.43 The local population assessment indicates that LHR-ENR would result in increases in exposure to all thresholds over the full assessment period, compared with the do minimum.

5.7.44 The local NSB assessment indicates that LHR-ENR would also result in increases in exposure to all adverse effect level over the full assessment period, compared with the do minimum.

Table 5-14 Estimated Changes as a consequence of LHR-ENR in DALYs Lost Compared with Do Minimum, by Health Effect (Assessment of Need Carbon Traded)

Health effects	2030			2040			2050		
	Disability Weightings								
	Low	**Medium**	**High**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Annoyance	440	882	5285	363	726	4360	331	662	3971
Sleep Disturbance	(245)	(428)	(613)	4	7	10	(199)	(349)	(498)
AMI	229	229	229	218	218	218	195	195	195
HT Strokes	23	23	23	22	22	22	20	20	20
HT Dementia	35	35	35	33	33	33	32	32	32
Total	482	739	4960	641	1008	4645	378	559	3720
NOTE: Decreases indicated by values in parentheses. Total DALYs are calculated from the total health cost values, not from summation of the separate effects, which are based on rounded data.									

5.7.45 The changes in the total DALYs lost over a 60-year design life period were estimated at 13,798 (for the low disability weighting), 20,334 (for the mid disability weighting), and 126,360 (for the high disability weighting) for the 45 dB(A) threshold case.

5.7.46 The health effects assessment from aircraft noise as result of the LHR-ENR second runway (Table 5-14) indicates:

- With the exception of sleep disturbance, all health effects are expected to result in increases in DALYs lost compared with the do minimum;
- DALYs lost due to sleep disturbance are expected to be reduced compared with the do minimum for all assessment years and all disability weightings;
- DALYs lost to all other assessed health effects are expected to be increased compared with the do minimum;
- The differences in total DALYs lost in the do something scenario are expected to be increased in 2040 compared with 2030, but reduced in 2050 compared with 2030;
- Annoyance, sleep disturbance and AMI effects dominate total estimated values of DALYs lost for all disability weightings; and
- Annoyance becomes the dominant adverse health effect as the disability weightings are increased.

5.7.47 Local effects of airspace noise for LHR-ENR are considered to be major adverse.

5.7.48 The local ground noise assessment for LHR-ENR indicates that the total population exposure to the >57 dB $L_{Aeq, 0700-2300}$ threshold is expected to reduce compared with the do minimum in the medium term (2030). Although a reduction in exposure is expected compared with the do minimum, a significant residual population could remain exposed to ground noise exceeding 57 dB $L_{Aeq, 0700-2300}$. Therefore, local effects of ground noise for LHR-ENR are considered to be mixed moderate beneficial/moderate adverse, of medium intensity and long-term in duration.

5.7.49 The impact of modifying the annoyance and sleep disturbance effects thresholds from 45dB(A) to 48 dB(A) has the broad effect of reducing the estimated changes in lost DALYs (both increases and reductions) as indicated in Figure 4-30, shown for mid-weighting. In particular, reductions in sleep disturbance provide smaller benefits, and for the 2030 scenario are predicted as an increase, rather than a reduction in lost DALYs.

5.7.50 The effects of the LHR-ENR scheme on the aircraft noise related health outcomes assessed are estimated to be moderate adverse[305] of high intensity and long-term in duration.

5.7.51 It is recognised however that some beneficial effects may be expected due to potential relative reductions in sleep disturbance over all of the assessment years, compared with the do minimum. When considering the sensitivity case however, these potential benefits are greatly reduced, indicating the difficulty in producing accurate estimates, and the uncertainty involved.

5.7.52 The LHR-ENR scheme is expected[306] to generally result in increases in exposure of schools to the metrics assessed, with the exception of a reduction in exposure to noise >54 dB $L_{Aeq, 0700-2300}$ for one assessment year (2030). These results can be interpreted as having predominantly major adverse effects for children's cognitive development.

5.7.53 It is estimated based on the available information that there are areas that could be brought above the thresholds by the combination of ground and airspace noise.

5.7.54 Although a reduction in the total population exposure to ground noise exceeding 57 dB $L_{Aeq, 0700-2300}$ is expected, this potential benefit may be offset by increases in airspace noise for the affected populations in close proximity to the airport. For some areas, in particular towards the northwest of the northern runway, there is a risk that cumulative airspace and ground noise could be sufficient to bring populations above the thresholds.

5.7.55 The local cumulative effects of LHR-2R for are considered to be mixed moderately beneficial/moderately adverse, of high intensity and long-term in duration.

NOISE ASSESSMENT: LHR-NWR

5.7.56 The local population assessment indicates that LHR-NWR would result in increases in population exposure to the 57 dB $L_{Aeq,16hr}$ and significant observed adverse effect level thresholds over the full assessment period, compared with the do minimum. The shortlisted scheme is expected to result in reductions in the population exposed to the upper adverse level effect over the full assessment period. This is due to reduced populations within the >69 dB $LAeq_{, 0700-2300}$ contour, but also because some dwellings exposed in the do minimum scenario would be within the expanded footprint of LHR-NWR, and so are excluded from the do something exposure[307].

[306] Pages 23-24, Clark,C, 2015. *Aircraft noise effects on health.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446311/noise-aircraft-noise-effects-on-health.pdf) Accessed 21/12/2015.

[307] Page 189, paragraph 2, Jacobs, 2014. *5. Noise: Local Assessment. Prepared for the Airports Commission.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372488/noise--local-assessment.pdf) Accessed 21/12/2015.

5.7.57 The local NSB assessment indicates that LHR-NWR would result in increases in NSB exposure to all thresholds over the full assessment period, compared with the do minimum.

Table 5-15 Estimated Changes as a consequence of LHR-ENR in DALYs Lost Compared with Do Minimum, by Health Effect (Assessment of Need Carbon Traded)

Health Effects	2030			2040			2050		
	Disability Weightings								
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Annoyance	442	882	5294	504	1008	6052	259	517	3104
Sleep Disturbance	(288)	(504)	(719)	(19)	(32)	(46)	(219)	(382)	(546)
AMI	135	135	135	184	184	184	90	90	90
HT Strokes	12	12	12	15	15	15	9	9	9
HT Dementia	17	17	17	22	22	22	13	13	13
Total	315	540	4736	706	1197	6226	151	245	2670

NOTE: Decreases indicated by values in parentheses.
Total DALYs are calculated from the total health cost values, not from summation of the separate effects, which are based on rounded data.

5.7.58 The changes in the total DALYs lost over a 60-year design life period were estimated at 9,005 (for the low disability weighting), 15,105 (for the mid disability weighting), and 114,741 (for the high disability weighting) for the 45 dB(A) threshold case.

5.7.59 The health effects assessment from aircraft noise as result of the LHR-NWR scheme (Table 5-15) indicates:

- With the exception of sleep disturbance, all health effects are expected to result in additional DALYs lost compared with the do minimum;
- For sleep disturbance, increases in DALYs lost are expected for all assessment years other than 2050, for which reductions in DALYs lost are expected (compared with the do minimum);
- Annoyance, sleep disturbance and AMI effects dominate total estimated differences in DALYs lost for all disability weightings;
- Annoyance becomes the dominant adverse health effect as the disability weightings are increased;
- The difference in DALYs lost due to annoyance is expected to increase over the assessment years; and
- The difference in total DALYs lost is expected to be highest in 2040 compared with 2030 and 2050 for low and mid-weighted estimations, but increases to a maximum in 2050 for the high-weighted estimation, as the increasing annoyance-related DALYs lost comes to dominate.

5.7.60 Local effects of airspace noise for LHR-NWR are considered to be mixed major moderate beneficial/moderate adverse of high intensity and long-term in duration.

5.7.61 The local ground noise assessment for LHR-NWR indicates that the total population exposure to the 57 dB $L_{Aeq,\ 0700\text{-}2300}$ threshold is expected to reduce compared with the do minimum in the medium term (2030). This is due to relocation of some sources of ground noise away from more

densely populated areas[308]. Local effects of ground noise for LHR-NWR are considered to be mixed moderate beneficial/moderate adverse, of medium intensity and long-term in duration.

5.7.62 Since, whilst a reduction in exposure is expected compared with the do minimum, a significant residual population could remain exposed to ground noise exceeding 57 dB $L_{Aeq, 0700-2300}$.

5.7.63 The impact of modifying the annoyance and sleep disturbance effects thresholds from 45dB(A) to 48 dB(A) has the broad effect of reducing the estimated changes in lost DALYs. In particular, decreases in sleep disturbance provide smaller disbenefits, and for the 2040 scenario are predicted as a reduction, rather than an increase in lost DALYs.

5.7.64 The effects of the LHR-NWR scheme for the health outcomes assessed are considered to be predominantly moderate adverse[309], although it is recognised that some beneficial effects may also expected due to potential reductions in sleep disturbance compared with the do minimum: in particular for the 2050 future assessment year, but also for the 2040 assessment year, when considering the sensitivity case (i.e. a higher effects threshold of 48 dB L_{night}).

5.7.65 The LHR-NWR scheme is expected[310] to generally result in increases in exposure of schools to the metrics assessed, with the exception of a reduction in exposure to noise >54 dB $L_{Aeq, 0700-2300}$ and N70>20 for one assessment year (2030). These results can be interpreted as having predominantly major adverse effects for children's cognitive development.

LOCAL EFFECTS: CUMULATIVE FOR LHR-NWR

5.7.66 Based on the available information it is estimated that there are areas that could be brought above the thresholds by the combination of ground and airspace noise.

5.7.67 Some areas could experience increases in both ground and airspace noise, particularly towards the northwest around the new runway. The combined noise may in some cases be sufficient to push areas above the thresholds.

5.7.68 Whilst a reduction in the total population exposure to ground noise exceeding 57 dB $L_{Aeq, 0700-2300}$ is expected, this potential benefit may be somewhat counteracted by increases in airspace noise for areas in close proximity to the airport. However, there are also some areas that (in the medium term) may experience a reduction in both ground and airspace noise (averaged over the daytime period), such as the area to the southwest of the southernmost runway.

5.7.69 The local cumulative effects of LHR-NWR for the medium term are considered to be mixed beneficial/adverse of moderate intensity and long-term duration.

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[308] Page 197, Jacobs, 2014. *5. Noise: Local Assessment. Prepared for the Airports Commission.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372488/noise--local-assessment.pdf) Accessed 21/12/2015.

[309] There is no established guidance for describing the significance of lost DALYs in non-monetised terms.

[310] Pages 22-23, Clark,C, 2015. *Aircraft noise effects on health.* (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446311/noise-aircraft-noise-effects-on-health.pdf) Accessed 21/12/2015.

LAND USE: EVIDENCE

5.7.70 Many impacts on human health associated with land use are covered within other topics. This includes the loss of green and open space (addressed in the landscape and townscape determinants of this Health Impact Analysis), creation of barriers to physical activity (addressed in exercise and physical activity determinants of this Health Impact Analysis), impact on increased pollution runoff and flooding (addressed in Water) and economic impact (addressed in the economic determinants of this Health Impact Analysis).

5.7.71 The development of an airport will likely increase local activity (land-use), which may affect the health of the population living, travelling and working in the surroundings of or at the airport[311]. Airport developments will bring opportunities for investment, tourism and job which could lead to further development[312] and will create land-use rivalries[313]. This could result in increased negative health impacts associated with air and road traffic exhaust and noise (addressed in noise and air quality determinants of this Health Impact Analysis), which can contribute to distributions of nearby land use.

5.7.72 Airport development would cause increased urbanisation and potentially increased land use density. Higher densities, greater mixture of land use and a balance between housing and jobs have all been shown to increase walking and biking[314], which would have a beneficial impact on human health. However, denser residential areas could cause negative effects such as reduced access to local, cheap, healthy and culturally appropriate food[315]. For disadvantaged communities, this can lead to the consumption of high energy fast foods, which are linked to obesity and other adverse health conditions.

5.7.73 Typically urban development and agriculture are competing for the same land[316]. Airport developments have led to important loss of fertile and productive soils for plant production[317]. This change in land used could result in health effects associated food scarcity[318]. Furthermore, land use change could result in job loss and unemployment which has been found to be negatively correlated with health[319].

5.7.74 There may be a human health impact associated with in the loss of or increase distance to sports and recreational facilities through reduced physical activity[320,321]. The change in land use could cause increased exposure to toxins or pollutants and influence lifestyles that contribute to

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[311] Passchier, W. et al., 2000. *Public health impact of large airports*. Reviews of Environmental Health, 15, 83-96.
[312] Karacor, E. K. and D. Korshid., 2015. *Projected environmental effects of the third airport in Istanbul*. Journal of Food, Agriculture and Environment, 13, 223-227
[313] Conventz. S. and Thierstein, A., 2015. *Airports, Cities and Regions*. Routledge: London
[314] Lawrence, D. and Engelke, P., 2000. *How Land Use and Transportation Systems Impact Public Health*. Georgia Institute of Technology: Georgia.
[315] Thompson, S., *A planner's perspective on the health impacts of urban settings*. NSW Public Health Bulletin, 18, 157-160
[316] Morello, J. et al., 2000. *Urbanisation and the consumption of fertile land and other ecological changes: the case of Buenos Aires*. Environment & Urbanisation. 12, 119-131.
[317] Rodrigue, J-P. et al., 2009. *The Geography Transport System*. Routledge: Oxon.
[318] Godfray, C., et al., 2010. *Food Security: The Challenge of Feeding 9 Billion People*. Science, 327, 812-818.
[319] Salm, M., 2009. *Does job loss cause ill health*. Health Economics, 18, 1075-1089.
[320] Limstrand, T., 2008. *Environmental characteristics relevant to young people's use of sports facilities: a review*. Scandinavian Journal of Medicine & Science in Sports, 18, 275-287.
[321] Kaczynski, A. T. and Henderson, K. A., 2007. *Environmental correlates of physical activity: a review of evidence about parks and recreation*. Leisure Sciences, 29, 315-354

reduced health[322]. For example, heavily trafficked, polluted, unsafe and unpleasant environments do not promote walking.

LAND USE BASELINE: GATWICK[323]

5.7.75 Gatwick is situated within the northern part of Crawley Borough. Within the footprint of Gatwick airport and the 250m area around it a large proportion (44%) of the land is under agriculture and forestry use, primarily to the north of the airport. The general future baseline trends within the Thames area will include a reduction in the area devoted to farming. Many of the greenspaces in the borough are designated of conservation importance or used for recreation. Approximately 32% of the land is in transport use reflecting the existing airport land use. Less than 10% is in residential use mainly to the south and the northeast.

5.7.76 The majority of land to the north west of Gatwick in Mole Valley District and north east of Gatwick in Reigate and Banstead District are within the Metropolitan Green Belt. The land further west, is an AONB.

LAND USE BASELINE: HEATHROW

5.7.77 Heathrow is located in the south of Hillingdon Borough. Within the footprint of the Heathrow airport and the 250m area around it a large proportion (32%) of the land is under agriculture and forestry use, primarily to north and west of the airport. The general future trends within the Thames area will include a reduction in the area devoted to farming. Approximately 41% of the land is in transport use reflecting the existing airport land use. Less than 10% is in residential use with the relevant areas mainly to the east and south. Large areas of the borough are within the Metropolitan Green Belt. There also three minerals safeguarded sites just to the north of Heathrow.

5.7.78 Spelthorne Borough is on the south western edge of Heathrow. The area closest to Heathrow consists of the urban area of Stanwell, the Metropolitan Green Belt and three large reservoirs. Further afield are the urban settlements where development is proposed in the Borough's adopted core strategy. There is also a minerals safeguarding area in Spelthorne Borough. Slough Borough to the west of Heathrow currently has a large 'strategic gap' allocated in its adopted core strategy, intended to remain undeveloped. The rest of the borough is heavily developed. A number of open spaces on the edge of the borough are designated as Green Belt.

LAND USE ASSESSMENT: LGW-2R

5.7.79 The use of large areas of previously undeveloped land will affect land resources meaning these areas will no longer be suitable for other uses, including farming. Greenfield (including agricultural land) is a finite resource, and its loss cannot be compensated through provision of land elsewhere. Agricultural land loss predicted to result from this shortlisted scheme is 421 ha, and a significant proportion is likely to be 'Best and Most Versatile' agricultural land. This loss means loss of value for food provision and possible local food security issues in the long term.

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[322] Perdue, W. C. et al., 2003. *The Built Environment and Its Relationship to the Public's Health: The Legal Framework*. American Journal of Public Health, 93, 1390-1394.

[323] Jacobs, 2014. *10. Place: Baseline*. (https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjR16bajoTOAhUpL8AKHcEpD3QQFggpMAA&url=https%3A%2F%2Fwww.gov.uk%2Fgovernment%2Fuploads%2Fsystem%2Fuploads%2Fattachment_data%2Ffile%2F372160%2F10-place--baseline.pdf&usg=AFQjCNHtfxMSSSg_Y2wlygjb2urtLXG-dg&bvm=bv.127521224,d.ZGg) Accessed 21/07/2016.

5.7.80 The area will become increasingly urban with the loss of greenspace which will have a minor adverse health impact on all groups a cross section of the population due to indirect impacts health via loss of locally farmed foods, loss of recreational space, and change in land character. These will impact all groups, be of high intensity and be permanent in duration.

LAND USE ASSESSMENT: LHR-ENR

5.7.81 Greenfield (including agricultural land) is a finite resource, and its loss cannot be compensated through provision of land elsewhere. Agricultural land loss is 370ha and a significant proportion is likely to be 'Best and Most Versatile' agricultural land. This loss of resource for food provision and other benefits could affect human health through possible local food security issues in the long term.

5.7.82 The area will become increasingly urban with the loss of greenspace which will have a minor adverse health impact on all groups. This health impact will affect a wide cross section of the population due to indirect impacts upon health via loss of locally farmed foods, loss of recreational space, and change in land character. These will impact all groups, be of high intensity and be permanent in duration.

LAND USE ASSESSMENT: LHR-NWR

5.7.83 The use of large areas of previously undeveloped land will affect the land resources meaning these areas will no longer be suitable for other uses, including farming. Agricultural land loss is 430ha and a significant proportion is likely to be 'Best and Most Versatile' agricultural land. The loss of this land also means loss of value for food provision, which would affect human health through possible local food security issues in the long term.

5.7.84 The area will become increasingly urban with the loss of greenspace which will have a minor adverse health impact on all groups. This health impact will affect a wide cross section of the population due to indirect impacts upon health via loss of locally farmed foods, loss of recreational space, and change in land character. These will impact all groups, be of high intensity and be permanent in duration.

NATURAL HABITATS: EVIDENCE

5.7.85 Some reports indicate that people have an inherent inclination to affiliate with natural processes and diversity, and that this this is important in humans' physical and mental development[324]. The human health benefits of contact with nature are well documented and hold true regardless of age, gender, race, ethnicity and health status[325].

5.7.86 Research on the wellbeing benefits of contact with animals and plants has revealed that encounters with the natural environment are very likely to have a significant beneficial effect both physiologically and psychologically on human health and wellbeing[326] Contact with nature affects numerous aspects of a person's physical, mental and social life, including reducing anger, frustration and aggression and increasing a sense of belonging and acceptance[325, 326]. Furthermore, natural environments have been shown to increase feelings of social safety and to

[324] Kellert, S. and Derr, V., 1998. *A national study of outdoor wilderness experience*, Yale: School of Forestry and Environmental Studies, Yale University, CT.
[325] Townsend, M. and Weerasuriya, R., 2010. *Beyond Blue to Green: The benefits of contact with nature for mental health and well-being* Beyond Blue Limited: Melbourne.
[326] Groeneweggen, P., et al., 2006. *Vitamin G: Effects of green space on health, wellbeing and social safety*. BMC Public Health, 6, 149–159.

reduce crime and aggressive behaviours[327].

5.7.87 Studies have indicated beneficial effects and benefits from activities such as observing nature, taking walks in natural surroundings, gathering food and hunting[328]. Studies have also confirmed physical activity in natural settings improves positive emotions, self-esteem and behaviours and that natural setting promote social exchanges and interactions[329]. Nature near home is particularly important for children, increasing their ability to cope with stressful life events, directed attention and cognitive function[330,331]. The National Trust has reported on 'children's lack of engagement with nature[332]. The report commented on physical health problems including obesity and mental health problems. Younger children benefit from imaginative play, a foundation of social and cognitive development, within natural environments and environments with more trees[333,334]. There is evidence that suggests minority ethnic communities are disengaged from the natural environment due to economic circumstances, language barriers, poor access to information and lack of transport[335].

5.7.88 Multiple studies have identified the benefits of views of nature through a window[336]. Furthermore, a higher percentage of rural elements such as trees and plants in a given view can buffer the adverse impacts of job stress[337]. Physical activity in natural environments has been shown to improve functioning at work and home, as well as reduce rates of smoking, substance abuse and improve mental health[338,339]. For people with chronic and terminal illnesses, contact with nature and animals has also been shown to be beneficial.

NATURAL HABITATS BASELINE: GATWICK

5.7.89 Gatwick Airport is sited on a flood plain in a rural landscape. Much of the surrounding land is in mixed agricultural use and includes several areas of recreational value which are likely to contribute to human health. Woodlands are abundant and provide a sense of enclosure. The most significant hydrological feature locally is the River Mole.

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[328] Hansmann, R. et al., 2007. *Restoration and stress relief through physical activities in forests and parks*. Urban Forestry and Urban Greening, 6, 213–225.

[329] Townsend, M. and Weerasuriya, R., 2010. *Beyond Blue to Green: The benefits of contact with nature for mental health and well-being* Beyond Blue Limited: Melbourne.

[330] Wells, N. M.,2000. *At home with nature: effects of "greenness" on children's cognitive functioning*. Environment and Behaviour 32: 775–795.

[331] Wells, N. M. and Evens, G. W., 2003. *Nearby Nature, A Buffer of Life Stress Among Rural Children*. Environment and Behavior, 35, 311-330.

[332] Moss, S., 2012. *Natural Childhood*. The National Trust.

[333] Campbell, L. and Wiesen, A., 2011. *Restorative Commons: Creating health and wellbeing through urban landscapes*, USDA Forest Service, Pennsylvania

[334] Faber-Taylor, A. et al., 1998. *Growing Up in the Inner City: Green spaces as places to grow*. Environment and Behavior, 30, 3.

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[336] Kaplan, R., 2001. *The Nature of the View from Home, Psychological Benefits*. Environment and Behavior, 33, 507-542.

[337] Leather, P. et al., 1998. *Windows in the Workplace: Sunlight, view, and occupational stress*. Environment and Behavior, 30, 739–762.

[338] Thompson, C. J. et al., 2011. *Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors?* A systematic Review. Environmental Science and Technology, 45, 1761-1772.

[339] Morris, N., 2003. *Literature Review: Health, wellbeing and open space*. Edinburgh College of Art and Heriot-Watt University, Edinburgh.

5.7.90 Within 15 km of the LGW-2R footprint there are three sites of importance for biodiversity at European level, 35 SSSIs and four LNRs within 5km. There are 46 (SNCIs) within 5 km, three of which fall within the shortlisted scheme footprint. There is also a significant amount of ancient semi-natural woodland within the footprint. It is considered likely that the area would support a range of species. There are long distance views from high ground within AONBs towards Gatwick Airport. North east of Gatwick there is a Metropolitan Green Belt. This area it therefore likely to support health benefits associated with natural habitats.

NATURAL HABITATS BASELINE: HEATHROW

5.7.91 Within the footprint of the Heathrow airport and the 250m area around it a large proportion of the land is under agriculture and forestry use (32%). Heathrow sits within a largely man-made landscape of a predominantly urban/industrial nature. The surrounding area is relatively flat, low-lying and vegetation cover is relatively sparse, emphasizing its open character. The waterscape of the area comprises the River Colne and River Crane.

5.7.92 There are a number of areas and routes of recreational value and statutory Green Belt within 5 km of the airport which are likely to contribute to human health. The nearby River Thames corridor and the Colne Valley Regional Park are a focus for recreational space and tranquillity. There are eight sites of importance for biodiversity at European level within 15km of the Heathrow Airport and more than 30 SSSIs. There are a number of LNRs within 5km. The presence of species including bats, otter, water vole, reptiles, and various species of birds within 2km. This area it therefore likely to support health benefits associated with natural habitats.

NATURAL HABITATS ASSESSMENT: LGW-2R

5.7.93 LGW-2R is likely to contribute to the further urbanisation of the area, which has been linked to reduced mental health and wellbeing of local populations. This reduced wellbeing has been shown to have a particularly stronger relationship with lower socioeconomic groups, older people and children and young people[340].

5.7.94 Land take is likely to result in the losses of a number of habitats including woodland, hedgerow, rivers and brooks, although the promoter has proposed some mitigation for a number of habitats (see Appendix A Scoping Report). The recreational value of some sites would be affected and could result in the loss of a potentially vital resource for promoting healthy living, offering both opportunities for physical activity and wellbeing.[24] Furthermore, the loss of access to these natural habitats can reduce social exchanges and interactions[341]. There could be further impacts on habitats as a result of cumulative air quality impact and water quality change. This loss of habitat could also affect species that require it for their survival, such as Bechsteins bat. This loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, which would be of high intensity and permanent in duration. .

5.7.95 This urbanisation is not expected to be significantly visible from a number of natural habitats due to the intervening distance and current screening by existing built up areas, maintaining their 'natural' image for visual amenity and recreational value. Any change in the ability of people to observe nature may have a minor adverse health effect.

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[340] Mass, J. et al., 2006. *Green space, urbanity, and health: how strong is the relation?* Journal of Epidemiology & Community Health, 60, 587-592

[341] Townsend, M. and Weerasuriya, R., 2010. *Beyond Blue to Green: The benefits of contact with nature for mental health and well-being* Beyond Blue Limited: Melbourne.

NATURAL HABITATS ASSESSMENT: LHR-ENR

5.7.96 LHR-ENR is likely to contribute to the further urbanisation of the area, which has been linked to reduced mental health and wellbeing of local populations. This reduced wellbeing has been shown to have a particularly stronger relationship with lower socioeconomic groups, older people and children and young people[342].

5.7.97 LHR-ENR would result in a direct impact due to land take of natural habitats such as, woodland, rivers and brooks, reedbeds and lowland meadows. This may impact on species, such as dispersing bird populations. The recreational value of some sites would therefore be affected and could result in the loss of a potentially vital resource for promoting healthy living, offering both opportunities for physical activity and wellbeing.[24] Furthermore, the loss of access to these natural habitats can reduce social exchanges and interactions. This shortlisted scheme also would require the diversion of several rivers and streams and the incorporation significant culverts. There could be further impacts on habitats as a result of cumulative air quality impact and water quality change. This loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, which would be of high intensity and permanent in duration. The promoter has proposed habitat creation to offset effects on number of habitats (see Appendix A Scoping Report) although detailed evaluation would be needed during project design before it is known to what extent this would mitigate nature conservation value is mitigated.

5.7.98 Views from natural habitats could be impacted particularly from the construction works affecting their visual amenity and recreational value. This could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas, offering both opportunities for physical activity and wellbeing. Any change in the ability from people to observe nature may have a minor adverse health effect.

NATURAL HABITATS ASSESSMENT: LHR-NWR

5.7.99 LHR-NWR is likely to contribute to the further urbanisation of the area, which has been linked to reduced mental health and wellbeing of local populations. This reduced wellbeing has been shown to have a particularly stronger relationship with lower socioeconomic groups, older people and children and young people.

5.7.100 The shortlisted scheme would result in a direct impact due to land take of natural habitats such as woodland, rivers and brooks, reed beds and lowland meadows. This may affect the recreational values of some sites through dispersing bird populations. This could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas, which would normally offer both opportunities for physical activity and wellbeing. Furthermore, the loss of access to these natural habitats can reduce social exchanges and interactions. There could be further impacts on habitats as a result of cumulative air quality impact and water quality change. For example, this shortlisted scheme would require the diversion of several rivers and streams and the incorporation of a number of significant culverts. There could be further impacts on habitats as a result of cumulative air quality impact and water quality change. This loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, which would be of high intensity and permanent in duration. The promoter has proposed habitat creation to offset effects on number of habitats (see Appendix A Scoping Report) although detailed evaluation would be needed during project design before it is known to what extent this would

[342] Mass, J. et al., 2006. *Green space, urbanity, and health: how strong is the relation?* Journal of Epidemiology & Community Health, 60, 587-592

mitigate nature conservation value is mitigated.

5.7.101 Potential visibility of LHR-NWR would be constrained by the existing built-form to the north, east and south, and by vegetation and reservoir embankments to the west. However, there would be a large adverse visual effect on some recreational sites. This could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas, offering both opportunities for physical activity and wellbeing. Any change in the ability from people to observe nature may have a minor adverse health effect.

LANDSCAPE AND TOWNSCAPE: EVIDENCE

5.7.102 Landscape is increasingly seen to contribute to quality of life and human health[343],[344]. Urbanisation is arguably the most dramatic form of land transformation and is a potential threat to mental health and wellbeing[345]. People's living environment has an association with the perceived general health of residents[346]. Landscape preferences include wild land scenes, cultural landscape and traditional farm environment[347].

5.7.103 An important aspect of landscape is green and open space. This has been suggested to improve physical and mental health and wellbeing by increasing physical activity, reducing air pollution, noise, and ambient temperature, increasing social contacts and relieving psychophysiological stress[348]. Individuals living closer to urban greenspaces have lower mental distress and higher wellbeing[349]. Sound and visual stimuli interact with the impression of landscapes, with aircraft noise affecting the perceived overall recreational quality of the areas[350].

5.7.104 Greenspace is a valuable resource for physical activity and has potential to contribute to reducing obesity and improving health[351]. Exercising in natural, green environments creates greater improvements in adults' self-esteem than exercise undertaken in urban or indoor settings and has the potential to engage less active children in exercise[352]. Environmental factors such as the quality and accessibility of greenspace affects its use[353]. User determinants, such as age, gender, ethnicity, socioeconomic status and the perception of safety, are also important. Greenspace has also been observed to have a stronger positive relationship with lower socioeconomic groups, older people and children and young people. Findings have identified that women in lower greenspace areas showed higher levels of stress[354]. Other research suggests positive or similar

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[343] Waltert, F., 2011. *Landscape Amenities and Local Development*. University of Zurich: Zurich.
[344] Thwaites, K. et al., 2005. *Restorative urban open space: Exploring the spatial configuration of human emotional fulfilment is urban open space*. Landscape Research, 30, 525-547.
[345] White, M.P. et al., 2013. *Would You Be Happier Living in a Greener Urban Area? A Fixed-Effects Analysis of Panel Data*. Psychological Science, 24, doi: 10.1177/0956797612464659.
[346] Mass, J. et al., 2006. *Green space, urbanity, and health: how strong is the relation?* Journal of Epidemiology & Community Health, 60, 587-592.
[347] Kaltenborn, B. P. and Bjerke, T., 2002. *Associations between environmental value orientations and landscape preferences*. Landscape and Urban Planning, 59, 1-11.
[348] Dadvand, P. et al., 2012. *Green space, health inequality and pregnancy*. Environment International, 40, 110-115.
[349] Matsuoka, R.H., et al. *People needs in the urban landscape: Analysis of Landscape And Urban Planning contributions, Landscape and Urban Planning*, Volume 84, Issue 1, 11 January 2008, Pages 7–19.
[350] Krog, N. H., et al., 2010. *Effects of changed aircraft noise exposure on experiential qualities of outdoor recreational areas*. International Journal of Environmental Research & Public Health, 7, 3739-3759.
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[352] Reed, K. et al., 2013. *A repeated measures experiment of green exercise to improve self-esteem in UK school children*. PLoS ONE, 24, doi:10.1371/journal.pone.0069176
[353] Lee, A. C. K. and Maheswaran, R., 2013. *The Health Benefits of Urban Green Spaces: A Review of the Evidence*. Journal of Public Health, 33, 212-222.
[354] Roe, J.J., et al., 2013. *Green Space and Stress: Evidence from Cortisol Measures in Deprived Urban Communities*. International Journal of Environmental Research and *Public Health*, *10*, 4086-4103.

findings regardless of social group.[355,356]

5.7.105 Airport developments have been associated with disruptions to local place attachments and social activities, exacerbating spatial anxiety and the destabilisation of belonging to place[357]. Sense of place has been identified to contribute to healing and wellbeing[358]. Airports' global importance affects the local characteristics of cities in terms of increased built up areas, development density and fragmented landscapes.[359] This could affect the public realm which should possess structure, identity and meaning, and should enhance and support civic engagement.[360] Loss of public space within a townscape may effect social integration.[361]

LANDSCAPE AND TOWNSCAPE BASELINE: GATWICK

5.7.106 Gatwick Airport is sited on a flood plain in a rural landscape and much of the wider rural area is protected by national landscape designations. The surrounding land is predominantly in mixed agricultural use and includes several areas of recreational value which are likely to contribute to human health. Woodlands are abundant and provide a sense of enclosure. The most significant hydrological feature locally is the River Mole.

5.7.107 Crawley's character is largely defined by garden suburb type development, predominantly low-rise, with some industrial development concentrated south of the airport. Views north towards Gatwick Airport are filtered or screened by intervening topography and woodland. Horley has a more varied character. Both areas have townscape character of ordinary quality. Views towards Gatwick Airport are relatively limited by the built up areas, raised ground and woodland cover although there are long distance views from high ground within AONBs towards Gatwick Airport. There are a number of Conservation Areas and Scheduled Monuments, and various landscapes and townscapes of historical significance within this shortlisted scheme.[362]

5.7.108 The future landscape and townscape character baseline will be subject to pressure from urban development, including physical and visual impact as well as increased traffic or noise.

LANDSCAPE AND TOWNSCAPE BASELINE: HEATHROW

5.7.109 Heathrow sits within a largely man-made landscape of a predominantly urban/industrial nature, with no nationally designated landscapes within 15km but a locally designated landscape approximately 5 km to the south west. There are also a number of areas and routes of recreational value and statutory Green Belt within 5km of the airport. These are likely to contribute to human health. The nearby River Thames corridor and the Colne Valley Regional Park are a focus for recreational space and tranquillity.

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355 Matsuoka, R. H. and Kaplan, R., 2008. *People needs in the urban landscape: Analysis of Landscape and Urban Planning contributions*. Landscape and Urban Planning, 84, 7-19.

356 Richardson, J. et al., 2013. *Building HIA approaches into strategies for green space use: an example from Plymouth's (UK) Stepping Stones to Nature project*. Health Promotion International, 28, 502-511.

357 Stratford, E. and Wells, S., 2009. *Spatial anxieties and the changing landscape of an Australian airport*. Australian Geographer, 40, 69-84.

358 John, E. and Williams, A., 2008. *Sense of Place, Health and Quality of Life*. Ashgate: Aldershot.

359 Karacor, E. K. and Korshid, D., 2015. *Projected environmental effects of the third airport in Istanbul*. Journal of Food, Agriculture and Environment, 13, 223-227.

360 Sandalack, B. A., 1999. *Evolution of public realm: streets, squares, parks and open spaces in a prairie town* [Olds, Alberta]. Environment, 26, 49-58.

361 Madanipour, A., 1999. *Why Are the Design and Development of Public Spaces Significant for Cities*. Environment and Planning B: Planning and Design, 26, 879-891.

362 Jacobs, 2014. *10. Place Assessment. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372160/10-place--baseline.pdf)* Accessed 23/12/2015.

5.7.110 The surrounding area is relatively flat, low-lying and vegetation cover is fairly sparse, emphasizing its open character. Slough is located on higher ground to the Northwest, and Windsor and Runnymede to the west and south west. The topography of the landscape has been altered substantially by development. The waterscape of the area comprises of two rivers flanking the airport, the River Colne and River Crane, with two large bodies of water located to the west of Heathrow, including the Queen Mother Reservoir and the Wraysbury Reservoir and several large bodies of water to the south of Heathrow, including Staines Reservoir, King George VI and Bedfont Lakes.

5.7.111 Settlements close to the north and east of the airport are small villages of mixed styles with views of the airport. Further north, east and south of the airport built development comprises low-rise suburban housing and modern airport-related development. These have restricted views towards Heathrow Airport.

5.7.112 The future landscape and townscape character baseline will be subject to pressure from urban development, including physical and visual impact as well as increased traffic or noise.

LANDSCAPE AND TOWNSCAPE ASSESSMENT: LGW-2R

5.7.113 LGW-2R is likely to contribute to the further urbanisation of the area, which has been linked to reduced mental health and wellbeing of local populations, with individuals moving to less green areas having significantly worse mental health in the year preceding the move[363]. This reduced wellbeing has been shown to have a particularly stronger relationship with lower socioeconomic groups, older people and children and young people and women in lower greenspace areas have shown higher levels of stress. This could also affect perceived general health, which increases with increased greenspace.

5.7.114 This urbanisation is not expected to be significantly visible from AONBs and some recreational sites due to the intervening distance and current screening by existing built up areas. This would maintain their visual amenity and recreational value. However, the recreational value of some sites would be affected, such as Ancient Woodland which would need to be removed. The loss of this small highly valued landscape feature could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas, offering both opportunities for physical activity and wellbeing. Furthermore, the loss of access to these landscapes could have a minor adverse impact on health through reduced social contact, cohesion and psychophysiological stress benefits. These impacts would be of high intensity and permanent in duration.

5.7.115 In some areas currently showing moderate tranquillity, the anticipated increase in over-flights will reduce tranquillity levels due to increased noise. This is likely to adversely impact the impression of landscapes, causing annoyance and reducing the perceived overall recreational quality of the areas.

5.7.116 Some local landscape character would experience an impact from construction work, operation and permanent loss. It is unlikely that any townscape character areas will be noticeably affected long-term. There would be a reduction in tranquillity for some residential areas, which could harm the character of views. This disruption to local place and social activities could increase spatial anxiety and decrease the feeling of 'place', which could affect wellbeing, the public realm, and social integration[363].

[363] Alcock,I. et al., 2014. *Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas*. Environmental Science & Technology, *48*,1247–1255.

LANDSCAPE AND TOWNSCAPE ASSESSMENT: LHR-ENR

5.7.117 LHR-ENR is likely to contribute to the further urbanisation of the area, which has been linked to reduced mental health and wellbeing of local populations, with individuals moving to less green areas having significantly worse mental health in the year preceding the move. This reduced wellbeing has been shown to have a particularly stronger relationship with lower socioeconomic groups, older people and children and young people and women in lower greenspace areas have shown higher levels of stress. This may be significant with the local authorities surrounding Heathrow having higher percentages of young and older people than the UK average. This urbanisation could result in the deterioration of some valued views from the Chilterns AONB and overflying is expected to reduce tranquillity. There is the potential for the shortlisted scheme to impact upon the district and county level landscape character areas and townscape, due to physical changes for airport infrastructure and a reduction in visual amenity. This disruption to local place and social activities could increase spatial anxiety and decrease the feeling of 'place', which could affect wellbeing the public realm, and social integration.

5.7.118 Some of the Colne Valley Regional Park would be lost to accommodate the new runway. In addition, views from other potentially valued recreational areas, such as Public Rights of Way, would be impacted particularly from the construction works. This would affect their visual amenity and recreational value and could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas. Furthermore, the loss of access to these landscapes could reduce social contact, cohesion and psychophysiological stress benefits.

5.7.119 Views from properties in a number of locations would be impacted during construction and operation due to the proximity of works and the open nature of views. The surrounding landscape strongly influences the wellbeing, perceived general health and behaviour of inhabitants. There would also likely be a reduction in tranquillity in these residential areas affecting the character of views.

5.7.120 Changes in landscape as a consequence of LHR-ENR are likely to have a minor adverse impact on health from annoyance causing by changed the impression of landscapes, thereby reducing the perceived overall recreational quality of the areas. These impacts are likely to be of high intensity and temporary in duration, as landscape perceptions and expectation alter over time.

LANDSCAPE AND TOWNSCAPE ASSESSMENT: LHR-NWR

5.7.121 LHR-NWR is likely to contribute to the further urbanisation of the area, which has been linked to reduced mental health and wellbeing on local populations, with individuals moving to less green areas displayed significantly worse mental health in the year preceding the move. This reduced wellbeing has been shown to have a particularly stronger relationship with lower socioeconomic groups, older people and children and young people and women in lower greenspace areas have shown higher levels of stress. This urbanisation could deteriorate some valued views from the Chilterns AONB and overflying is expected to reduce tranquillity.

5.7.122 There is the potential for the shortlisted scheme to impact upon the district and county level landscape character areas and townscape, due to physical changes for airport infrastructure and a reduction in visual amenity. This disruption to local place and social activities could increase spatial anxiety and decrease the feeling of 'place', which could affect wellbeing, the public realm, and social integration.

5.7.123 Some of the Colne Valley Regional Park would be lost to accommodate the new runway. This would affect their visual amenity and recreational value and could result in the loss of a potentially vital resource for promoting healthy living for people in urban areas, offering both opportunities for physical activity and wellbeing. Furthermore, the loss of access to these landscapes could reduce social contact, cohesion and psychophysiological stress benefits.

5.7.124 Potential visibility of LHR-NWR would be constrained by the existing built-form to the north, east and south, and by vegetation and reservoir embankments to the west. However, there would be large adverse visual effects on occupiers of residential properties in a number of areas and recreational sites. The surrounding landscape strongly influences the wellbeing, perceived general health and behaviour of inhabitants.

5.7.125 Changes in landscape as a consequence of LHR-NWR are likely to have a minor adverse impact on health from annoyance causing by changes in the impression of landscapes, thereby reducing the perceived overall recreational quality of the areas. These impacts are likely to be of high intensity and temporary in duration, as landscape perceptions and expectation alter over time.

TRANQUILLITY: EVIDENCE

5.7.126 Tranquillity is a quality of calm that people experience in places full of the sights and sounds of nature. Campaign for the Protection of Rural England (CPRE) define tranquillity as 'the quality of calm experienced in places with mainly natural features and activities, free from disturbance from manmade ones' (CPRE, 2006).

5.7.127 As such, tranquillity can be damaged by the intrusive sights and sounds of man-made structures such as new roads, poorly-designed lighting and power lines.

5.7.128 The National Planning Policy Framework places importance on tranquillity and requires that planning policies and decisions aim to "identify and protect areas of tranquillity, which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason" (paragraph 123, page 29).

5.7.129 There are no national statutory limits for tranquillity. Within the AoS, tranquillity was assessed using the CPRE Tranquillity Mapping[364] with overlain noise contours to illustrate where low-flying aircraft could impact on landscapes and sites of tranquillity.

5.7.130 Noise from aircraft can annoy users of recreational areas, with a relationship between aircraft noise annoyance and perceived overall recreational quality of the areas having been identified[365]. Moreover, changes in aircraft noise exposure can inflict a behavioural response through influencing individual choices as to whether to use local outdoor recreational areas near airports.[366].

5.7.131 Changes to the soundscape of tranquil areas can alter the contribution that the natural environment makes to both physical and psychological wellbeing [367]. Natural, tranquil surroundings can lessen the profound physiological effects experienced by people suffering from stress[368]. Reductions in tranquillity could reduce these beneficial effects and affect satisfaction with outdoor recreational areas.

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[364] Campaign to Protect Rural England, 2007 *Developing an Intrusion Map of England* [online] Accessed 22/02/2016

[365] Krog, N. H., et al. 2010. *Effects of changed aircraft noise exposure on experiential qualities of outdoor recreational areas*. International Journal of Environmental Research & Public Health [Electronic Resource] 7(10): 3739-3759.

[366] Krog, N. H., et al. 2010. *Effects of changed aircraft noise exposure on the use of outdoor recreational areas*. International Journal of Environmental Research & Public Health [Electronic Resource] 7(11): 3890-3915.

[367] Environmental Research and Consultancy Department, REPORT 1207. Tranquillity: An overview CAA. June 2012 https://www.caa.co.uk/WorkArea/DownloadAsset.aspx?id=4294971641

[368] Ulrich,R.S ., Simons, F. et al. 1991. *Stress recovery during exposure to natural and urban environments*. Journal of Environmental Psychology 11, 201-230

5.7.132 Merely noticing sound from aircraft has been reported as detracting from the outdoor recreational experience, as the natural soundscape, which is free from the sounds of society, forms an essential element of the natural experience.[369,370]

5.7.133 Tranquillity levels in the vicinity of the affected areas could be reduced by aircraft noise, aircraft movement - particularly during take-off and landing. However, the landscape appendix of the AoS has stated that potential impacts on tranquillity cannot be assessed with accuracy in relation to any of the shortlisted schemes until further information is available for the proposed direction, height and number of flights[371].

TRANQUILLITY BASELINE: GATWICK

5.7.134 CPRE's assessment of tranquillity around Gatwick Airport found the least tranquil areas to be Horley, Crawley and the M23, with tranquillity increasing to the east and west of the airport[372].

TRANQUILLITY BASELINE: HEATHROW

5.7.135 CPRE's assessment of tranquillity around Heathrow Airport found that large areas surrounding Heathrow are dominated by areas of low tranquillity[373], including the airport, urban areas inside the M25, the M25 itself and Slough. The most tranquil areas were found to the south west of the airport, where the Colne Valley Regional Park to the west and south west is a centre of tranquillity.

TRANQUILLITY ASSESSMENT: LGW-2R

5.7.136 In the absence of a specific measure of loss of tranquillity, the noise metric N70[374] (the number of noise events above 70 dB(A)) has, where possible, been applied as an indication of audible disturbance and loss of tranquillity. The 70 dB(A) level was chosen as an external single noise event will be attenuated by approximately 10 dB(A) by the fabric of a house with open windows. The resulting internal noise level of 60 dB(A) is the noise level which is likely to interfere with conversation or with listening to the radio or the television.

5.7.137 Construction works within the Ifield and Langley Green townscape character areas would have a noticeable impact upon tranquillity. Impacts are also possible in these areas during operation, although the impacts are likely to be less significant than during construction since the disturbance would be physically closer during construction. It has also been predicted that there would be a reduction in tranquillity during operation in some residential areas.

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369 Mace, B.L.; Bell, P.A.; Loomis, R.J. *Aesthetic, affective, and cognitive effects of noise on natural landscape assessment landscape assessment*. Soc. Natur. Resour. 1999, 12, 225-242.

370 McDonald, C.D.; Baumgarten, R.M.; Iachan, R. *Aircraft Management Studies: National Park Service Visitors Survey*; HMMH Report No. 290940.12; NPOA Report No. 94-2; National Park Service, US Department of the Interior: Burlington, MA, USA, 1995

371 Appraisal of Sustainability, Appendix A-12 Landscape. Third Draft. May 2016

372 Campaign to Protect Rural England Tranquillity Mapping presented in Jacobs, 2014. 10. Place: Baseline. [online] Accessed 23/12/2015.

373 CPRE Tranquillity Mapping presented in Jacobs, 2014. *10. Place: Baseline*. [online] Accessed 23/12/2015.

374 The level of 70 dB(A) Lmax was selected because it corresponded to an internal noise level that was considered to be likely to interfere with conversation or listening to the radio or television (the 70 dB(A) figure allows for about 10 dB(A) attenuation through the fabric of a house with its windows open – in effect plotting, therefore, a 60 dB(A) contour for those indoors).

5.7.138 The Surrey Hills AONB, High Weald AONB and Kent Downs AONB lie within15km of Gatwick Airport. Potential indirect impacts from the direction, height and number of flights over the AONB cannot be assessed with accuracy until further information is available. However, it is considered likely that these factors could cause deterioration in tranquillity levels.

5.7.139 In particular, it is considered likely that there will be increased numbers of aircraft over-flying areas of higher tranquillity as part of LGW-R2 in comparison to the current operations. However, it is also possible that the corridors of over-flight may be reduced in number and extent, which would potentially reduce noise and visual disturbance over the AONBs.

5.7.140 In some areas currently showing moderate tranquillity, the anticipated increase in over-flight will have a minor adverse impact on tranquillity in the future, which is high in intensity, and permanent in duration.

5.7.141 For LGW-2R, as with all shortlisted schemes, cumulative effects on areas of tranquillity may arise from airport expansion in combination with other major infrastructure development. This may include transport infrastructure, which is delivered in support of the National Networks NPS, or from nearby residential, commercial or infrastructure development that is planned by local authorities as part of their plans for growth, as set out in individual local development plan documents.

5.7.142 However, significant uncertainty remains regarding the details of routes, and hence impacts on tranquillity, due to both the detailed design issues associated with the shortlisted scheme development and the application of the UK Future Airspace Strategy.

TRANQUILLITY ASSESSMENT: LHR-ENR

5.7.143 The Chilterns AONB lies over 15km from the shortlisted scheme and impacts on views from the AONB during construction and operation would not be significant due to the intervening distance. Potential indirect impacts of the direction/height/number of flights over the AONB cannot be assessed with accuracy until further information is available. It is considered likely that these factors could cause deterioration in some valued views and vistas from the AONB.

5.7.144 In comparison to the baseline, there are expected to be increased numbers of aircraft over-flying the AONB which may reduce future tranquillity levels. In addition, the corridors of over-flights may be increased in extent which could impact on tranquillity.

5.7.145 Impacts are likely to be greatest for those receptors to the west of the shortlisted scheme, around Colnbrook, and to the north around Harmondsworth and Sipson. However, the areas shown to be most affected are currently considered to be in the least tranquil category, with some areas to the west considered to be of moderate tranquillity.

5.7.146 For LHR-ENR, as with all shortlisted schemes, cumulative effects on areas of tranquillity may arise from airport expansion in combination with other major infrastructure development. This may include transport infrastructure, which is delivered in support of the NN NPS, or from nearby residential, commercial or infrastructure development that is planned by local authorities as part of their plans for growth, as set out in individual local development plan documents. In particular, potential cumulative effects on the Chilterns AONB may arise in conjunction with HS2.

5.7.147 There is uncertainty regarding the details of future flight routes and the application of the UK Future Airspace Strategy and, therefore, the areas in which tranquillity may be affected. As such, potential indirect impacts cannot be assessed with accuracy until further information is available. Notwithstanding this, it is considered likely that the shortlisted scheme would have a minor adverse effect on tranquillity, which is high in intensity, and permanent in duration.

TRANQUILLITY ASSESSMENT: LHR-NWR

5.7.148 The effects of the shortlisted scheme would be most significant for those receptors to the west around Colnbrook and Horton and to the north at Longford. However, the areas shown to be most affected are currently considered to be in the least tranquil category, with some areas to the west considered of moderate tranquillity.

5.7.149 The corridors of over-flight may be increased in number and extent, which has the potential to increase noise and visual disturbance over the Chilterns AONB.

5.7.150 For LHR-NWR, as with all shortlisted schemes, cumulative effects on areas of tranquillity may arise from airport expansion in combination with other major infrastructure development. This may include transport infrastructure, which is delivered in support of the NN NPS, or from nearby residential, commercial or infrastructure development that is planned by local authorities as part of their plans for growth, as set out in individual local development plan documents. In particular, potential cumulative effects on the Chilterns AONB may arise in conjunction with HS2.

5.7.151 There is, however, uncertainty regarding the details of flight routes due to both the detailed design issues associated with the shortlisted scheme development and application of the UK Future Airspace Strategy and, therefore, the areas which may be affected. As such, potential indirect impacts of new lighting and the direction/height/number of flights cannot be assessed with accuracy until further information is available but it is considered likely that these factors would have an adverse effect on tranquillity, which is high in intensity, and permanent in duration.

FLOOD RISK: EVIDENCE

5.7.152 Floods are the most common natural disaster in Europe[375]. Airport construction is likely to involve major landform changes[376] and increased development potentially increases the risk from flooding in urban areas[377].

5.7.153 The impacts of flooding on human health can be very serious, complex and far-reaching: including drowning, injuries, and an increased incidence of common mental disorders[378]. Most flood-related deaths can be attributed to 'rapid rise' floods, due to the increased risk of drowning[379]. Injuries include sprains/strains, lacerations and abrasions/contusions. There is also a small risk of communicable disease following flooding; however this is rare in industrialised countries as a result of good public health infrastructure prior to and following flooding.

5.7.154 As stated above, the psychological impacts of flooding are potentially significant, and include post-traumatic stress, anxiety and depression[380,381]. This can be caused by the experience of being flooded, geographic displacement, damage to the home or possessions and stress caused by dealing with the aftermath. This anxiety and depression may last years after the flood event. A

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[375] Hajat, S. et al., 2003. The human health consequences of flooding in Europe and the implications for public health: a review of the evidence. *Applied Environmental Science and Public Health*, 1, 13-21.
[376] Douglas, I. and Lawson, N., 2003. *Airport Construction: Materials use and geomorphic change*. Journal of Air Transport Management, 9, 177-185.
[377] Nirupama, N. and Simonovic, S. P., 2007. *Increase of Flood Risk due to Urbanisation: A Canadian Example*. Natural Hazards, 40, 25.
[378] Tapsell, S., 2001. *The health effects from fluvial flooding*. Report to the Environment Agency. Flood Hazard Research Centre: Enfield.
[379] French, J. et al., 1983. *Mortality from flash floods: a review of national weather service reports*, 1969 – 81. Public Health Reports, 98, 584 – 588.
[380] Jha, A. K. et al., 2012. *Cities and Flooding – A Guide to Integrated Urban Flood Risk Management for the 21st Century*. The World Bank: Washington.
[381] Ahern, M., et al., 2005. *Global Health Impacts of Floods: Epidemiologic Evidence*. Epidemiol Rev, 27, 36-46.

study conducted on the 2007 UK Summer floods showed that the prevalence of mental health symptoms can be two to five-folds higher among individuals affected by flood water in the home than among the general population[382]. Furthermore, the direct impacts of flooding will have knock-on economic effects and people who perceived adverse impact on finances as a result of the 2007 floods were more likely to report common mental disorders. A survey of 647 households undertaken after the flood event displayed that 39% of respondents said the flooding had affected their physical health and 67% their emotional health[383]. These results are consistent with other studies, such as those undertaken following Hurricane Katrina in New Orleans[384].

5.7.155 There are groups which have increased vulnerability to flooding as a result of their capacity to anticipate, cope, resist and recover. The most vulnerable are the older people, disabled, children, women, ethnic minorities, and those on low incomes. Walker *et al* (2007)[385] suggest a strong social regressive gradient such that if you are highly deprived you are more likely to live in a flood risk area (principally for coastal flooding). Fielding and Burningham (2005)[386] also suggest that lower social classes are most at risk from flood hazard. This suggests that a general claim of inequality in flood risk exposure could be established[387], although there is uncertainty in the analyses.

5.7.156 Awareness of flood risk and knowledge of how best to respond varies by socio-economic group, with those in in higher socio-economic groups having higher awareness. This provides one mechanism for the observation that deprived or poorer households are likely to experience impact of flooding more severely than others[388]. That is to say, such households are typically less prepared, less able to access financial resources to aid recovery and more susceptible to a range of health impacts. Furthermore, poorer people are more likely to occupy housing which is least resilient to flooding, such as mobile homes, and less able to afford flood protection products. The financial impacts may be exacerbated as half of households in the lowest income decile in the UK do not have home contents insurance[389]. This makes financial recovery more difficult and contributes to increased susceptibility to psychological health effects.

5.7.157 Older people may be at increased risk in being over-represented amongst residents of bungalows, ground floor flats and mobile homes[390]. Furthermore, older people are more likely to be adversely affected by the cold, damp conditions caused by flooding[391] and more vulnerable to psychological conditions. This could also be stated for children. Women are also over-

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382 Paranjothy, S., et al., 2011. *Psychosocial impact of the summer 2007 floods in England*. BMC Public Health, 11. (http://bmcpublichealth.biomedcentral.com/track/pdf/10.1186/1471-2458-11-145?site=bmcpublichealth.biomedcentral.com) Accessed 11/07/2016.

383 Cabinet Office, 2008. *The Pitt Review Learning lessons from the 2007 floods* - Full Report. (http://webarchive.nationalarchives.gov.uk/20100807034701/http:/archive.cabinetoffice.gov.uk/pittreview/_/media/assets/www.cabinetoffice.gov.uk/flooding_review/pitt_review_full%20pdf.pdf) Accessed 11/07/2016.

384 DeSalvo, K. B. et al., 2007. *Symptoms of posttraumatic stress disorder in a New Orleans workforce following Hurricane Katrina*. Journal of Urban Health, 84, 142-52.

385 Walker, G. et al., 2007. *Addressing environmental inequalities: flood risk*. Environment Agency: Bristol.

386 Fielding, J. and Burningham, K., 2005. *Environmental inequality and flood hazard*. Local Environment: The International Journal of Justice and Sustainability. 10, 1-17.

387 Walker, G. and Burningham, K., 2011. *Flood risk, vulnerability and environmental justice: Evidence and evaluation of inequality in the UK context*. Critical Social Policy. (http://csp.sagepub.com/content/early/2011/02/16/0261018310396149.abstract) Accessed 11/07/2016.

388 Scottish Executive Social Research, 2007. *Exploring the social Impacts of Flood Risk and Flooding in Scotland*. Scottish Executive: Edinburgh.

389 Association of British Insurers, 2008. *ABI /Government Statement on Flooding and Insurance for England*. Association of British Insurers. https://www.abi.org.uk/~/media/Files/Documents/Publications/Public/Migrated/Flooding/Statement%20of%20principles%20England.pdf

390 Ketteridge, A. and Fordham, M., 1998. *Flood Evacuation in two communities in Scotland: Lessons from European Research*. International Journal of Mass Emergencies and Disaster, 16, 119-143.

391 Tapsell, S. M. et al., 2002. *Vulnerability to flooding: health and social dimensions* Phil. Trans. Royal Society London A, 360, 1511-1525.

represented in the 75+ age group, and have specific vulnerabilities associated with major 'home life' responsibilities. Flooding effects to ethnic minorities may be exacerbated by language difficulties, cultural differences and a lack of knowledge of the systems in place[392].

FLOOD RISK BASELINE: GATWICK

5.7.158 There are areas downstream of Gatwick Airport which are at risk of flooding. Though likely to be infrequent in occurrence, should it occur flooding would have a detrimental impact upon the Human Health of sections of the study area population, particularly within the floodplain of the River Mole, the Gatwick Stream, and Crawter's Brook and areas downstream of Gatwick airport which are at particular risk of flooding. [393]

FLOOD RISK BASELINE: LHR-ENR

5.7.159 The current airport site is potentially vulnerable from flooding from the River Crane, and the area of the proposed scheme footprint extending to the west of the current airport site would be vulnerable to flooding from the River Colne, Colne Brook and Wraysbury River. There are also flood risks associated with surface water (drainage from rainfall) and groundwater.[393]

FLOOD RISK BASELINE: LHR-NWR

5.7.160 The current airport site is potentially vulnerable from flooding from the River Crane, and the area of the proposed scheme which extends to the north-west of the current airport site would be vulnerable to flooding. There are also flood risks associated with surface water (drainage from rainfall) and groundwater.[393]

FLOOD RISK ASSESSMENT: LGW-2R

5.7.161 The baseline for LGW-2R highlighted that areas in the vicinity of Gatwick Airport are at risk of flooding. Further development at Gatwick has the potential to influence the flood risk and may increase the current flood risk baseline for surrounding communities.

5.7.162 In particular, the increase in impermeable area and loss of flood plain storage, without suitable mitigation, could lead to runoff rates greater than the greenfield rate resulting in increased risks of flooding elsewhere.

5.7.163 Approximately half of the area proposed for the Gatwick development is located in Flood Zones 2 and 3 and is at risk from fluvial flooding. Mitigation may not be sufficient to cover the predicted increase in rainfall intensity and peak river flows expected by 2085.

5.7.164 Furthermore, this increased risk of flooding poses an increased risk of impacts on human health. This could be a result of the physical flooding itself, such as drowning and injuries (e.g. sprains/strains, lacerations and abrasions), as well as the geographic displacement, damage to the home or possessions and stress and other mental disorders caused by dealing with the aftermath. This has been assessed as potentially having a major adverse impact on health, of low intensity and intermittent in nature.

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[392] Tapsell, S. M. et al., 1999. *The Health Effects of the 1998 Easter Flooding in Banbury and Kidlington*, Flood Hazard *Research Centre, Middlesex University*.

[393] Jacobs, 2014 . 9. *Water and Flood Risk: Baseline*. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372156/9-water-and-flood-risk--baseline.pdf) Accessed 22/07/2016.

5.7.165 The severity of any flooding will determine the extent of the above health impacts as will any increased vulnerability of the surrounding population. However, the Gatwick community profile is not expected to result in significant impacts to particular communities.

FLOOD RISK ASSESSMENT: LHR-ENR

5.7.166 The proposed runway will extend onto the floodplain and is expected to lead to a loss of up to 45 ha of undefended flood plain with only a 33 ha being set aside for compensation purposes. Whilst the existing fluvial flood risk at Heathrow is low, the consequences of this net loss of flood storage are likely to be a direct increase of flood areas downstream of the site with the likely impact of increased risk to developed areas. Furthermore, this will result in the shortlisted scheme itself occupying floodplain areas designated as Flood Risk Zones 2 and 3.

5.7.167 The impact of the shortlisted scheme on the surface water drainage systems was found to be insignificant overall[394].

5.7.168 This increased risk of flooding poses an increased risk to impacts on human health including drowning and injuries, as well as the geographic displacement, damage to the home or possessions and stress caused by dealing with the aftermath. These issues resulting from flooding are known to cause increased incidence of common mental disorders which may last for years after the flood event. This has been assessed as potentially having a major adverse impact on health, of low intensity and intermittent in nature.

5.7.169 The severity of any flooding will, together with the vulnerability of the local population, determine the extent of the above health impacts. This is of particular concern at Heathrow, since the local authorities surrounding Heathrow have both a higher percentage of young and older people, and lower proportion of residents who are white compared with the national average. As such, this shortlisted scheme is likely to have the most adverse effect of flood risk.

FLOOD RISK ASSESSMENT: LHR-NWR

5.7.170 The proposed runway will extend onto the floodplains designated as Flood Risk Zones 2 and 3. Whilst the existing fluvial flood risk to Heathrow Airport is low, the development is expected to lead to a loss of up to 40ha of undefended flood plain with 47ha being set aside for compensation purposes. This net increase in the overall flood storage for the catchment may have a beneficial impact on the local flood risk.

5.7.171 The impact of the future development proposals on the surface water drainage systems was found to be insignificant overall[395].

5.7.172 This reduction in risk of flooding suggest a reduction in risk to impacts on human health, including a reduction in drowning/ injuries, as well as the geographic displacement, and a reduction in damage to the home or possessions and stress caused by dealing with the aftermath. Risks of these are reduced as flooding risks reduced. This has been assessed as potentially having a major adverse impact on health, of low intensity and intermittent in nature.

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[394] Black and Veatch, 2010. *Heathrow Airport Site Wide Flood Risk Assessment – Explore Stage for BAA*, Version 2.0, April 2010.

[395] Black and Veatch, 2010. *Heathrow Airport Site Wide Flood Risk Assessment – Explore Stage for BAA*, Version 2.0, April 2010.

ASSUMPTIONS AND LIMITATIONS

5.7.173 The Water and Flood Baseline report concludes[393] that for Heathrow peak river flows would increase by 10% up to 2026 and by 25% up to 2086 and rainfall by 5%. This may mean that developments on the floodplain and zones are increasingly susceptible to groundwater flooding and that, without appropriate mitigation, all shortlisted schemes could result in increased risks both on and off airport as a result of increased peak river/overland flows and runoff rates.

RESILIENCE TO GLOBAL CLIMATE CHANGE: EVIDENCE

5.7.174 Resilience and adaption to climate change is an essential requirement for the owners and operators of national infrastructure. This can be undertaken by embedding adaptation throughout their organisation and the organisation's decision making, integrating adaptation into the maintenance regimes of existing infrastructure, considering how the impacts of climate change may affect new infrastructure and by implementing adaptation measures as necessary[396]. The impacts of climate change may pose a risk to service disruption from weather, affect the ability to meet customers' needs and higher operating and restoration costs.

5.7.175 The Civil Aviation Authority (CAA) has stated that climate change impacts would potentially cause disruption to business through more exceptional weather events, for example, more turbulence when flying; impacts to the safe departure and arrival of aircraft from fog, snow and ice; or to the airfield operations from flooding[397]. Other impacts of climate change include greater pressure on drainage systems, increased summer cooling demands, health issues due to high temperature and outdoor workers being exposed to adverse weather. Table 5.16 below summaries some issues.

Table 5-16 Climate Impacts to Airports[398]

CLIMATE IMPACT	EN-ROUTE (I.E. PLANES TRAVELLING TO AND FROM THE AIRPORT)	AIRPORTS OPERATIONS	AIRPORTS INFRASTRUCTURE
Precipitation change		Airfield flooding, ground subsidence. Reduction in airport throughput	Drainage system capacity, inundation of underground infrastructure and of ground surface access
Temperature change		Change in performance and noise	Heat damage to airport surface (runway, taxiways), increased heating and cooling requirements
Sea-level rise	Impact on en-route capacity due to loss of ground capacity	Loss of airport capacity	Loss of airport infrastructure
Wind change	Convective weather, route extension jet stream, increase in turbulence	Convective weather and local wind patterns, changes to distribution of noise patters	Damage to infrastructure
Extreme weather	Disruption to operations and route extensions	Disruption to operations	Damage to infrastructure

[396] Defra, 2011. Climate Resilient Infrastructure: *Preparing for a Changing Climate*. HM Government: London.
[397] Civil Aviation Authority, 2015. *Climate Change Adaptation Report*. Civil Aviation Authority: London.
[398] Civil Aviation Authority, 2015. *Climate Change Adaptation Report*. Civil Aviation Authority: London.

5.7.176 Adaptation to the increased risk posed by climate change involves a combination of preparedness and plans for emergency response. Planning for floods and storms should be part of emergency planning, while building adaption to long-term climate change must incorporate short-term severe winter conditions and longer term overall climate[399].

5.7.177 The CAA have stated that a new runway would not only provide extra capacity, but it would also help to improve resilience in the South East of England, enabling the system to cope better against unpredictable weather conditions exacerbated by climate change.

5.7.178 In addition, the Chartered Institute of Environmental Health identifies eight broad groups of potential health effects of climate change for which baseline data on incidence and cause exist.

- Infectious diseases: vector borne, waterborne, food related
- Mortality attributable to heatwaves
- Mortality attributable to cold periods
- Malnutrition related to climate effects on food supply
- Trauma attributable to adverse/extreme weather events
- Medium and long-term effects of flooding, including mental health as well as infection and impact on other diseases
- Illness attributable to air pollution
- Morbidity associated with ozone depletion: skin cancers, cataracts

RESILIENCE TO GLOBAL CLIMATE CHANGE BASELINE: GATWICK

5.7.179 Gatwick is the world's busiest single runway airport, with 40.3 million passengers in 2015, and is an important public transport hub[400]. Airports that already operate close to capacity are more vulnerable to severe weather events, as the recovery time available following disruption is very small.

5.7.180 The previous section highlighted that Gatwick is at risk from flooding and the airport's latest risk assessment confirms that flooding and ice/snow are the key climate-related risk and resilience priorities. This has resulted in an expanded flood resilience action plan, with an overarching focus on power resilience, and an upgraded Adverse Weather Plan. In addition, Gatwick Airport is currently ensuring that any flood resilience put in place to alleviate any possible future increased risk of flooding will also contribute to the flood resilience of local communities. Improved snow and ice resilience included investment in snow clearing equipment and de-icer storage facilities; and development of an enhanced snow contingency plan.

5.7.181 The severe weather event of December 2013 caused flooding failures to multiple systems. This was a key driver for the airport to develop its climate change resilience, which supports safety and passenger welfare. Since this event Gatwick has increased the resilience and redundancy between switch rooms, developed a standby power generation system, relocated sensitive equipment and acquired water pumps.

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[399] Stanwell-Smith, R., 2008. *Climate change and its health implications: A summary report for environmental health practitioners on the health implications of climate change*. Chartered Institute of Environmental Health: London.

[400] Gatwick Airport Limited, 2016. *Climate Change Adaptation Progress Report*. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/530908/climate-adrep-gatwick-airport.pdf) Accessed 22/07/2016.

5.7.182 The impact of weather on aviation is likely to escalate in the future as a result of increased convective weather, changes in wind speed and direction, increased precipitation and storm surges, higher temperature and sea level rise. This could disrupt en-route and terminal operations to such an extent that it may force changes to infrastructure, runway configuration and airspace design.

RESILIENCE TO GLOBAL CLIMATE CHANGE BASELINE: HEATHROW

5.7.183 London Heathrow Airport is currently the world's sixth busiest airport[401] and a critical element of UK infrastructure[402]. Weather can pose challenges to operations, including fog, high winds, heavy rain, snow, and extreme temperatures.

5.7.184 The site is relatively low-lying and is within close proximity to watercourses. This means it can be prone to fog although the wider area around Heathrow is classified as having a low to moderate vulnerability to flooding.[402]. The low lying nature of the site, and the large expanse of hard-standing associated with the terminals and runways has resulted in occasional historic flooding episodes.

5.7.185 For Heathrow the most significant risks arise from climate change from projected longer term changes to temperature and precipitation extremes. The biggest uncertainties surround future prevailing wind conditions as the airport does not have a cross-wind runway. Heavy snow fall and significant ice formation may in the future occasionally cause disruption to normal operation. There have been a number of instances of disruption at airports in recent years, caused by severe weather and therefore, becoming more operationally resilient will help ensure suitable adaption to the effects of climate change.

5.7.186 The aviation industry is weather-sensitive, and without mitigation adverse weather conditions have the potential to affect its safety.[402]. Climate risks in the short term are predominantly low, and more significant risks are largely already managed. If there are no changes to existing control measures the risks associated with climate change are predicted to worsen. If the airport implements and evolves adaptation strategy, the residual risk will be managed.

5.7.187 The weather can pose health and safety risks to passengers and employees. Slips, trips and falls are more common during cold conditions and hot weather can cause health problems for vulnerable passengers. Temperature extremes would also affect operating costs due to heating and cooling demand. These extreme conditions also have the potential can damage infrastructure.

5.7.188 The impact of weather on aviation is likely to escalate in the future as a result of increased convective weather, changes in wind speed and direction, increased precipitation and storm surges, higher temperature and sea level rise. This could disrupt en-route and terminal operations to such an extent that airports will force changes to infrastructure, runway configuration and airspace design.

[401] Airports Council International ACI releases preliminary world airport traffic rankings - Apr 04, 2016 http://www.aci.aero/News/Releases/Most-Recent/2016/04/04/ACI-releases-preliminary-world-airport-traffic-rankings-
[402] Heathrow Airport Limited, 2011. *Heathrow Airport Climate Change Adaptation Reporting Power report*. Heathrow Airport Limited: London.

RESILIENCE TO GLOBAL CLIMATE CHANGE ASSESSMENT: LGW-2R

5.7.189 The main direct threats from climate change to the airport and broader community are isolated to an increase of extremes and frequent of weather events, pressure on water supply, power demands and social pressure to travel less. Health outcomes would include heat-related illnesses as a consequence of exposure to extreme heat and an increase in respiratory and cardio-vascular effects, including increase in mortality as a consequence of ground-level ozone likely to increase.

5.7.190 A significant uncertainty is the impact of changing 'storminess' on surface water flood risk. To overcome this uncertainty a probabilistic approach has been proposed to better quantify the risk.[400] The McMillan review of the Airport's response to the severe weather at Christmas 2013 identified power resilience as a key issue. Specific recommendations on switch rooms, alternate/back up power sources, and monitoring systems have been implemented.

5.7.191 Currently it is believed that the airfield has high levels of power resilience, whereas other parts of the customer journey have some resilience requiring investment. Furthermore, an additional flood alleviation scheme still required completion. Further work also needs to be undertaken to assess the potential impact of flooding at Gatwick on local communities upstream and downstream of the airport.

5.7.192 Gatwick is taking steps to minimise this vulnerability to climate change. Overall, the risks associated with climate change to Gatwick Airport operations has been considered minimal[403].

5.7.193 Limited health effects from climate change resilience are anticipated due to the good climate change resilience of LGW-2R, therefore is has been assessed as neutral. All flood risk has been previously dealt with in previous sections.

RESILIENCE TO GLOBAL CLIMATE CHANGE ASSESSMENT: LHR-ENR

5.7.194 The severity and frequency of weather-related disruption and the type of challenges encountered at and around Heathrow are likely to change as a result of the changing climate. Generally the most significant consequences of weather extremes are impacts on air traffic movements due to the high capacity factor that Heathrow operates at, meaning any decrease has the potential to result in delays and cancellations.

5.7.195 For Heathrow the most significant risks arise from climate change from projected longer term changes to temperature and precipitation extremes, although the main uncertainty surrounds future prevailing wind conditions. This is significant since Heathrow's does not have a cross-wind runway.

5.7.196 Proposed improvements to Heathrow include new investment in equipment to deal with heavy snow, increased staffing resources and better training, new crisis management processes, better communication systems and improvements to passenger care and support.

5.7.197 Limited health effects from climate change resilience are anticipated due to the effective climate change resilience of LHR-ENR; all flood risk has been previously dealt with in previous sections.

[403] Arup, 2014. *A Second Runway for Gatwick Appendix A25 Operational Risk*. Ove Arup & Partners Ltd: London.

RESILIENCE TO GLOBAL CLIMATE CHANGE ASSESSMENT: LHR-NWR

5.7.198 The severity and frequency of weather-related disruption and the type of challenges encountered at and around Heathrow are likely to change as a result of the changing climate. Generally the most significant consequences of weather extremes are impacts on air traffic movements due to the high capacity factor that Heathrow operates at, meaning any decrease has the potential to result in delays and cancellations.

5.7.199 For Heathrow the most significant risks arise from climate change from projected longer term changes to temperature and precipitation extremes, although the main uncertainty surrounds future prevailing wind conditions. This is significant since Heathrow's does not have a cross-wind runway.

5.7.200 Proposed improvements to Heathrow include new investment in equipment to deal with heavy snow, increased staffing resources and better training, new crisis management processes, better communication systems and improvements to passenger care and support.

5.7.201 Limited health effects from climate change resilience are anticipated due to the effective climate change resilience of LHR-NWR; all flood risk has been previously dealt with in previous sections.

SUMMARY OF HEALTH IMPACTS FROM AIRPORT EXPANSION SCHEMES

5.7.202 A summary of health impacts have been brought together for each of the shortlisted schemes in Tables 5.17, 5.18, 5.19, 5.20, 5.21 and 5.22 below.

Table 5-17 Summary LGW-2R Health Impacts Construction Phase

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
		Construction Phase															
		Lifestyle															
Exercise and Physical Activity	--- Min L	-- Mod L	--- Min L	--- Min L	--- Min L	--- Min L	— Mod L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The health outcomes associated with any changes in exercise and physical activity associated with the LGW-2R shortlisted scheme have been assessed as minor adverse. Moderate impacts are likely to be felt by vulnerable groups including children and young people and people living in areas with poor health status
	Personal circumstances																
Childhood Development	-- Mod L	--- Mod P	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Health outcomes associated with impacts upon childhood development associated with the LGW-2R shortlisted scheme have been assessed as moderate adverse upon all groups, with exception to older people and includes loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home.
Employment Status	++ Mod L	++ Mod L	0	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	- Mod L	- Mod L	0	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	- Mod L	Largely beneficial health outcomes such as improved mental health, a reduction in episodes of depression and risk of coronary heart disease. Improvement in the mental health of those who gain employment as a result of expansion. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Level of Income	+++ Min L	+++ Min L	0	+++ Mod L	+++ Mod L	+++ Min L	+++ Min L	+++ Mod L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	Health outcomes would be minor beneficial, though are likely to be moderately beneficial in Crawley, as it has the highest unemployment within the Gatwick Study area, which is often associated with low household income. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Housing Tenure	-- Mod L	-- Mod L	-- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Threat to housing tenure within the LGW-2R expansion shortlisted scheme health impacts would be moderately adverse, long-term and of moderate intensity. However it could potentially have a major adverse impact upon older people.
	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Due to the scale of improvement to employment and income levels the gains in housing tenure within the LGW-2Rk expansion shortlisted scheme these health outcomes would be moderately beneficial to all groups.
Housing Conditions	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	The threat to housing conditions within the Gatwick expansion shortlisted scheme could potentially increase respiratory disease and episodes of depression, alcohol and drug misuse with a moderate adverse long-term impact of moderate intensity t. These health outcomes would have particularly impact within Crawley. And could potentially have a major adverse impact upon older people.
									Access to services, facilities and amenities / utilities								
Access to Greenspace/ Bluespace	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The potential health outcome of loss of sites has been assessed as being minor adverse in terms of mental distress and higher wellbeing with respect to the LGW-2R shortlisted scheme. This though would

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
																	disproportionately impact upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active / unemployed.
Access to leisure and recreation services and facilities to utilities	- Min M	- Mod M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	A minor adverse health outcome on all groups, with a moderate adverse impact on children and young people, as well as people living with from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users. Adverse health outcome on the general from loss of access to health facilities.
	Social Factors																
Participation in the community, social inclusion/ exclusion, social support	-- Mod L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome, including risk of episodes of depression, poor mental health, poor child health. Moderately adverse impact on different faith groups, older people, disabled people and those with other health problems, people with young children.
	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial impacts of low intensity, and permanent in duration from health improvements as a consequence of improved social networks, new community facilities.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Community severance	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome from loss of social support resulting in life stresses. The young, older people or disabled are at particular risk of suffering moderate adverse consequences of community severance
									Economic Factors								
Distribution of Wealth	+ Min P	+ Min P	0	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial health outcomes as a consequence of a reduction in income inequality would result in a reduction of health problems and stress potentially caused by status anxiety. A neutral impact for the elderly.
Job Creation/ Availability of employment opportunities/ Quality of employment opportunities/ Training and Skills	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Potentially moderate beneficial health outcomes including mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for all vulnerable groups including the general population, excluding older people. These health outcomes would be moderate, of high intensity and long-term, though may are likely to of major benefit in Crawley.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Amount of Traffic Congestion	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	Disruptions and alterations are likely due to an increase of large construction vehicles travelling and manoeuvring within the assessment area. Health impacts are likely to be minor adverse, moderate in intensity and temporary in duration.
									Environmental Factors								
Air Quality	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	Moderate adverse impact upon health outcomes, including increased risk of respiratory disease, cardiovascular disease and adverse, short-term, temporary and intermittent impacts. Major adverse impact upon vulnerable groups where health effects could lead directly to deaths, acute or chronic diseases. These vulnerable groups include children and young people and people living with long-term health conditions may be susceptible to major adverse health impacts children and those with long-term health issues.
Water Quality	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	The health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Soil Quality	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	The potential impact from these health outcomes should they occur have been assessed as potentially major adverse, though of low intensity temporary in duration during construction and neutral during airport operation.
Noise	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	Noise impacts during construction are mixed minor beneficial / moderate adverse, of medium intensity and long-term in duration. Since the population would remain exposed to ground >57 dB $L_{Aeq, 0700-2300}$ is expected to be a smaller number than exposed in the do minimum.
	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	
Land Use	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of greenspace which will have a minor adverse health impact on a cross section of the population, of high intensity and permanent in duration.
Natural Habitats	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, high intensity and long-term
Landscape/ Townscape	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse impacts on landscape during the construction period and of high intensity and long-term.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Tranquillity	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse health impacts on both physical and psychological wellbeing, particularly of high intensity and permanent in duration.
Flood Risk	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	Health impacts from flooding include could include physical injury or an increase incidence of common mental disorders such as post-traumatic stress, anxiety and depression. Though impacts could have major health outcomes, there occurrence would be low risk, low intensity and of intermittent.
Resilience to global climate change	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health outcomes have been assessed as neutral

Table 5-18 Summary LGW-2R Health Impacts Operation Phase

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	Operation Phase																
	Lifestyle																
Exercise and Physical Activity	- Min L	-- Mod L	- Min L	- Min L	- Min L	- Min L	- Mod L	- Min L	- Min L	- Min L	- Min L	- Min L	- Min L	- Min L	- Min L	- Min L	The health outcomes associated with any changes in exercise and physical activity associated with the LGW-2R shortlisted scheme have been assessed as minor adverse. Moderate impacts are likely to be felt by vulnerable groups including children and young people, and people living in areas with poor health status
	Personal circumstances																
Childhood Development	-- Mod L	-- Mod P	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Health outcomes associated with impacts upon childhood development associated with the LGW-2R shortlisted scheme have been assessed as moderately adverse upon all groups, with exception to older people and includes loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home.
Employment Status	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	-- Mod L	-- Mod L		-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Largely beneficial health outcomes such as improved mental health, a reduction in episodes of depression and risk of coronary heart disease. Improvement in the mental health of those who gain employment as a result of expansion. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Level of Income	+++ Min L	+++ Min L	0	+++ Mod L	+++ Mod L	+++ Min L	+++ Min L	+++ Mod L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	Health outcomes would be minor beneficial, though are likely to be moderately beneficial in Crawley, as it has the highest unemployment within the Gatwick Study area, which is often associated with low household income. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed.
Housing Tenure	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Threat to housing tenure within the LGW-2R expansion shortlisted scheme health impacts would be moderately adverse, long-term and of moderate intensity. However it could potentially have a major adverse impact upon older people.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to	People from BME	Shift workers	General Population	Commentary
	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Due to the scale of improvement to employment and income levels the gains in housing tenure within the LGW-2R expansion shortlisted scheme these health outcomes would be moderately beneficial to all groups.
Housing Conditions	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	The threat to housing conditions within the Gatwick expansion shortlisted scheme could potentially increase respiratory disease and episodes of depression, alcohol and drug misuse with a moderate adverse long-term impact of moderate intensity. These health outcomes would have particularly impact within Crawley. And could potentially have a major adverse impact upon older people.
	Access to services, facilities and amenities / utilities																
Access to Greenspace/ Bluespace	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The potential health outcome of loss of sites has been assessed as being minor adverse in terms of mental distress and higher wellbeing with respect to the LGW-2R shortlisted scheme

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Access to leisure and recreation services and facilities to utilities	- Min M	- Mod M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	A minor adverse health outcome on all groups, with a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users. Adverse health outcome on the general from loss of access to health facilities.
	Social Factors																
Participation in the community, social inclusion/ exclusion, social support	-- Mod L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome, including risk of episodes of depression, poor mental health, poor child health. Moderately adverse impact on different faith groups, older people, disabled people and those with other health problems, people with young children.
	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial impacts of low intensity, and permanent in duration from health improvements as a consequence of improved social networks, new community facilities.
Community severance	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome from loss of social support resulting in life stresses. The young, older people or disabled are at particular risk of suffering moderate adverse consequences of community severance

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to	People from BME	Shift workers	General Population	Commentary
	Economic Factors																
Distribution of Wealth	+ Min P	+ Min P	0	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial health outcomes as a consequence of a reduction in income inequality would result in a reduction of health problems and stress potentially caused by status anxiety. A neutral impact for the elderly.
Job Creation/ Availability of employment opportunities/ Quality of employment opportunities/ Training and Skills	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Potentially moderate beneficial health outcomes including mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for all vulnerable groups including the general population, excluding older people. These health outcomes would be moderate, of high intensity and long-term, though may are likely to of major benefit in Crawley.
Amount of Traffic Congestion	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	Disruptions and alterations are likely due to an increase of large construction vehicles travelling and manoeuvring within the assessment area. Health impacts are likely to be minor adverse, moderate in intensity and temporary in duration.
	Environmental Factors																

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Air Quality	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	Moderate adverse impact upon health outcomes, including increased risk of respiratory disease, cardiovascular disease and adverse, short-term, temporary and intermittent impacts. Major adverse impact upon vulnerable groups where health effects could lead directly to deaths, acute or chronic diseases. These vulnerable groups include children and young people and people living with long-term health conditions may be susceptible to major adverse health impacts children and those with long-term health issues.
Water Quality	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	The health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.
Soil Quality	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	The potential impact from these health outcomes should they occur have been assessed as potentially major adverse, though of low intensity temporary in duration during construction and neutral during airport operation.
Noise	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	++ Min L	Ground Noise: Minor beneficial impacts, moderate intensity and long-term.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Aircraft noise: Moderately adverse for all groups, of moderate intensity and long-term.
Land Use	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of greenspace which will have a minor adverse health impact on a cross section of the population, of high intensity and permanent in duration.
Natural Habitats	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, high intensity and long-term
Landscape/ Townscape	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse impacts on landscape during the construction period and of high intensity and long-term.
Tranquillity	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse health impacts on both physical and psychological wellbeing, particularly of high intensity and permanent in duration.
Flood Risk	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	Health impacts from flooding include could include physical injury or an increase incidence of common mental disorders such as post-traumatic stress, anxiety and depression. Though impacts could have major health outcomes, there occurrence would be low risk, low intensity and of intermittent.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services,	People with poor access to	Pregnant, women/ trying to	People from BME	Shift workers	General Population	Commentary
Resilience to global climate change	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health outcomes have been assessed as neutral

Table 5-19 Summary LHR-ENR Health Impacts Construction Phase

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Construction Phase																	
Lifestyle																	
Exercise and Physical Activity	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	The health outcomes associated any changes in exercise and physical activity associated with the LHR-ENR shortlisted scheme have been assessed as moderately adverse, for all groups, with a high intensity and Long-term in duration.
Personal circumstances																	
Childhood Development	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Health outcomes associated with impacts upon childhood development associated with the LHR-ENR shortlisted scheme have been assessed as moderately adverse upon childhood development, including loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home. This would affect all groups, with exception to older people.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Employment Status	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Largely beneficial health outcomes such as improved mental health, a reduction in episodes of depression and risk of coronary heart disease. Improvement in the mental health of those who gain employment as a result of expansion. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Level of Income	+++ Min L	+++ Min L	0	+++ Mod L	+++ Mod L	+++ Min L	+++ Min L	+++ Mod L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	Health outcomes would be minor beneficial, though are likely to be moderately beneficial in Slough, Ealing and Hounslow, as it has the highest unemployment within the Heathrow Study area, which is often associated with low household income. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Housing Tenure	--- Mod L	--- Mod L	--- Maj L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	Threat to housing tenure within the LHR-ENR shortlisted scheme these health outcomes would be moderately adverse high intensity impact upon all groups. However it could potentially have a major adverse impact upon older people.
	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Due to the scale of improvement to employment and income levels the gains in housing tenure within the LHR-ENR shortlisted scheme these health outcomes would be moderately beneficial of high intensity to all vulnerable groups.
Housing Conditions	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Impact upon health from change in housing conditions within the LHR-ENR expansion shortlisted scheme could potentially increase respiratory disease and episodes of depression, alcohol and drug misuse with moderate impact. These health impacts would be moderately adverse, of moderate intensity and long term. The health impact would be weighted towards populations of Slough, Ealing and Hounslow, as these areas have the highest unemployment within the Heathrow Study Area. Health impacts would be would be major adverse, low intensity impact upon older people.
Access to services, facilities and amenities / utilities																	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Access to Greenspace/ Bluespace	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The potential health outcome of loss of sites has been assessed as being minor adverse in terms of mental distress and higher wellbeing with respect to the LHR-ENR shortlisted scheme. This though would disproportionately impact upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active / unemployed.
Access to leisure and recreation services and facilities to utilities	- Min M	- Mod M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	Potentially minor adverse health outcome on all groups, with a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users. Adverse health outcome on the general from loss of access to health facilities.
Social Factors																	
Participation in the community, social inclusion/ exclusion, social support	-- Min L	-- Mod L	-- Mod L	- Min L	- Min L	-- Mod L	-- Mod L	Min L	Min L	Min L	Min L	Min L	Min L	Min L	Min L	Min L	Minor adverse health outcome, including risk of episodes of depression, poor mental health, poor child health. Moderately adverse impact on vulnerable older people, disabled people (and those with other health problems) and people with young children.
	+ Min P	+ Min P	+	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
			Min P														Minor beneficial impacts of low intensity, and permanent in duration from health improvements as a consequence of improved social networks, new community facilities.
Community severance	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome from loss of social support resulting in life stresses. The young, older people or disabled are at particular risk of suffering moderate adverse consequences of community severance
Economic Factors																	
Distribution of Wealth	+ Min P	+ Min P	0	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial health outcomes as a consequence of a reduction in income inequality would result in a reduction of health problems and stress potentially caused by status anxiety. A neutral impact for the elderly.
Job Creation/ Availability of employment opportunities/ Quality of employment opportunities/ Training and Skills	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Potentially moderate beneficial health outcomes including mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for all vulnerable groups including the general population, excluding the older people. These health outcomes would be moderate, of high intensity, though may likely be of major benefit in Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study area.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Amount of Traffic Congestion	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	Disruptions and alterations are likely due to an increase of large construction vehicles travelling and manoeuvring within the assessment area. Health impacts are likely to be minor adverse, moderate in intensity and temporary in duration.
Environmental Factors																	
Air Quality	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	Moderate adverse impact upon health outcomes, including increased risk of respiratory disease, cardiovascular disease and adverse, short-term, temporary and intermittent impacts. Major adverse impact upon vulnerable groups where health effects could lead directly to deaths, acute or chronic diseases. These vulnerable groups include children and young people and people living with long-term health conditions may be susceptible to major adverse health impacts children and those with long-term health issues.
Water Quality	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	The health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Soil Quality	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	The potential impact from these health outcomes should they occur have been assessed as potentially major adverse, though of low intensity temporary in duration during construction and neutral during airport operation.
Noise	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	Noise impacts during construction are mixed minor beneficial / moderate adverse, of medium intensity and long-term in duration. Since the population would remain exposed to ground >57 dB $L_{Aeq,\ 0700\text{-}2300}$ it is expected to be a smaller number than exposed in the do minimum.
	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	
Land Use	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of greenspace which will have a minor adverse health impact on a cross section of the population, of high intensity and permanent in duration.
Natural Habitats	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, high intensity and long-term

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Landscape/ Townscape	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	Minor adverse impacts on landscape during the construction period. These impacts are likely to be of high intensity and temporary in duration, as landscape perceptions and expectation alter over time.
Tranquillity	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse health impacts on both physical and psychological wellbeing, particularly of high intensity and permanent in duration.
Flood Risk	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	Health impacts from flooding could include physical injury or an increase incidence of common mental disorders such as post-traumatic stress, anxiety and depression. Though impacts could have major health outcomes, there occurrence would be low risk, low intensity and of intermittent.
Resilience to global climate change	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health outcomes have been assessed as neutral

Table 5-20 Summary LHR-ENR Health Impacts Operation Phase

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Operation Phase																	
Lifestyle																	
Exercise and Physical Activity	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	The health outcomes associated any changes in exercise and physical activity associated with the LHR-ENR shortlisted scheme have been assessed as moderately adverse, for all groups, with a high intensity and Long-term in duration.
Personal circumstances																	
Childhood Development	-- Mod L	-- Mod L	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Health outcomes associated with impacts upon childhood development associated with the LHR-ENR shortlisted scheme have been assessed as moderately adverse upon childhood development, including loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home. This would affect all groups, with exception to older people.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Employment Status	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Largely beneficial health outcomes such as improved mental health, a reduction in episodes of depression and risk of coronary heart disease. Improvement in the mental health of those who gain employment as a result of expansion. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Level of Income	+++ Min L	+++ Min L	0	+++ Mod L	+++ Mod L	+++ Min L	+++ Min L	+++ Mod L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	Health outcomes would be minor beneficial of high intensity, though are likely to be moderately beneficial in Slough, Ealing and Hounslow, as it has the highest unemployment within the Heathrow Study area, which is often associated with low household income. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to pregnar	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Housing Tenure	--- Mod L	--- Mod L	-- Mod	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	Threat to housing tenure within the LHR-ENR expansion shortlisted scheme health impacts would be moderately adverse, long-term and of moderate intensity. However it could potentially have a major adverse impact upon older people.
	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Due to the scale of improvement to employment and income levels the gains in housing tenure within the LHR-ENR shortlisted scheme these health outcomes would be moderately beneficial to all vulnerable groups.
Housing Conditions	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Impact upon health from change in housing conditions within the LHR-ENR expansion shortlisted scheme could potentially increase respiratory disease and episodes of depression, alcohol and drug misuse with moderate impact. These health impacts would be moderately adverse, of moderate intensity and long term. The health impact would be weighted towards populations of Slough, Ealing and Hounslow, as these areas have the highest unemployment within the Heathrow Study Area. Health impacts would be would be major adverse, low intensity impact upon older people.
Access to services, facilities and amenities / utilities																	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to services	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Access to Greenspace/ Bluespace	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The potential health outcome of loss of sites has been assessed as being minor adverse in terms of mental distress and higher wellbeing with respect to the LHR-ENR shortlisted scheme. This though would disproportionately impact upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active / unemployed.
Access to leisure and recreation services and facilities to utilities	- Min M	- Mod M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	Potentially minor adverse health outcome on all groups, with a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users. Adverse health outcome on the general from loss of access to health facilities.
Social Factors																	
Participation in the community, social inclusion/ exclusion, social support	-- Min L	-- Mod L	-- Mod L	- Min L	- Min L	-- Mod L	-- Mod L	Min L	Min L	Min L	Min L	Min L	Min L	Min L	Min L	Min L	Minor adverse health outcome, including risk of episodes of depression, poor mental health, poor child health. Moderately adverse impact on vulnerable the older people, disabled people and those with other health problems, people with young children.
	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
																	Minor beneficial impacts of low intensity, and permanent in duration from health improvements as a consequence of improved social networks, new community facilities.
Community severance	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome from loss of social support resulting in life stresses. The young, older people or disabled are at particular risk of suffering moderate adverse consequences of community severance
Economic Factors																	
Distribution of Wealth	+ Min P	+ Min P	0	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial health outcomes as a consequence of a reduction in income inequality would result in a reduction of health problems and stress potentially caused by status anxiety. A neutral impact for the elderly.
Job Creation/ Availability of employment opportunities/ Quality of employment opportunities/ Training and Skills	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Potentially moderate beneficial health outcomes including mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for all vulnerable groups including the general population, excluding the older people. These health outcomes would be moderate, though may are likely to of major benefit in Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study area.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Amount of Traffic Congestion	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	Disruptions and alterations are likely due to an increase of large construction vehicles travelling and manoeuvring within the assessment area. Health impacts are likely to be minor adverse, moderate in intensity and temporary in duration.
Environmental Factors																	
Air Quality	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	Moderate adverse impact upon health outcomes, including increased risk of respiratory disease, cardiovascular disease and adverse, short-term, temporary and intermittent impacts. Major adverse impact upon vulnerable groups where health effects could lead directly to deaths, acute or chronic diseases. These vulnerable groups include children and young people and people living with long-term health conditions may be susceptible to major adverse health impacts children and those with long-term health issues.
Water Quality	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	The health outcome has been assessed as being minor adverse during construction and neutral during the operational phase of the expanded airport.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Soil Quality	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	The potential impact from these health outcomes should they occur have been assessed as potentially major adverse, though of low intensity temporary in duration during construction and neutral during airport operation.
Noise	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Ground noise impacts during operation are mixed minor beneficial / moderate adverse, of medium intensity and long-term in duration. Since the population would remain exposed to ground >57 dB $L_{Aeq,\ 0700\text{-}2300}$ is expected to be a smaller number than exposed in the do minimum.
	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	Aircraft noise: Moderately adverse for all groups, of moderate intensity and long-term.
Land Use	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of greenspace which will have a minor adverse health impact on a cross section of the population, of high intensity and permanent in duration.
Natural Habitats	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, high intensity and long-term

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Landscape/ Townscape	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	Minor adverse impacts on landscape during the construction period. These impacts are likely to be of high intensity and temporary in duration, as landscape perceptions and expectation alter over time.
Tranquillity	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse health impacts on both physical and psychological wellbeing, particularly of high intensity and permanent in duration.
Flood Risk	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	Health impacts from flooding include could include physical injury or an increase incidence of common mental disorders such as post-traumatic stress, anxiety and depression. Though impacts could have major health outcomes, there occurrence would be low risk, low intensity and of intermittent.
Resilience to global climate change	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health impacts resulting from resilience to global climate change have been assessed as neutral

Table 5-21 Summary LHR-NWR Health Impacts Construction Phase

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to services	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Construction Phase																	
Lifestyle																	
Exercise and Physical Activity	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	The health outcomes associated any changes in exercise and physical activity associated with the LHR-NWR shortlisted scheme have been assessed as moderately adverse, for all groups, with a high intensity and long-term in duration.
Personal circumstances																	
Childhood Development	-- Mod L	-- Mod L	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Health impacts associated with impacts upon childhood development associated with the LHR-NWR shortlisted scheme have been assessed as moderately adverse upon childhood development, including loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home. This would affect all groups, with exception to older people.
Employment Status	++ Mod L	++ Mod L	0	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	-- Mod L	-- Mod L	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Largely beneficial health impacts such as improved mental health, a reduction in episodes of depression and risk of coronary heart disease. Improvement in the mental health of those who gain employment as a result of expansion. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Level of Income	+++ Min L	+++ Min L	0	+++ Mod L	+++ Mod L	+++ Min L	+++ Min L	+++ Mod L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	Health impacts would be minor beneficial, though are likely to be moderately beneficial in Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study area, which is often associated with low household income. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Housing Tenure	--- Mod L	--- Mod L	-- Maj L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	Threat to housing tenure within the LHR-NWR expansion shortlisted scheme these health impacts would be moderately adverse.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
																	However it could potentially have a major adverse impact upon older people.
	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Due to the scale of improvement to employment and income levels the gains in housing tenure within the LHR-NWR expansion shortlisted scheme these health outcomes would be moderately beneficial, long-term and of major intensity to all groups, .
Housing Conditions	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	The threat to housing conditions within the LHR-NWR expansion shortlisted scheme these health impacts could potentially increase respiratory disease and episodes of depression, alcohol and drug misuse with adverse long-term impact of moderate intensity. This adverse impact would be weighted towards populations of Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study Area. And could potentially have a major adverse impact upon older people.
Access to services, facilities and amenities / utilities																	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to services	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Access to Greenspace/ Bluespace	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The potential health outcome of loss of sites has been assessed as being minor adverse in terms of mental distress and higher wellbeing with respect to the LHR-NWR shortlisted scheme. This though would disproportionately impact upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active / unemployed.
Access to leisure and recreation services and facilities to utilities	- Min M	- Mod M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	A minor adverse health outcome on all groups, with a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users. Adverse health outcome on the general from loss of access to health facilities.
Social Factors																	
	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Participation in the community, social inclusion/ exclusion, social support	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor adverse health outcome, including risk of episodes of depression, poor mental health, poor child health. Moderately adverse impact on vulnerable groups including older people, disabled people and those with other health problems, people with young children. Minor beneficial impacts of low intensity, and permanent in duration from health improvements as a consequence of improved social networks, new community facilities.
Community severance	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome from loss of social support resulting in life stresses. The young, older people or disabled are at particular risk of suffering moderate adverse consequences of community severance
Economic Factors																	
Distribution of Wealth	+ Min P	+ Min P	0	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial health outcomes as a consequence of a reduction in income inequality would result in a reduction of health problems and stress potentially caused by status anxiety. A neutral impact for the elderly.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Job Creation/ Availability of employment opportunities/ Quality of employment opportunities/ Training and Skills	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Potentially moderate beneficial health outcomes including mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for all vulnerable groups including the general population, excluding the older people. These health outcomes would be moderate, though may are likely to of major benefit in Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study area,
Amount of Traffic Congestion	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	Disruptions and alterations are likely due to an increase of large construction vehicles travelling and manoeuvring within the assessment area. Health impacts are likely to be minor adverse, moderate in intensity and temporary in duration.
Environmental Factors																	
Air Quality	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	Moderate adverse impact upon health outcomes, including increased risk of respiratory disease, cardiovascular disease and adverse, short-term, temporary and intermittent impacts.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
																	Major adverse impact upon vulnerable groups where health effects could lead directly to deaths, acute or chronic diseases. These vulnerable groups include children and young people and people living with long-term health conditions may be susceptible to major adverse health impacts children and those with long-term health issues.
Water Quality	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	The health outcome has been assessed as being minor adverse during construction.
Soil Quality	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	- Maj S	The potential impact from these health outcomes should they occur have been assessed as potentially major adverse, though of low intensity temporary in duration during construction.
Noise	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	Noise impacts during construction are mixed minor beneficial / moderate adverse, of medium intensity and long-term in duration. Since the population would remain exposed to ground >57 dB $L_{Aeq, 0700-2300}$ is expected to be a smaller number than exposed in the do minimum.
	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	
Land Use	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of greenspace which will have a minor adverse health impact on a cross section of the population, of high intensity and permanent in duration.

Determinant category	Different faith /belief groups	Children and young people	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Natural Habitats	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, high intensity and long-term
Landscape/ Townscape	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	Minor adverse impacts on landscape during the construction period. These impacts are likely to be of high intensity and temporary in duration, as landscape perceptions and expectation alter over time.
Tranquillity	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse health impacts on both physical and psychological wellbeing, particularly of high intensity and permanent in duration.
Flood Risk	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	Health impacts from flooding include could include physical injury or an increase incidence of common mental disorders such as post-traumatic stress, anxiety and depression. Though impacts could have major health outcomes, there occurrence would be low risk, low intensity and of intermittent.
Resilience to global climate change	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health outcomes have been assessed as neutral

Table 5-22 Summary LHR-NWR Health Impacts Operational Phase

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographical/social	Non-motorised users	People with poor access to services	People with poor access to greenspace	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	Operation Phase																
Lifestyle																	
Exercise and Physical Activity	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	The health outcomes associated any changes in exercise and physical activity associated with the LHR-NWR shortlisted scheme have been assessed as moderately adverse, for all groups, with a high intensity and Long-term in duration.
Personal circumstances																	
Childhood Development	-- Mod L	-- Mod L	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Health impacts associated with impacts upon childhood development associated with the LHR-NWR shortlisted scheme have been assessed as moderately adverse upon childhood development, including loss of safe and stable housing as well as, reduction in access to high-quality learning opportunities at home. This would affect all groups, with exception to older people.
Employment Status	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
	-- Mod L	-- Mod L	0	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	Largely beneficial health impacts such as improved mental health, a reduction in episodes of depression and risk of coronary heart disease. Improvement in the mental health of those who gain employment as a result of expansion. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Level of Income	+++ Min L	+++ Min L	0	+++ Mod L	+++ Mod L	+++ Min L	+++ Min L	+++ Mod L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	+++ Min L	Health impacts would be minor beneficial, though are likely to be moderately beneficial in Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study area, which is often associated with low household income. Health outcomes would be of major benefit to people on a low income, people living in areas of deprivation, people who are economically inactive/ unemployed. Moderately beneficial to most vulnerable groups, excluding older people.
Housing Tenure	--- Mod L	--- Mod L	-- Maj L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	Threat to housing tenure within the LHR-NWR expansion shortlisted scheme these health impacts would be moderately adverse.

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
																	However it could potentially have a major adverse impact upon older people.
	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	Due to the scale of improvement to employment and income levels the gains in housing tenure within the LHR-NWR expansion shortlisted scheme these health impacts would be moderately beneficial to all groups.
Housing Conditions	-- Mod L	-- Mod L	- Maj L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	-- Mod L	The threat to housing conditions within the LHR-NWR expansion shortlisted scheme these health impacts could potentially increase respiratory disease and episodes of depression, alcohol and drug misuse with moderate adverse impact. These adverse impacts would be weighted towards the populations of Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study Area, and could potentially have a major adverse impact upon older people.
Access to services, facilities and amenities / utilities																	

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to services	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Access to Greenspace/ Bluespace	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	--- Min L	The potential health outcome of loss of sites has been assessed as being minor adverse in terms of mental distress and higher wellbeing with respect to the LHR-NWR shortlisted scheme. This though would disproportionately impact upon vulnerable groups such as people with poor access to greenspace, non-motorised users, people with disabilities, older people, children and young people, people who are economically active / unemployed.
Access to leisure and recreation services and facilities to utilities	- Min M	- Mod M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	- Min M	A minor adverse health outcome on all groups, with a moderate adverse impact on children and young people from local communities who currently access such facilities, with a potential increase in risk of obesity and type 2 diabetes in children, young people and leisure users. Adverse health outcome on the general from loss of access to health facilities.
Social Factors																	
	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Participation in the community, social inclusion/ exclusion, social support	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor adverse health outcome, including risk of episodes of depression, poor mental health, poor child health. Moderately adverse impact on vulnerable groups including older people, disabled people and those with other health problems, people with young children. Minor beneficial impacts of low intensity, and permanent in duration from health improvements as a consequence of improved social networks, new community facilities.
Community severance	-- Min L	-- Mod L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Mod L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	-- Min L	Minor adverse health outcome from loss of social support resulting in life stresses. The young, older people or disabled are at particular risk of suffering moderate adverse consequences of community severance
Economic Factors																	
Distribution of Wealth	+ Min P	+ Min P	0	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	+ Min P	Minor beneficial health outcomes as a consequence of a reduction in income inequality would result in a reduction of health problems and stress potentially caused by status anxiety. A neutral impact for the elderly.

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Job Creation/ Availability of employment opportunities/ Quality of employment opportunities/ Training and Skills	+++ Mod L	+++ Mod L	0	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	+++ Mod L	Potentially moderate beneficial health outcomes including mental health, a reduction in child poverty, episodes of depression and risk of coronary heart disease for all vulnerable groups including the general population, excluding the older people. These health outcomes would be moderate, though may are likely to of major benefit in Slough, Ealing and Hounslow, as these have the highest unemployment within the Heathrow Study area.
Amount of Traffic Congestion	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	-- Min T	Disruptions and alterations are likely due to an increase of large construction vehicles travelling and manoeuvring within the assessment area. Health impacts are likely to be minor adverse, moderate in intensity and temporary in duration.
Environmental Factors																		
Air Quality	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	-- Maj M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	--- Mod M	Moderate adverse impact upon health outcomes, including increased risk of respiratory disease, cardiovascular disease and adverse, short-term, temporary and intermittent impacts.

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
																	Major adverse impact upon vulnerable groups where health effects could lead directly to deaths, acute or chronic diseases. These vulnerable groups include children and young people and people living with long-term health conditions may be susceptible to major adverse health impacts children and those with long-term health issues.
Water Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health impact with mitigation has been assessed as being neutral during operational phase of LHR-NWR expanded airport.
Soil Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Potential neutral health impact during airport operation.
Noise	+++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	++ Mod L	Ground Noise: Minor beneficial impacts, moderate intensity and long-term.
	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	--- Mod L	Aircraft noise: Moderately adverse for all groups, of moderate intensity and long-term.
Land Use	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of greenspace which will have a minor adverse health impact on a cross section of the population, of high intensity and permanent in duration.

Determinant category	Different faith /belief groups	Children and young	Older people	People on a low income	Economically inactive/ unemployed	Disabled people with a physical or	People living in areas with poor health	People living in areas of	People living in geographic al/social	Non-motorised users	People with poor access to service	People with poor access to greenspac	Pregnant, women/ trying to become	People from BME	Shift workers	General Population	Commentary
Natural Habitats	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Loss of potential contact with animals and plants within natural environments could have a minor adverse impact on both physiologically and psychologically on human health and wellbeing, high intensity and long-term
Landscape/ Townscape	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	--- Min T	Minor adverse impacts on landscape during the operation period. These impacts are likely to be of high intensity and temporary in duration, as landscape perceptions and expectation alter over time.
Tranquillity	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	--- Min P	Minor adverse health impacts on both physical and psychological wellbeing, particularly of high intensity and permanent in duration.
Flood Risk	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	- Maj I	Health impacts from flooding include could include physical injury or an increase incidence of common mental disorders such as post-traumatic stress, anxiety and depression. Though impacts could have major health outcomes, there occurrence would be low risk, low intensity and of intermittent.
Resilience to global climate change	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Health outcomes have been assessed as neutral

6 CONCLUSIONS

6.1 LIMITATIONS

6.1.1 As the shortlisted scheme plans and baseline information supplied by the Airport Commission were limited in their detail, this assessment has been limited to consider the impacts of each shortlisted scheme at a policy level. Collection and review of additional baseline data to identify vulnerable groups, and supporting information has been limited to the District level or above.

6.1.2 Information regarding surface access arrangements for each shortlisted scheme was not available at the time of this analysis. Therefore traffic impacts were not assessed in detail.

6.1.3 Committed development within each of the plan, including public transport plans have not formed part of this analysis, though there will ultimately be some cumulative impacts, both adverse and beneficial within all of the three shortlisted schemes.

6.1.4 Due to the confidential nature of elements of this study, no targeted stakeholder consultation has taken place at this stage.

6.2 OVERVIEW

6.2.1 Increased air traffic generates costs to society by effecting health and wellbeing, particularly through noise and air quality pollution.

6.2.2 This health impact analysis study has attempted to support the Department of Transport in determining broader impacts upon health of each shortlisted scheme.

6.3 CONCLUSIONS

6.3.1 This health impact analysis study has found commonality between key health issues and those recognised within previous HIAs studies on airports. These included:

- Noise Impacts – from additional aircraft flights and ground movement, leading to significant health impacts and increases in DALYs
- Air Quality Impacts – health impacts resulting from degradation of local air quality from additional aircraft emissions, and airport road traffic could impact on compliance with limit values, with a risk of future non-compliance of AQO in the Greater London area.
- Socio-economic – beneficial impacts on employment opportunities; and potentially adverse impacts on dwellings or established businesses.

6.3.2 Other impacts identified included community severance, reduced access to recreation facilities, greenspace, flood risk and potential loss of tranquillity. These impacts are common to all three shortlisted schemes, although the severity of the impact varies slightly. Further detail is provided in the summaries below.

6.3.3 In addition, it is likely that those most affected by the expansions shortlisted schemes are also less likely to benefit from the opportunities provided. This issue of equity will need to be considered further in the development of mitigation for each shortlisted scheme to reduce the overall impact on health and wellbeing.

GATWICK

Health impacts from construction

6.3.4 Health impacts arising from construction of LGW-2R are associated with poor air quality, increases in noise, health effects from loss of housing and are generally minor to moderately adverse, of low and medium intensity, short-term, intermittent and/or temporary in nature. However, major long-term permanent impacts resulting from land take and rehousing have been predicted to occur.

Health impacts from operation

6.3.5 Health impacts from operation of LGW-2R range from major adverse to moderately beneficial and are low to medium intensity, long-term, intermittent and/or permanent in nature. However, moderate adverse long-term permanent impacts resulting from noise, air quality, land take and rehousing are predicted to occur.

Health Determinants affected

6.3.6 Health determinants that have been assessed as potentially experiencing an adverse change as a consequence of the construction of the Gatwick expansion scheme included:

- Exercise and physical activity
- Childhood development
- Housing tenure
- Housing conditions
- Access to greenspace/ bluespace
- Access to leisure and recreation services and facilities
- Participation in the community, social inclusion/exclusion, social contact/support
- Community severance
- Amount of traffic congestion
- Air quality
- Noise
- Land use
- Natural habitats
- Landscape, including green and open spaces
- Townscape, including civic areas and public realm
- Tranquillity
- Flood risk

6.3.7 Health determinants that have been assessed as potentially experiencing a neutral or mixed change as a consequence of the construction of the Gatwick expansion scheme included:

- Water quality,
- Soil quality,
- Resilience to global climate change

6.3.8 Health determinants that have been assessed as potentially experiencing a beneficial change as a consequence of the construction of the Gatwick expansion scheme included:

- Level of income
- Employment status
- Distribution of wealth
- Job creation
- Availability of employment opportunities
- Quality of employment opportunities
- Training and skills development

6.3.9 Despite its lower beneficial health impacts arising from economic effects, overall LGW-2R was judged to have a lower detrimental impact upon health; this was in part due to LGW-2R requiring fewer residential properties to be demolished. This would result in a fewer groups being subjected to moderately adverse health effects from the risk to both their housing tenure and housing conditions. In addition, it would result in fewer older people being subjected to potential major adverse health effects, once again, from the risk to both their housing tenure and housing conditions.

6.3.10 Noise impacts arising from LGW-2R were predicted of a lower magnitude and of lesser intensity, affecting a smaller population, than either of the unmitigated Heathrow expansion shortlisted schemes. The changes in the metric DALYs lost, attributed solely to total environmental noise as a consequence of LGW-2R were lower for LGW-2R than for either Heathrow shortlisted scheme. Over the 60-year design life period DALYs associated with changes in total environmental noise attributed to LGW-2R were significantly lower for LGW-2R (3,486 for low weighting estimate; 5,810 for mid weighting estimate, and 23,239 for high weighting estimate) than either LHR-ENR (13,798 for low weighting estimate; 20,334 for mid weighting estimate, and 126,360 high weighting estimate) or LHR-NWR (9,005 for low weighting estimate; 15,105 for mid weighting estimate, and 114,741 for high weighting estimate), estimated to be for the 45 dB(A) threshold case

6.3.11 Air quality impacts for LGW-2R were estimated to be limited, due to relatively low existing air pollutant concentrations. Increases in exposure to air pollutants as a result of expansion at Gatwick airport are not predicted to be significant due to small changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations. This will have an adverse health impact on several thousand local residents.

Differential effects between General Population and Vulnerable Groups

6.3.12 LGW-2R is likely to further increase inequalities between a number of vulnerable groups and the general population (Table 6-1) with regard to:

- Exercise and physical activity reducing for children and young people, ‘people living in areas with poor health status’
- Level of income of families of including ‘children and young people’ as well as ‘people living in areas with poor health status’
- Housing tenure amongst ‘Different Faith groups’, ‘Older people’, ‘Black and ethnic minority groups’ and ‘Shift workers’
- Housing conditions of ‘older people’

- Access to leisure, recreation services, facilities and utilities' for 'children and young people' for the health
- Participation in the community for 'different faith groups', 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people in areas of poor health status'
- Community severance for 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people living in geographical/social isolation'
- 'Air Quality' for including 'children and young people', 'people living in areas with poor health status'.

Table 6-1 LGW-2R Differential Effects between General Population and Vulnerable Groups

		VULNERABLE GROUPS										
Determinants	General Population	Children and Young People'	People on a low income	Different Faith groups	Economically Inactive/ unemployed	Older People	People living in area s of deprivation	Black and Ethnic Minority Groups	Shift Workers'	People Living in Geographical/ Social Isolation	People living in areas with poor health status	Disabled people with a physical or mental impairment
Exercise and Physical Activity	- Min	-- Mod									-- Mod	
Level of Income	+ Min		+++ Mod		+++ Mod		+++ Mod					
Threat to Housing Tenure												
	- Min			+++ Mod		+++ Mod		+++ Mod	+++ Mod			
Housing Conditions	-- Mod					- Maj						
Access to Leisure, Recreation Services, Facilities and Utilities	- Min	-- Mod									-- Mod	
Participation in the Community	- Min	-- Mod		-- Mod		-- Mod					-- Mod	-- Mod
Community Severance	- Min	-- Mod				-- Mod				-- Mod		-- Mod
Air Quality	-- Mod	--- Maj									--- Maj	

LHR-ENR

Health impacts from construction

6.3.13 Health impacts from construction of LHR-ENR are generally minor and moderately adverse, of low and medium intensity, short-term, intermittent and/or temporary in nature. However, major long-term permanent impacts resulting from land take are predicted to occur.

Health impacts from operation

6.3.14 Health impacts from operation of LHR-ENR range from moderately adverse to moderately beneficial and are low to high intensity, long-term, intermittent and/or permanent in nature. Major long-term permanent impacts resulting from access to services, facilities and amenities, social factors, environmental factors, including air quality, noise and landscape are predicted to occur.

Health Determinants affected

6.3.15 Health determinants that have been assessed as potentially experiencing an adverse change as a consequence of the construction of the Gatwick expansion scheme included:

- Exercise and physical activity
- Childhood development
- Housing tenure
- Housing conditions
- Access to greenspace/bluespace
- Access to leisure and recreation services and facilities
- Participation in the community, social inclusion/exclusion, social contact/support
- Community severance
- Amount of traffic congestion
- Air quality
- Noise
- Land use
- Natural habitats
- Landscape, including green and open spaces
- Townscape, including civic areas and public realm
- Tranquillity
- Flood risk

6.3.16 Health determinants that have been assessed as potentially experiencing a neutral or mixed change as a consequence of the construction of the Gatwick expansion scheme included:

- Water quality,
- Soil quality,
- Resilience to global climate change

6.3.17 Health determinants that have been assessed as potentially experiencing a beneficial change as a consequence of the construction of the Gatwick expansion scheme included:

- Level of income
- Employment status
- Distribution of wealth
- Job creation

- → Availability of employment opportunities
- → Quality of employment opportunities
- → Training and skills development

6.3.18 LHR-ENR has been predicted to result in an increase in emissions from aircraft and road traffic associated with the airport. Due to the densely populated urban area surrounding Heathrow, poor air quality resulting from the LHR-ENR would affect several thousand local residents as well as sensitive receptors being affected by poorer air quality, resulting in a reversal of the baseline air quality improvements. The shortlisted scheme could potentially have major adverse health effects on selected 'children and young people' and 'people with living in areas with poor health status' and moderately adverse health impacts upon all other groups.

6.3.19 Overall LHR-ENR was judged to have a lower detrimental impact upon health than LHR-NWR; this was primarily due to LHR-ENR requiring fewer residential properties to be demolished affecting a lower number of residents. In addition it was predicted to have higher noise impacts affecting a larger population than LGW-2R.

Differential effects between General Population and Vulnerable Groups

6.3.20 LHR-ENR is likely to further increase inequalities between a number of vulnerable groups and the general population (Table 6-2) with regard to:

- Level of income of families of including 'children and young people' as well as 'people living in areas with poor health status'
- Housing tenure amongst 'Different Faith groups', 'Older people', 'Black and ethnic minority groups' and 'Shift workers'.
- Housing conditions of 'older people'
- Access to leisure, recreation services, facilities and utilities' for 'children and young people' for the health
- Participation in the community for 'different faith groups', 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people in areas of poor health status'
- Community severance for 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people living in geographical/social isolation'
- 'Air Quality' for including 'children and young people', 'people living in areas with poor health status'.

Table 6-2 LHR-ENR Differential Effects between General Population and Vulnerable Groups

		Vulnerable Groups										
Determinants	General Population	Children and Young People'	People on a low income	Different Faith groups	Economically Inactive/ unemployed	Older People	People living in area s of deprivation	Black and Ethnic Minority Groups	Shift Workers'	People Living in Geographical/ Social Isolation	People living in areas with poor health status	Disabled people with a physical or mental impairment
Level of Income	+ Min		+++ Mod		+++ Mod		+++ Mod					
Threat to Housing Tenure	- Min			-- Mod		-- Mod		-- Mod	-- Mod			
Housing Conditions	-- Mod					--- Maj						
Access to Leisure, Recreation Services, Facilities and Utilities	- Min	-- Mod									-- Mod	
Participation in the Community	- Min	-- Mod		-- Mod		-- Mod					-- Mod	-- Mod
Community Severance	- Min	-- Mod				-- Mod				-- Mod		-- Mod
Air Quality	-- Mod	--- Maj									--- Maj	

LHR- NWR

Health impacts from construction

6.3.21 Health impacts from construction of LHR-NWR are generally minor and moderately adverse, of low and medium intensity, short-term, intermittent and/or temporary in nature. However, major long-term permanent impacts resulting from land take and rehousing are predicted to occur.

Health impacts from operation

6.3.22 Health impacts from operation of LHR-NWR range from moderately adverse to moderately beneficial and are low to high intensity, long-term, intermittent and/or permanent in nature. Major long-term permanent impacts resulting from access to services, facilities and amenities, social factors, environmental factors, including air quality, noise and landscape are predicted to occur.

Health Determinants Impacted

6.3.23 Health determinants that have been assessed as potentially experiencing an adverse change as a consequence of the construction of LHR-NWR included:

- → Exercise and physical activity
- → Childhood development
- → Housing tenure
- → Housing conditions

- Access to greenspace/bluespace
- Access to leisure and recreation services and facilities
- Participation in the community, social inclusion/exclusion, social contact/support
- Community severance
- Amount of traffic congestion
- Air quality
- Noise
- Land use
- Natural habitats
- Landscape, including green and open spaces
- Townscape, including civic areas and public realm
- Tranquillity
- Flood risk

6.3.24 Health determinants that have been assessed as potentially experiencing a neutral or mixed change as a consequence of the construction of the LHR-NWR expansion scheme included:

- Water quality,
- Soil quality,
- Resilience to global climate change

6.3.25 Health determinants that have been assessed as potentially experiencing a beneficial change as a consequence of the construction of the LHR-NWR expansion scheme included:

- Level of income
- Employment status
- Distribution of wealth
- Job creation
- Availability of employment opportunities
- Quality of employment opportunities
- Training and skills development

6.3.26 LHR-NWR has been predicted to result in an increase in emissions from aircraft and road traffic associated with the airport. Due to the densely populated urban area surrounding Heathrow, poor air quality resulting from the LHR-NWR would affect several thousand local residents as well as sensitive receptors being affected by poorer air quality, resulting in a reversal of the baseline air quality improvements. The shortlisted scheme could potentially have major adverse health effects on selected ‘children and young people’ and ‘people with living in areas with poor health status’ and moderately adverse health impacts upon all other groups.

6.3.27 Overall LHR-NWR was judged to have a greater detrimental impact upon health; this was primarily due to LHR-NWR requiring a greater number of residential properties to be demolished than either of the other shortlisted schemes, affecting a higher number of residents. In addition it was predicted to have higher noise impacts affecting a larger population than LGW-2R.

Differential effects between General Population and Vulnerable Groups

6.3.28 LHR-NWR is likely to further increase inequalities between a number of vulnerable groups and the general population (Table 6-3) with regard to:

- Level of income of families of including 'children and young people' as well as 'people living in areas with poor health status'
- Housing tenure amongst 'Different Faith groups', 'Older people', 'Black and ethnic minority groups' and 'Shift workers'.
- Housing conditions of 'older people'
- Access to leisure, recreation services, facilities and utilities' for 'children and young people' for the health
- Participation in the community for 'different faith groups', 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people in areas of poor health status'
- Community severance for 'children and young people', 'older people'; 'disabled people with a physical or mental impairment' and 'people living in geographical/social isolation'
- 'Air Quality' for including 'children and young people', 'people living in areas with poor health status'.

Table 6-3 LHR-NWR Differential Effects between General Population and Vulnerable Groups

		VULNERABLE GROUPS										
Determinants	General Population	Children and Young People'	People on a low income	Different Faith groups	Economically Inactive/	Older People	People living in area s of deprivation	Black and Ethnic Minority Groups	Shift Workers'	People Living in Geographical /Social Isolation	People living in areas with poor health status	Disabled people with a physical or mental impairment
Level of Income	+ Min		+++ Mod		+++ Mod		+++ Mod					
Threat to Housing Tenure	- Min			-- Mod		-- Mod		-- Mod	-- Mod			
Housing Conditions	-- Mod					--- Maj						
Access to Leisure, Recreation Services, Facilities and Utilities	- Min	-- Mod										
Participation in the Community	- Min	-- Mod		-- Mod		-- Mod					-- Mod	-- Mod
Community Severance	- Min	-- Mod				-- Mod				-- Mod		-- Mod
Air Quality	-- Mod	--- Maj									--- Maj	

RECOMMENDATIONS

6.3.29 The Health Impact Analysis has been undertaken with the assistance of an independent steering group, with information from each of the AoS topic leads providing support. For future health studies upon any of the shortlisted schemes it is recommended that, project specific health and detailed spatial data should be collated.

6.3.30 The impacts described above should be revisited in any future health assessment associated with a preferred shortlisted scheme when further design information and baseline information is available. The full list of health determinants presented in Section 3 should be checked to determine whether further information is available regarding determinants not selected.

6.3.31 Once the detail of the preferred airport capacity expansion scheme has been developed, a project specific HIA should be undertaken. A central output of the project level HIA should include health mitigations, which would be designed to maximise the health benefits of the scheme and mitigate against any detrimental health impacts.