

HIGH SPEED RAIL (LONDON- WEST MIDLANDS)

Health impact assessment

November 2013

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Health impact assessment

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Department
for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

A report prepared for High Speed Two (HS2) Limited.

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Contents

1	Introduction	3
1.1	The purpose of the Health Impact Assessment and this report	3
1.2	Evaluating health issues and effects	4
1.3	Relationship to the Environmental Statement	5
2	HIA process	7
2.1	Overview	7
2.2	Evidence base	7
2.3	Community profiles	7
2.4	Consultation and engagement	8
2.5	HIA scoping	8
2.6	Assessment of health effects	9
2.7	Mitigation of health effects	10
3	General mitigation	11
3.2	Measures incorporated into the Proposed Scheme design	11
3.3	Environmental management	11
3.4	Ongoing engagement and mitigation	11
3.5	Community liaison	11
4	Potential health effects at the national and regional level	13
4.1	Employment and incomes	13
4.2	Rail network capacity	13
5	Potential health effects along the route	15
5.1	Introduction	15
5.2	Employment and income	15
5.3	Residential property	19
5.4	Local environment	22
5.5	Air quality	27
5.6	Noise and vibration	29
5.7	Physical activity	33
5.8	Access to services	40

5.9	Traveller stress	43
5.10	Road safety	46
5.11	Social capital	46

Appendices

Appendix 1 – Detailed assessment criteria

Appendix 2 – Scoping

Appendix 3 – Consultation and engagement

Appendix 4 – Health evidence base

Appendix 5 – Existing baseline

Appendix 6 – Quantitative noise and vibration information from the ES

1 Introduction

1.1 The purpose of the Health Impact Assessment and this report

- 1.1.1 This Health Impact Assessment (HIA) Report presents the assessment of the potential health effects resulting from the construction and operation of High Speed Two (HS2), Phase One, London-West Midlands ('the Proposed Scheme').
- 1.1.2 The construction and operation of any major infrastructure project has the potential to cause substantial changes to the surrounding environment and these may have consequences for the people who live and work there. Therefore, during the planning and design process for HS2, such changes have been considered as part of the environmental assessment process and measures have been incorporated into the Proposed Scheme to avoid or reduce them. The predicted resultant effects on the environment and people are reported in the Environmental Statement (ES) that has been prepared to support the Phase One hybrid Bill.
- 1.1.3 HS2 Ltd appreciates that such effects on people could, without appropriate controls or mitigation measures, lead to anxiety and/or other effects on people's health and wellbeing. Therefore, an HIA has been undertaken as part of the design and planning process for the Proposed Scheme prior to submission of the hybrid Bill. The HIA seeks to identify and understand the issues and to identify appropriate and reasonably practicable measures either to prevent them occurring or to reduce them, or to provide mitigation or compensation to those affected.
- 1.1.4 This HIA report describes the outcome of this process in that it reports HS2 Ltd's current evaluation of the issues and the means that are proposed to avoid, reduce or compensate for them. It has been prepared in accordance with established good practice for large infrastructure projects in the UK. In addition to providing decision makers with information about the proposed scheme, it is also intended to inform communities about issues with the potential to affect health and how these will be controlled.
- 1.1.5 Consideration of potential health issues has been an integral part of the planning and design of the Proposed Scheme to date, alongside consideration of other environmental, community and economic issues. They were considered in development of the draft Code of Construction Practice (CoCP), in environmental assessment and in the measures that are included in the design described in the ES to avoid causing impacts on people and to reduce, where reasonably practicable, those impacts that might otherwise be likely to occur. HS2 Ltd's Sustainability Policy also contains policies that would address health issues.
- 1.1.6 Notwithstanding this, HS2 Ltd recognises that there needs to be an on-going process of assessment, engagement and communication throughout the detailed planning, construction and operation of the Proposed Scheme. This is particularly important since many of the measures to avoid or reduce effects will need to be implemented with the involvement of third parties, such as local authorities, or in partnership with them.

- 1.1.7 The HIA is neither a statutory requirement nor a requirement of the Private Business Standing Orders of the Houses of Parliament that identify what documents are required to accompany the hybrid Bill. However, it will be submitted alongside the hybrid Bill as supporting information.

1.2 Evaluating health issues and effects

- 1.2.1 This HIA is based on the World Health Organization's (WHO's) definition of health as "a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity".
- 1.2.2 The state of the health of individuals and communities is determined by many factors including their circumstances and environment. To determine the potential impacts of the project on health the HIA has evaluated the changes to a number of factors that can influence health (which are termed health determinants) and considered the effect of those changes. The health determinants include community and economic factors as well as the physical environment.
- 1.2.3 A person's response to such changes will also depend on very many factors, including for example the person's individual characteristics and behaviours and factors such as their income and social status (higher income and social status are linked to better health), their level of education (low education levels are linked with poor health) and their social support networks (greater support from families, friends and communities is linked to better health). It is therefore not appropriate to assess the potential effects on individuals, but rather to assess whether a change is likely to improve or worsen the general health characteristics of the general population who will experience the change.
- 1.2.4 The health determinants identified as causing potential health effects are described in Section 2.5. The assessment sections of this report are organised according to health determinants. A summary of the linkages between the determinant and the health outcome is given at the start of each assessment section, with further information in Appendix 4. It should be noted that for some determinants the evidence of consequential health impacts is limited. This is because of the complex nature of links between an aspect of the project, effects on community or environmental factors, and the causal pathway leading to a health outcome, which may be influenced by many other factors.
- 1.2.5 Differential and disproportionate effects on Protected Groups (as defined by the Equality Act, 2010) are assessed in the Equality Impact Assessment (EqIA). This report highlights those differential and differential effects that relate specifically to health effects.
- 1.2.6 Health effects may be triggered or exacerbated by perceptions about the Proposed Scheme. These may comprise mental or psychological effects associated with anxiety, or health effects resulting from behavioural changes triggered by perceived effects.
- 1.2.7 Perceptions have the potential to affect the way that individuals and communities experience and respond to the effects of the proposed scheme, and can affect health outcomes in a number of ways, including:

- increased levels of anxiety for local residents arising from concern about the perceived effects of the Proposed Scheme, such as reduced desirability of the areas along the route affecting local property markets, or crime and antisocial behaviour associated with construction sites;
- health effects resulting from behavioural changes, such as:
 - a decrease in the number of people walking and cycling due to road safety concerns, resulting in reduced levels of physical activity (see Sections 5.5 and 5.8); and
 - reluctance to use community services and facilities that are frequented by the construction workforce, resulting in a reduction in beneficial activities such as physical activity or social interaction.

1.2.8 Section 2 provides more information on how the scale of health effects has been evaluated.

1.3 Relationship to the Environmental Statement

- 1.3.1 The assessment of effects of the Proposed Scheme on health is based on the scheme information described in the HS2 ES. The HIA draws on the ES description of environmental and community effects and measures to avoid, reduce and, if possible, remedy significant adverse effects. However, the HIA does not use the same assessment process or significance criteria to judge the significance of effects. Instead, it uses a more qualitative approach to describe the potential effects on health.
- 1.3.2 The HIA has used baseline studies comprising desk-top research, drawing on publicly available information (presented in Appendix 5). The baseline profile of communities affected by the Proposed Scheme draws on 2011 Census data released up to the end of June 2013, supplemented by local datasets and other secondary data sources. This means there is some inevitable inconsistency in the available data for different geographical areas of the Proposed Scheme.
- 1.3.3 The composition of communities affected by the Proposed Scheme will change over time, in accordance with demographic trends, as well as the influence of wider government policy and economic factors. The HIA does not include a future baseline profile of communities due to the limited availability and reliability of data. The assessment has used scheme information and maps produced as part of the ES, and has drawn on the emerging identification of environmental effects, particularly residual community, socio-economic, noise, air quality and transport effects.

2 HIA process

2.1 Overview

- 2.1.1 As there is no prescribed methodology for undertaking an HIA, the approach has drawn on best practice, key elements of published guidance and proven techniques from previous major infrastructure projects.
- 2.1.2 A variety of HIA toolkits and guidance documents have been drawn on, including:
- Department of Health, 2010: Transport and Health Guidance;
 - Health Scotland, 2007: Health Impact Assessment for Transport: A Guide;
 - National MWIA¹ Collaborative 2011: Mental Well-being Impact Assessment Toolkit; and
 - London Health Observatory, 2006: A Guide to Reviewing Published Evidence for use in Health Impact Assessment.
- 2.1.3 The key stages undertaken in completing this HIA are described below.

2.2 Evidence base

- 2.2.1 Using available literature, including individual research articles and recently published literature reviews, an evidence base has been collated to identify links between health determinants and likely health effects. This evidence base underpins the qualitative assessment of likely health effects in this HIA. A summary of the published evidence reviewed is presented in Appendix 4.
- 2.2.2 The evidence base has been collated from up-to-date research, using recent Government evidence reviews where available, to provide a basis for the assessment. The strength of evidence linking environmental and community effects to health effects varies across the different issues considered in the HIA. Where the evidence for an association is weak, this does not necessarily mean that the health effects will be small - but rather that existing published research does not provide strong evidence for an association.

2.3 Community profiles

- 2.3.1 Information has been gathered from a variety of published sources in order to provide a profile of the existing communities along the route, including socio-economic, demographic and health characteristics.
- 2.3.2 The community profiles have used the most detailed and up to date information available from publicly accessible sources. The level of spatial detail varies between different data sets used, ranging from small localised areas of around 150 households (lower super output areas) to regional level data.

¹ Mental Wellbeing Impact Assessment.

- 2.3.3 Where reasonably practicable, as part of the community health profiling exercise, available information on existing vulnerable groups within the communities along the route has been collated. This has focused on:
- communities that are vulnerable to health effects due to existing deprivation (as defined by the Indices of Multiple Deprivation and other data); and
 - groups of people who may be particularly susceptible to health effects due to characteristics such as age or disability.

2.4 Consultation and engagement

- 2.4.1 To inform the scope of the HIA, a stakeholder engagement exercise was undertaken with public health officials along the route of the Proposed Scheme, including the relevant local and regional Directors of Public Health and the Public Health Observatories. The engagement took the form of written correspondence. Health professionals were asked to comment on the following issues in their areas:
- key health issues and challenges;
 - key opportunities for health improvement;
 - identification of vulnerable communities and health inequality issues;
 - key policy objectives related to health, and health improvement agendas;
 - sources of baseline data to inform the baseline health profiles; and
 - health issues to consider in relation to the design, construction and operation of the Proposed Scheme.
- 2.4.2 The comments received are summarised in Appendix 3. This feedback helped to shape the scope of the HIA, and provided information to assist in the assessment of effects.
- 2.4.3 In addition, health related issues which were highlighted during various HS2 public consultation and engagement exercises have been systematically reviewed in order to inform the HIA process. The key findings of this review are summarised in Appendix 3.

2.5 HIA scoping

- 2.5.1 The scope of this HIA has been informed by an on-going review of the likely health effects of the Proposed Scheme, which has been informed by the assessment of environmental and community effects in the ES. As a result of this process, the health determinants identified for inclusion in the assessment were:
- economic determinants including job losses and gains and effects of regeneration;
 - residential determinants including the relocation of residents, and associated community determinants;
 - the local environment, including aesthetic quality, access to green space and perceived safety;
 - air quality;

- noise and vibration;
- opportunities for physical activity;
- access to services including shops, health services and other local services;
- traveller stress; and
- social capital, including community isolation, community facilities and community cohesion.

2.5.2 A number of health determinants have been scoped out of the HIA following careful consideration of their potential to exert health effects with respect to the Proposed Scheme, as listed below. An explanation of the reasons for scoping out these topics is provided in Appendix 2:

- electromagnetic fields;
- ground contamination;
- groundwater quality; and
- occupational health and safety.

2.6 Assessment of health effects

2.6.1 A qualitative assessment of health effects has been undertaken for this HIA. This has involved the identification of potential effects on environmental and community health determinants, the levels of exposure to these changes and the general characteristics of the communities affected.

2.6.2 Research evidence for links between changes in the health determinant and resulting health effects have been used to underpin the assessment – for example, lack of physical activity is known to be associated with obesity, cardiovascular health and depression. The term 'associated' when used in an epidemiological context describes a strong causal link that has been established through research. This does not imply that all individuals exposed to a certain change will experience a health effect; rather that there will be an increased risk of health effects occurring within the exposed population.

2.6.3 Health effects have been considered at varying spatial levels according to the extent of change to the determinant. The spatial scope has been guided by other relevant assessment scopes (e.g. the ES), and professional judgement.

2.6.4 In undertaking the qualitative assessment of potential health effects, the following criteria have been considered:

- the strength of evidence for a link (or 'association') between a change in health determinant and a health outcome, based on the review of published evidence;
- the nature of the change in an environmental or community factor (or 'health determinant') resulting from the Proposed Scheme;
- the duration of the change in a health determinant (operational effects are

assumed to be permanent in most cases; construction effects are defined as short-term if under six months, medium-term if six months to two years, or long-term if more than two years in duration);

- the 'extent' of exposure, i.e. the size of the population exposed to the change;
- the 'intensity' of exposure, i.e. the intensity at which the exposed population is likely to experience the change in a health determinant, taking into account factors such as the magnitude and duration of the effect;
- the sensitivity of the affected population, based on the community profiles. This includes consideration of the vulnerability of the population as a whole, based on deprivation indicators, and particular vulnerable groups within the population;
- the effects of perception, which may influence the way in which people experience or react to a change in health determinant; and
- the extent to which the change in a determinant can be reduced or controlled in order to minimise the risk of adverse health effects, or enhancement of beneficial effects.

2.6.5 This methodology provides a mechanism for identifying the risk of potential health effects occurring within a population. In most cases, the linkages identified in the evidence review do not include information on exposure-response relationships that would enable the magnitude of health effects to be defined. Additionally, health is influenced by a wide range of factors, making the process of attributing a specific health effect to a single causal factor complex and potentially unreliable.

2.7 Mitigation of health effects

2.7.1 Health issues have been considered alongside environmental, community and economic issues in the development of the Proposed Scheme, the draft Code of Construction Practice (CoCP), and in the measures that are included in the design described in the ES. Through this process, adverse effects on health determinants have been reduced. The HIA has informed this process, and specific recommendations arising from the HIA process have been incorporated into the draft CoCP.

2.7.2 Measures to reduce the risk of adverse health effects and enhance health benefits will continue to be developed in collaboration with third parties. HS2 Ltd has put in place mechanisms to facilitate this process, as described in Section 3.

3 General mitigation

- 3.1.1 The following mitigation measures, to which HS2 Ltd has committed, will serve to reduce the potential adverse health effects and enhance the beneficial effects of the Proposed Scheme.

3.2 Measures incorporated into the Proposed Scheme design

- 3.2.1 Consideration of potential health issues has been an integral part of the planning and design of the Proposed Scheme, alongside consideration of other environmental, community and economic issues. Examples of the outcomes of this process include the design of the route to reduce the loss of property and community assets as far as reasonably practicable, a reduction in the height of the railway line, an increase in the total tunnelled sections, and the incorporation of landscape design and screening. Additional mitigation measures to reduce adverse environmental effects associated with health, such as noise, visual effects and loss of community assets are described in the ES.

3.3 Environmental management

- 3.3.1 HS2 Ltd will require its contractors to comply with the environmental management regime for the Proposed Scheme, which will include the following core documents:
- the Code of Construction Practice (CoCP), which will provide a generic basis for route-wide construction environmental management; and
 - local environmental management plans (LEMP), which will apply the management strategies at a local level.
- 3.3.2 The CoCP will be the means of controlling the construction works associated with the Proposed Scheme to ensure that the effects of the works upon people and the natural environment are kept to a practicable minimum. A copy of the draft CoCP is included as a Volume 5 appendix within the ES.

3.4 Ongoing engagement and mitigation

- 3.4.1 HS2 Ltd will put in place an on-going process of assessment, engagement and communication throughout the detailed planning, construction and operation of the Proposed Scheme to continue to identify and mitigate adverse effects. Many of the measures to avoid or reduce effects will need to be implemented with the involvement of third parties, such as local authorities, or in partnership with them.

3.5 Community liaison

- 3.5.1 The draft CoCP commits the Nominated Undertaker and its contractors to produce and implement a stakeholder engagement framework and provide appropriately experienced community relations personnel to implement it. The Nominated Undertaker will engage with the community, particularly focusing on those that may be adversely affected during construction. The Nominated Undertaker and its contractors will ensure that local residents, occupiers, businesses, local authorities and parish councils affected by the proposed construction works, as outlined in the ES, will be informed in advance of works taking place, by methods identified in the

framework. The notifications will detail the estimated duration of the works, the working hours and the nature of the works. In addition the draft CoCP commits the project to produce LEMP which will set out local arrangements for construction activity.

- 3.5.2 The stakeholder engagement framework will be implemented during the stages up to the commencement of construction. This will focus on communicating potential effects and mitigation measures, with the aim of minimising unnecessary concern or blight.
- 3.5.3 As specified in the draft CoCP, information for the public will be provided using a variety of methods such as social media, email alerts, local radio and newspapers as appropriate. The service will also be available in different languages, on a case by case basis as agreed by the nominated undertaker.

4 Potential health effects at the national and regional level

4.1 Employment and incomes

Links to health effects

- 4.1.1 The links between employment, income and health are widely recognised, and include a range of physical and mental health indicators, linked to lifestyle and other factors (see Section 5.2). Appendix 4 contains the full review of evidence for health linkages.

Effects on employment

- 4.1.2 The wider economic benefits of the Proposed Scheme have been reported in the Socio-economic assessment within the ES, based on the Economic Case produced by HS2 Ltd. During operation, the Proposed Scheme is predicted to give rise to increased employment on a scale that will reach beyond the area directly affected by the construction and operation of the railway. It is considered that such an increase in employment has the potential to have health benefits across a broad range of indicators.
- 4.1.3 During construction there will be a net benefit in overall employment at a national scale, taking into account job losses from businesses affected by the construction of the Proposed Scheme and employment generated by construction. This has the potential to lead to health benefits associated with a net improvement in income and employment status within the population.
- 4.1.4 The beneficial effects on employment are likely to be most concentrated around London and Birmingham, at either end of the Proposed Scheme. The areas in which the stations are located include communities with relatively poor health associated with high levels of deprivation, and the Proposed Scheme provides an opportunity to reduce the levels of deprivation in these communities. However, job losses at the construction stage will also mainly occur within these areas. This is described further in Section 5.2.

4.2 Rail network capacity

Links to health effects

- 4.2.1 Potential health benefits associated with improved transport services may arise as a result of economic benefits and improved access to employment opportunities (see Section 5.2), or from improved 'journey ambience' and reduced levels of traveller stress (see Section 5.8.12).
- 4.2.2 Evidence for links between economic and employment status and traveller stress and health effects are described in Appendix 4.

Effects on network capacity

- 4.2.3 Long distance services and passengers transferring from the West Coast Main Line (WCML) to the Proposed Scheme are expected to free up capacity on the classic rail network, allowing the provision of more local services and capacity. This will have a

beneficial effect on overall transport choices, which has the potential to benefit health through increased access to employment and reduced traveller stress, as described above.

5 Potential health effects along the route

5.1 Introduction

- 5.1.1 This section of the HIA report describes the potential effects on health arising from changes in health determinants resulting from the construction and operation of the Proposed Scheme.

5.2 Employment and income

Links to health effects

- 5.2.1 There is strong evidence of links between employment and income and health status. Being in employment is associated with social and psychological wellbeing, with work being an important aspect of individual identity and social status. Unemployment is a significant risk factor for physical and mental health, and is a major determinant of health inequalities. Increasing material wealth provides increased opportunities for participation in society and increased access to healthier lifestyle choices, which are associated with improved mental and physical health. However, these relationships are complex, and compounded by many other variables.
- 5.2.2 Changes to employment status and income associated with the Proposed Scheme have the potential to influence the health of the communities along the route, both positively and negatively.
- 5.2.3 Evidence for the links between economic and employment status and health is presented in Appendix 4.

Construction employment

- 5.2.4 HS2 Ltd is preparing an Employment and Skills Strategy which will set out how it will facilitate the take up of employment opportunities along the line of the Proposed Scheme by local residents. The strategy will consider local employment, apprenticeships and education initiatives when recruiting staff. This includes engaging with unemployed people along the line of route.
- 5.2.5 HS2 Ltd is also developing a Procurement Strategy, which will consider opportunities to encourage local businesses to tender for work contracts and to promote the use of local suppliers, goods and services.
- 5.2.6 The construction sites located along the route will generate significant demand for workers, ranging from unskilled and low-skilled jobs to technical and managerial roles. The ES has predicted the approximate number of person-years of employment generated at worksites along the route, as follows:
- Euston: 21,000 person years or 2,100 full-time equivalent jobs;
 - London corridor and Old Oak Common: 13,100 person years or 1,310 full-time equivalent jobs;
 - Rural areas: 30,150 person years or 3,015 full-time equivalent jobs;
 - West Midlands and Birmingham Interchange: 5,850 person years or 585 full-time equivalent jobs; and

- Washwood Heath to Curzon Street: 6,100 person years or 610 full-time equivalent jobs.

- 5.2.7 In addition, the ES reports that a further 70,000 construction employment opportunities will be created outside the worksites, resulting in a total of approximately 146,000 person years or the equivalent of 14,600 permanent full time construction jobs.
- 5.2.8 The ES reports that construction works will generate additional indirect demand for goods and services through the business supply chain and expenditure effects of workers which could deliver business opportunities and generate further employment. As a consequence, an estimated further 54,000 person years of employment could be created, or approximately the equivalent of 5,400 full-time jobs, which will be a major beneficial effect and is therefore considered to be significant.
- 5.2.9 Uptake of jobs from within local communities is likely to be predominantly in lower skilled roles, as contractors will generally appoint the majority of skilled and managerial staff from their existing workforce. The jobs created will be located within the study area for the duration of the works, which will last for several years in many cases. After this, the training, skills and experience gained may improve future employment prospects in the construction sector.
- 5.2.10 The construction of the Proposed Scheme will introduce new training and employment opportunities. Young people may benefit from construction related training and apprenticeship opportunities, which will be particularly valuable in the LB Camden and in the Birmingham area where youth unemployment is relatively high. The ES has estimated around 1,000 apprenticeships could be provided in the construction workforce.
- 5.2.11 The extent of beneficial health effects within the local communities along the route will depend on the number of people who are able to, and choose to, take up opportunities for construction employment and training. For those who do, this may result in improved income, employment status and self-esteem, and associated health benefits.
- 5.2.12 Health benefits are likely to be greatest in the more urban areas along the route, as these typically contain higher proportions of people of working age, more people with existing skills in the construction sector, and higher existing levels of unemployment and deprivation (see Community Profile in Appendix 5). Jobs created in the construction phase are likely to provide alternative employment for some individuals affected by job losses.

Job losses and displacement during construction

- 5.2.13 The construction of the Proposed Scheme will result in the demolition of a number of commercial premises, particularly around the proposed station locations. In most cases it is anticipated that companies will relocate to alternative premises within the local area, and most jobs will be retained (the ES assumes, based on evidence from the Olympics, that 88% of businesses will be successfully relocated). The ES has predicted the approximate numbers of jobs lost or displaced along the route, as follows:

- Euston: 2,720 jobs displaced and 370 jobs lost;
- London Corridor and Old Oak Common: 1,553 jobs displaced and 212 jobs lost;
- Rural areas: 572 jobs displaced and 78 jobs lost;
- West Midlands and Birmingham Interchange: 238 jobs displaced and 32 jobs lost; and
- Washwood Heath to Curzon Street: 2,288 jobs displaced and 312 jobs lost.

5.2.14 Businesses required to relocate due to the construction of the Proposed Scheme will be eligible for compensation under the Compensation Code. However, HS2 Ltd recognises the importance of businesses being able to relocate to new premises and will therefore provide additional support over and above statutory requirements to facilitate this process and to reduce and/or offset the effects of the Proposed Scheme.

5.2.15 Businesses with specific requirements, such as the need for a particularly large site or proximity to a railhead, are less likely to find suitable alternative premises close to their existing site and may have to relocate further afield. In these instances, although the total number of jobs may remain the same, some local workers, particularly in the lower paid positions, may be unable to commute to the new location, resulting in the loss of their job.

5.2.16 The loss and displacement of jobs gives rise to the potential that some individuals may experience long-term effects on their employment status, leading to potential adverse health effects.

Local economic effects during construction

5.2.17 As described above, the direct employment generated in the construction phase will lead to additional indirect employment through demand for goods and services through the business supply chain and expenditure by workers. A proportion of these benefits will go to local businesses and suppliers within the areas along the route, potentially benefitting local communities.

5.2.18 In developing its Procurement Strategy, HS2 Ltd will consider opportunities to encourage local businesses to tender for work contracts and to promote the use of local suppliers, goods and services, where reasonably practicable. The potential for goods and services to be procured locally will depend on the availability of appropriate local suppliers and will be governed by contractual and financial considerations.

5.2.19 Disruption during construction also has the potential to adversely affect the trade of local businesses. Road closures and diversions, and construction traffic on local roads, may restrict vehicle access. Road and footpath closures may also reduce footfall and passing trade. Additionally, the trade of some businesses such as cafes and restaurants may be affected by noise and visual effects which alter the ambience of the dining experience. The adverse economic effects from these disruptions are expected to be low. However, individual businesses may experience effects for the duration of the construction works, and business owners may experience anxiety relating to uncertainties about the nature and timing of effects and how these could affect their trade.

- 5.2.20 The national and regional economic benefits of the Proposed Scheme are described in Section 4.

Job gains during operation

- 5.2.21 The operation of the proposed scheme will result in employment opportunities at locations along the route including stations, train crew facilities and infrastructure / maintenance depots. The ES has estimated the approximate numbers of jobs created along the route, as follows:
- Euston station: gross direct employment for station and train operations at the enhanced station may amount to approximately 500 jobs;
 - Old Oak Common: initial estimates suggest that gross direct employment for station operations at Old Oak Common interchange may be 100 jobs;
 - Infrastructure Maintenance Depot (IMD): initial estimates as reported in the ES suggest that direct employment alone may be 290 jobs;
 - Birmingham Interchange: initial estimates suggest that gross direct employment for station operations at Birmingham Interchange station may be 100 jobs;
 - Washwood Heath RSMD: initial estimates suggest direct employment of 500 persons;
 - Curzon Street station: initial estimates of job creation in the ES state that 200 HS2-related jobs will be created at Curzon Street station and that an estimated 160 train crew jobs will also be located in the area; and
 - Handsacre to Glasgow: initial estimate of 500 jobs at other stations north of the Proposed Scheme on the existing classic rail network namely Manchester, Liverpool, Preston and Glasgow.
- 5.2.22 The ES also reports that operation of the Proposed Scheme will create indirect employment opportunities at locations along the route associated with stations and maintenance depots, as well as employment associated with train crew facilities. These indirect jobs will result from expenditure on supplies and services necessary for the operation of the Proposed Scheme, expenditure by those directly employed as part of operations on the Proposed Scheme and expenditure by workers employed by suppliers contracted to the Proposed Scheme. It is estimated that 830 jobs will be created route-wide through indirect effects as a result of the operational phase.
- 5.2.23 At the operational phase there are assessed to be beneficial effects on health for those local people in the study area who take up new HS2 related opportunities and new retail employment opportunities at station locations. This may particularly benefit people who were previously unemployed as there is strong evidence to suggest that employment is associated with beneficial social and psychological wellbeing, with work being central to individual identity, social roles and social status.

Regeneration around stations during operation

- 5.2.24 The Proposed Scheme is expected to generate demand for property development around the four HS2 stations, which could provide substantial new employment space

and new homes. Overall, it has been forecast that the Proposed Scheme could attract some 30,000 jobs² from the planned growth in employment for London and the West Midlands to the areas around the proposed HS2 stations.

- 5.2.25 As described above, employment is associated with wide-ranging mental and physical health benefits. The areas around the four stations are characterised by relatively high levels of deprivation and unemployment. By attracting employment and regeneration to these areas, the Proposed Scheme has the potential to provide opportunities to those sectors of the community most in need, thereby helping to reduce social and economic inequalities. This in turn has the potential to reduce health inequalities.

5.3 Residential property

Links to health effects

- 5.3.1 There is moderate to strong evidence on the links between housing and health, relating to the quality and security of housing, and also to the effects of involuntary relocation.
- 5.3.2 Relocation of people from their homes has been shown to influence health outcomes, as disturbance to people's living and social environment and routine may precipitate stress and related symptoms. Moving house involves significant disruption, uncertainty and changes to social networks and familiar environments and routines.
- 5.3.3 The degree of health effect associated with moving will depend on the vulnerability or resilience of the individuals affected. Age is likely a common factor in determining the ability of people to adapt to the effects of relocation. Older people are likely to find it more difficult to adapt to the effects of relocation, as are disabled people, or those with existing mental or physical health conditions. Young families may need to move their children to different schools, or face longer journeys to school, particularly in rural areas.
- 5.3.4 Evidence for the links between housing and health is presented in Appendix 4.

Relocation of residents

- 5.3.5 Individuals whose properties have to be acquired for the construction of the Proposed Scheme will be eligible for compensation pursuant to the provisions of the Compensation Code. Similarly, compensation is also available under the Code once the line is in operation (for people who find that their homes are physically affected by the operation of the scheme (for example by noise from the railway)). However, the Government has been clear from an early stage of the process that it considers it appropriate to do more in respect of the Proposed Scheme, having regard in particular to the timescale involved in design and construction and the linear nature and overall length of the project. It has therefore committed to providing a discretionary package of compensation measures, going above and beyond the Compensation Code, which addresses cases of exceptional hardship.

² HS2 (February 2011); HS2 London to the West Midlands Appraisal of Sustainability Main Report Volume 1.

- 5.3.6 The Government is consulting until December 2013 on options for long-term discretionary property compensation schemes to assist owner-occupiers of properties affected by Phase One of HS2.
- 5.3.7 Until such measures are brought into force, HS2 Ltd will continue to operate the Exceptional Hardship Scheme (EHS) for Phase One, which has been in operation since August 2010. The EHS is a voluntary purchase scheme designed to assist property owners during the early stages of the project whose properties are on or in close proximity to the route of the Proposed Scheme and who urgently need to sell their properties but have not been able to except at a substantially reduced price. There is no definition, or formal categories, of 'exceptional hardship' – applications are considered on a case-by-case basis – although as set out in the updated guidance, it may arise from matters such as health and disability, family circumstances or domestic or care needs. In considering applications under the EHS, the panel considers applications on a case-by-case basis, taking into account the specific circumstances of individual households, which includes the disability needs of affected householders, and the cost of adaptations. The construction of the Proposed Scheme will necessitate the compulsory purchase and demolition of residential properties along the route. As described above, people whose properties are required for construction of the Proposed Scheme may be eligible for compensation and, in cases of exceptional hardship, will be able to sell their properties to HS2 Ltd in advance of the proposed works if they qualify under the EHS or such other longer-term discretionary compensation arrangements as may be in place.
- 5.3.8 The number of properties affected in each study area along the route is as follows:
- Euston: approximately 168 homes in three social housing blocks on the Regent's Park Estate (some of which are now privately owned), and 46 privately owned residential properties in the vicinity of Euston station;
 - London Corridor and Old Oak Common: 16 privately owned or rented residential properties;
 - Rural areas: approximately 99 privately owned or rented residential properties;
 - West Midlands and Birmingham International: one privately owned or rented residential property; and
 - Washwood Heath to Curzon Street: 12 privately owned or rented residential properties.
- 5.3.9 The majority of residents whose properties are required for the construction of the Proposed Scheme are likely to experience some degree of adverse effect resulting from the disruption and stress of moving. For many this may include emotional responses to the loss of their home. The onset of adverse effects will occur before the acquisition of properties, with uncertainty and concerns regarding timescales for the purchase and the impacts and logistics associated with the move.
- 5.3.10 The largest number of residential relocations will take place on the Regent's Park Estate near Euston, affecting predominantly social housing tenants. The demolitions and relocations will affect a large number of tenants from a community which has relatively poor overall health associated with high levels of deprivation, making

people potentially less resilient to the effects of moving. Additionally, there is evidence to suggest that social housing tenants may be particularly vulnerable to the effects of involuntary relocation, due to a lack of control around the move and a lack of choice about where they are relocated. Exposure to the potential adverse effects of involuntary relocation is assessed to be of high extent and high intensity for the affected residents on the Regent's Park Estate.

- 5.3.11 However, there is also a potential for beneficial effects where tenants are provided with modern purpose-built housing to replace the existing, ageing blocks. The degree of benefit will depend on the quality of design and build, and the space standards applied in the new housing provision.
- 5.3.12 The Secretary of State for Transport is working in partnership with LB Camden on the replacement of the social rented housing that will be lost. Where reasonably practicable, this will be in the Euston area and with individual tenants moving only once. Options for the provision of replacement social rented housing continue to be developed with LB Camden. This could include both the provision of new purpose-built housing and the provision of alternative existing housing, which would be owned and managed by the council.
- 5.3.13 The number of homes affected in the rest of London, and the West Midlands, including the Curzon Street, area is relatively low, and the availability of local housing stock means that the majority of people are likely to be able to relocate within their existing communities if they choose to do so.
- 5.3.14 Although the total number of relocations in rural areas is relatively low, people in smaller rural settlements are likely to have a limited choice of alternative properties in their local area, which may increase stress associated with the move and result in a higher degree of effect on social networks than in urban areas. Rural areas typically have a lower turnover of residents than urban areas, and people are likely to have well established local networks that could be weakened following relocation.
- 5.3.15 The degree to which the adverse effects associated with moving home and potentially relocating to a new neighbourhood are felt will depend on the individual vulnerability or resilience of the people affected. For example, older people, young families, disabled people or those with long-term limiting illness are likely to be more dependent on support from within their local communities. Children may be particularly affected if the move results in a change of school. Communities in the rural areas along the route generally have relatively low levels of deprivation and perform well on indicators of health, meaning that they are likely to be more resilient than those in more deprived areas such as Euston.

Relocation and community effects

- 5.3.16 With the exception of areas in Euston, Birmingham, and a small number of rural hamlets and villages, most of the properties required for the construction of the Proposed Scheme are individual or small groups of properties. However, where a significant number of properties are lost from within a community, there is a potential for the remaining community to experience changes to their social environment and loss of social networks (see Section 5.11 for further discussion of effects on 'social capital'). For example:

- at Euston, the scale of relocations is likely to alter the social environment for remaining residents in the northern part of the Regent's Park Estate; and
- two rural communities have been identified as potentially experiencing changes to their social environment as a result of the loss of properties comprising a large proportion of the existing community. These are Stoneleigh Park, east of Kenilworth, where six properties will be lost at the East Gate of the park, and a small hamlet located on the junction of Knox's Grave Lane and Flats Road in a rural area south of Lichfield, where 13 properties will be demolished, comprising approximately half of the hamlet.

5.3.17 The erosion of social networks and, in the case of some rural communities, increased isolation, has the potential to result in a reduction of the beneficial health effects that are gained through social contact and support. Although exposure to these effects over the route as a whole is low, the intensity of exposure in the affected communities may be moderate to high.

5.4 Local environment

5.4.1 This section assesses issues affecting the quality of public space and the local environment, including:

- changes to the natural and built environment, including changes to landscape and townscape character and effects on the quality of views;
- access to open space and natural environments, including parks, public open space and countryside; and
- fear of crime and anti-social behaviour.

Links to health effects

5.4.2 As described in Appendix 4, there is moderate evidence that people have a preference for views of natural environments over man-made environments, and that exposure to views of natural environments is associated with wellbeing. There is moderate to strong evidence that access to green space and natural environments is beneficial for health, including associations with mental wellbeing and reduced stress in addition to other related issues such as physical activity. The attractiveness and quality of green space is important in determining how this space is used and its potential health benefits.

5.4.3 The link between health and the aesthetic value of the public realm is not well understood but there is evidence to suggest that an attractive urban environment, including buildings and public space, can improve people's enjoyment and sense of wellbeing. Conversely, stressful and poor quality urban environments have been shown to have negative effects on people's health.

5.4.4 Increased fear of crime can occur as a result of the presence of construction sites. Fear of crime has been linked to health effects such as anxiety, and changes in behaviour such as reduced participation in activities that are beneficial to health.

5.4.5 Evidence for the links between the quality of the local environment, green space, fear of crime and health is presented in Appendix 4.

Visual effects and changes to local character

- 5.4.6 Due to the scale of the Proposed Scheme, the construction works and permanent infrastructure will be visible from a large number of locations. In some areas, effects on the landscape or townscape may affect residents' perceptions of the quality and character of their local environment. The perception of a more stressful and poor-quality environment, particularly during construction, may contribute to adverse health effects.
- 5.4.7 Adverse effects from views of construction sites will mainly occur during the peak construction phase, which will be of short to medium-term duration in most areas and long-term at some sites, such as tunnelling and viaducts. In urban areas where the route is not in tunnel there will be changes to the character of the townscape resulting from the presence of worksites and construction plant, hoarding, demolitions and the loss of vegetation. There will also be some localised effects around vent shaft construction sites in tunnelled sections. In rural areas, work sites will be visible from country roads, PRowS and residential streets on the edges of towns and villages. In general, visibility of the construction works from town and village centres will be low, although there will be significant adverse effects on settlements that are crossed by the route, such as Burton Green and Lower Thorpe Mandeville.
- 5.4.8 Effects from permanent infrastructure will result from the loss of existing landscape and townscape features and the presence of new infrastructure, particularly in rural areas. Visual effects have been reduced through the design process, including lowering the height of the railway, screening, and the inclusion of tunnelled sections.
- 5.4.9 Loss of screening vegetation and green spaces will result in adverse effects on views and on the perceived quality of the local environment. These effects will lessen after construction in many cases, as replacement planting becomes established and open spaces are reinstated. There is a potential for long-term beneficial effects as a result of planting and reinstatement.
- 5.4.10 There is also a potential for beneficial effects resulting from the presence of permanent infrastructure, particularly around the new stations. These will be highly visible from the public realm and may be considered to be either beneficial or adverse depending on individuals' responses to the final design of the station buildings. However, it is considered that the visual effects will generally be considered to be beneficial as the new station buildings will be of a higher architectural quality than the current mixture of buildings and derelict land in these areas.
- 5.4.11 The nature of the existing environment will influence people's response to visual changes: in general, effects on views of natural or green environments will be more likely to generate a negative response and adversely affect people's perception of the quality of the environment. People in areas that are currently dominated by views of industrial areas, such as around Old Oak Common, Birmingham Interchange and Curzon Street, are likely to be less sensitive to the visual effects of the construction works and permanent infrastructure.

Specialist schools and care facilities

- 5.4.12 Pupils at specialist schools along the route may be more sensitive to changes in the environment, including visual effects. The ES has identified significant adverse visual

effects at the Island Project School at Diddington Hall in Warwickshire. There are also a number of other specialists schools (Wendover House School on the southern edge of Wendover, Booker Park School on the southern edge of Aylesbury, Stoke Mandeville Combined School on the western edge of Stoke Mandeville) which are close to the proposed works, and where visual effects have been identified at nearby viewpoints.

5.4.13 HS2 Ltd will work closely with affected schools to identify further measures to mitigate visual effects, where reasonably practicable, with a view to producing a satisfactory outcome. Where appropriate, HS2 Ltd will set out specific working practices in the LEMP to provide further mitigation.

5.4.14 The Wells House Road Care Home near Old Oak Common, a residential care home which accommodates adults with mental health and learning difficulties, will be affected by the construction works for the Proposed Scheme. Residents of the care home, with learning impairments or mental health issues, could be particularly affected by the severance of access and change in the local neighbourhood.

Public open space

5.4.15 The construction of the Proposed Scheme will require the acquisition of land including areas of public open space. Some land will be acquired permanently, whereas other areas will be returned and reinstated as public open space after the construction phase has ended. During the construction phase, the remaining areas of open space close to the works will be subject to amenity impacts which may affect their quality and desirability.

5.4.16 HS2 Ltd will support the dissemination of information on public open space closures via the use of Community Liaison Officers and measures contained within the draft CoCP.

5.4.17 Where the HS2 ES reports a significant community effect resulting from the temporary or permanent loss of public open space, the options for the mitigation of temporary and permanent effects are:

- improvements or alterations to the remaining portion of the public open space (in instances where the public open space is partially occupied so as to limit a primary use), such as reconfiguring pitch layouts or relocating play areas;
- improvements to other existing public open spaces in the area that could reduce the effect;
- improving accessibility to other existing public open space; and/or
- identifying land owned by the relevant local authority that could be brought into use as public open space with their agreement.

5.4.18 Additionally, in relation to the permanent loss of public open space, HS2 Ltd will consider whether appropriate compensation open space could be built into the design of the permanent works.

5.4.19 The main effects on public open space are along the urban areas of the route, as described below.

Euston

5.4.20 The Regent's Park Estate to the west of Euston station contains small areas of public open space and green space. These spaces break up the highly dense urban environment and, in an area where housing is dominated by blocks of flats without gardens, provide people with access to an outdoor space close to their homes. A number of these spaces will be lost during the construction of the Proposed Scheme, including:

- Euston Gardens, to the front of Euston station, which will be used as a construction site for up to ten years. This site is considered to be of limited value to the local community;
- closure of St James's Gardens during the construction works for up to ten years. After construction, around 25% of the gardens will be re-instated. This is the largest green space in the Regent's Park Estate area and is considered to be of high value to the local community; and
- permanent loss of Hampstead Road Open Space. This small area of open space is close to a number of large residential blocks and has the potential to be of value to the local community

5.4.21 The effects on St James's Gardens and Hampstead Road Open Space are likely to adversely affect people's perceptions about the quality of their living environment, and will reduce ease of access to green space, which has a range of health benefits. The area is densely populated, and alternative sites for re-provision of open space within the Regent's Park Estate are limited. Therefore the intensity and extent of exposure to these adverse effects is considered to be high at the peak of the construction period, but will reduce as open space is reinstated and replaced. HS2 Ltd and LB Camden intend to improve existing public open spaces within Regent's Park Estate in order to mitigate the effects.

London Corridor

5.4.22 Camden Gardens will be used as a construction site for up to 1 year, for works to widen the Chalk Farm Viaduct and replace overhead lines. This is a small triangular area of green space between Kentish Town Road and Camden Street, which is crossed by the existing railway lines. While its use as a recreational resource is limited, it contains mature trees and provides an attractive green space within the townscape. The intensity and exposure to adverse effects on access to open space are considered to be low. Improvements to wayfinding from the area around Camden Gardens to Regent's Canal will provide access to an alternative public space during construction. In the long term, restitution of Camden Gardens may provide opportunities to benefit users.

5.4.23 Victoria Gardens will be used as a construction site for two years. This is a small park comprises a children's play area and a grassed area, separated by Midland Terrace. HS2 Ltd will work with LB Ealing and local residents to identify a suitable area for temporary relocation of the children's play area during the construction period. However, there will be medium to long-term adverse effects on access to open space for local people during construction. Following construction both the grassed area and

play area will be reinstated in their original location, presenting an opportunity to enhance to local environment in the long term.

West Midlands

- 5.4.24 An 850m section of Kenilworth Greenway to the north of Burton Green will be used as a construction haul route for approximately 5 years, with a temporary diversion provided to an equivalent standard. This is a former railway line lined with mature vegetation that is used as both a PRow and an area of public open space. However, the diversion will be affected by nearby HGV traffic and visual impacts from the haul route and nearby construction sites, reducing its amenity value. The Greenway is a valued open space and recreational walking and cycle route.
- 5.4.25 The intensity and exposure to adverse effects on access to open space as a result of the use of Kenilworth Greenway are considered to be moderate, and the duration of exposure will be long term. During construction, its loss is likely to adversely affect local people's perceptions about the quality of their environment, and will reduce access to green space, which has a range of health benefits. Following construction it is proposed that the Kenilworth Greenway will be reinstated on its existing alignment.

Birmingham

- 5.4.26 Park Hall nature reserve will be permanently affected by the construction of the Proposed Scheme across the site, and diversion of the River Tame. The nature reserve comprises approximately 366,000 m² of grassland, wetlands and ancient woodlands, and is an important resource for local people and visitors. During construction, the nature reserve will be closed to visitors for approximately five years, plus a further year for reinstatement.
- 5.4.27 The extent and intensity of exposure to adverse effects on access to Park Hall nature reserve during construction are considered to be moderate, and the duration of this exposure is considered to be long term. The closure of the site will reduce access to green space, which is associated with a range of health benefits.
- 5.4.28 The impacts on the eastern part of the site from the presence of the Proposed Scheme are likely to adversely affect local people's perceptions about the quality of their environment. Although there will be a permanent effect, due to the restoration of the site the intensity of exposure to adverse effects is considered to be low.

Fear of crime and antisocial behaviour

- 5.4.29 Construction sites are sometimes perceived as having the potential to attract activities such as vandalism, fly-tipping and theft of materials. Those living adjacent to construction compounds may experience increased fear of crime associated with the presence of the site. Additionally, the diversion of footpaths around construction sites has the potential to affect actual or perceived personal safety, both in terms of road safety and environmental changes such as sight lines and lighting.
- 5.4.30 The extent and intensity of exposure to fear crime and antisocial behaviour resulting from the scheme is likely to be low, as construction sites will be appropriately fenced and secured, and the potential for crime and anti-social behaviour will be minimised through measures set out in the draft CoCP.

5.5 Air quality

Links to health effects

- 5.5.1 The ES provides an assessment of the likely significant effects on local air quality arising from the construction and operation of the Proposed Scheme, covering nitrogen dioxide (NO₂), fine particulate matter (PM₁₀ and PM_{2.5})³ and dust.
- 5.5.2 The links between road traffic emissions and health are well established, with the main health damaging pollutants being particulate matter and NO₂. Particulate matter may be deposited within the lungs, with smaller particles having a greater chance of reaching the deeper parts of the lungs, affecting the lung function.
- 5.5.3 The effects of road traffic related NO₂ on health are less well understood than the effects of PM₁₀, but it is thought to cause respiratory problems, with short-term acute exposure having a greater adverse effect than a longer term exposure at lower concentrations.
- 5.5.4 It is generally accepted that large particulate matter (dust) does not penetrate the lungs to cause respiratory health problems. However, dust can cause eye, nose and throat irritation and lead to nuisance effects.
- 5.5.5 Evidence for the links between air quality and health is presented in Appendix 4.

Construction dust

- 5.5.6 Emissions to the atmosphere from construction activities including dust and emissions from on-site plant and equipment will be controlled and managed through the route-wide implementation of the draft CoCP. The draft CoCP includes a range of mitigation measures that are accepted by the Institute of Air Quality Management as being suitable to reduce impacts to as low a level as reasonably practicable. It also makes provision for the preparation of LEMP which will set out how the project will adapt and deliver the required environmental and community protection measures within each area.
- 5.5.7 With the implementation of mitigation measures contained within the draft CoCP, including the use of LEMP in places where receptors are very close to sources of dust, the assessment of impacts arising from dust emissions in the ES has concluded that the effects will be slight adverse or negligible and not significant at all receptors.
- 5.5.8 On the basis of the evidence presented in Appendix 4 and the conclusions of the ES, it is considered that there will be no respiratory health effects arising from construction dust emissions.
- 5.5.9 The consultations undertaken by HS2 Ltd have identified public concern relating to the potential health effects of construction dust, particularly from people with existing respiratory conditions such as asthma. There is no evidence to suggest that dust at levels expected near to the construction sites could exacerbate these conditions. Furthermore, at the low levels of effects predicted in the ES, any irritation of the eyes,

³ PM_{2.5} and PM₁₀ describe two size fractions of airborne particles that can be inhaled and therefore are of concern for human health. The designations refer to particles of size less than 2.5 and 10 microns in diameter.

nose and throat is unlikely to occur. However, concern about the perceived health effects of dust, which may cause anxiety to some individuals.

- 5.5.10 The low levels of dust deposition predicted in the ES, and the probable short-term nature, means that the extent and intensity of exposure to these effects along the route are considered to be low.

Construction traffic

- 5.5.11 Screening and detailed assessment of the potential effects on nitrogen dioxide (NO₂), and fine particulate matter (PM₁₀ and PM_{2.5}) from road traffic emissions has been undertaken for the ES, based on the magnitude of change and whether air quality standards are exceeded.
- 5.5.12 Significant effects on NO₂ concentrations, both beneficial and adverse, have been identified in the ES. These effects are predicted based on several conservative assumptions including: 2017 background concentrations and vehicle fleet emissions applied throughout the assessment period of 2017-2026; and an assumption that the peak traffic flows in the construction programme will apply over the whole construction period. The maximum duration of significant impacts is 12 months, based on the worst-case emissions within this period.
- 5.5.13 Significant adverse effects are predicted in the following areas:
- Euston:
 - 5 substantial adverse and 15 moderate adverse temporary NO₂ effects, at receptors on three routes or areas: on or near Eversholt Street on the east side of Euston station (resulting mainly from traffic diversions); on Euston Road/Grays Inn Road (an access route for construction traffic from the east), and on the route taken by vehicles removing the material excavated from Euston (A400 Hampstead Road/Euston Road/A5 Edgware Road/A5205 St Johns Wood Road/A41 Wellington Road).
 - London:
 - moderate adverse temporary NO₂ effects on receptors at A41 Finchley Road, the A502 Chalk Farm Road and the A502 Rosslyn Hill/Heath Street, B509 Adelaide Road will also be affected. One receptor at the junction of the A41 Finchley Road and A41 Hendon Way is also predicted to experience a moderate adverse impact;
 - moderate adverse temporary NO₂ effects on receptors on the A4000 Old Oak Lane and Wales Farm Road;
 - moderate adverse temporary NO₂ effects on receptors on Swakeleys Road, Woodhall Close and Park Avenue. Substantial adverse temporary NO₂ effects on receptors on Warren Road, Roker Park Avenue and Shorediche Close.
- 5.5.14 Rural areas (towards the southern end of the route):
- substantial adverse temporary NO₂ effects on receptors along Swakeleys Road.
 - moderate adverse temporary NO₂ effects on receptors along the section of the A41 Gatehouse Road and the A41 Bicester Road on the west side of Aylesbury.

- 5.5.15 The ES also identifies substantial adverse effects on concentrations of PM₁₀ at receptors on the A501 Euston Road, and moderate adverse effects at receptors along Gordon Street and Chalton Street, and on the A501/A5200 Gray's Inn Road.
- 5.5.16 The increased risk of health effects to any individual as a result of emissions associated with the Proposed Scheme will be extremely small. There may be anxiety caused by perceived health risks from increased traffic emissions, particularly for people with existing respiratory conditions.

Operational traffic

- 5.5.17 During the operation of the Proposed Scheme, the redistribution of traffic around Euston will result in the redistribution of emissions, with both beneficial and adverse effects. Significant adverse effects on concentrations of NO₂ have been identified at one receptor on Euston Road, one receptor on Upper Woburn Place, and one receptor at the junction of Euston Square and Grafton Place. PM₁₀ impacts are predicted to be negligible at receptors in the study area during the operational phase. Based on the very low levels of exposure to increased concentrations of NO₂, it is considered that there will be no adverse health effects.

5.6 Noise and vibration

Links to health effects

- 5.6.1 Direct health effects from noise are well established in terms of sleep disturbance, annoyance, cardiovascular effects and cognitive impairment of children when at school. There is also an established link between vibration and annoyance.
- 5.6.2 In the case of cardiovascular effects and cognitive impairment of children when at school, the evidence relates primarily to long-term exposure to aviation noise and also road traffic noise, rather than railway noise.
- 5.6.3 Evidence for the links between noise and health, and specifically the effects of high speed rail noise compared to other noise sources such as aviation noise for example, is presented in Appendix 4.

Construction

- 5.6.4 The management and control of noise and vibration impacts from the Proposed Scheme is set out in Appendix 6, together with a description of the envisaged avoidance and mitigation measures for construction activities. Construction noise and vibration will be controlled and managed in accordance with the draft CoCP and the noise insulation and temporary re-housing policy. The principles of the control and management processes in the CoCP are based on Best Practicable Means (BPM) as defined by the Control of Pollution Act 1974 (CoPA). This includes control of noise and vibration at source; use of screening; and provision of noise insulation or ultimately temporary re-housing.
- 5.6.5 The proposed measures for the control and management of construction noise and vibration will reduce the risk of annoyance and sleep disturbance inside residential properties.
- 5.6.6 The measures also reduce the construction noise effects on acoustic character outdoors in the majority of residential communities, although it is recognised that

some level of disturbance will occur. Community areas, including "shared community open areas"⁴ that are particularly affected by noise from construction activities are reported in Volume 2 of the ES, including information on exposure levels and the duration of construction works.

- 5.6.7 The outdoor learning environment at a number of schools and educational facilities close to the construction worksites may be affected by construction noise for varying durations. The affected schools and educational facilities are reported in Volume 2 of the ES and include a number of schools catering for children with special needs.
- 5.6.8 Noise entering classrooms can be reduced using sound insulation and other measures, and it is reasonable to assume therefore that significant disturbance inside classrooms can be avoided. The risk of cognitive impairment at schools will therefore be avoided by putting in place avoidance, mitigation and management measures as set out in the draft CoCP.
- 5.6.9 Pupils with special needs may be more sensitive to changes in the environment including changes in noise levels. For example, such pupils may have greater difficulty in adapting to change, and be particularly vulnerable to the disruptive effects of noise.
- 5.6.10 HS2 Ltd will work closely with affected schools with special needs pupils to identify further measures to mitigate noise effects, where reasonably practicable, including discretionary measures identified in the draft CoCP. Where appropriate, HS2 Ltd will set out specific working practices in the LEMP to provide further mitigation.
- 5.6.11 There is the potential for daytime noise impacts to occur at the James Town Mental Health Centre on Adelaide Road in London due to the construction of the Adelaide Road Vent Shaft. Effects have been identified on users in the ES, due to the specific nature of the centre as a noise sensitive medical facility. Noise impacts can exacerbate mental health conditions and it is thought that vulnerable people (particularly disabled people, older people and children) are less able to cope with the effects of noise exposure, and may be at greater risk of harmful effects. HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid significant noise effects. In doing so, HS2 Ltd will continue to engage with the centre to fully understand its use.

Operation

- 5.6.12 HS2 trains will be quieter than the relevant current European Union specifications. The track will be specified to reduce noise, as will the maintenance regime.
- 5.6.13 The design of the Proposed Scheme, including the vertical alignment and noise barriers and tunnel portal arrangements, will take account of the need to control levels of noise and vibration.
- 5.6.14 For the few properties close to the route that remain exposed to levels of noise that will result in an adverse noise effect indoors, either during the day or night, noise

⁴ 'shared community open areas' are those that the emerging National Planning Practice Guidance identifies may partially offset a noise effect experienced by residents at their dwellings and are either a) relatively quiet nearby external amenity spaces for sole use by a limited group of residents as part of the amenity of their dwellings or b) a relatively quiet external publicly accessible amenity space (e.g. park or local green space) that is nearby

insulation will be offered if the qualifying criteria are met and, if accepted, will avoid this effect.

Airborne noise

- 5.6.15 Railway noise from the Proposed Scheme might be expected to increase annoyance if it exceeds the existing external ambient noise levels and if it is above 50dB during the day. By comparison to the number of properties exposed to existing daytime ambient sound levels of 50dB⁵ or more within 1 km of the route of the Proposed Scheme, the number of properties exposed to such noise levels arising from the Proposed Scheme during the daytime will be comparatively small (see Appendix 6). This reflects the amount of mitigation that has been incorporated into the design.
- 5.6.16 The environmental assessment has identified approximately 1,850 residential properties, mainly close to the route and in locations where the existing noise levels are low, that are likely to experience an appreciable change in daytime noise levels. However, only a small proportion (in the region of 5%-20%) of the total number of people living in properties exposed to these noise increases would be expected to become annoyed or experience an increase in annoyance.
- 5.6.17 By comparison to the number of properties exposed to existing external ambient sound levels of 40dB⁶ or more at night with 1 km of the proposed route, the number of properties exposed to such noise levels arising from the Proposed Scheme during the night time is small (see Appendix 6). As well as the amount of mitigation that has been incorporated into the Proposed Scheme this also reflects the forecast service patterns⁷.
- 5.6.18 In general an increase in reported sleep disturbance at night is unlikely if the level of noise from the railway⁸ is lower than existing levels. Railway noise from the Proposed Scheme might be expected to result in an increased risk of reported sleep disturbance if it exceeds the existing ambient noise levels and if exposure is above 40dB at night⁹. The environmental assessment has identified approximately 1,450 residential properties that will be subject to these conditions, mainly close to the route and in locations where the existing noise levels are low. This does not mean that increased adverse effects on sleep will occur at these properties. There is a greater risk of sleep disturbance at higher levels of exposure and the level of disturbance will depend upon a number of factors including:
- maximum noise levels;
 - number of noise events which people already experience;

⁵ Below 50dB, sound from transportation (railways, road traffic and aircraft), although potentially noticeable, would not generally be expected to give rise to an observed adverse effect - refer to Appendix 4.

⁶ Below 40dB, sound from transportation (railways, road traffic and aircraft) would not generally be expected to give rise to an observed adverse effect - refer to Appendix 4.

⁷ Passenger services on the Proposed Scheme would start at or after 05.00hrs, and would start to run at the maximum hourly service pattern after 07:00 and up to 21:00. The number of services would then progressively decrease after 21:00hrs and the last service would arrive at terminal stations by 24:00. As a consequence there would be up to 36 passenger train movements each night (2300-0700) on the main sections of the route.

⁸ Unless otherwise stated, noise levels for the night period refer to the 8-hour night (23:00 to 07:00) equivalent continuous sound pressure level, LpAeq,8hr

⁹ Below 40dB, sound from transportation (railways, road traffic and aircraft) would not generally be expected to give rise to an observed adverse effect at night (ref Appendix x: HIA evidence base).

- how the level, composition and character of the noise at night will change as a result of the Proposed Scheme; and
- whether windows to bedrooms are open or closed¹⁰.

5.6.19 In general, there is a greater risk of adverse effects if the change occurs at locations where there are higher ambient noise levels.

5.6.20 There is evidence to suggest an association between exposure to noise and cardiovascular effects. A broad indication of a potential for increased risk of cardiovascular effects may be given where:

- the exposure to noise is relatively high¹¹; and
- noise from the Proposed Scheme is equal to or exceeds the existing ambient noise levels (see Appendix 6).

5.6.21 The environmental assessment has identified approximately 250 residential properties that will be subject to these conditions. Given the small fraction of the population within the study area¹² potentially exposed to relatively high noise levels due to the Proposed Scheme, and the much larger proportion of that population already exposed to high noise levels from existing sources, it is highly unlikely that the Proposed Scheme will result in an increase in the risk of cardiovascular effects within the study area.

5.6.22 There is evidence to suggest an association between noise exposure and cognitive impairment of children at school. The environmental assessment has identified one school (Booker Park School, Aylesbury), which will experience noise from the Proposed Scheme that just exceeds the existing ambient noise and is above 50dB, which may suggest a low level of risk.

5.6.23 Booker Park School caters for children with special needs who may be more sensitive to changes in the environment including changes in noise levels. HS2 Ltd will continue to engage with stakeholders regarding this school, to fully understand its use characteristics and the benefit of the envisaged mitigation measures.

Combined noise and vibration effects (surface sections)

5.6.24 The environmental assessment has identified about 50 residential properties that are very close to the surface sections of route that could be adversely affected by ground-borne vibration¹³.

5.6.25 These properties will also be exposed to adverse effects from airborne noise levels. Inhabitants could experience greater annoyance than that expected if either noise or vibration was present in isolation. This is a moderate effect on a very small number of receptors.

¹⁰ The 40dB criterion assumes that windows are open for much of the year.

¹¹ Indicated by daytime noise levels exceeding 60dB L_{pAeq,0700-2300} as noted in Appendix 4.

¹² This is defined as 1km either side of the railway in rural areas and 500m either side in urban areas.

¹³ As described in the ES and in Appendix 4, this is a magnitude of vibration on the floors of a property above 0.2ms^{-1.75} during the day or 0.1ms^{-1.75} at night.

Noise and vibration effects (tunnelled sections)

- 5.6.26 Taking account of the envisaged avoidance and mitigation measures incorporated into the Proposed Scheme the environmental assessment has identified no significant effects from operational noise or vibration along the tunnelled sections of route. The assessment has identified about 15 residential properties directly over or adjacent to one short section of tunnel in the London Corridor and adjacent to one green tunnel where ground-borne noise and /or vibration could give rise to annoyance and sleep disturbance.

5.7 Physical activity

Links to health effects

- 5.7.1 Environmental factors have been shown to have an influence on participation in physical activity, which in turn affects health. This includes issues such as the accessibility of facilities for physical exercise, perceived safety and, to a lesser degree, the aesthetic features of the environment and parks. Evidence shows that physical activity can be encouraged by improving accessibility to green spaces, and by ensuring green spaces are attractive and of a high quality.
- 5.7.2 There is strong evidence on the link between physical activity and health benefits. Exercise is known to reduce the risk of many chronic conditions including coronary heart disease, stroke, type 2 diabetes, cancer, obesity, mental health problems and musculoskeletal conditions. Relatively small increases in physical activity are associated with some protection against chronic diseases and improved quality of life.
- 5.7.3 The health benefits to children from physical activity are particularly important. These include building bone density, avoidance of weight gain, and establishing positive habits which improve health status in later life.
- 5.7.4 Evidence for the links between physical activity and health is presented in Appendix 4.

Sports and leisure facilities

- 5.7.5 The construction of the Proposed Scheme will result in the whole or partial loss of a number of facilities used for sports and physical activity, as well as indirect effects such as increased journey times to facilities during construction. In some cases the facilities will be reinstated following the construction period. However in cases where land is required for the construction of new infrastructure there will be a permanent effect on the function of the facilities, resulting in reduced opportunities for people to partake in physical activity.
- 5.7.6 The ES identifies sports and recreational facilities that will be affected by the construction of the Proposed Scheme. For the purposes of the HIA these have been considered from the point of view of effects on physical activity, taking into account the types of activity undertaken, the nature and duration of disruption, and other factors such as whether the facility is used by the community or paying members.
- 5.7.7 Those facilities where it is considered that the Proposed Scheme has the potential to result in reduced opportunities for physical activity include:
- children's play grounds and outdoor sports courts around Euston and Victoria Gardens in Ealing;

- Hillingdon Outdoor Activity Centre (HOAC) in Middlesex;
- several sports clubs including Old Saltleians Rugby Football Club near Water Orton, Weights and Measures Gym at South Heath, and Wendover Cricket Club.
- Aylesbury Park Golf Club and Whittington Heath Golf Club in Staffordshire;
- several riding stables including Washbrook Farm Equestrian Centre, Dunton Stables, Chalfont Valley Equestrian Manege, Washbrook Farm Equestrian Centre and Middleton Equestrian Centre;
- areas of woodland used for recreation including Mantle's Wood at Hyde Heath and Sibley's Coppice at South Heath, both in Buckinghamshire;
- canal towpaths, including the grand Union Canal and the Digbeth Branch Canal in Birmingham;
- Olympia Motorcycle Track, Birmingham; and
- playing fields such as those at Turweston in Buckinghamshire, Heath Park at Chelmsley Wood, and Farnborough Road Park in Castle Vale.

5.7.8 The temporary or permanent reduction in levels of physical activity at these facilities will reduce opportunities for local communities to benefit from the positive health effects associated with physical activity.

5.7.9 Effects on sports and leisure facilities will be mitigated in accordance with effects on community facilities, as described in Section 5.11.

5.7.10 For those facilities that are assessed to be particularly affected in terms of potential health impacts, further detail is provided below.

Play spaces at Euston

5.7.11 The Eskdale Play Area on the Regent's Park Estate will be lost for up to ten years during the construction works. This facility includes children's climbing frames and swings and serves the people living in the surrounding residential blocks. The Proposed Scheme will also result in the permanent loss of Hampstead Road Open Space on the west side of Hampstead Road – including a children's playground. The nearest alternative children's play area for those living in the northern part of the estate will be approximately 500m to the south at Cumberland Market.

5.7.12 Some of the existing users of these play areas are likely to be those living in the adjacent blocks that will be demolished, reducing demand for these facilities. However there is likely to be an overall loss of access to play facilities for remaining residents during the construction period.

5.7.13 The scheme will also result in the temporary closure (up to ten years) of St James's Gardens Open Space and the permanent loss of 75% of the open space. This site includes a basketball/five-a-side football court/multi-use games area.

5.7.14 HS2 Ltd is working with LB Camden to identify mitigation measures for the long-term loss of these play spaces, and it is anticipated that the majority of play spaces lost during construction will be re-provided at alternative locations within close proximity

to the lost facilities. Playground equipment lost as a result of construction of the Proposed Scheme is likely to be re-provided at locations such as Cumberland Market, Munster Square, Clarence Gardens, Hope Gardens and Tolmers Square. The multi-use games area lost from St James's Gardens will be re-provided at Cumberland Market along with an 'eco-gym' and improvement schemes will be implemented. However, there is a potential for residents to experience a temporary lack of facilities, unless replacement play space can be made available prior to the start of construction.

- 5.7.15 The construction of the Proposed Scheme is assessed to result in a medium to high extent and high intensity of exposure to the loss of play space within the Regent's Park Estate. This has the potential to result in a reduction in access to the beneficial effects of physical activity. As an area of high deprivation, access to private sports facilities and clubs for residents on the Regent's Park Estate is limited and many people are dependent on free facilities such as football and basketball pitches. Although the loss of access to these facilities will be temporary, the duration of impact may be significant, particularly for children, depending on how soon replacement facilities are provided. As described in Appendix 4, children and young people are particularly vulnerable to the effects of reduced physical activity.
- 5.7.16 The scheme will also result in the loss of the children's playground at Lancing Street to the east of Euston station to make way for a satellite compound. The playground serves the surrounding residential blocks on the Churchway Estate and there are few alternatives nearby.
- 5.7.17 HS2 Ltd proposes to relocate the playground equipment at Wellesley House, Lancing Street, to an adjacent area of vacant land (just to the north of the existing playground), outside the land required for construction of the Proposed Scheme.

Hillingdon Outdoor Activity Centre

- 5.7.18 The construction of the Colne Valley viaduct will require the demolition of three outbuildings associated with the Hillingdon Outdoor Activity Centre (HOAC) and the permanent placement of piers at the site and the adjoining 18ha lake where water based activities take place. The land required for construction of the Proposed Scheme will result in closure of the lake and impair the land based activities of HOAC during the construction period. It is likely that the ability of the activities centre to function will be severely compromised and it may not be viable to remain open during the construction period.
- 5.7.19 The HOAC is a valuable resource and there are no centres providing similar services within the region. Users of the HOAC include local people, education groups (e.g. schools and colleges) and community groups (e.g. Scouts and Guides). Specific facilities are in place to enable those with disabilities to participate. Whilst the outdoor centre caters for the whole community, it prioritises young people, disadvantaged people and those with disabilities. Closure of the centre may have knock-on effects for health due to the loss of opportunities for exercise, and particularly for children and disabled people for whom it is an important resource providing both physical and social benefits.
- 5.7.20 In the event that it does prove possible for HOAC to continue to operate during construction as a result of on-going discussions or alternatively, HOAC is re-

established on its existing location after construction then there will be an effect during the operation of the Proposed Scheme. This will include changes to the areas used for their on-site activities and storage and restrictions on the use of the lake, affecting water-based activities as a result of the Colne Valley viaduct. In-combination effects on amenity from a combination of significant noise and visual effects from the operational scheme will continue to affect the use of the recreational resource as a place for exercise.

5.7.21 Users wishing to partake in the range of water and land-based physical activities offered by the HOAC are assessed to experience a high intensity and medium to high extent of exposure to adverse effects on opportunities for physical activity both during construction and operation.

5.7.22 HS2 Ltd has committed to continue to engage actively with the Hillingdon Outdoor Activity Centre to explore opportunities for relocation or for staying on a reconfigured site. HS2 Ltd will seek in its negotiations, agreement on an alternative venue and associated compensation package sufficient to enable re-provision of facilities. In investigating suitable alternative locations, HS2 Ltd will seek to identify locations:

- capable of offering a comparable range of outdoor activities for disadvantaged young people and for disabled people; and
- which provide a viable alternative location to offer services to young people from local/surrounding boroughs, including Hillingdon, to visit the venue at a comparable travel cost.

Turweston playing fields

5.7.23 The Proposed Scheme will result in the temporary and permanent loss of land at the playing field in Turweston. Approximately 40% of the playing field will be required temporarily to accommodate the construction of a cutting for the Proposed Scheme. Construction will last for approximately four years with no comparable local alternatives (the nearest playing fields are in Brackley). Approximately 8% of the playing field will be required on a permanent basis. The resource provides a range of exercise opportunities, particularly for children and young people. It is within walking distance for many users, who may need to drive to access an alternative site.

5.7.24 It is assessed that there will be a high intensity and medium extent of exposure to the loss of space used for exercise as a result of the temporary and permanent loss of land at the playing field in Turweston.

5.7.25 HS2 Ltd will work with the Parish Council and the landowners at Turweston playing field, to re-provide or reconfigure the playing field lost during construction and operation, consistent with HS2 Ltd's position on the restitution of community facilities. This re-provision will include appropriate refurbishing to current safety and accessibility standards.

Old Saltleians Rugby Club

5.7.26 Old Saltleians Rugby Football Club near Water Orton lies directly on the line of the route, and will be affected by temporary and permanent use of the majority of the land including the clubhouse parking, rugby pitches, training and storage areas. The club has four pitches and an additional training area, and has three men's senior

teams, a ladies team and many junior age categories. Following construction, the satisfactory reinstatement of the facilities cannot be achieved within the land that will remain, and the club will be required to relocate.

- 5.7.27 There will be a medium extent and medium to high intensity of exposure to loss of opportunities for physical activity resulting from effects on Old Saltleians Rugby Football Club.
- 5.7.28 At Old Saltleians Rugby Club, HS2 Ltd will continue to work with the Club to assist them with the identification of suitable compensatory land or premises, to which the affected resource could relocate on the basis that they will be eligible for financial compensation under the Compensation Code.

Whittington Heath Golf Club

- 5.7.29 On the southern approach to Lichfield, the route will pass through the centre of the Whittington Heath Golf Club. Effects will include the demolition of the club house, loss of the adjacent car park, and effects on approximately half of the 18 holes. The club is a well-used and valued facility, which hosts a number of tournaments throughout the year and has a large number of playing members. The club will be temporarily closed for over a year during construction, and following this further time will be needed for reinstatement of the course. The club is used by paying members and therefore not available to the wider community for physical activity. However, considering the severity of effects on the facility and the limited number of alternative courses available in the area, there is a potential for levels of physical activity to be adversely affected. The intensity of exposure to loss of opportunities for physical activity resulting from effects on Whittington Heath Golf Club is assessed to be of medium extent and medium to high.
- 5.7.30 HS2 Ltd will work with the owners of Whittington Heath Golf Club to assist them to reconfigure their operations and/or identify suitable replacement land on the basis it will be eligible for financial compensation under the Compensation Code.

Olympia Motorcycle Track

- 5.7.31 The Proposed Scheme will result in the permanent loss of the Olympia Motorcycle Track off Middle Bickenhill Lane as a result of land required and cutting north of the Birmingham Interchange station and to the north of Middle Bickenhill. The facility is a motocross track that provides a recreational and sporting facility including a track for beginners and children. The effect on opportunities for exercise and physical activity are of low intensity and extent of exposure due to the nature of the activities undertaken at this site which is considered to be a specialist sport undertaken by a limited sector of the population. There are alternative comparable motocross tracks within the West Midlands area, including in Stipers Hill, Bromsgrove, Telford and Coventry.
- 5.7.32 HS2 Ltd will continue to work with the owners of the facility to assist with the identification of suitable replacement land on the basis they will be eligible for financial compensation under the Compensation Code.

Public open space and rights of way

- 5.7.33 Public rights of way (PRoW) provide opportunities for walking and cycling, both as a form of recreation on leisure routes and as a means of travel between communities, shops, services and employment sites. The construction of the Proposed Scheme will require the temporary closure and diversion of a large number of public rights of way, resulting in increased journey times and, in many cases, a reduction in the amenity value of the routes. This could potentially deter some users. In most cases these impacts will be short or medium term.
- 5.7.34 The Proposed Scheme includes crossings to enable the majority of PRoWs to remain open following the construction of the railway, with the exception of some instances where alternative routes are available or usage is negligible. In some cases there will be a permanent change in journey times as a result of minor re-routing of PRoWs.
- 5.7.35 During construction, the Nominated Undertaker will maintain, where reasonably practicable, public rights of way (PRoW), including diversions, for pedestrians, cyclists and equestrians affected by the Proposed Scheme. Measures outlined in the draft CoCP will also ensure that the Nominated Undertaker and its contractors will provide advance notice to local residents of any changes to access arrangements and diversions to public footpaths, including the duration of closure and date of reopening.
- 5.7.36 User surveys undertaken as part of the ES have demonstrated that the majority of affected PRoWs have low levels of usage, and the increases in walking or cycling times for most diversions are minor. Therefore the effects on overall levels of physical activity are expected to be very small in most cases. However, effects on certain specific routes have been identified as having the potential to affect levels of physical activity.
- 5.7.37 Key routes affected include:
- the section of the Old Shire Lane Circular Walk from the junction with the A412 Denham Way/North Orbital Road near West Hyde House, west and north-west, to its intersection with the M25 runs alongside areas of construction activity including the Chiltern tunnel main construction compound. Part of the route will be temporarily diverted and part will be closed during the construction period for five and a half years. The users of the remaining section of the route within this study area are predicted to experience a significant change in amenity when using the alternative route, principally as a result of the views from the construction activity;
 - two PRoW through Mantle's Wood, north-west of Hyde Heath will be permanently affected. These routes are currently used by local residents for walking activities. One PRoW will be temporarily re-routed and another will be stopped up;
 - several PRoWs through Sibley's Coppice, linking South Heath to Great Missenden will be temporarily closed off to the public during construction;
 - Shakespeare's Avon Way and Millennium Way at South Cubbington Wood with effects lasting approximately two years. The route is popular for local

people living at Cubbington and as part of a long-distance trail.

- just north of Kenilworth, the recently completed Connect2 Kenilworth public footpath, bridleway and cycleway will be closed for six to twelve months. This route also forms part of NCR 52, and is used as a commuter link between Kenilworth and the University area to the north;
- at Burton Green, the Kenilworth Greenway, which forms part of the Coventry Way between Crackley and Berkswell, will be closed for up to two years. The route is considered to be of high importance for Burton Green residents, particularly in view of the lack of other public open space in the area. A permanent diversion will be constructed over the cut-and-cover tunnel through Burton Green and then alongside the HS2 route;
- to the north of Burton Green, the Millennium Way public footpath will be closed for up to twelve months. A permanent diversion will be constructed to cross the railway via the Waste Lane overbridge, but this diversion will not be available during the construction period;
- a temporary diversion will be provided for the route of the Coventry Way/Centenary Way long distance footpath, where it is crossed by the Proposed Scheme, just east of Kenilworth Golf Course;
- the Heart of England Way will be crossed in two places. At the crossing point at Bucks Head Farm, Rock Hill, near Hints, the route will be permanently diverted to the east of the farm and will cross beneath the realigned A5 carriageway via a new underpass. During construction there will be no use of the existing Heart of England Way crossing over the A5, and any scope for diversion is limited. Users will need to cross the A5 approximately 600m further east, via the bridleway which runs along the access road to Hints Quarry. Usage of this footpath is high and it has additional value as a link to bridleways to the north;
- the second crossing of the Heart of England Way is just north of Packington Moor Farm, where the route will be diverted along the east side of the new rail line and cross via a new bridge over the realigned A51 Tamworth Road, reconnecting back to the original bridleway route at Freeford Home Farm. Temporary closure of the route could be necessary at some point in the construction process. The route is well used and is the only connection to the PRow network to the north at Whittington; and
- construction of the Proposed Scheme will also result in the temporary diversion of approximately 850m of the Kenilworth Greenway in the Balsall Common area. During construction Kenilworth Greenway will be used as a construction route with potential effects on the amenity value of the Kenilworth Greenway. However, the Greenway will be diverted and remain open for use throughout the construction period, meaning that any effect will be small and will be reinstated back to its current alignment post construction to an equivalent standard. Planting will be provided alongside the reinstated Kenilworth Greenway for screening the Proposed Scheme.

- 5.7.38 The Proposed Scheme also results in the temporary loss of some areas of public open space that are used for physical activities such as dog walking, jogging and cycling, particularly along the urban and suburban sections of the route. The type of areas affected include:
- canal towpaths at Old Oak Common and in Birmingham; and
 - nature reserves at Hampton-in-Arden and Castle Vale in Birmingham.
- 5.7.39 The Nominated Undertaker will maintain PRow, where reasonably practicable, including diversions for pedestrians, cyclists and equestrians affected by the Proposed Scheme. The draft CoCP will ensure that the Nominated Undertaker and its contractors will provide advance notice to local residents of any changes to access arrangements and diversions to public footpaths, including the duration of closure and date of reopening.

Active travel on the road network

- 5.7.40 During construction there may be some effects on the number of active travel journeys (cyclists and pedestrians) as a result of increased volumes of HGV traffic on parts of the road network. Fear of traffic is identified as the most common barrier to cycling, although the level of fear is often exaggerated in comparison with the likelihood of injury. Fear of walking on footpaths and crossing roads with increased HGV traffic is also likely to deter walkers, particularly those with young children.
- 5.7.41 These issues have the potential to reduce levels of active travel during the construction period, particularly in rural areas where there are fewer alternative routes available.
- 5.7.42 During operation, improved cycle parking for commuters at Euston and Curzon Street stations and additional bike hire stations at Euston station are expected to have a beneficial effect on commuters at either end of the route, facilitating active travel journeys.

5.8 Access to services

Links to health effects

- 5.8.1 There is strong evidence linking access to healthcare facilities with health outcomes, and there is also evidence to suggest that transport problems are a key barrier to people's ability to access these services. Therefore changes in journey times to healthcare services have the potential to result in adverse health effects, if the delays are sufficient to deter people from attending appointments or seeking advice.
- 5.8.2 There is weak to moderate evidence to suggest that access to shops and other local services can affect health. This is based on a range of factors affecting quality of life, and includes issues such as reducing feelings of isolation and enabling participation in society, as well as accessing basic needs such as food shopping.
- 5.8.3 Evidence for the links between access to services and health is presented in Appendix 4.

Health service capacity

- 5.8.4 During the construction phase in rural areas, temporary workers from outside the local area will reside in the vicinity of the Proposed Scheme, either in construction workers' accommodation near the main construction sites or within the community in rented accommodation, bed and breakfasts etc.
- 5.8.5 It is considered likely that the majority of these workers will continue to be registered with their existing GPs rather than registering with a GP in the local area. The small minority who may choose to relocate to the area and register with a GP will be accommodated within the existing healthcare funding systems, which allocates funds to local health authorities on the basis of population size. Workers choosing to live in the local area for the purpose of accessing construction employment will remain in the area on a temporary basis for the duration of the works, and will not contribute to long-term population growth.
- 5.8.6 HS2 Ltd or the Nominated Undertaker will provide occupational health care to temporary workers, including health assessment, health monitoring, preventative treatment where necessary, and first aid. This is expected to help to reduce additional demand for local services, including A&E services.
- 5.8.7 The extent and intensity of effects arising from the potential additional burden on local GPs and other services is considered likely to be low or negligible.

Emergency services

- 5.8.8 The construction of the Proposed Scheme will result in road closures and diversions and increased traffic flows in the vicinity of emergency services in four locations along the route:
- UCL Hospital Accident and Emergency department, close to the Euston station construction site;
 - Stoke Mandeville Hospital Accident and Emergency department on Mandeville Road near Aylesbury;
 - Bickenhill Fire station on the Northway in the West Midlands study area, in close proximity to the Proposed Scheme; and
 - West Midlands Fire Service Headquarters close to the Curzon Street station site, which will be subject to direct effects on the staff car parking areas, service yards and workspaces.
- 5.8.9 HS2 Ltd is working with emergency services to ensure that emergency response times are not adversely affected by construction traffic, road closures and diversions. This will include consideration of strategies for temporary and permanent traffic arrangements and construction routes, to minimise any potential effects.

Access to local shops and services

- 5.8.10 The construction of the Proposed Scheme will result in road closures, diversions and increased congestion at some junctions, which will increase some journey times to shops and services by car and bus (see Transport section below). This will mainly occur in rural areas where communities are more likely to rely on shops and services in

nearby towns and villages, and where opportunities for short alternative routes are scarce, resulting in longer diversions.

5.8.11 Based on information contained in the ES on the locations of key services within the study area, it is considered that some communities will experience increased difficulty in accessing shops, local facilities and health services during construction. The duration of these effects is predominantly short to medium term. Those services and/or communities affected include the following:

- widening of Kentish Town Road railway bridge in Camden will require the demolition of the Ivy House Dental Practice located on Kentish Town Road opposite Camden Gardens and adjacent to the existing railway line. There are alternative dental practices on Kentish Town Road (approximately 200m to the north and south), although it is not known whether these practices have spare capacity. It is also possible that the practice will relocate within the local area, on the basis that it will be eligible for compensation. There is assessed to be a low intensity and low extent of exposure to adverse effects of loss of access to dental care related to the demolition of the Ivy House Dental Practice as there are alternative facilities available in close proximity;
- reduced access to and from residential properties on Wells House Road, near Old Oak Common as a result of construction activities will leave the community only accessible from the north, and sharing the road with construction vehicles. A reduction in access, coupled with increased traffic on local roads, may result in the community facing more difficulty accessing services including schools, childcare and shops located to the south of Wells House Road, at East Acton. Exposure to long-term effects on access to local services for residents of Wells House Road is assessed to be adverse and of medium intensity and extent;
- temporary closure of School Hill for up to 2 years will reduce access to services in Steeple Claydon, Buckinghamshire for the villages of Calvert and Charndon;
- long diversions will potentially affect access to schools, shops, healthcare facilities and services in Kenilworth, Warwickshire for residents of Stoneleigh;
- at Burton Green, Warwickshire, construction of the cut-and-cover tunnel will cause disruption to day-to-day journeys across the village;
- sequential road closures around Gilson, Warwickshire will temporarily affect access to shops, healthcare facilities and services in surrounding areas such as Coleshill and Water Orton;
- temporary road closures will affect access from Middleton, Warwickshire to shops, healthcare facilities and services in nearby towns and villages, most notably Tamworth; and
- road works around Hints, Staffordshire will affect journeys to shops and services in Lichfield, Shenstone and local villages.

The Island Project at Diddington Hall

- 5.8.12 Pupils of The Island Project School at Diddington Hall regularly use Diddington Lane, as a pedestrian route, to access Hampton-in-Arden village as part of life skills education. As pupils at the school are on the autistic spectrum, they are highly sensitive to changes in their environment. Diddington Lane will be stopped up to vehicles permanently as part of the Proposed Scheme, whilst pedestrian access will be removed temporarily during the construction period. The ES has identified a major adverse isolation effect on the pupils for approximately three years.
- 5.8.13 HS2 Ltd will continue to work with the school to identify any adverse effects on the wellbeing and education of pupils and to establish whether any reasonably practicable measures can be taken to address any effects.

5.9 Traveller stress

Links to health effects

- 5.9.1 Government guidance has identified 'traveller stress' as an outcome of transport delays and disruption, affecting both drivers and public transport users. This comprises feelings of discomfort, annoyance, frustration or fear, culminating in physical and emotional tension that detracts from the quality and safety of a journey.
- 5.9.2 Evidence for the links between traveller stress and health is presented in Appendix 4.

Private car users during construction

- 5.9.3 The main aspect of the construction of the Proposed Scheme affecting private car users will be the stopping-up and diversion of a number of roads along the route to enable the construction of crossings (overbridges, underbridges, viaducts and green tunnels), and other works such as utilities. The extent to which this may lead to traveller stress will depend on the length of diversion and increase in journey time and the duration of the closure. Increased traffic flows and congestion, particularly around junctions, will also contribute to increased journey times.
- 5.9.4 The majority of road closures will be short term, with many half day and overnight closures having very little effect on road users. In other cases roads will remain open, with lane closures resulting in minor delays. Diversions will generally be short, with marginal increases in journey times. However, the ES has identified some routes that will be subject to significant increases in traffic flows and/or diversions for the medium to long term, which may contribute to traveller stress.

Private car users during operation

- 5.9.5 At operation, a small number of road closures will remain which may have some minimal impact on journey time, however the biggest factor that may contribute to driver stress is additional vehicle trips on roads around the Calvert IMD, Birmingham Interchange, Washwood Heath and Curzon Street. Further details are provided below.

Birmingham Interchange

- 5.9.6 The operational phase of the scheme has been assessed in the ES to generate additional vehicle trips on the roads through Balsall Common and Hampton-in-Arden; and the roads around the Birmingham Interchange itself, as a result of passenger movements to and from Birmingham Interchange. It is assessed that exposure to

traveller stress as a result of additional vehicle trips will be of low intensity and extent of exposure in the Balsall Common and Hampton-in-Arden area; but of low-medium extent and medium intensity exposure for some roads in the Birmingham Interchange area (i.e. the A452 and Stonebridge Island).

Washwood Heath

- 5.9.7 The proposed RSMD in Washwood Heath is forecast to generate additional vehicle trips (approximately 350 two-way vehicular trips during a 24-hour period). The highway peak hour trip generation is forecast to be low though as workers at the depot will work shifts with shift changeover times generally outside the highway peak hours.
- 5.9.8 Exposure to traveller stress as a result of additional vehicle trips is assessed to be of low intensity and extent of effects for road users in east Birmingham due to shift patterns.

Curzon Street

- 5.9.9 The Proposed Scheme will result in additional vehicle movements in the Curzon Street area of Birmingham as a result of passengers boarding and alighting at Curzon Street, although a significant percentage of these are anticipated to interchange with Birmingham New Street and Moor Street stations.
- 5.9.10 The main effect on traveller stress though relates to peak hour and off peak traffic flows local to Curzon Street station as a result of local road closures. In particular, Moor Street Queensway and the Ring Road will have an increase in traffic in the morning peak period, whilst Moor Street Queensway is also expected to experience an increase in the evening peak period
- 5.9.11 The Proposed Scheme will require the permanent closure of Park Street as well as amendments to existing highways around Curzon Street station. These changes will include the realignment and one-way operation of New Canal Street and amendments to Andover Street, Banbury Street, Bartholomew Street, Fazeley Street, and Viaduct Street.
- 5.9.12 Exposure to traveller stress as a result of road closures and amendments to existing highways around Curzon Street, increasing traffic on other roads in the area, is assessed to be of medium intensity and extent of exposure for road users.

Public transport users during construction

- 5.9.13 Bus routes running on affected roads will be subject to the same journey time delays as private cars. In addition, in some instances, there will be a need to relocate stops, increasing or decreasing walking times. As with private car users, the effects will generally be minor. However, some bus users may be adversely affected with potential effects on traveller stress.
- 5.9.14 In terms of effects on effects on train users and interchange between different modes of public transport, Euston station is likely to experience some effects as a result of the demolition/renovation of the station.

Euston

- 5.9.15 The process of demolition/renovation at the existing Euston station will adversely affect passenger access to, and movements through, the station and interchanges with London Underground, buses and taxis.
- 5.9.16 At the beginning of the Euston station enabling works, there will also be effects on some national rail services into Euston station for a period of up to eight months.
- 5.9.17 There will also be effects on access to London Underground services during construction resulting in disruption to passengers during these periods with re-routing onto alternative underground services, increases in journeys on foot from adjacent stations and increases in short-distance bus journeys.
- 5.9.18 Exposure to the effects of traveller stress on public transport users at Euston station as a result of disruption and changes to access is assessed to be of high extent and low to medium intensity.

Public transport users during operation

- 5.9.19 At the operational phase, effects on public transport users are mainly considered to be positive with the Proposed Scheme providing greater capacity on the rail network and contributing to a better and more comfortable journey experience and reduced traveller stress.

Euston station

- 5.9.20 At Euston station, the design of the station, including the addition of new escalators, lifts and travelators, will increase accessibility for those with mobility impairments compared with the existing station and reduce crowding levels in the concourse, with additional and improved access points which will be aligned with the surrounding street network.
- 5.9.21 The relocation and remodelling of Euston Underground station ticket hall to increase passenger area, together with the provision of new escalators serving both branches of the Northern line and the Victoria line will improve access to London Underground platforms. However, the increase in rail users at Euston station and consequent increases in London Underground users will result in increased passenger volumes on London Underground services and some increase in crowding on platforms. Increased crowding is expected to be greatest on the Circle, Hammersmith & City and Metropolitan lines due to the new link proposed between Euston station and Euston Square underground.

Old Oak Common

- 5.9.22 The opening of the proposed station at Old Oak Common will provide substantial transport accessibility improvements for local users and travellers from the wider area to the HS2, Great Western Main Line (GWML) and Crossrail services. There will be a major beneficial effect on rail capacity and improved journey times between London and Birmingham. Further interchange benefits will be obtained through local access to, and interchange between, GWML and Crossrail.
- 5.9.23 Reconstruction of the railway bridges on Old Oak Common Lane will permit the passage of double deck buses, allowing for expanded destinations and improved bus

frequencies, conferring further benefits to local users. There will be local pedestrian and cycle improvements and the station will also be provided with dedicated taxi facilities.

- 5.9.24 Reductions in traveller stress for public transport users through Old Oak Common are assessed to be of medium intensity and extent of exposure as a result of the operation of Old Oak Common station.

5.10 Road safety

Links to health effects

- 5.10.1 Road safety is linked to rates of injuries and deaths of motorised and non-motorised road users. The HGV content of traffic can affect road safety, particularly for walkers, cyclists and equestrians. However, the rate of fatal or serious accidents involving HGVs is reducing significantly due to improved awareness and safety measures, with fatal or serious accidents involving HGVs falling by more than half between 2000 and 2007. Evidence relating to road safety is presented in Appendix 4.

Pedestrians, equestrians and cyclists

- 5.10.2 The construction of the Proposed Scheme will increase the amount of HGV traffic on some roads which, if not properly managed, has the potential to adversely affect safety for pedestrians, cyclists and equestrians. HS2 Ltd will discuss with local authorities measures to provide for road safety for the public and construction staff during construction works. The Nominated Undertaker, in line with the draft CoCP, will produce traffic management plans which will include measures to address road safety and reduce the risks to non-motorised users from HGVs on the roads.

5.11 Social capital

Links to health effects

- 5.11.1 Social capital comprises connections between the individuals within communities, and the inclination that arises through these networks for individuals to feel valued, to feel a sense of belonging, to have companionship and to tangibly support each other.
- 5.11.2 Participation in social activities is very important to people's quality of life and can play a major part in improving health. Social networks and connections provide emotional support that can help people to cope with stressful life events. This type of support has also been shown to exert positive physiological effects on the body's hormonal and immune systems, and reduce susceptibility to mental and physical illness.
- 5.11.3 Evidence for the links between social capital and health is presented in Appendix 4.

Community isolation

- 5.11.4 The construction of the Proposed Scheme will increase isolation effects within and between communities, due to journey time increases caused by road closures and diversions. Potential effects on social capital are considered to occur where there are medium to long-term effects on journey times which affect people's access to neighbouring residential areas, or opportunities for social interaction at facilities such as churches, community centres and public houses.

- 5.11.5 Community isolation effects will occur predominantly in rural areas of the route, and will mirror the impacts on access to services as outlined at 5.8.11. Key communities that are likely to experience isolation effects as a result of increased journey times include:
- South Heath to Great Missenden;
 - Calvert and Charndon to Steeple Claydon;
 - Stoneleigh village to Kenilworth; and
 - Gilson to Water Orton and Coleshill.
- 5.11.6 While the affected villages will still be able to access neighbouring communities, increased journey times will cause inconvenience and may deter people from travelling, reducing levels of social interaction. These effects will generally be medium term, lasting between six months and two years. Exposure to increased levels of isolation over the study area as a whole is low, and for those affected the intensity is considered to be moderate.

Community facilities

- 5.11.7 The compulsory acquisition of community facilities, or issues affecting their useability, may affect social capital. The ES has identified adverse effects on facilities including community halls, clubs, public houses, cultural centres and faith centres along the route.
- 5.11.8 Where the ES reports a significant community effect resulting from the temporary or permanent loss of a community facility the options for mitigation are:
- improvements or alterations to the remaining portion of the community facility;
 - improvements to other existing community facilities in the area that could reduce the effect;
 - improving accessibility to other community facilities; and/or
 - identifying land owned by the relevant local authority that could be brought into use as a community facility with their agreement.
- 5.11.9 Additionally, in relation to the permanent loss of community facilities, HS2 will consider whether appropriate compensation community facilities could be built into the design of the permanent works within Bill limits. Where none of these measures provide suitable mitigation, HS2 will potentially acquire land for the mitigation of temporary or permanent loss of community facilities.
- 5.11.10 Where a community facility is owned and operated as a commercial enterprise (i.e. is provided by the market, is not in public or charitable ownership or does not provide publicly or charitably funded services) the above policies do not apply. In such cases, HS2 will work with the affected landowner to help them identify a solution which will enable them to continue to operate, on the basis that they will be eligible for compensation under the Compensation Code.

Community centres and village halls

Old Tenants Hall

- 5.11.11 The loss, through demolition, of the recently refurbished Old Tenants Hall community building on Harrington Street on the Regent's Park Estate at Euston will remove an important community venue. The hall is currently used by LB Camden, HS2 Ltd, Peabody and the Metropolitan Police (Regent's Park Safer Neighbourhoods Team) for various meetings, consultation sessions and exercise classes. It is also used by the local community for various group meetings. The loss of The Old Tenants Hall will affect the community around Harrington Street, which is an area of relatively high deprivation.
- 5.11.12 HS2 Ltd will continue to work with LB Camden, which owns the hall, to assist with the identification of suitable compensatory land or premises to which the affected resource could relocate, on the basis that that they will be eligible for financial compensation under the Compensation Code.

Burton Green village hall

- 5.11.13 Burton Green village hall will be demolished to facilitate construction of the Proposed Scheme. The hall is a well-used and valued community resource, with regular bookings on a daily basis for a range of private and group events, including sports and leisure groups, art classes, parish council meetings, resident association meetings and use by the Burton Green Congregation as a place of worship once per month. The charitable trust which manages the hall estimates that it is used on a regular basis by 29 groups for organised events and that over 14,000 people visited it in the period September 2011 to September 2012.
- 5.11.14 Land has been identified within Bill limits which could be used to re-provide Burton Green village hall if this is acceptable to the trustees. HS2 Ltd will work with the organisers of the village hall to consider how the alternative facility will meet the needs of and be accessible to users of the range of services offered at the hall.
- 5.11.15 Depending on whether the hall can be relocated satisfactorily, there is a potential for a high extent and medium intensity of exposure to adverse effects on social capital caused by the displacement of Burton Green Village Hall.

Religious and cultural centres

Nadi Park Royal Mayfair Islamic Centre

- 5.11.16 The Proposed Scheme is likely to affect the amenity value of the Nadi Park Royal Mayfair Islamic Centre on Old Oak Common Lane in Brent, due to its location adjacent to the Old Oak Common station construction site and on a construction traffic route. The centre offers hall hire, courses, lectures and a gym. The facility provides an important social venue for the local Islamic community. Potential effects on the amenity value of this resource, including noise effects from construction activities and effects on accessibility as a result of construction traffic movements and road closures on Old Oak Common Lane, could potentially deter people from using the facility. However, it is noted that the centre is already surrounded by working railways and associated depots and warehousing on all sides.

Arya Samaj Vedic Mission

- 5.11.17 The Proposed Scheme will result in the demolition and loss of the Arya Samaj Vedic Mission building on Inkerman Street for route alignment and construction of the Duddeston Viaduct. The Mission serves a branch of the Hindu faith, with approximately 200 registered members. The Arya Samaj Vedic Mission building is a well-used and valued community resource and there are no alternative places of worship of this kind in the region. The building includes residential accommodation for people in crisis or visitors and a flat for the priest and his family.
- 5.11.18 The loss of the Arya Samaj Vedic Mission is considered to result in a high intensity exposure to adverse effects on social capital for its users.
- 5.11.19 HS2 Ltd will continue to work with the Arya Samaj Vedic Mission to identify a suitable equivalent replacement premises prior to the demolition of the existing building, on the basis that they will be eligible for financial compensation under the Compensation Code.

Polish Centre and St Michael's Catholic Church

- 5.11.20 The construction of the Proposed Scheme will result in reduced access to the Polish Centre on Bordesley Street in Birmingham. Ease of pedestrian access between the Polish Centre and St Michael's Catholic Church (where members of the Polish Centre attend services) will be reduced due to the permanent closure of local roads. As access to both sites will be maintained via alternative routes, the extent and intensity of exposure to adverse effects on social capital is considered to be low.

Masjid Ali Mosque

- 5.11.21 The Proposed Scheme will result in amenity effects on the Masjid Ali Mosque on the corner of Aston Church Road with Arley Road in Birmingham as a result of a combination of significant noise and HGV effects. This is considered to have to potential to deter some users during the construction period. The extent and intensity of exposure to reduced levels of social capital are considered to be low.

Recreational organisations

- 5.11.22 The construction of the Proposed Scheme will also result in the loss of several clubs along the route, which are privately owned and used by members to pursue their interests, as well as having a social function.

West Ruislip Rifle Club

- 5.11.23 The construction of the tunnel portal at West Ruislip will permanently require the use of the land currently occupied by West Ruislip Rifle Club and it will be permanently lost from this site. There are no local alternative facilities of a similar nature. It is considered that there will be a low extent of exposure to adverse effects on social capital resulting from this loss.

Berkswell Clay Pigeon Club

- 5.11.24 The Berkswell Clay Pigeon Club site will be lost permanently due to the route of the Proposed Scheme and earthworks through the site. The site is well established and used regularly by local members. However, there are similar alternative facilities

locally. It is considered that there will be a low extent of exposure to adverse effects on social capital resulting from this loss.

- 5.11.25 HS2 Ltd will continue to work with the owners of the Berkswell Clay Pigeon Club to assist them with the identification of suitable compensatory land to which the affected resource could relocate or reconfigure their operations on the basis that they will be eligible for financial compensation under the Compensation Code.

Heart of England Aeromodellers

- 5.11.26 The Heart of England Aeromodellers site to the south of the B4102 Meriden Road will be lost permanently due to the construction of the Proposed Scheme through the site. The site is used daily by the Heart of England Aeromodellers Club and there are few alternatives with a similar capacity having regard to flying restrictions. As well as providing a venue for people to fly model aeroplanes, the club also stages of social events. Exposure to adverse effects on social capital are assessed low extent, but of moderate intensity for those affected.
- 5.11.27 HS2 Ltd will continue to work with the owners of the Aeromodellers club to assist them with the identification of suitable compensatory land to which the affected resource could relocate or reconfigure their operations on the basis that they will be eligible for financial compensation under the Compensation Code.

Temporary construction workforce

- 5.11.28 The Proposed Scheme will require a large temporary construction workforce, which is likely to comprise a mixture of local people and workers from further afield. Some workers who live outside commuting distance of the site may choose to seek accommodation within the local community, in rental properties, hostels and bed and breakfasts etc. Others will be located in temporary construction workers' accommodation located close to the works.
- 5.11.29 Within London and Birmingham, the effects of temporary construction workers will be negligible as workers will be widely dispersed through these heavily populated areas. However, within smaller communities, temporary changes in local population size and demographics may be noticeable.
- 5.11.30 Workers' accommodation sites will provide basic welfare services, but workers will also use facilities such as shops, banks, post offices, pubs and restaurants within the local towns and villages. Those communities most likely to be affected by the presence of construction workers are the towns and villages closest to the main construction compounds, temporary workers accommodation sites and work sites.
- 5.11.31 Based on the proximity to the Proposed Scheme and availability of local services and facilities, the following rural towns and villages where workers are likely to be used by the construction workforce: Maple Cross, Chalfont St Peter, Wendover, Aylesbury, Waddesdon, Steeple Claydon, Twyford, Chardon, Calvert, Brackley and Chipping Warden, Southam, Leamington Spa, Kenilworth, Balsall Common, Hampton-in-Arden, Coleshill, Water Orton, Curdworth, Streethay and Lichfield.
- 5.11.32 The presence of the construction workforce may result in a localised and temporary change in the demographic composition of the community in some locations. Such changes have the potential to affect community cohesion, often for the worse, for

example due to mistrust of the incoming community. However, there is also a potential for the presence of the temporary workforce to have a beneficial effect on local communities through increased use of local services and opportunities for social interaction.

- 5.11.33 HS2 Ltd will continue to liaise with local authorities along the route regarding the location and management of temporary construction workers' accommodation sites.

Glossary and abbreviations

BPM	Best Practicable Means
CoCP	Code of Construction Practice
CoPA	Control of Pollution Act 1974
dB	Decibels - The decibel (abbreviated to 'dB') is the unit used to measure the intensity of a sound
EHS	Exceptional Hardship Scheme
EIA	Environmental Impact Assessment
EqIA	Equality Impact Assessment
ES	Environmental Statement
GP	General Practitioner
GWML	Great Western Main Line
HGV	Heavy Goods Vehicles
Health determinants	Factors affecting health, including the social and economic environment, the physical environment, and a person's individual characteristics and behaviours.
HIA	Health Impact Assessment
HOAC	Hillingdon Outdoor Activity Centre
HS2	High Speed Two
IMD	Infrastructure Maintenance Depot
LB	London Borough
LEMP	Local Environmental Management Plan
NCR	National Cycle Route

NO ₂	Nitrogen dioxide
PM 2.5 & PM ₁₀	Airborne particles of less than 2.5 and 10 microns in diameter respectively, which can penetrate the lungs.
Protected Groups	Groups identified in the Equality Act 2010 as sharing a particular characteristic against which it is illegal to discriminate.
PRoW	Public Right of Way
RSMD	Rolling Stock Maintenance Depot
Social capital	Social capital comprises connections between the individuals within communities, and the inclination that arises through these networks for individuals to feel valued, to feel a sense of belonging, to have companionship and to tangibly support each other.
UCL	University College London
WCML	West Coast Main Line
WHO	World Health Organization
Well-being	Well-being is a general term for the condition of an individual or group, for example their social, economic, psychological, spiritual or medical state; high well-being means that, in some sense, the individual or group's experience is positive, while low well-being is associated with negative conditions.

Contents

HS2 Health Impact Assessment Report	1
Appendix 1- Detailed assessment criteria	1
1 Assessment criteria	3
1.1 Description of change	3
1.2 Exposure	3
1.3 Vulnerable groups	4
1.4 Strength of evidence	4
1.5 Perception of impacts	5

HS2 Health Impact Assessment report

Appendix 1- Detailed assessment criteria

1 Detailed assessment criteria

1.1 Introduction

- 1.1.1 The assessment of health effects is based on a set of criteria that have been developed using professional judgement and precedent from other large-scale HIAs. These criteria are described below.

1.2 Description of change

- 1.2.1 The change to the health determinant is described, including commentary on the following factors:

- the aspect of the Proposed Scheme causing the change;
- a description of how the health determinant will change, including the direction of this change (beneficial or adverse); and
- the duration of change (operational effects are assumed to be permanent in most cases; construction effects may be short-term if under six months, medium-term if six months to two years, or long-term if more than two years in duration).

- 1.2.2 Where relevant, reference has been made to the residual effects as assessed in the Environmental Statement (ES). (Residual effects take into account mitigation measures that have been explicitly committed to by HS2 Ltd).

1.3 Exposure

- 1.3.1 The degree of exposure of communities to changes in health determinants is qualitatively assessed in terms of the 'extent' of exposure and 'intensity' of exposure.

- 1.3.2 The extent of exposure is judged to be low, medium or high depending on the number of people in the affected community likely to be exposed to the change in a health determinant, based on the following examples:

- low extent of exposure: this may refer to effects on a small number of isolated rural properties / a small number of properties on the outskirts of a village or larger conurbation / a community resource or public space that is used sporadically or by a small number of people / effects likely to affect a small number of individuals within the population;
- medium extent of exposure: this may refer to a collection of rural properties / a group of properties within a village or on the outskirts of a larger conurbation / a community resource used regularly by a moderate number of people / a moderate number of individuals within a population; and
- high extent of exposure: a moderate to large number of residential properties (this will vary depending on the context, so in a small settlement 10-20 properties may be considered as high exposure, whereas in London or Birmingham the same number may not be considered high) / community

resource used frequently by a large number of people / a large number of individuals, or a high proportion of a particular group of people within a community.

- 1.3.3 The intensity of exposure is judged to be low, medium or high. Factors such as the severity and duration of effect and/or the value of the affected resource will be taken into account when considering intensity. Where relevant, the level of effect identified in the ES is also taken into account.
- 1.3.4 The extent and intensity of exposure are applied where practical to do so; in some cases, such as issues that could potentially affect an unknown number of individuals along the route as a whole, these criteria have not been applied.

1.4 Vulnerable groups

- 1.4.1 The sensitivity of the population exposed to the change in health determinant is considered in the assessment. 'Vulnerable groups' are sections of the population that for certain reasons may be more likely to be exposed to a change in a health determinant, or more likely to experience health effects as a result of this exposure.
- 1.4.2 Consideration of vulnerable groups takes into account: whether a health effect is shown (in the scientific literature) to affect a particular community; whether the affected community is already facing existing deprivation (social, economic or environmental) that could make them more vulnerable; and individual characteristics such as age, health conditions, or other physical or mental characteristics that make people more vulnerable to health effects.

1.5 Strength of evidence

- 1.5.1 The evidence on which the link (or 'association') between a change in health determinant and a health effect is based is described as:
- weak:
 - a few peer-reviewed research studies to suggest an association; or
 - the studies show conflicting findings;
 - moderate:
 - a range of international (but not necessarily national) peer-reviewed research studies showing similar associations and strength of associations;
 - the association is widely accepted by the public health community; and
 - there may be debate about the specific causal factors, the mechanism of effect and/or the strength of association;
 - strong:
 - a wide range of national and international peer-reviewed research studies showing similar associations and strengths of association; and

- the association is widely accepted by the public health community and there is consensus on the specific causal factors, the mechanism of effect and the strength of association.

1.5.2 It should be noted that a lack of research studies or lack of consensus among the public health community does not necessarily mean that the link between them does not exist, but that there is currently uncertainty in the assessment of the likely effect.

1.6 Perceived effects

1.6.1 Addressing perceived effects is important in reducing adverse effects on health, particularly mental wellbeing. Where there is known to be concern among the affected community about a potential health effect (based on consultation responses), this is taken into account in the assessment.

Contents

HS2 Health Impact Assessment Report	1
Appendix 2 - Scoping	1
1 HIA scoping	3
1.2 Health determinants scoped into the HIA	3
1.3 Health determinants scoped out of the HIA	3

HS2 Health Impact Assessment Report

Appendix 2 - Scoping

1 HIA scoping

- 1.1.1 The scope of this HIA was set out at an early stage in an HIA Scope and Methodology Report, following a review of information on the Proposed Scheme, preliminary baseline and community data and consultation responses. The scope has been further refined based on the findings of the ES. The conclusions from the scoping process are described below, including a list of the determinants to be included in the HIA and a description of those determinants that have been scoped out.

1.2 Health determinants scoped into the HIA

- 1.2.1 The determinants proposed to be assessed in the HIA are:
- economic determinants including job losses and gains and effects of regeneration;
 - residential determinants including the relocation of residents, and associated social determinants;
 - the local environment, including aesthetic quality, access to green space and perceived safety;
 - air quality;
 - noise and vibration;
 - opportunities for physical activity;
 - access to services including shops, health services and other local services;
 - traveller stress; and
 - social capital, including community isolation, community facilities and community cohesion.

1.3 Health determinants scoped out of the HIA

- 1.3.1 Below is a description of the health determinants that have been scoped out of the HIA, based on consideration of the potential health effects resulting from the Proposed Scheme.

Occupational health and safety

- 1.3.2 The potential impacts on construction workers' health and safety whilst working on the project are not assessed within the HIA. HS2 will prepare a Health and Safety Plan for the Proposed Scheme which will include actions to ensure all relevant health and safety issues are addressed.

Electromagnetic field impacts

- 1.3.3 Since potential electromagnetic effects can be 'designed out' of the Proposed Scheme, specific assessment was not required as part of the EIA and has been scoped out of the HIA.

- 1.3.4 High voltage electrical equipment creates electromagnetic fields (EMF), which can potentially have implications for human health and may cause electromagnetic interference (EMI) to other electric/electronic equipment (e.g. communications) or infrastructure (e.g. power lines).
- 1.3.5 The main potential source of EMI associated with the Proposed Scheme will be the traction power system, comprising the OLE along the route and supporting infrastructure such as feeder stations. In addition, the railway communications system will generate radio signals.
- 1.3.6 Electromagnetic fields extend over relatively short distances. On the assumption that acceptable levels are achieved on the railway itself, any residual risk to nearby receptors (e.g. residential properties, businesses or communications infrastructure) will be insignificant.
- 1.3.7 Equipment used during construction of the Proposed Scheme will also comply with applicable standards for EMF and EMC. Assuming that this equipment is installed, operated and maintained correctly, levels of electromagnetic emissions are unlikely to exceed the acceptable limits for workers or the public, or to cause EMI. Power supplies used for construction are generally insufficient to cause any significant EMI.

Ground contamination

- 1.3.8 The potential effects of ground contamination on construction workers on site will be dealt with through occupational health and safety procedures, which are outside the scope of this HIA. The current baseline and the post-construction ground conditions are likely to be similar. There may be improvements to ground conditions due to remediation of contaminated land in some locations. The risk to public health of ground contamination arising from the Proposed Scheme is considered to be negligible and this determinant has therefore been scoped out of the HIA.

Groundwater quality

- 1.3.9 The Proposed Scheme crosses potable aquifers and some of the proposed works may have the potential to penetrate the aquifer and/or mobilise contaminants that could affect water quality. However, these effects are avoidable through appropriate site investigations, design and construction control measures that will be incorporated into the scheme. Groundwater quality is regulated by the Environment Agency and the project has a legal requirement to ensure that no contamination of aquifers results from the proposed works. The risk to public health of groundwater contamination arising from the Proposed Scheme is considered to be negligible and therefore this determinant has been scoped out of the HIA.

Contents

HS2 Health Impact Assessment Report	1
Appendix 3- Consultation and engagement	1
1 Consultation and engagement	3
1.2 Review of High Speed Rail: Investing in Britain's Future	3
1.3 HIA stakeholder engagement	6
1.4 Review of consultation on the draft Environmental Statement (ES)	10

HS2 Health Impact Assessment Report

Appendix 3- Consultation and engagement

1 Consultation and engagement

- 1.1.1 This section provides a summary of health related information and issues which have been highlighted during various HS2 public consultation and engagement exercises. A systematic review of the consultation responses has been undertaken to inform the HIA. This exercise has pulled out key stakeholder concerns relating to the determinants of human health that are assessed in this HIA.

1.2 Review of High Speed Rail: Investing in Britain's Future

Background

- 1.2.1 The Government launched its review on High Speed Rail: Investing in Britain's Future and its supporting documents on the 28th February 2011. The consultation period ended on the 29th July 2011. The suite of documents consulted on included: High Speed Rail: Investing in Britain's Future; Economic Case for HS2: The Y Network and London – West Midlands; HS2 London to the West Midlands – Appraisal of Sustainability.

- 1.2.2 Views were sought from consultees on:

- the economic case for rail capacity and performance improvement;
- the economic case for a high speed rail link from London to Birmingham, Leeds and Manchester;
- the desirability of the proposed staggered approach to the delivery of a national high speed rail network, inclusive of links to Heathrow Airport and High Speed One;
- the principles and specification used and the route selection process employed in the development of proposals for high speed rail;
- the route selected between London and the West Midlands and the approach proposed for mitigating impacts;
- the Appraisal of Sustainability; and
- the compensation options outlined for those whose properties would be devalued by a new high speed rail line.

Route-wide effects

Employment and economy

- 1.2.3 Respondents along the route raised concerns about loss of land and/or buildings and the resulting impact on business profitability and viability. Land severance reducing agribusiness profitability and operability was a central concern, as was land severance separating businesses from local markets.
- 1.2.4 It was also noted that business viability may be affected in ways that do not relate to land-take, including: road closures and other impacts on local transport infrastructure

affecting business accessibility; effects of noise, vibration and air pollution on business premises; reduction in tourist numbers.

- 1.2.5 Other economic and employment issues raised included: mismatches between jobs arising as a result of HS2 and local skill-sets, preventing local people from benefitting from employment; impacts on local property rental markets; and the potential for planning blight to undermine other proposed development projects and regeneration strategies.
- 1.2.6 At the national level, respondents were concerned about the possibility of an exacerbation of the 'North-South' divide and a migration of businesses away from settlements not connected by HS2.

Housing

- 1.2.7 A particularly common concern related to property blight arising from both construction and operation of HS2, and the financial and emotional impacts of reductions in housing prices and the economic potential of development sites. Homeowners feared they may find themselves unable to re-mortgage due to blight. Also of great concern was the prospect of compulsory purchase of properties along the route, particularly with regard to local authority owned housing. Concerns that construction and operation of HS2 may undermine the structural integrity and thus safety of buildings were also voiced.
- 1.2.8 With regards to relocation, concerns were raised about health impacts relating to: loss of connections to school, family and work; a negative effect on those in a community who are not relocated (i.e. 'left behind'); and uncertainty around the location of replacement housing. There was also concern that displaced individuals may not be able to afford to re-buy in their local area.

Social capital

- 1.2.9 Consultees were apprehensive about the potential for the construction and operation of a high speed line to physically sever communities. Concerns were also raised about the capacity for HS2 to alter the composition of communities, through the need for relocation of people and businesses. Disruption to or loss of key community facilities such as community halls, leisure facilities and open spaces, was a key concern. It was also suggested that HS2 could precipitate increased crime rates around construction sites.

Noise and air quality

- 1.2.10 The potential for dust and other pollutants to impact on residents and schools during construction and operation was raised by respondents. Concerns around the noise and vibration arising from HS2 during construction and operation were raised, namely with regards to: the ability of residents to carry on living comfortably in their homes and gardens; the continued suitability of school sites; the quality of public open spaces; and the viability of particular business and healthcare (e.g. residential care home) venues.

Local environment and physical activity

- 1.2.11 Respondents raised several examples of open spaces that may be subjected to land take and/or disruption during construction and/or operation of HS2. Decreased usability of footpaths and other public rights of way (e.g. cycle paths) was also a central concern. Moreover, concerns around the fate of various outdoor recreational sites (e.g. sports pitches) and centres (e.g. outdoor activity centres) were also voiced.

Access to services

- 1.2.12 It was noted by respondents that the viability of particular services could be impacted where they experience fluctuations in demand as a result of HS2 (e.g. reduction during construction and increase during operation). It was also suggested that blight arising from HS2 may hinder public service upgrades (e.g. to schools). Another key concern of respondents related to HS2's capacity to impact buildings central to the delivery of services (e.g. tenant's halls). Lastly, disruption of local transport networks during construction was linked to possible reductions in the accessibility of services.

Traffic and transport

- 1.2.13 Respondents commented on the potential for HS2 to result in a reduction in frequency and reliability of 'classic rail' services. Of particular concern was the potential for disruption to stations and in-situ transport routes and services (e.g. strategic road network, public rights of way). Congestion of transport networks in settlements with HS2 stations was also raised.

Location-specific effects

- 1.2.14 Although not intended to be exhaustive, the following paragraphs provide information on area-specific concerns raised repeatedly by stakeholders.
- Euston station faces up to ten years of disruption to transport services during construction, under HS2 proposals.
 - Camden residents and services (e.g. Maria Fidelis School) may experience considerable impacts, including loss of homes, involuntary relocation, loss of local authority owned housing and disruption during construction.
 - the Chilterns Area of Outstanding Natural Beauty (AONB) faces considerable disruption and adverse change under HS2 proposals.
 - in rural areas, the usability of numerous public rights of way may be impacted by HS2.
 - settlements (e.g. Coventry) in the vicinity of the HS2 route that are not provided with a station may find their 'classic rail' commuter services operating at a decreased frequency and at a slower rate, as well as finding themselves at an economic disadvantage compared with settlements that are provided with an HS2 station.

1.3 HIA stakeholder engagement

Purpose of the stakeholder engagement

- 1.3.1 To inform the scope of the HIA, a stakeholder engagement exercise was undertaken with public health officials along the route of HS2, including the relevant Local and Regional Directors of Public Health and the Public Health Observatories. The engagement took the form of written correspondence. Health professionals were asked to comment on the following issues in their areas:

- key health issues and challenges;
- key opportunities for health improvement;
- identification of vulnerable communities and health inequality issues;
- key policy objectives related to health, and health improvement agendas;
- sources of baseline data to inform the baseline health profiles; and
- health issues to consider in relation to the design, construction and operation of HS2.

Outcomes of the stakeholder engagement

London Metropolitan, Euston Station and Old Oak Common

- 1.3.2 Of the seven local authorities in this study area, one (Ealing Council) responded. It should be noted that engagement took place prior to the announcement that much of the route in this area will be placed in bored tunnel.
- 1.3.3 Ealing Council identified that health inequalities were a significant issue in their area. In addition, other health priorities identified included older people's health, residents with long term health conditions, mental health, child health and alcohol.
- 1.3.4 Other key concerns and vulnerabilities raised by Ealing, specifically in relation to the development of HS2 included:
- concerns about increasing health inequalities for the most vulnerable groups; and
 - concerns about the number of suicidal behaviour incidents that occur at the rail and tube stations within the borough.
- 1.3.5 In terms of potential benefits, respondents identified possible opportunities for employment during the construction and operational phases, along with improved transport links to Birmingham (the Old Oak Common Interchange station lies just across the borough boundary in Hammersmith and Fulham).

Country South

- 1.3.6 Of the four county councils in this area, one (Buckinghamshire County Council) responded. A response was also received from the Director of Public Health for East Midlands.

- 1.3.7 Buckinghamshire County Council, which covers the affected district councils of Aylesbury Vale District Council, Chiltern District Council and South Buckinghamshire District Council, identified the following key health issues and challenges related to the development of HS2:
- mental health and wellbeing issues arising from concerns and uncertainty over the impact of HS2 on house prices, and potential compensation;
 - potential for blight during the construction and operational phases with impacts on health and wellbeing, through changes to physical activity and contact with the unspoilt natural environment. Noise from trains is a key local concern, particularly where mitigating actions are more difficult, for example on flat ground around Stoke Mandeville and on the proposed viaduct for Wendover;
 - community severance as a result of temporary and permanent interruptions to public rights of way, footpaths and roads;
 - disruption to communities during construction from noise, vibration, dust, air pollution, traffic congestion, and access to services/amenities; and
 - impact of works related traffic on the local road network. There may be an increased risk of pedestrian, cyclist and road accidents, either from construction traffic or increased traffic on other routes.
- 1.3.8 There are existing health inequalities in the area, with the Council identifying that small areas fairly near to the route are within the 30% most deprived areas nationally, and most deprived in Bucks. These areas already have poorer health outcomes across a range of indicators. Potential to widen the disadvantage in these areas, particularly through impact on mental wellbeing.
- 1.3.9 Vulnerable groups in the area include:
- residents of Aylesbury, especially Quarrendon, Coldharbour, Southcourt and Gatehouse wards, which fall within the 30% most deprived areas nationally, and most deprived in Buckinghamshire;
 - isolated rural communities and single pensioner households, as there is the potential for increased social isolation and reduced access to services during the construction phase. Single pensioners, people with disabilities, and families with young children are particularly vulnerable; and
 - in terms of opportunities for health benefits, Buckinghamshire County Council saw opportunities being limited by the fact that there are no station stops within the county. However, the Council identified possible opportunities for employment during the construction phase.

Country North

- 1.3.10 Extensive responses were provided by both Staffordshire Council and Warwickshire County Council. Responses were also received from the Regional Director of Public Health for the West Midlands and the West Midlands HIA Gateway.

- 1.3.11 Key issues and potential health impacts raised by stakeholders included:
- mental health impacts, including both individual and society health;
 - impacts of loss of green space and public rights of way on physical activity and obesity;
 - construction impacts, including disruption to rural routes, noise and disturbance impacts, air pollution;
 - increase in accidental deaths on the new lines and during the construction/road works;
 - residential displacement and the effects of separating communities;
 - access and accessibility issues, both for station and during construction; and
 - health equity issues.
- 1.3.12 Vulnerable groups identified in the study area included:
- isolated rural communities, and particularly the elderly, young families and people with physical and/or mental learning disabilities in these communities; and
 - schoolchildren - the planned route will run parallel to Water Orton Primary School and Burton Green Church of England (Assisted).
- 1.3.13 Both authorities saw opportunities for health improvement being limited as there are no station stops within the study area. However, Warwickshire County Council identified that the scheme may bring about some reduction in traffic on the roads as a result of improved travel opportunities for those travelling between London and Birmingham, with associated air quality improvement.
- 1.3.14 Staffordshire County Council identified that the proposals may bring about a potential boost to the local economy from local construction jobs and spending by construction workers in the area.
- 1.3.15 Staffordshire also suggested that there was the potential for the scheme to bring about added benefits to the local community if money was put towards improvements to the local environment (footpaths, cycle route and green spaces) and funding for other community infrastructure that may increase physical activity and wellbeing.
- West Midlands and Curzon Street Station*
- 1.3.16 Responses were received from Birmingham City Council and Solihull Metropolitan Borough Council. A response was also received from the West Midlands HIA Gateway. Responses from the Regional Director for Public Health and the West Midlands Public Health Observatory referred back to the response from the West Midlands HIA Gateway.
- 1.3.17 Current health issues for the Birmingham City area were identified as:

- high rates of chronic obstructive pulmonary disease (COPD);
- high rates of childhood obesity, associated with a lack of open, green spaces;
- high rates of early death from accidents; and
- high levels of unemployment and worklessness.

1.3.18 General health issues identified by Solihull Metropolitan Borough Council included:

- inequalities in health, particularly in areas of deprivation, including unhealthy lifestyles, shorter life expectancy and increasing long term conditions (especially in older people);
- lack of opportunities for people not in employment, education or training;

1.3.19 Health issues specific to the development and running of the line, identified by Solihull Metropolitan Borough Council, included:

- construction traffic: safety, noise and air pollution, impacts on pedestrians and cyclists;
- noise and vibration from new roadway infrastructure, construction activities, normal running of the service and maintenance; and
- other environmental quality issues: increase in particulates during construction, from normal running of the service and also from increased traffic and car parking; increase in light pollution; loss or fragmentation of urban and rural green space and countryside.

1.3.20 Vulnerable groups and areas identified include:

- large Black and Minority Ethnic (BME) community in Hodge Hill, Washwood Heath and Nechells, with a high prevalence of diabetes and vulnerability to cardiovascular disease, coronary heart disease and stroke;
- pockets of deprivation along the route including areas around Washwood Heath that fall within the 10% most deprived in the country. These communities are more vulnerable to mental health problems such as respiratory disease and cardiovascular disease;
- areas with a high proportion of children such as Washwood Heath, Hodge Hill and Nechells, with high numbers of admissions for childhood asthma; and
- Chelmsley Wood, which is an area of deprivation.

1.3.21 Both local authorities identified opportunities for training and employment associated with construction of the route. This included both direct and indirect opportunities.

1.3.22 Opportunities to improve or contribute to community assets were also identified by both authorities. Suggestions included regeneration, development of green spaces and development of safe accessible transport routes. Opportunities to improve access were also identified, with recognition of the benefits to health of improved access to services and improved accessibility to employment opportunities.

1.4 Review of consultation on the draft Environmental Statement (ES)

Background and purpose

1.4.1 On 16th May 2013 the Secretary of State for Transport launched the consultation on the draft Environmental Statement for Phase One of HS2 between London and the West Midlands. The consultation closed on 11th July 2013. The suite of documents consulted on included:

- Non-Technical Summary;
- Volume 1: Draft ES Overview;
- Community Forum Area Reports (1-26);
- Report 27: Route-wide effects;
- Draft Code of Construction Practice;
- Sustainability Policy; and
- Plan and Profile maps.

1.4.2 A systematic review of the consultation responses was undertaken by a third party and, where appropriate, any issues were addressed in the preparation of the final Environmental Statement documents. As the HIA is not a statutory requirement and does not form part of the Hybrid bill the HIA was not amongst the suite of the documents consulted on, however a number of issues and concerns raised by stakeholders during the consultation process were relevant to the HIA. A high level summary of the concerns raised by stakeholders is provided below.

Outcomes of the stakeholder engagement

General issues

1.4.3 Many respondents highlighted issues of stress and anxiety within the affected communities, caused by the proposed construction and operation of HS2. Impacts on housing, local amenity, access, community severance and impacts of the construction workforce were identified as particular causes of anxiety. It was also noted that stress and anxiety is considered to already have been caused by the Proposed Scheme.

Employment and economy

1.4.4 Concerns were raised about the potential impacts of job losses, particularly in rural communities where losses may be more significant due to restricted access to alternative employment, in some sectors. Concerns were raised that job loss could lead to a range of issues including mental health issues, debt, increased alcohol consumption and associated ill health.

Housing

- 1.4.5 Concerns were raised with regard to residents losing their long-term homes and facing blight, as well as residents suffering distress concerning the proximity of the Proposed Scheme to properties.
- 1.4.6 Other concerns relating to housing included impacts on amenity value, resulting in reduced enjoyment of indoor and outdoor areas of the home, and possible health effects from increased noise and dust in the home.

Noise, vibration and air quality

- 1.4.7 Multiple stakeholders expressed concerns about potential noise and vibration impacts during construction and operation of the Proposed Scheme and in particular the potential effects on physical and mental health from sleep disturbance.
- 1.4.8 Impacts of noise and vibration on particularly sensitive receptors, including educational facilities such as schools and nurseries, residential properties and health care facilities such as hospitals, GP surgeries and care homes, were of particular concern within a number of communities.
- 1.4.9 The impact of construction traffic movements and construction activities on air quality was also raised as a potential concern.

Local environment and physical activity

- 1.4.10 Concerns were raised regarding effects on the local environment centred on the noise and visual impacts of the Proposed Scheme during operation, and the effects of increased traffic, visual intrusion, noise and dust during construction. A number of receptors were identified as being particularly vulnerable to noise and visual impacts, including schools in close proximity to the route.
- 1.4.11 Respondents commented on the potential degradation of landscape quality and the associated impacts on amenity value and recreational opportunities. There was concern that the benefits derived from the countryside, including the recreational opportunities and the contribution these benefits make to health and well-being, are not considered.

Access to services and healthcare

- 1.4.12 A common theme was the concern about potential impacts on access between communities and the impact this might have on local amenities, services and facilities, both during construction and operation. An example of this is at Burton Green in Warwickshire, where respondents were concerned about being isolated and severed from their communities and facilities.
- 1.4.13 Impacts on access for emergency services during construction due to road closures, diversions, increased journey times and the presence of construction vehicles on local roads was also raised as a concern. This was considered to be a particular concern for emergency services operating out of Stoke Mandeville Hospital in Buckinghamshire.
- 1.4.14 Concerns were raised about the potential impacts on healthcare and local amenities as a result of construction workers living in the local vicinity of small rural

communities. Wendover in Buckinghamshire was one such community that raised this as a concern.

Traffic and transport

- 1.4.15 Concerns were raised about construction traffic volumes and routes, with issues around road safety, congestion and delays to local traffic, and delays to public transport all highlighted. Coupled with this were concerns about the impact of road closures and diversions increasing severance, reducing access to community services and increasing journey distances and travel time.
- 1.4.16 Schoolchildren were identified as being particularly vulnerable to changes in traffic volumes, from a road safety perspective, particularly around schools and on narrow roads in rural communities.
- 1.4.17 There was also similar concern expressed by non-motorised travellers such as walkers, pedestrians, cyclists and equestrians who had concerns about altered routes and increased journey times. Certain groups, such as the elderly and the disabled, were considered to be particularly vulnerable to such changes.

Contents

HS2 Health Impact Assessment Report	1
Appendix 4 - Health evidence base	1
1 Introduction	2
2 Employment and economy	2
2.1 Employment	2
2.2 Income	3
2.3 Job security and job relocation	3
2.4 Training and skills	3
2.5 Vulnerable groups	3
3 Housing	4
3.1 Housing quality	4
3.2 Security of ownership, value and saleability	4
3.3 Involuntary and prompted relocation	4
3.4 Vulnerable groups	5
4 Noise	5
4.1 Overview of noise effects	5
4.2 Relative effects of transport noise sources	7
4.3 Annoyance	8
4.4 Sleep disturbance	12
4.5 Cardiovascular disease	15
4.6 Mental illness	16
4.7 Cognitive impairment in schoolchildren	16
4.8 Vibration	18
4.9 Combined effects of noise and vibration	19
4.10 Construction noise and vibration	20
5 Air quality	21
5.2 Dust	21
5.3 Road traffic emissions	21

5.4	PM ₁₀	21
5.5	Nitrogen dioxide (NO ₂)	22
5.6	Ozone (O ₃)	22
5.7	Air pollution links to deprivation	23
5.8	Vulnerable groups	23
6	Local environment	24
6.1	Green space and contact with nature	24
6.2	Landscape, townscape and visual issues	24
6.3	Crime	25
6.4	Vulnerable groups	26
7	Physical activity	26
7.1	Environmental influences on physical activity	26
7.2	Physical health effects	27
7.3	Mental health effects	27
7.4	Vulnerable groups	28
8	Access to services	28
8.2	Healthcare	28
8.3	Shops	29
8.4	Leisure, faith, culture and recreational facilities	29
8.5	Vulnerable groups	29
9	Transport	29
9.2	User experience	29
9.3	Accessibility of stations	30
9.4	Road safety	30
10	Social capital	30
10.2	Community consistency	31
10.3	Crime	31
10.4	Vulnerable groups	31
11	Vulnerable groups	31
11.2	Overview of vulnerable groups	32
11.3	Older people	32
11.4	Children and adolescents	32
11.5	Disabled people and long-term illness sufferers	32
11.6	Low income/lower socio-economic groups	33
11.7	Minority ethnic groups	33

HS2 Health Impact Assessment Report

Appendix 4 - Health evidence base

1 Introduction

- 1.1.1 This appendix provides a summary of key research evidence, drawn from recently published literature reviews, research papers and policy documents that suggest the links between health determinants and potential health outcomes. The information presented in this appendix underpins the assessment of health effects within the HS2 HIA report.

2 Employment and economy

2.1 Employment

- 2.1.1 Evidence for the links between employment and health is most commonly focused on the negative impacts of unemployment, although this can be used to infer the positive impacts associated with gaining employment.
- 2.1.2 The Marmot Review (2010)¹, which was commissioned by the Department of Health to look into health inequalities in England, looks at the differences in health and wellbeing between social groups. The report 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'.
- 2.1.3 The London Health Commission's report Health in London: Review of the London Health Strategy High Level Indicators (2005)² describes unemployment as: 'a significant risk factor for poor physical and 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'.
- 2.1.4 Employment is related to social and psychological wellbeing; a study commissioned by the Department of Work and Pensions³ 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'.
- 2.1.5 As acknowledged in a National Health Service (NHS) evidence review on the causal relationship between worklessness and health⁴, the relationship is complex and 'confounded by other variables such as educational attainment, the environment and economic circumstances'.

¹ 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

² Greater London Authority, 2005, Health in London: Review of the London Health Strategy High Level Indicators, London Health Commission

³ Waddell, G., Burton, A. K., 2007, Is work good for your health and well-being?, The Stationery Office

⁴ Mclean. C., Carmona.C, Francis.S, Wohlgemuth. C. and Mulvihill. C., 2005, Worklessness and health – what do we know about the causal relationship? Evidence review, NHS Health Development Agency

2.2 Income

- 2.2.1 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 well-being 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'.

2.3 Job security and job relocation

- 2.3.1 The Marmot review highlights that, for the health benefits of employment to be realised, jobs must be secure: 'Insecure and poor quality employment is [also] associated with increased risks of poor physical and mental health. There is a graded relationship between a person's status at work and how much control and support they have there. These factors, in turn, have biological effects and are related to increased risk of ill-health'.
- 2.3.2 Involuntary or prompted job relocation, as well as causing financial concerns, can impact on people's home and family lives. Research has found that 'those who relocate initially experience two varieties of stress: operational stress, resulting from the new job and setting-up activities in the new community, and emotional stress resulting from family-related activities. It was found that those who relocate for work often face forced self-reliance, a lack of family support, and an increase in family demands, although the overall stress was reduced for persons taking white-collar or professional positions because of employer assistance. It was found that much of the initial stress dissipated with time...'⁵

2.4 Training and skills

- 2.4.1 The Marmot review highlights the links between inequalities in educational outcomes and physical and mental health, and identifies 'Reducing the social gradient in skills and qualifications' as a priority objective to reduce health inequalities. The main routes by which education affects health are identified in the review as employment, income, living standards and behaviours. The review makes policy recommendations including increasing lifelong learning opportunities, including work-based learning, to improve health outcomes.

2.5 Vulnerable groups

- 2.5.1 Unemployment leads to adverse circumstances such as increased deprivation and isolation, which in turn can increase vulnerability to a wide variety of health effects.
- 2.5.2 Certain groups such as older people and disabled people may be more vulnerable to job losses, as these people may face greater difficulty in finding alternative employment.
- 2.5.3 Temporary workers are more likely to experience poor self-reported health, erosion of Occupational Safety and Health (OSH) procedures and strategies, psychological ill health associated with job insecurity, higher rates of job dissatisfaction, less access to training and worse working conditions.

⁵ Riemer, J. W., 2000, Job Relocation, source of stress and sense of home, Community, Work and Family, 3(2): 205–217. Abstract accessed via <http://www.tandfonline.com/doi/abs/10.1080/713658901?journalCode=ccwf20>

3 Housing

3.1 Housing quality

- 3.1.1 Housing quality affects both physical and mental health. WHO research⁶ has shown 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'.

3.2 Security of ownership, value and saleability

- 3.2.1 Housing security provides financial and social stability, and the WHO study has identified links between secure home ownership and health: 'financially secure home ownership has been linked to improved health, which may be due to better housing quality and feelings of security⁶.

3.3 Involuntary and prompted relocation

- 3.3.1 Involuntary or prompted relocation of people from their homes has been shown to play a determinative role in health outcomes. Disturbance to people's living and social environment and routine may precipitate stress and health deterioration in relocated individuals⁷.
- 3.3.2 Moving house involves significant disruption, uncertainty and changes to social networks and familiar environments and routines. Thomson et al, 2003⁸ undertook a systematic review of evidence on health outcomes associated with housing interventions, including the effects of moving and relocation. This identified that 'moving house is considered to be a stressful, health damaging life-event'. In the case of social housing this has been attributed to a 'lack of opportunity to negotiate with the housing authority regarding control around the move'.
- 3.3.3 Research into elderly people's experiences of forced relocation has identified a variety of emotional experiences, including loss of trust and feelings of insecurity, reduced sense of belonging, powerlessness and stress⁹. In the extreme, relocation has been implicated in increased mortality in highly vulnerable persons, such as the institutionalised elderly⁷.
- 3.3.4 While the majority of health outcomes associated with involuntary relocation are reported as negative, there may be potential for health benefits in some cases, for example by upgrading to a newer property with better standards of design, heating, security, or local facilities.

6 Thomson, H. and Petticrew, M., 2005, Is housing improvement a potential health improvement strategy, World Health Organisation Europe

7 Heller, T., 1982, The Effects of Involuntary Residential Relocation: A Review, American Journal of Community Psychology, 10 (4): 471-492, cited in BAA, 2008, The G2 Project: A Health Impact Assessment, Annex A. HIA Gateway, West Midlands Public Health Observatory

8 Thomson, H., Petticrew, M and Douglas, M., 2003, Health impact assessment of housing improvements: incorporating research evidence

9 Ekstrom, M. 1994, Elderly people's experiences of housing renewal and forced relocation: Social theories and contextual analysis in explanations of emotional experiences, Housing Studies, 9 (3): 369-391. Abstract accessed via <http://www.tandfonline.com/doi/abs/10.1080/02673039408720793?journalCode=chos20>

3.4 Vulnerable groups

- 3.4.1 Not all individuals are likely to be impacted by involuntary relocation in the same way or to the same degree. Age, income, physical health and disability are examples of factors that may influence the degree of impact from relocation.
- 3.4.2 For those living in social housing, the impact of moving house, which is considered to be a stressful, health damaging life-event, can be compounded by a lack of opportunity to negotiate with the housing authority regarding control of the move.

4 Noise

4.1 Overview of noise effects

- 4.1.1 Sound is produced by mechanical disturbance propagated as a wave motion in air or other media. Noise is unwanted sound. According to the World Health Organisation, 'In some situations, but not always, noise may adversely affect the health and well-being of individuals or populations'¹⁰. More recently, the World Health Organisation has stated that 'Environmental noise is a threat to public health, having negative impacts on human health and well-being'¹¹.
- 4.1.2 Hearing loss does not occur from typical exposure to environmental noise, it is more commonly associated with occupational exposure to much higher noise levels. In the everyday environment, the response of an individual to both sound and noise is more likely to be behavioural or psychological (i.e. non-auditory) than physiological. There are a wide range of non-auditory health effects that may be associated with exposure to environmental noise, although the pathways, strength of association, and possible causal mechanisms for these are not fully understood. Examples of non-auditory health effects which have been linked to environmental noise include annoyance, sleep disturbance and other night time effects, cardiovascular and physiological effects, mental health effects, reduced performance, communication and learning effects.
- 4.1.3 Previous reviews of the links between everyday noise exposure and longer term health outcomes have proposed various conceptual "models" to try to simplify and describe the complexities of the subject and to help to design and improve future research. One such model that encompasses many of the known and suggested health outcomes is that proposed by Babisch in 2002¹² and updated in 2013¹³, reproduced here as Figure 1.

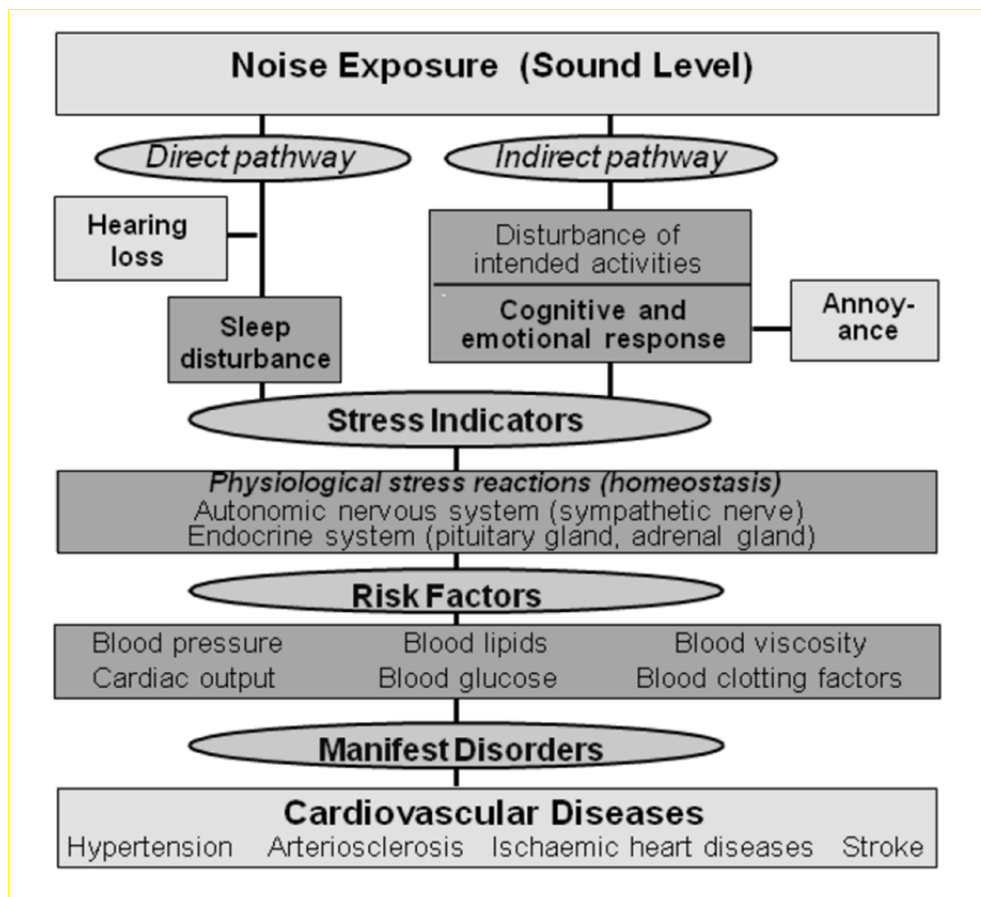
¹⁰ World Health Organisation (1995). Community Noise. Edited by B. Berglund & T. Lindvall

¹¹ World Health Organisation (2009). Night Noise guidelines for Europe

¹² Babisch W (2002). The noise/stress concept, risk assessment and research needs. Noise Health 4(16):1-11.

¹³ Babisch W (2013). Exposure-response curves of the association between transportation noise and cardiovascular diseases - an overview. First International Congress on Hygiene and Preventative Medicine, Belgrade, Serbia.

Figure 1: Noise effects model (after Babisch)



- 4.1.4 The Babisch model seeks to simplify the cause-effect chain (i.e. noise- annoyance- physiological arousal- biological risk factors- disease). This theoretical model initially differentiates between the direct (non-conscious) and indirect (conscious and subjective) effect pathways, but both are depicted acting through an intermediate stress reaction stage which then, depending on individual risk factors, may ultimately lead to disease outcomes. To quote Babisch¹⁴ 'Causality in epidemiology can never be proven. It is a gradual term of which evidence is increasing with increasing number of facts. However, the magnitude of effect, presence of dose-response relationship, consistency with other studies in different populations and with different methodology, and coherence (biological plausibility) are commonly accepted arguments for a causal relationship'.
- 4.1.5 The Government's Noise Policy Statement for England¹⁵ (NPSE) acknowledges that noise can affect people's quality of life and that there is emerging evidence linking noise with direct health effects. The NPSE clearly states the long term vision of Government noise policy which is 'to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development'.

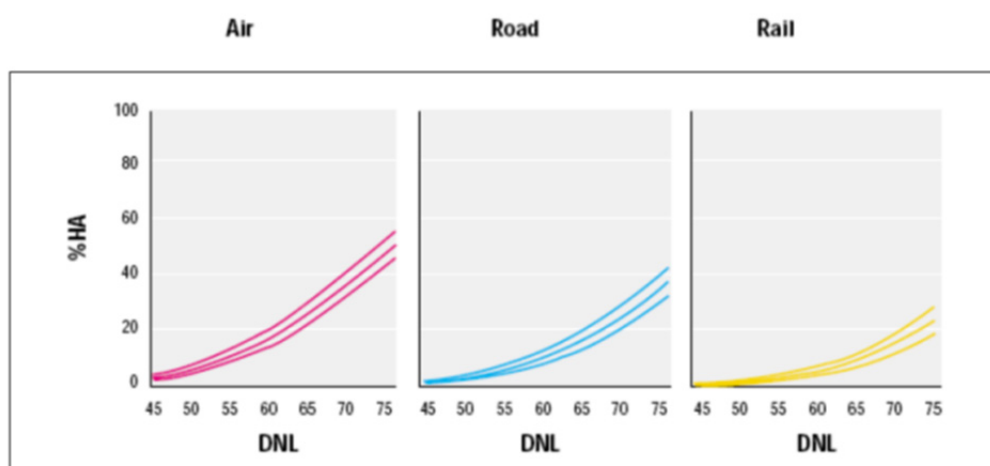
¹⁴ Babisch, W. (2006). Transportation Noise and Cardiovascular Risk - Review and Synthesis of Epidemiological Studies. Federal Environmental Agency, Germany.

¹⁵ Noise Policy Statement for England, Defra, March 2010

4.2 Relative effects of transport noise sources

- 4.2.1 The most common source of noise pollution in Europe is transport, and road traffic has been identified as being the major cause of human exposure to noise¹⁶. There is significantly more literature available on the health and wellbeing effects of road traffic noise and air transport noise than of conventional rail noise, and relatively little research on the effects of high speed rail noise.
- 4.2.2 Establishing exposure-response relationships for environmental noise can be problematic and subject to significant uncertainty. The effects of exposure vary between different types of noise source and are compounded by other environmental factors, as well as personal factors such as sensitivity, attitude and pre-existing health conditions. There is a great deal of variation between individual responses to noise, and variation between studies. Typically there is no threshold of effect but the effect increases slowly with increasing noise exposure.
- 4.2.3 Notwithstanding the variability between individual studies there have been 'meta-analyses' where the results of individual studies are combined. Figure 2 below is taken from the work of Miedema¹⁷ and subsequently formed the basis of the European Union Position Paper on exposure-response relationships between transport noise and annoyance¹⁸ as well as underpinning other key World Health Organisation¹⁹ and European Environment Agency²⁰ documents in this field. In Figure 2 the central curve in each case is the "mean curve", with the upper and lower curves indicating the uncertainty. The figure shows that, for a given noise level, the percentage of the community highly annoyed by rail noise is lower than that from the other transport sources. This finding is typical of such analyses which frequently find that individuals and communities report less annoyance for rail noise all other things being equal. However, there are no high speed railways included in the Miedema research dataset.

Figure 2: Example dose-response relationships - % highly annoyed v noise level (after Miedema and Oudshoorn)



¹⁶ World Health Organization. (2000) Transport, environment and health. WORLD HEALTH ORGANISATION Regional Publications, European Series. No.89, p9

¹⁷ H M E Miedema and H Vos. Exposure-response relationships for transportation noise, J. Acoust. Soc. Am. 104 (6), December 1998 3432-3445

¹⁸ European Communities (2002). Position paper on dose response relationships between transportation noise and annoyance. Luxembourg: Office for Official Publications of the European Communities. 2002. ISBN 92-894-3894-0, http://ec.europa.eu/environment/noise/pdf/noise_expert_network.pdf

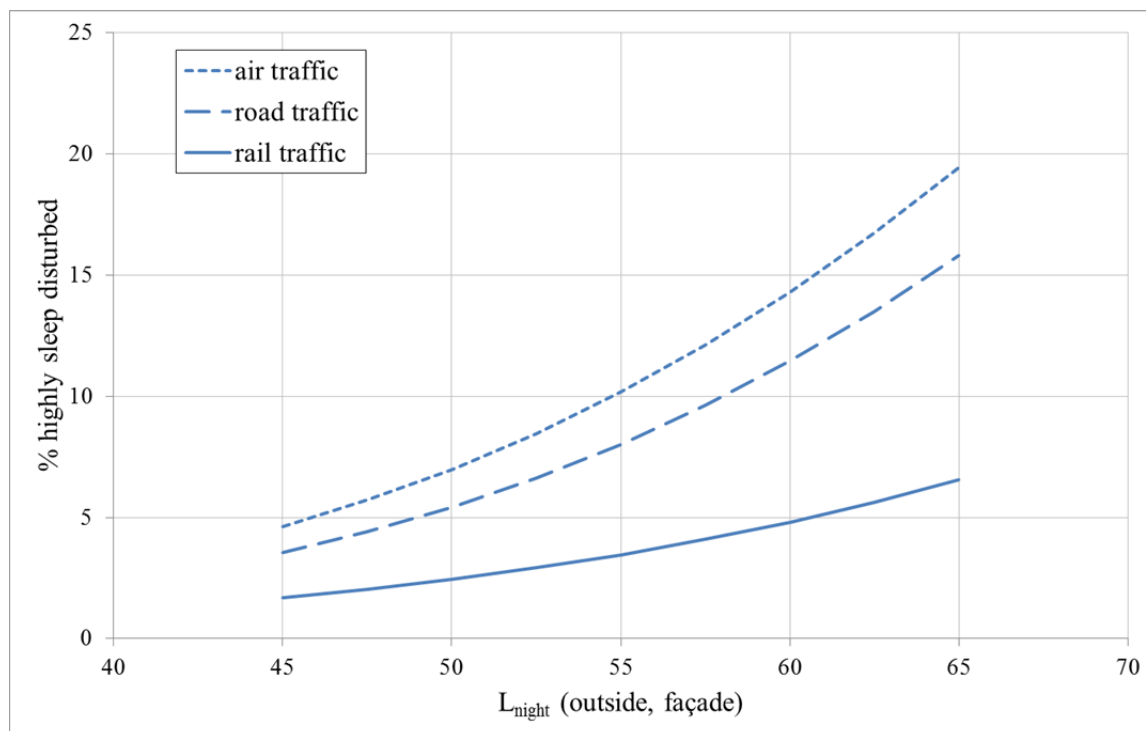
¹⁹ WORLD HEALTH ORGANISATION (2011), Burden of disease from environmental noise. Quantification of healthy life years lost in Europe.

²⁰ EEA (2010), Good practice guide on noise exposure and potential health effects, EEA Technical Report 11/2010.

4.2.4 The Government's Transport Analysis Guidance²¹ includes a 6dB differential between road and rail noise for equal levels of annoyance to take account of people's higher tolerance for rail noise. This effect is only observed at high noise levels so the differential is applied when daytime noise levels are above 60dB²². This is based on research undertaken up to 1991 (summarised in the Mitchell Committee's report²³), and is based on conventional rail noise.

4.2.5 There is no international consensus on the relative effects of road and rail noise on sleep disturbance, although studies undertaken in some European countries have suggested that the effects of road noise are greater than rail at a given noise level, leading to the higher admissible limits of night noise from rail in several countries²⁴. Figure 3 below shows exposure-response relationships for night time noise derived by Miedema and Vos²⁵ using data from 24 field studies - rail traffic noise gives rise to a lower level of self-reported sleep disturbance compared to other transport sources. None of the studies considered by Miedema and Vos included high speed railways.

Figure 3: Percentage highly disturbed by noise at night (after European Commission Working Group).



4.3 Annoyance

4.3.1 Annoyance is the most frequently reported problem caused by exposure to transport noise and is often the primary outcome used to evaluate the effect of noise on communities. There is some evidence that attitudes and opinions about some sources of transport noise may have been changing over the past twenty or thirty years. A widely cited example is a study on

²¹ <http://www.dft.gov.uk/webtag/> (2011)

²² Unless otherwise stated, quoted dB values for the daytime refer to the 16 hour daytime (07.00 to 23.00) equivalent continuous sound pressure level, L_{pAeq,16hr}

²³ Department of Transport (1991), Railway Noise and Insulation of Dwellings, Report of the Mitchell Committee, HMSO.

²⁴ Griefahn B, Schuemer-Kohrs A, Schuemer R, Moehler U, Mehnert P (2000) Physiological, subjective, and behavioural responses to noise from rail and road traffic. *Noise & Health* 3, 59-71

²⁵ H.M.E. Miedema & H. Vos (2007), Associations between self-reported sleep disturbance and environmental noise based on reanalyses of pooled data from 24 studies. *Behavioural Sleep Medicine*, 5(1), 1-20.

people's attitude to aircraft noise by Jansen et al.²⁶, who observed an increase in annoyance at a given level of aircraft noise exposure. There is, however, no equivalent study for conventional or high speed railway noise. On the other hand, there is some evidence from Grimwood et al.^{27 28} and Notley et al.²⁹ which suggests that people's attitude towards railway noise in the UK has not significantly changed since 1990. Notley reports the preliminary results emerging from the UK National Noise Attitude Survey undertaken during 2012 which indicate that around 30% of those who hear road traffic noise report being moderately, very or extremely bothered, annoyed or disturbed whereas about 2% of those who hear noise from trains or railway stations (albeit a much smaller sample in the study) report this same level of moderate, very or extreme disturbance.

- 4.3.2 The research on noise annoyance from high speed trains is relatively recent and a review paper by Fenech et al.³⁰ reports significant variability between studies. No evidence was found that the different spectral content of high speed train sound might affect annoyance. Studies report no difference in noise annoyance between traditional and high speed rail for the same timetable frequency³¹. In contrast, earlier studies from Japan report higher levels of annoyance than the Miedema synthesis curves predict, particularly amongst respondents living very close to high speed railways, although a higher level of annoyance response was also seen in other studies from China and Korea for people living very close to conventional railways. More recent studies from Japan have shown that annoyance from Shinkansen schemes with appropriate noise and vibration mitigation measures is comparable to that represented by the Miedema curve³². These findings are reproduced in Figure 4.

²⁶ S. Janssen, H. Vos, A. Eisses & E. Pedersen (2011), Trends in aircraft noise annoyance. *J. Acoust. Soc. Am.* 129 (4), pp 3746-3753

²⁷ C. Grimwood, C. Skinner, & G. Raw (2005), The UK Noise Climate 1990-2001: Population Exposure and Attitudes to Environmental Noise, *Applied Acoustics* Vol 66 (2) pp231-243

²⁸ C. Grimwood, C. Skinner & G. Raw (2002), The UK national noise attitude survey 1999/2000. Noise Forum Conference. <http://www.bre.co.uk/pdf/NAS.pdf>

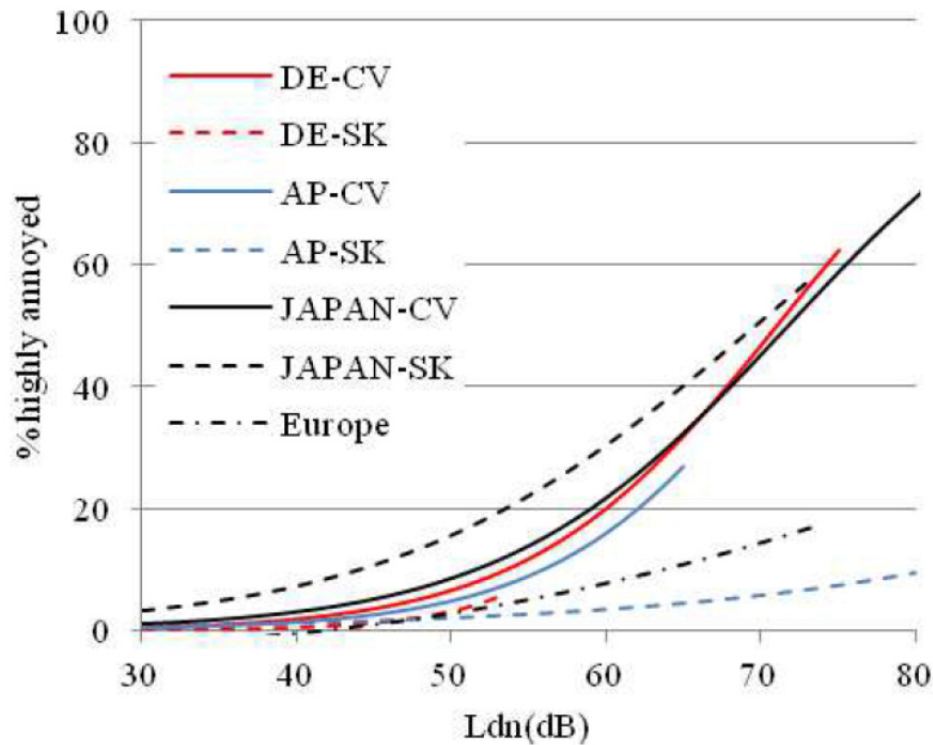
²⁹ H. Notley, C. Grimwood, G. Raw, C. Clark, R. Van de Kerckhove & G. Zepidou (2013), The UK national noise attitude survey 2012 - the sample, analysis and some results. *Proc. Internoise 2013*.

³⁰ B. Fenech, C. Cobbing, R. Greer & T. Marshall (2013), Health effects from high-speed railway noise - a literature review, *Proc Internoise 2013*

³¹ D. Botteldooren, B. De Coensel, T De Muer (2005). Experimental investigation of noise annoyance caused by high speed trains. *Proc. 12th International Congress on Sound & Vibration*

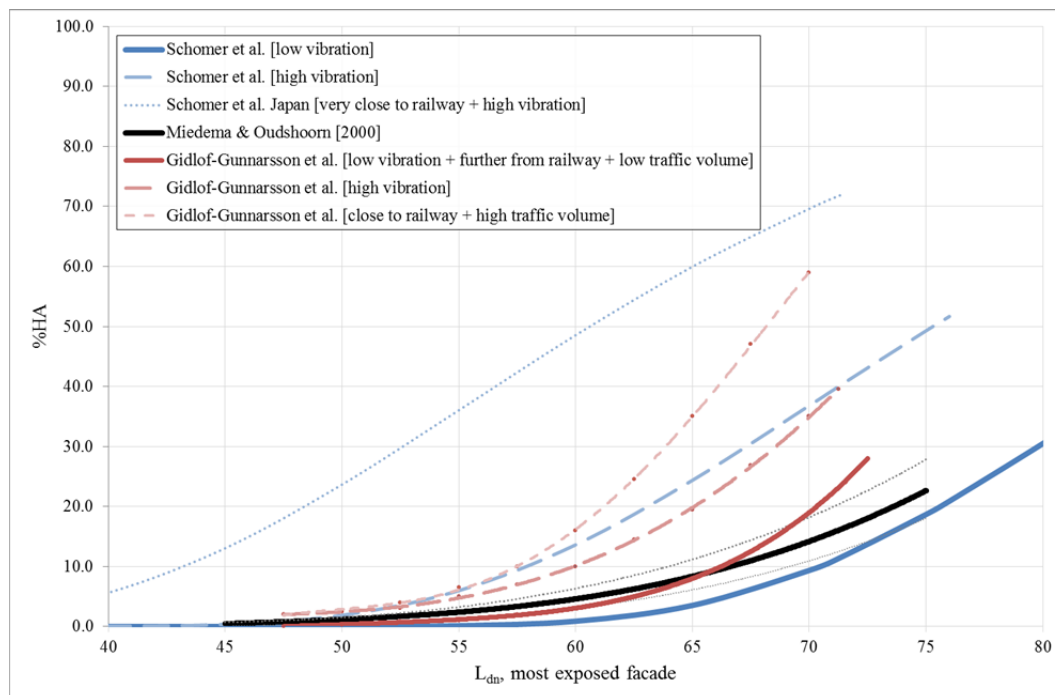
³² S. Oka, Y. Murakami, H. Tetsuya, T. Yano (2013), Community response to a step change in railway noise and vibration exposures by the opening of a new Shinkansen Line. *Internoise 2013*.

Figure 4 Comparison of exposure-response relationships for conventional railway (CV) and Shinkansen (SK) railway in Japan. The curves marked DE (detached houses) and AP (apartments) are from a recent study by Oka et al.³² carried out between 2008 and 2012. The curves marked Japan are average curves based on older datasets. The Europe curve represents the Miedema curve. After Oka et al.³²



4.3.3 The on-going research into noise annoyance from high speed rail suggests a number of modifying factors may be influencing response. These factors include distance from railway, onset rate, combined effects of noise and vibration, and number of train passbys (especially for people living very close to the railway). For new railway schemes there is also evidence that uncertainty about the future may increase annoyance whilst subsequent habituation with the changed situation may reduce annoyance. In one study in France 75% of the sample living close to TGV-Atlantique became accustomed to the noise within one year³⁰.

Figure 5 Comparison of exposure-response relationships for percentage of people highly annoyed (%HA), showing the modifying effect of vibration, distance to railway, and high traffic volumes to noise annoyance. After Fenech et al.³⁰



4.3.4 In generating their synthesis curves for annoyance that were subsequently used in the European Commission Position Paper, Miedema and Oudshoorn³³ acknowledge the uncertainty associated with the predictability of annoyance. They argue that properly established confidence intervals can be used to describe and account for the variation between individuals as well as the variation between studies. Although the number of studies which cover high speed rail is relatively small, there is nothing to suggest that response to noise will fall outside the applicability of the Miedema and Oudshoorn synthesis curves, provided that any modifying factors are accounted for. The levels of exposure and numbers of events associated with the Proposed Scheme are likely to fall within the range of exposures and numbers of events covered in their meta-analysis. It must be recognised that there is significant heterogeneity in the studies and possible factors which have been identified in the literature and which might be used to explain likely variability should be considered wherever possible.

4.3.5 A recently published study by Oka et al³⁴ reports a case study (in Kumamoto, Japan) of changes in community response to railway noise exposure caused by a shift from conventional express trains to "super-express" high speed trains on the Kyushu Shinkansen Line. The authors report that the noise and vibration exposures were almost the same before and after the shift but that community annoyance decreased after the opening. The authors suggest this may have been due to the inclusion (and related communication) of effective noise and vibration countermeasures in the scheme.

³³ H.M.E. Miedema & C.G.M. Oudshoorn (2000), Elements for a position paper on relationships between transportation noise and annoyance, TNO Report PG/VGZ/00.052

³⁴ S. Oka, Y. Murakami, H. Tetsuya, T. Yano (2013), Community response to a step change in railway noise and vibration exposures by the opening of a new Shinkansen Line, Proc Internoise 2013

4.4 Sleep disturbance

- 4.4.1 A World Health Organisation Report³⁵ cites numerous studies that detail the effects of transport noise on sleep. Studies have shown that noise can effect sleep in terms of immediate effects (e.g. arousal responses, sleep state changes, awakenings, body movements, total wake time, autonomic responses), after-effects (e.g. sleepiness, daytime performance, cognitive function) and long-term effects (e.g. self-reported chronic sleep disturbance). Sleep disturbances can be quantified either by subjective means or by monitoring physiological or behavioural awakenings. However, it is important to recognise that people are not conscious of their own bodies when asleep and studies^{36 37} have reported inconsistencies between the physiological effects of noise exposure (objective measures) and the subjects' perceived disturbance. At least one study³⁸ found no statistically significant relation between the subjective assessment of perceived sleep quality and noise data (whole night averages and single event levels). In fact, self-reported sleep disturbance is often considered to be a poor indicator of actual sleep disturbance and associated health effects. Nonetheless, self-reported sleep disturbance is an important indicator of community perception of night noise effects.
- 4.4.2 Miedema and Vos³⁹ have undertaken an updated meta-analysis of twenty eight datasets from twenty four field studies of self-reported sleep disturbance from transport noise using the outdoor Lnight noise indicator. The results confirm earlier findings that at the same average night time exposure levels, aircraft noise is associated with more sleep disturbance than road traffic noise, and road traffic noise is associated with more sleep disturbance than railway noise. Of the twenty eight datasets, five were for conventional railway noise and none were for high speed rail. This updated dataset is the best currently available for assessing self-reported sleep disturbance effects from land based transport noise.
- 4.4.3 As with the research on noise annoyance, studies from the Far East seem to show large deviations from the Miedema and Vos dose-response relationships. For example, one study⁴⁰ found that in Korea railway noise is associated with more sleep disturbance than road traffic noise. The authors suggest that this difference could be due to several factors including shorter distances between homes and the railway and consequent increased vibration, high proportion of freight and heavy diesel locomotives and cultural and situational differences between Korea and the countries covered by the Miedema dataset.
- 4.4.4 Over the last four to five decades a lot of research has been carried out into noise-induced sleep disturbance using objective techniques such as EEG and polysomnography. In 1982 Rice and Morgan⁴¹ published a synthesis of studies on noise-induced sleep disturbance, in which they concluded that: "Source specific noise disturbance of sleep may be expected to become

³⁵ World Health Organisation Europe (2009) Night Noise Guidelines for Europe.

³⁶ U. Moehler & L. Greven (2005), Community response to railway and road traffic noise - a review on German field studies. *Internoise 2005*.

³⁷ M. Basner, U. Müller, E-M. Elmenhorst (2011), Single and combined effects of air, road and rail traffic noise on sleep and recuperation, *SLEEP* 34(1):11-23.

³⁸ B. Griefahn, A. Schuemer-Kohrs, R. Schuemer, U. Moehler & P. Mehnert (2000), Physiological, subjective, and behavioural responses during sleep to noise from road and rail traffic. *Noise Health* 2000;3:59-71.

³⁹ H. Miedema & H. Vos (2007), Associations between self-reported sleep disturbance and environmental noise based on reanalyses of pooled data from 24 studies, *Behavioural Sleep Medicine* 5(1), pp 1-20.

⁴⁰ J. Hong, J. Kim, C. Lim, K. Kim, S. Lee (2010), The effects of long-term exposure to railway and road traffic noise on subjective sleep disturbance. *J. Acoust. Soc. Am.* 128(5):2829-2835.

⁴¹ C.G. Rice & P.A. Morgan (1982), A synthesis of studies on noise-induced sleep disturbance, *ISVR Memorandum No. 623*.

significant once the outdoor night-time (22:00-0700 hour) LAeq exceeds 55dB providing the peak levels do not exceed about 75-80 dB. Higher LAeq values up to 60dB may be allowed providing the peak levels do not exceed 85 dB(A), and the number of such events is less than about 20 per night. In this latter context, special account also needs to be taken of the 2200-2400 hour going-to-sleep period, when particularly noisy events should be avoided.” This conclusion was based on the best available studies at that time, and included data from social surveys, and laboratory and field studies using objective measures of awakenings (electroencephalograms (EEG)).

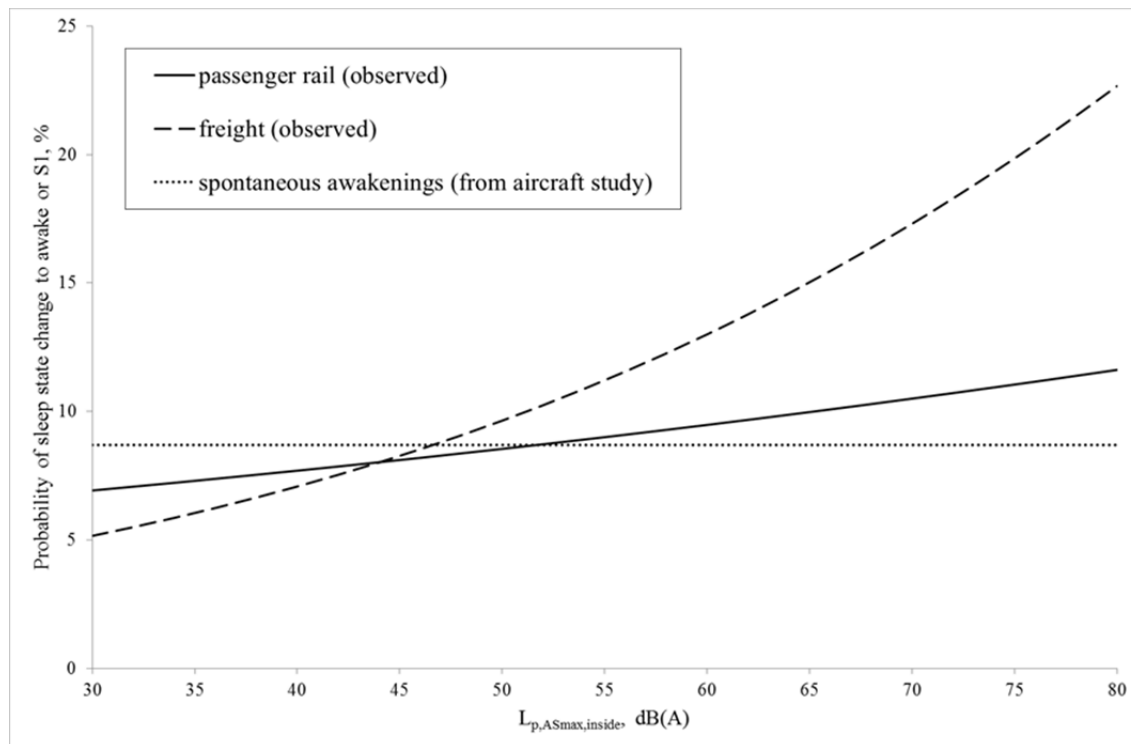
- 4.4.5 In 1992 findings from a study into aircraft noise and sleep disturbance commissioned by the Department of Transport were published⁴². The results suggested that below outdoor event levels of 90 dBA SEL (about 80 dB L_{Amax}), aircraft noise events are most unlikely to cause any increase in measured sleep disturbance from that which occurs naturally during normal sleep. For those events above this level, the average arousal rate was about 1 in 30, corresponding to a waking rate of about 1 in 75. This study used social survey methods together with actigraphy and EEG measurements on sub-groups of participants.
- 4.4.6 According to the European Environment Agency⁴³, the best quantitative insight into awakenings observed using polysomnography comes from research undertaken by the German Aerospace Centre (DLR) on aircraft noise. In a similar and related study, Elmenhorst et al⁴⁴ carried out a field study investigating railway noise using the same methodology as the DLR study. Thirty three subjects were included, making it the largest polysomnographic study on awakenings from railway noise events to date.
- 4.4.7 The reactions of sleeping humans to noise cannot be differentiated from spontaneous reactions using polysomnography. In the DLR aircraft noise study about 24 spontaneous awakenings on average were observed using electroencephalograms (EEG awakenings). The relationships shown in Figure 6 show the total number of observed EEG awakenings (combination of spontaneous awakenings and noise induced awakenings). The figure also shows the probability of spontaneous awakenings without the influence of noise (reproduced from the Basner aircraft noise study). Noise induced EEG awakenings are predicted when the probability of an awakening is greater than the probability of spontaneous awakenings i.e. when the curves showing probability of sleep state changes exceed the baseline. Elmenhorst et al. found that railway noise did not lead to prolonged sleep latencies or to impaired sleep efficiency compared to normal population values. Important reported modifying factors include the number and duration of train passbys; passby sound rise time (onset rate); distance to railway; and incidence of perceptible vibration. The results of the Elmenhorst study are considered to provide the best available objective evidence for the assessment of awakenings associated with night time train event noise.

⁴² J.B. Ollerhead et al. (1992), Report of a field study of aircraft noise and sleep disturbance, Department of Transport.

⁴³ EEA (2010), Good Practice Guide on noise exposure and potential health effects, EEA Technical Report 11/2010.

⁴⁴ E. Elmenhorst et al.(2012), Examining nocturnal railway noise and aircraft noise in the field: sleep, psychomotor performance and annoyance, Science of the total Environment, 424, pp 48-56.

Figure 6: Probability of EEG awakenings due to noise from railway noise (after Elmenhorst et al.)



4.4.8 The long term health consequences of noise induced EEG awakenings are not fully understood. There are some suggestions that humans may be able to adapt to a certain level of noise induced awakening without negative health consequences. In this context, it is necessary to consider the level of impact on sleep resulting from noise induced EEG awakenings in comparison to those that would naturally occur in the absence of noise. For example, one additional awakening per night is a value that has been suggested by Basner et al⁴⁵, and is currently used by the Leipzig/ Halle airport in Germany, to manage the risk of sleep disturbances associated with aircraft noise⁴⁶.

4.4.9 In particular, Basner et al recommended that:

- (1) On average there should be less than one additional EEG awakening induced by aircraft per night, and
- (2) Awakenings recalled the following morning should be prevented as much as possible, and
- (3) There should be no relevant impairment to the process of falling asleep again.

4.4.10 In order to prevent recalled awakenings Basner et al proposed that the maximum noise level⁴⁷ inside the bedroom should not exceed 65 dB. The impairment to the process of falling asleep again is suggested to be dependent upon the number of events and the time interval between events.

⁴⁵ M. Basner, A. Samel, U. Isermann (2006). Aircraft noise effects on sleep: Application of the results of a large polysomnographic field study. J Acoust. Soc. Am. 119(5) pp2772-84

⁴⁶ Leipzig/Halle Airport (2010). Current Noise Pollution Protection Programme.

⁴⁷ Quoted dB values for the maximum noise refer to the L_{pAmax} sound pressure level

- 4.4.11 Assuming a sound level difference between indoors and outdoors of 15dB (representative of a bedroom façade with a partially open window), the most recent findings by Basner and Elmenhorst are generally consistent with the findings by Rice and Morgan in the 1980s and the aircraft study in the 1990s.

4.5 Cardiovascular disease

- 4.5.1 It has been shown that long term exposure to road traffic noise may increase the risk of heart disease, which includes myocardial infarctions. Both road traffic noise and aircraft noise have also been shown to increase the risk of high blood pressure. It has been noted that there are few studies that exist regarding the cardiovascular effects of exposure to rail traffic noise⁴⁸.
- 4.5.2 Van Kempen and Babisch carried out an extensive review and synthesis of epidemiological studies in order to derive a quantitative exposure-response relationship between road traffic noise exposure and the prevalence of hypertension. An earlier review and synthesis of studies by Babisch identified only one study referring to railway noise, and this found no significant association between hypertension and people exposed to high levels of railway noise.
- 4.5.3 According to the recent literature review by Fenech et al⁴⁹, there have been three further relevant studies of conventional railway noise to date, one of which found a statistical (non-significant) association between railway noise and hypertension, and two of which found no such association. There are no reported studies that specifically investigate possible associations between cardiovascular disease and noise from high speed rail. It should also be borne in mind that hypertension is one of many risk factors for cardiovascular disease, other risk factors include genetic predisposition, age, sex, socio-economic status, lifestyle and risk taking behaviour. Exposure to air pollutions may also be a relevant factor. Studies to date have not clarified whether noise exposure during the day or night (or total noise dose) are contributing to this health outcome.
- 4.5.4 Considering the results of these studies it is not possible to draw definitive conclusions about the presence or absence of an association between hypertension /cardiovascular disease and exposure to noise from conventional or high speed railways. Laszlo et al⁵⁰ have highlighted the uncertainties at lower levels of exposure and the problems associated with establishing the Lowest Observable Adverse Effect Levels for both hypertension and heart disease. Notwithstanding the uncertainties, it is clear that individuals exposed to higher levels of noise are exposed to the greater risk, especially at daytime noise levels above 60 dB. Moreover, to some extent the level of uncertainty is less important when considering relative risks, such as risk introduced by a proposed scheme in comparison to the risk caused by existing levels of exposure. It is reasonable therefore to perform a high level risk assessment considering daytime noise levels above 60 dB, with and without a scheme, as an approximation of relative risk.
- 4.5.5 There are still uncertainties on the relative importance of exposure during the day and night periods, and the importance of sleep disturbance as a mechanism that leads to cardiovascular

⁴⁸ World Health Organisation (2011) Burden of disease from environmental noise, Quantification of healthy life years lost in Europe

⁴⁹ B. Fenech, C. Cobbing, R. Greer & T. Marshall (2013), Health effects from high-speed railway noise - a literature review, Proc Internoise 2013

⁵⁰ H. Laszlo, B. Berry, P. Abbott & A. Hansell (2012), Environmental noise and cardiovascular disease - observations on a well known dose response relationship. Proc. Internoise 2012.

diseases. Given these uncertainties it is considered that a risk assessment of railway noise and sleep disturbance may be more meaningful than a general consideration of health risk factors associated with exposure to noise at night.

4.6 Mental illness

- 4.6.1 Although environmental noise is not believed to be the direct cause of mental illness, studies suggest that it can accelerate and intensify the development of latent mental disorders. Studies on the adverse effects of environmental noise on mental health cover a variety of symptoms which include anxiety, emotional stress, nausea, headaches as well as general psychiatric disorders e.g. neurosis, psychosis and hysteria. Longer scale population studies have shown an association between noise exposure and various mental health indicators e.g. single rating of well-being, standard psychological symptom profiles, intake of psychotropic drugs and the consumption of tranquilizers and sleeping pills⁵¹.
- 4.6.2 Recent reviews on noise effects and mental health have concluded that there is no direct association between environmental noise and mental health, in both adults and children. Noise annoyance is consistently found to be an important mediator. Evidence for an effect of noise on psychological health suggests that, for both adults and children, noise is probably not associated with serious psychological ill-health, but may affect quality of life and well-being⁵².

4.7 Cognitive impairment in schoolchildren

- 4.7.1 A World Health Organisation document on Burden of Disease⁵³ references three European studies on cognitive impairment in schoolchildren from transport noise. Of the three studies, only one included railway noise within scope, and this was in a specific narrow Alpine valley setting where it was difficult to separate road and rail noise. There is evidence from the other two studies (Munich and RANCH) of an association between aircraft noise exposure and cognitive performance in schoolchildren (reading comprehension and recognition memory), but the same association was not seen for road traffic noise. Neither aircraft noise nor road traffic noise affected sustained attention, self-reported health, or mental health.
- 4.7.2 The Burden of Disease document and a separate document by the European Environment Agency (EEA)⁵⁴ present a hypothetical exposure -response for cognitive impairment based upon these studies. The relationship assumes 100% of children are cognitively impaired at a very high noise level (95 dB L_{dn}) and that none are affected at a safe low level (50 dB L_{dn}). Within this range cognitive impairment is assumed to follow a sigmoidal function, as shown in Figure 7.

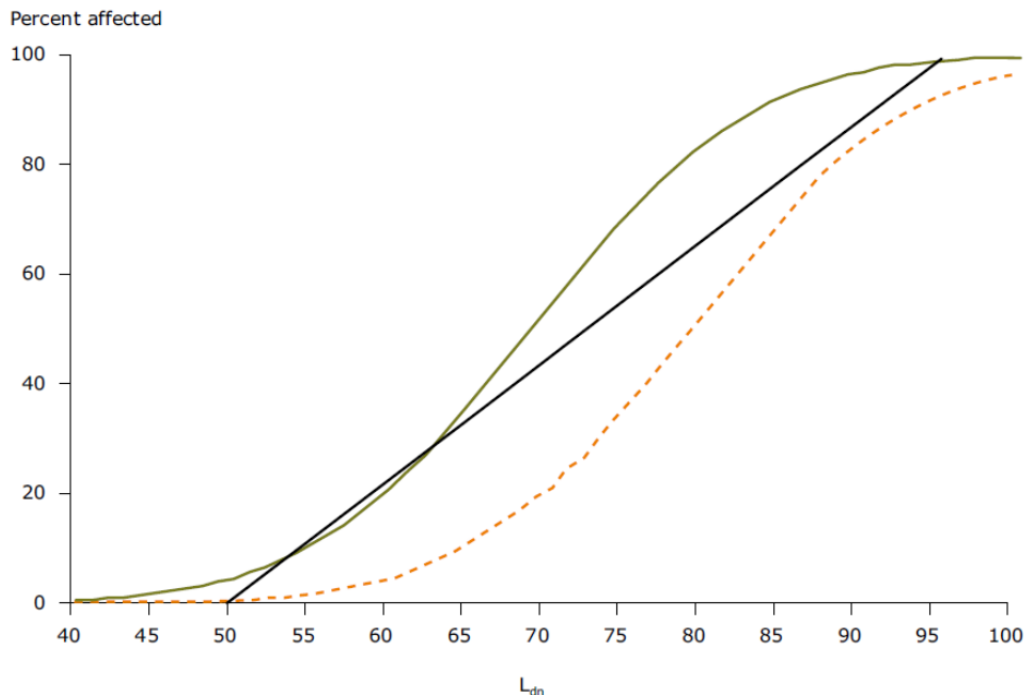
⁵¹ World Health Organisation (1995). Community Noise. Edited by B. Berglund & T. Lindvall

⁵² I. van Kamp, E. van Kempen, C. Baliastas, D. Houthuijs (2013), Mental health as a context rather than health outcome of noise: competing hypotheses regarding the role of sensitivity, perceived soundscapes and restoration. Proc. Internoise 2013.

⁵³ WHO (2011), Burden of disease from environmental noise. Quantification of healthy life years lost in Europe.

⁵⁴ European Environment Agency (2010), Good practice guide on noise exposure and potential health effects. EEA Technical Report No 11/2010.

Figure 7: Hypothetical association between aircraft noise level and cognitive impairment in children, assuming all children are cognitively impaired at 95 dB Ldn and that none are affected at 50 dB Ldn. A straight line connecting the two points would be an underestimation of the real effect, which is assumed to follow a sigmoidal distribution (dashed yellow curve). The assumed association (solid green curve) shows that the percentage of children affected is 20% at 55-65 dB Ldn, 45-50% at 65-75 dB Ldn and 70-85% above 75 dB Ldn. After European Environmental Agency⁵⁴



- 4.7.3 Data from the Munich and RANCH studies was reanalysed by Stansfeld et al.⁵⁵, who concluded that night aircraft noise exposure did not appear to add any cognitive performance impairment to the cognitive impairment induced by daytime aircraft noise alone. Based on the data from the two studies, the authors suggested that the school should be the main focus of attention for protection of children against the effects of aircraft noise on school performance.
- 4.7.4 It has been suggested that the intensity, location of source, variability and unpredictability of aircraft noise is likely to result in a greater effect on children's reading than road traffic noise, which was of a more constant level in the studies. Whilst railway sound occurs as events, and may therefore be considered more similar to aircraft exposure than road traffic noise exposure, there are important differences between railway and aircraft noise events. For an equivalent distance, high speed train sound levels are lower than aircraft. Trains operate on fixed tracks and therefore train sound events are more repeatable than aircraft where flight paths will vary due to a range of factors, particularly meteorological conditions. For modern passenger railways the character of the train sound is consistent and regular as the train approaches the listener and after it passes. For aircraft the character not only changes as it passes as a function of the type of plane but also for each type of plane the sound character will vary as the pilot/aircraft responds to meteorological conditions (e.g. change in engine speed due to varying wind conditions during approach to an airport). The duration of an audible aircraft sound event is longer than for a train due to differences in the directivity of the two sources and also because topography, building and noise barriers screen train sound.

⁵⁵ S. Stansfeld, S. Hygge, C. Clark, T. Alfred (2010) Night time aircraft noise exposure and children's cognitive performance. *Noise Health* 24 (49).

- 4.7.5 The weakness in the evidence relative to railway noise means that it will not be possible to quantify this effect. However, the absence of evidence does not mean that there is an absence of effect or that there is not a potential risk. Consequently, a high level risk assessment based upon noise exposure levels above 50 dB day (07:00-23:00)⁵⁶ outside schools from the Proposed Scheme, where noise levels from the proposed Scheme would be equal to, or higher than existing noise levels, would be appropriate. .

4.8 Vibration

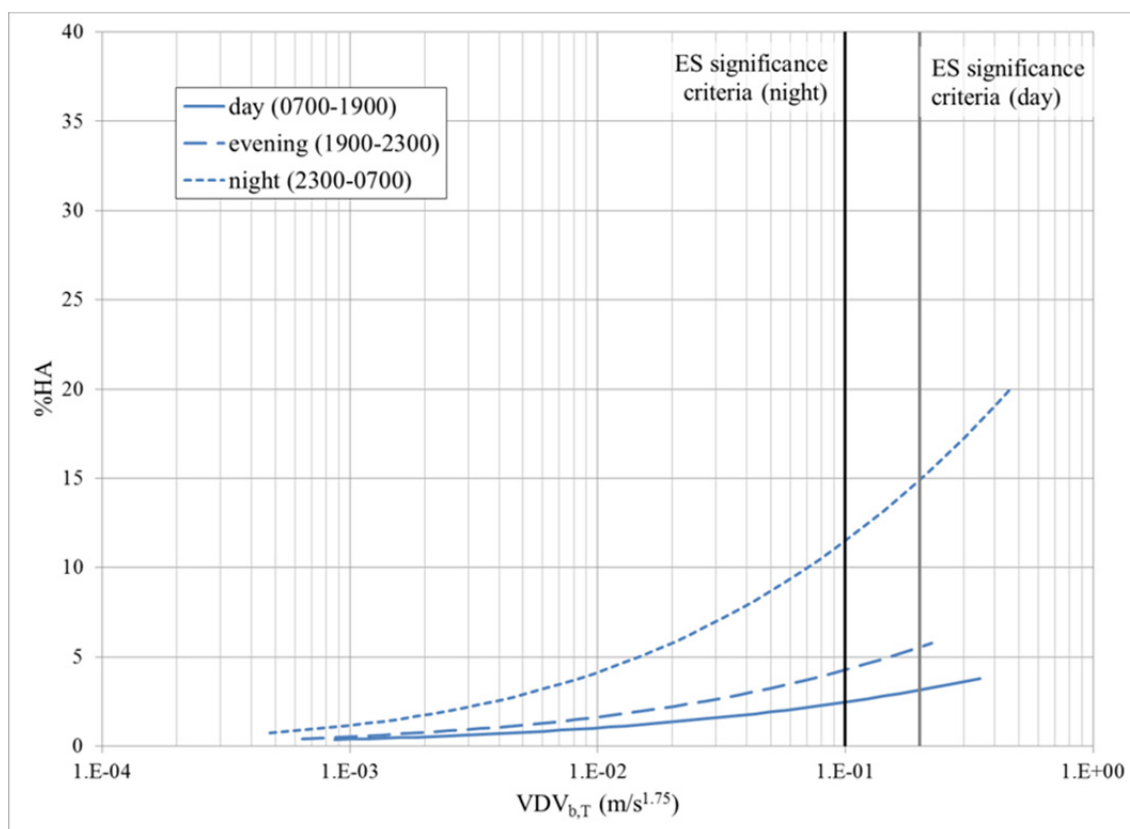
- 4.8.1 The reaction of the human body to vibration can range from annoyance, sleep disturbance, discomfort, interference with activities and it may affect quality of life. Occupants of buildings where there is perceptible vibration may have additional concerns of building damage, safety or a reduction in property value. Levels of vibration at which adverse comment is likely are well below the levels of vibration that may result in even cosmetic damage to buildings.
- 4.8.2 Research reported in 1987 by Woodroof and Griffin⁵⁷ investigated annoyance from railway induced vibration in buildings in Scotland. No good correlation was found between objective measures of vibration and reported annoyance. The strongest correlation for annoyance was with the number of train passbys in a 24 hour period. The results suggest that railway induced building vibration did not cause significant annoyance even though about a third of respondents within 100m of the railway could perceive the vibration.
- 4.8.3 A recent study in the UK was undertaken for Defra and carried out by a team from Salford University, reporting in 2011⁵⁸. This was a major study, involving almost one thousand face to face interviews and over 500 measurements of vibration inside buildings. The study was carried out in the North-West of England and the Midlands area during 2009 and 2010. Exposure-response relationships were developed for human response to railway vibration.

⁵⁶ Based on the assumed train movements during the day and night, the $L_{pAeq,0700-2300}$ is approximately equal to L_{dn}

⁵⁷ H. Woodroof, M. Griffin (1987). A survey of the effect of railway-induced building vibration on the community. ISVR Technical Report 160, University of Southampton.

⁵⁸ University of Salford for Defra (2011). Human response to vibration in residential environments, Reports 1 - 6.

Figure 8: Percentage highly annoyed by vibration during the day, evening and night



4.8.4 The percentage of respondents expressing a given level of annoyance is higher for night than it is for evening and higher for evening than it is for day. For a vibration level of $0.1\text{ms}^{-1.75}$ ⁵⁹ the proportion of respondents expressing high annoyance is around 2% during the day, 4% in the evening, and 12% during the night.

4.8.5 There is very little evidence in the existing literature to suggest direct long term physical health effects on people inside buildings are relevant in relation to vibration at the typical levels encountered in the everyday environment⁶⁰.

4.9 Combined effects of noise and vibration

4.9.1 Numerous laboratory and field studies^{61, 62, 63} have consistently found an interaction between vibration and noise with respect to annoyance to both stimuli. Vibrations may facilitate the perception of noise and make it difficult to ignore and habituate to, which may lead to an increased risk of perceiving the railway noise as more annoying than in situations with no simultaneous vibrations. This synergistic effect is believed to be one of the main factors why studies in the Far East report higher level of annoyance than that predicted using the

⁵⁹ Quoted vibration levels in $1\text{ms}^{-1.75}$ refer to the frequency weighted Vibration Dose Value for the respective day and night periods

⁶⁰ ANC (2012). Measurement & Assessment of Groundborne Noise & Vibration, 2nd edition,

⁶¹ E. Öhrström (1997), Effects of exposure to railway noise - a comparison between areas with and without vibration. J. Sound & Vibration 205(4):555-560.

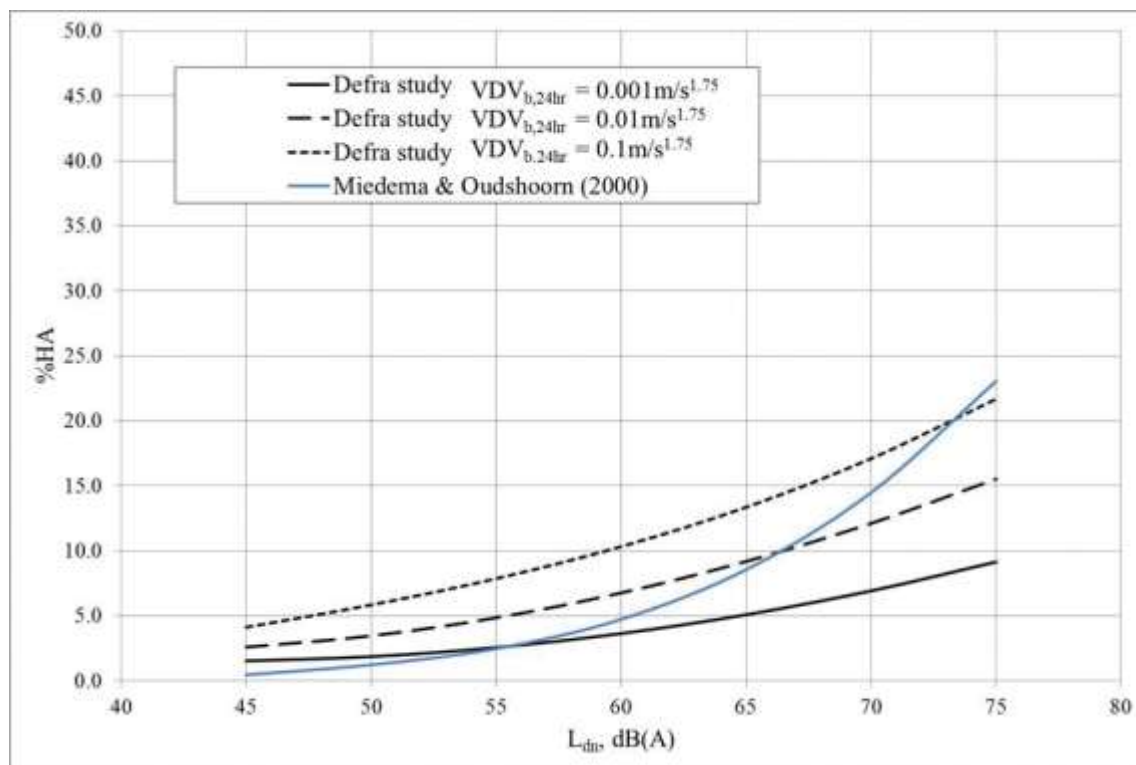
⁶² A. Gidlöf-Gunnarsson, M. Ögren, T. Jerson & E. Öhrström (2012), Railway noise annoyance and the importance of number of trains, ground vibration, and building situational factors. Noise Health 14:190-201.

⁶³ P. Lee & M Griffin (2013), Combined effect of noise and vibration produced by high-speed trains on annoyance in buildings. J. Acous. Soc. Am. 133(4):2126-2135.

Miedema curve^{64, 65}. In the Far East properties tend to be situated very close to the railway, and groundborne vibrations tend to be exacerbated by the lightweight residential constructions.

- 4.9.2 The Defra-commissioned study on human response to vibration in residential environments gives exposure-response relationships for annoyance caused by noise for a given noise exposure and different levels of vibration exposure. A comparison of these curves with the Miedema curve suggests that the latter takes into account the synergistic effect of low to moderate levels of vibration at high levels of noise exposure. This is not surprising, given that approximately one-third of the data points used in Miedema and Oudshoorn's meta analysis is from Swedish studies at sites with weak or strong railway-induced vibrations.

Figure 9: Percentage of people highly annoyed due to airborne railway noise, for different levels of vibration exposure (from Defra-commissioned study). The blue curve represents the Miedema curve for railway, as discussed in the annoyance section. Assumption $L_{den} \gg L_{dn}$



4.10 Construction noise and vibration

- 4.10.1 Much of the evidence underpinning the discussion of noise and vibration related health effects comes from studies where there has been long term exposure, during the day, evening and night to the various sources of transport noise. The current models which suggest an association between noise exposure and adverse health effects such as hypertension and heart disease operate through longer term stress reaction mechanisms.
- 4.10.2 Potentially high levels of construction noise over a sustained period could impact upon children at school if there was prolonged exposure during the school day. Noise could have an adverse effect on children's learning indoors and on various outdoor learning or rest activities.

⁶⁴ S. Oka, Y. Murakami, H. Tetsuya & T. Yano (2013), Community response to a step change in railway noise and vibration exposures by the opening of a new Shinkansen Line. Proc. Internoise 2013.

⁶⁵ S. Yokoshima, Y. Matsumoto, H. Shiraishi, A. Ota & A. Tamura (2013), Effects of house vibrations on community response to ground transportation noise. Proc. Internoise 2013.

However, experience on other projects such as HS1 and Crossrail has shown that such impacts can be successfully managed. Therefore it is reasonable to assume that such effects can be avoided if proper levels of protection will be put in place for schools as part of the Code of Construction Practice.

- 4.10.3 It is important to note that the potential for sleep disturbance will normally only arise in those locations where it is necessary to work at night for engineering, safety or other operational reasons. The amount of surface work at night is likely to represent a small proportion of the overall works. It is recognised that there may be an impact on shift workers or others who have to sleep during the day.
- 4.10.4 The recent Defra-commissioned study⁵⁸ on human response to vibration in residential environments derived exposure-response relationships for annoyance from construction noise and vibration.
- 4.10.5 There is a reasonable level of consensus from other major projects about tolerable levels of construction noise which clearly depend on the duration of works as well as the level of noise (or vibration) in any particular locality. This issue will be addressed in the Code of Construction Practice.

5 Air quality

5.1 Dust

- 5.1.1 There is no established evidence linking airborne dust such as that from construction sites with adverse health effects. It is generally accepted that particles greater than 10 µm in diameter (PM₁₀) do not penetrate the lungs to cause respiratory health problems. However, dust can cause eye, nose and throat irritation and lead to deposition on cars, windows and property⁶⁶.

5.2 Road traffic emissions

- 5.2.1 Evidence on the links between road traffic emissions and health is well established, based on numerous research studies. A WHO report in 2000 suggested that about 36,000–129,000 adult deaths a year are brought forward due to long-term exposure to air pollution generated by traffic in European cities⁶⁷. The main health damaging pollutants released as emissions from road traffic are PM₁₀ and nitrogen dioxide.

5.3 PM₁₀

- 5.3.1 PM₁₀, which is an important source of pollution with regard to health impacts, comprises atmospheric particles that are less than 10 µm in diameter. Road transport is a major source of PM₁₀, which is emitted from the combustion of vehicle fuels. An important property is the extent to which these particles may be deposited within the lungs, which is dependent on size of particles (smaller particles have a greater chance of reaching the deeper parts of the lungs). There is growing evidence that smaller respirable particulate matter may be more relevant to

⁶⁶ The control of dust and emissions from construction and demolition Best Practice Guidance, Greater London Authority (2006)

⁶⁷ World Health Organization. (2000) Transport, environment and health. WHO Regional Publications, European Series. No.89

health than larger particles. Recent studies⁶⁷ have found that ultra-fine particles (less than 0.1 µm) have been associated with stronger effects on the lung function and symptoms in asthmatics than either PM₁₀ or PM_{2.5}.

- 5.3.2 Studies have also suggested that particulate pollution of various sizes may exacerbate pre-existing asthma⁶⁸.

5.4 Nitrogen dioxide (NO₂)

- 5.4.1 The effects of road traffic related NO₂ on health are less well understood than the effects of PM₁₀. Numerous epidemiological studies have identified associations between levels of NO₂ and respiratory health⁶⁹, but it may be that in these studies NO₂ is a key marker for traffic-related pollution more generally. NO₂ is a precursor for the formation of ground-level ozone, which is strongly linked with respiratory disease.
- 5.4.2 A study by Searl (2004)⁷⁰ of various experiments identified minor respiratory changes at concentrations of NO₂ similar to those that would arise at high pollution events. The results suggest exposure to such an event would have a greater adverse impact on health than a longer term exposure at lower concentrations.
- 5.4.3 Quantifying short and long term impacts of NO₂ pollution is problematic due to uncertainties in the concentration-response functions available. It has been estimated that the direct effect of NO₂ on the health of the UK's population could be that between 600 and 6000 deaths per year may have been brought forward by a matter of days or weeks as a result of the exposure of NO₂ in the ambient air. Likewise it has been estimated that between 1,400 and 14,000 hospital admissions and between 200,000 and 2 million GP consultations for respiratory illnesses may arise as a result of exposure to the ambient NO₂ in the UK each year. Ambient NO₂ is said to contribute to an average of 1-7 extra days of symptoms in asthmatics annually⁷⁰.

5.5 Ozone (O₃)

- 5.5.1 Ground level ozone (O₃) is not released directly into the atmosphere; it is a secondary pollutant that is produced from a reaction with hydrocarbons, road traffic related nitrogen dioxide (NO₂) and sunlight. Ozone has the potential to irritate the eyes and air passages which can cause breathing difficulties and can increase susceptibility to infection. Short term effects of ozone include changes to lung functions and increased airways inflammation. Longer/higher exposure to ozone can result in more severe alterations in lung function⁶⁹.

⁶⁸ DoH Committee of the Medical Effects of Air Pollutants, 1998, Quantification of the Effects of Air Pollution on Health in the United Kingdom

⁶⁹ Health Scotland, MRC Social and Public Health Sciences Unit and Institute of Occupational Medicine. Health Impact Assessment of Transport Initiatives: A Guide. NHS Health Scotland, 2007

⁷⁰ Searl A. 2004. A review of the acute and long term impacts of exposure to nitrogen dioxide in the United Kingdom. Institute of Occupational Medicine

5.6 Air pollution links to deprivation

- 5.6.1 Defra commissioned a study in 2006 to review recent research evidence on links between air quality and social deprivation in the UK⁷¹. The analysis for England showed that there is a tendency for higher relative mean annual concentrations of nitrogen dioxide (NO₂) and particulate matter (PM₁₀) in the most deprived areas of the country. This distribution can largely be explained by the high urban concentrations driven by road transport sources, and the higher proportion of deprived communities in urban areas. If exceedences of National Air Quality Standards are considered, the correlation between poor air quality and deprivation is stronger, showing that when the most polluted areas are considered, the greatest burden is on the most deprived communities, and very little on the least deprived.

5.7 Vulnerable groups

- 5.7.1 According to the Defra review (2006)⁷¹, there are a number of factors that affect how susceptible a community is to air pollution effects. These include:

- Exposure patterns – for example, indoor/outdoor work, exposure during travel etc. Daily activities/patterns will affect the exposure to air pollution e.g. how we travel to work/school etc;
- Individual factors, for example, choice of diet, smoking, level of exercise all impact on overall human health. These lifestyle factors could lead to greater susceptibility to air pollution impacts and may be prevalent in certain socio-economic groups (e.g. links to relationships between diet and income etc.);
- State of health, including physical and mental health, can have a bearing on the level of the immune response which is linked to air pollution exposure. For example, there is evidence to suggest that deprived communities experience poorer health than less deprived communities as outlined in the Independent Inquiry into Inequality in Health report (Acheson 1998)⁷¹; and
- Age of population – the elderly and children would be more susceptible to air pollution impacts.

- 5.7.2 The review identifies age as a key indicator of susceptibility to air pollution: 'children and elderly groups [are] deemed more susceptible to certain health impacts. An example of this greater susceptibility is the higher rates of asthma observed in children – 1 in 10 (Asthma UK 2004), the symptoms of which can be exacerbated by poor air quality, resulting in additional consultations with physicians ... On this basis, if a population has a higher proportion of old or young, we could infer that the susceptibility of that population to specific impacts is greater.' The study also notes that 'In England, the most deprived deciles have a greater proportion of children in them relative to other age groups'. This means that 'the inequality already experienced because a deprived community experiences worse air pollution is compounded

⁷¹ Defra, Netcen, Department for Communities and Local Government, National Statistics. Air Quality and Social Deprivation in the UK: an environmental inequalities analysis - Final Report to Department of Environment, Food and Rural Affairs AEAT/ENV/R/2170, June 2006

because that community is likely to be made up of proportionately more children, who in themselves are more susceptible to the negative health impacts associated with air pollution’.

6 Local environment

6.1 Green space and contact with nature

- 6.1.1 A recent literature review of peer reviewed papers undertaken by the Forestry Commission⁷² has found evidence that proximity, size and amount of green space available to people in urban environments influences physical and mental health outcomes. The review identifies the key health benefits of green space as:
- ‘Long and short term physical benefits associated with obesity, life expectancy, heart rate and blood pressure;
 - Attention and cognitive benefits associated with restoration, mood and self-esteem;
 - Physical activity benefits associated with the use of greenspace;
 - Self-reported benefits in terms of health and life satisfaction; and
 - Community cohesion benefits through social contact fostered by greenspace’.
- 6.1.2 The review suggests various mechanisms for the beneficial effects of green space including ‘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’.
- 6.1.3 A literature review by Greenspace Scotland⁷³ also found a positive relationship between green space and general health. Importantly this study also identified that ‘the attractiveness or quality of greenspace is an important determination of green space use’.
- 6.1.4 The Greenspace Scotland review also identified links to mental health, stating that ‘studies consistently show a relationship between levels of stress and access to urban green spaces’ and identified ‘activity and exercise, natural daylight, stimulation of the senses and aesthetic experience’ as potential factors in reducing stress.

6.2 Landscape, townscape and visual issues

- 6.2.1 Research into the effects of the visual and aesthetic environment on wellbeing is mainly focused on the psychological effects of ‘natural’ versus ‘man-made’ or urban views. In general, evidence shows a preference for views of natural over man-made scenes. These links are often tied in with other, related issues such as opportunities for exercise and contact with nature.

⁷² 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

⁷³ Croucher, K., Myers, L., and Bretherton, J., 2007, The links between greenspace and health: a critical literature review, Greenspace Scotland

6.3 Crime

- 6.3.1 The effects of crime on health include both direct effects, for example through violence, and indirect social and psychological effects arising from fear of crime⁷⁴. A recent ONS report on Measuring National Wellbeing⁷⁵ identified crime as a key factor in determining wellbeing. In the 2008 Place Survey⁷⁶ respondents were asked to identify up to 5 priorities for a good place to live, and 61% identified low levels of crime as a priority.
- 6.3.2 Research by Hirschfield (2003)⁷⁷ showed that victimisation or fear of crime may manifest itself through symptoms such as stress, sleeping difficulties, loss of appetite, loss of confidence and health harming 'coping' mechanisms such as smoking and alcohol consumption. The research also suggested that neighbourhood problems such as disorder and anti-social behaviour, which are not strictly criminal offences, can have adverse effects on health.
- 6.3.3 A recent study⁷⁸ has identified links between fear of crime and mental and physical health, relating largely to participation in health-promoting physical and social activities. In terms of mental health, the study found that 'participants reporting high levels of fear were 50% more likely to exhibit symptoms of common mental disorder and more than 90% more likely to exhibit symptoms of depression than were those with the lowest levels'. The study also found that participants who reported the highest levels of fear had 'limitations in physical functioning that were commensurate with that of people 9 years apart in age'. The study does not claim a direct causal relationship between fear of crime and health, particularly as poor health may be a driver for fear of crime. However, after adjustments for previous mental and physical health conditions, there remained evidence to suggest that fear of crime was a contributory factor in some adverse health outcomes.
- 6.3.4 A comprehensive review undertaken in 2013 by BMC Public Health⁷⁹ set out to synthesize qualitative evidence on fear of crime and the environment. The report notes that 'most research on crime and health hitherto has focused on the direct health impacts suffered by victims of crime. However, the indirect effects of crime and its broader harms on individuals and communities may also have important impacts on wellbeing. Fear of crime is of particular interest here, as it has been shown in several studies to have a modest, but consistently significant, association with health and wellbeing. The report also notes that fear of crime is only weakly correlated with actual crime rates, and highlights other issues such as urban neglect and social cohesion as factors affecting fear of crime.
- 6.3.5 The BMC study examines the consequences of fear of crime, stating that 'relatively few participants see fear as having serious mental health impacts, although several report some degree of psychological stress as a result of fear. A much more widely perceived consequence of fear is to limit people's activities, including social and cultural activities, sometimes leading to social isolation. Participants from across the population report such limitations, but they

⁷⁴ British Medical Association (1999). 'Health and Environmental Impact Assessment: an Integrated Approach'. Earthscan Publications Ltd.

⁷⁵ Randall, C., Measuring National Well-being, Where we Live, 2012, Office for National Statistics

⁷⁶ Department for Communities and Local Government, 2008, Place survey

⁷⁷ Hirschfield, A., 2003. 'The Health Impact Assessment of Crime Prevention'. Sourced from NHS National Institute for Health and Clinical Evidence.

⁷⁸ Stafford, M., Chandola, T., Marmot, M., Association Between Fear of Crime and Mental Health and Physical Functioning, American Journal of Public Health, November 2007

⁷⁹ Lorenc, T., Petticrew, M., Whitehead, M., Neary, D., Clayton, S., Wright, K., Thomson, H., Cummins, S., Sowden, A., Renton, A. Fear of crime and the environment: systematic review of UK qualitative evidence, BMC Public Health. 2013; 13: 496.

appear to be more serious for women, older people and people with disabilities. Parents also report placing serious restrictions on children's activities.'

6.4 Vulnerable groups

6.4.1 Social inequalities are particularly marked in urban environments, with different population subgroups experiencing impacts to different degrees. A review conducted by Parkes and Kearns, 2004⁸⁰ of a number of studies identified that women were more vulnerable to neighbourhood conditions than men, and particularly those women with children, who were not employed outside the home.

6.4.2 There are other groups that may be particularly vulnerable to certain impacts; for example children may be disproportionately affected by loss of open space, and older people may be particularly likely to suffer as a result of fear of crime.

7 Physical activity

7.1 Environmental influences on physical activity

7.1.1 A review of available data and literature undertaken for the NHS (2011)⁸¹ has shown that the environment has an effect on people's participation in physical activity, which in turn affects their health. The report looked at a number of systematic reviews summarising the evidence linking the environment and physical activity to identify those aspects of the environment found to be associated with physical activity. These include:

- Access to physical activity facilities;
- Distance to destinations;
- Levels of residential density;
- Type of land use;
- Urban walkability; and
- Perceived safety'.

7.1.2 The report also states that 'less clear associations have been noted for aesthetic features of the environment and parks, and perceived crime'.

7.1.3 Research suggests that most sustained exercise is taken during the course of everyday activities such as travelling to work or going to the shops, rather than specifically for health purposes⁸². However, safety concerns relating to road traffic can influence choice of mode of transport and levels of physical activity. The fear of traffic is the most common barrier to cycling; a fear that is 'exaggerated in comparison with the likelihood of injury'.

⁸⁰ Parkes, P. & Kearns, A. 2004. The multi-dimensional Neighbourhood and Health: A Cross Sectional Analysis of the Scottish Household Survey, 2001'. CNR Paper 19. ESRC Centre for Neighbourhood Research. www.neighbourhoodcentre.org.uk

⁸¹ Cavill, N and Roberts, K. Sources of data for investigating the influence of the environment on physical activity and diet. Oxford: National Obesity Observatory, 2011

⁸² Caldwell, L.L., 2005, Leisure and health: Why is leisure therapeutic?

- 7.1.4 Physical activity can be encouraged by improving accessibility to green spaces, ensuring green spaces are of a high quality and attractive⁸³. The evidence indicates that green space is most valuable as a resource for physical activity when used by high volumes of people therefore spaces need to be accessible, of sufficient size, and connected to residential areas⁸⁴. In addition to accessibility to green space, evidence suggests that access to leisure facilities can determine levels of physical activity and reduce the risks of obesity⁸⁵.
- 7.1.5 However, a review of evidence for environmental influences on obesity⁸⁶ has suggested that 'the contribution of environmental variables in explaining variation of physical activity or walking is small and less important than socio-demographic variables'.

7.2 Physical health effects

- 7.2.1 Evidence demonstrates that 'an inactive lifestyle has a substantial, negative impact on both individual and public health – specifically, physical inactivity is a primary contributor to a broad range of chronic diseases such as coronary heart disease, stroke, diabetes and some cancers'⁸⁴.
- 7.2.2 A recent Department of Health report⁸⁷ states that 'regular physical activity can reduce the risk of many chronic conditions including coronary heart disease, stroke, type 2 diabetes, cancer, obesity, mental health problems and musculoskeletal conditions. Even relatively small increases in physical activity are associated with some protection against chronic diseases and an improved quality of life.'
- 7.2.3 It has been shown that 'physical activity improves health throughout the life course – from childhood through to older age'⁸⁸. The health benefits of physical exercise occur across virtually the full range of diseases, and when this is combined with the prevalence of inactivity among the public, it 'makes physical activity one of the main contemporary public health issues'.

7.3 Mental health effects

- 7.3.1 Positive mental health effects associated with exercise have been highlighted in evidence reviews by Cave et al⁸⁹, Sport England⁹⁰ and AEA Technology⁹¹. Mental health effects cited include improvements in people with generalised anxiety disorders including phobias, panic attacks, and stress disorders.

⁸³ Randall, C., 2012, Measuring National Well-being - Where we Live – 2012, Office for National Statistics

⁸⁴ At least five a week: evidence on the impact of physical activity and its relationship to health, Department of Health, Physical Activity, Health Improvement and Prevention, April 2004

⁸⁵ Greenspace Scotland, 2009, Health Impact Assessment of greenspace - A Guide

⁸⁶ Dr A Jones, Prof G Benthall, Dr C Foster, Dr M Hillsdon and J Panter, Obesogenic Environments Evidence Review, Office of Science and Innovation

⁸⁷ Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers, Department of Health, Physical Activity, Health Improvement and Protection, July 2011

⁸⁸ Harding, T., 1997, A Life Worth Living: the Independence and Inclusion of Older People, London: Help the Aged, cited in Beaumont, J., 2011,

Measuring National Well-being, Discussion paper on domains and measures, Faculty of Public Health, Office for National Statistics

⁸⁹ Cave, B, Curtis, S, Aviles, M, and Coutts, A, 2001. 'Health Impact Assessment for Regeneration Projects. Volume II Selected evidence base'. East London and City Health Action Zone.

⁹⁰ Sport England. 2007. 'Active Design. Promoting opportunities for sport and physical activity through good design'. Supported by CABE, DH & DCMS. Sport England.

⁹¹ AEA Technology, 2000. 'Informing transport health impact assessment in London'. Commissioned by NHS Executive, London.

- 7.3.2 A Government review⁹² has also identified positive effects on psychological well-being in people with schizophrenia. The review also states that exercise can aid in the treatment of clinical depression, sleep problems and low self-esteem, and can contribute towards improved physical perception, and general psychological well-being as well as acting as a buffer to stress. Physical activity can also provide an important opportunity for social interaction, which in itself can aid mental well-being.

7.4 Vulnerable groups

- 7.4.1 Although all groups are shown to benefit from regular exercise, the benefits to children and the elderly are particularly emphasised. The importance of exercise for children is highlighted in terms of benefits in building up bone density, avoidance of weight gain, links to health status in later life, and in establishing habits, which may be more difficult to begin in later life (British Medical Association, 2002 and DH, 2004⁹³). The benefits for the elderly include retention of mobility, cognitive function and independence⁹³.

8 Access to services

- 8.1.1 According to Quigley et al⁹⁴, the accessibility of local shops, community services and healthcare facilities may be affected by:

- Effects on the capacity of existing services;
- Physical accessibility (i.e. distances travelled and transport connections);
- Social and/or cultural access (i.e. communication issues); and
- Separation imposed by a new piece of physical infrastructure.

8.2 Healthcare

- 8.2.1 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 live⁹⁵.
- 8.2.2 According to the Department for Transport, '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'⁹⁶. 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 services⁹⁷. Groups impacted by disability and of certain ages may experience even greater barriers to health and social care services⁹⁸.

⁹² Department of Health (DH), 2004. Chief Medical Officers Report – 'At least Five A Week: Evidence on the impact of physical activity and its relationship to health'. DH.

⁹³ Department of Health, 2004. 'Choosing Health Summaries: Diet and Nutrition'. Public Health White Paper. Department of Health.

⁹⁴ Quigley, R. and Thornley, L., 2011, Literature Review on Community Cohesion and Community Severance: Definitions and Indicators for Transport Planning and Monitoring, Report to New Zealand Transport Agency, Quigley and Watts Ltd

⁹⁵ Department for Communities and Local Government, 2008, Place survey, UK Government

⁹⁶ Social Exclusion Unit, 2003, Making the Connections: Final Report on Transport and Social Exclusion

⁹⁷ Randall, C., 2012, Measuring National Well-being - Where we Live – 2012, Office for National Statistics

⁹⁸ Hamer, L., 2004, Improving patient access to health services: a national review and case studies of current approaches, Health Development Agency

8.3 Shops

- 8.3.1 Research has suggested that 'access to local shops, post offices, places of entertainment and community activity all contribute to well-being'⁹⁹.
- 8.3.2 Results from a 2010/11 poll showed that 5% of adults in Great Britain feel 'isolated' as a result of difficulty in accessing local shops and services⁹⁷.

8.4 Leisure, faith, culture and recreational facilities

- 8.4.1 Access to leisure and cultural facilities is a determinant of health and wellbeing; according to research 'leisure activities can have a positive effect on people's physical, social, emotional and cognitive health through prevention, coping (adjustment, remediation, diversion), and transcendence'¹⁰⁰. People participate in cultural activities for a number of reasons including 'enjoyment and entertainment', personal growth and development, and as a 'means of creative expression', 'to learn new skills' or 'to meet new people' and to 'pass on cultural traditions'¹⁰¹.

8.5 Vulnerable groups

- 8.5.1 People without private cars are likely to be particularly vulnerable to impacts on access to local shops and facilities, particularly in rural areas. This is more common among people on low incomes and older people.
- 8.5.2 Mobility impaired or visually impaired people will be particularly vulnerable to impacts such as local footpath diversions.
- 8.5.3 People who rely on regular contact with local healthcare services, such as those with disabilities or long term illness, or those with young children, may be more vulnerable to impacts on access to these services.

9 Transport

- 9.1.1 Evidence on the health effects of transport is mainly focused on the effects of transport related noise, air emissions, access to services, community severance and physical activity. These issues are covered in other sections of this HIA and evidence for these health linkages is presented in the corresponding sections of the evidence base. Evidence related to the linkages between health and changes in road and public transport user experience, changes in the accessibility of stations, and road safety issues during the construction phase are outlined below.

9.2 User experience

- 9.2.1 Journey ambience is identified as an appraisal criterion in the Government's Transport Analysis Guidance¹⁰². This document includes guidance on traveller stress, stating that:

⁹⁹ Harding, T., 1997, A Life Worth Living: the Independence and Inclusion of Older People, London: Help the Aged, cited in Randall, C., 2012, Measuring National Well-being – Where we Live, 2012, Office for National Statistics

¹⁰⁰ Caldwell, L.L., 2005, Leisure and health: Why is leisure therapeutic?

¹⁰¹ New Zealand Government, 2007, Social Report: Leisure and Recreation, Ministry of Social Development, New Zealand Government

¹⁰² Transport Analysis Guidance (TAG), The Journey Ambience Sub-Objective, TAG Unit 3.3.13, Department for Transport, June 2003

'Traveller stress is the adverse mental and physiological effects experienced by travellers. Three main factors influence traveller stress: frustration; fear of potential accidents; and route uncertainty. Taken together, these can lead to feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the quality and safety of a journey. Extreme cases of traveller stress can contribute towards, or be caused by, 'transport rage'. The extent of stress will depend on the travellers driving skill and experience, temperament, knowledge of the route and state of health.'

- 9.2.2 The Guidance identifies major influences on frustration as including 'a driver's inability to drive at a speed consistent with his or her own wishes relative to the standard of the road (e.g. congestion), or delays on public transport'. Route uncertainty (e.g. uncertainty arising from temporary diversions) is also identified as a factor influencing traveller stress.

9.3 Accessibility of stations

- 9.3.1 The Government's Transport Analysis Guidance¹⁰² states that 'some public transport users (e.g. the disabled and mothers with young children) may experience frustration in accessing and egressing public transport'.

9.4 Road safety

- 9.4.1 Additional HGVs on the road network can influence the risk of serious accidents and fatalities, particularly those involving non-motorised vehicles. According to DfT figures¹⁰³ there were 7,103 accidents in 2010 involving at least one HGV, with 9,686 casualties of which 263 were fatal.
- 9.4.2 According to the Government's Transport Analysis Guidance¹⁰², 'fear of accidents is highest when speed, flow and the HGV content are high'. However, the rate of fatal or serious accidents involving HGVs is reducing significantly due to improved awareness and safety measures. The DfT figures state that 'there were around 83 fatal or serious accidents involving HGVs per billion HGV vehicle miles in 2010. This figure was lower than the rate for all vehicles (120 accidents per billion vehicle miles) and has decreased from 173 per billion HGV vehicle miles in 2000.'

10 Social capital

- 10.1.1 The World Bank definition of social capital is '...the institutions, relationships and norms that shape the quality and quantity of a society's social interactions... Social capital is not just the sum of the institutions which underpin a society – it is the glue that holds them together'¹⁰⁴.
- 10.1.2 According to a literature review by Cave et al. (2001)¹⁰⁵ social capital may:
- Protect health by buffering against the effects of life events which may be damaging to health;

¹⁰³ Road freight statistics, Statistical Release, Department for Transport, 27 October 2011

¹⁰⁴ The World Bank, 1999, What is Social Capital?, PovertyNet

¹⁰⁵ Cave, B., Curtis, S., Aviles, M. and Coutts, A., 2001, Health Impact Assessment for Regeneration Projects. Volume II Selected evidence base, East London and City Health Action Zone, University of London

- Have physiological effects, through the hormonal system, on the body's response to stress and functioning of the immune system;
- Reduce isolation, which is associated with disease, accidents and suicide;
- Enable people to cope with illness better and have better prognoses when ill; and
- Reduce or protect against mental health problems, such as anxiety and depression.

10.1.3 Social networks are also credited with 'creating opportunities for advice and informal care'¹⁰⁶.

10.1.4 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'.

10.2 Community consistency

10.2.1 Social capital is supported by stable communities where residential turnover is low. According to Government research, 'residential mobility is negatively associated with social capital at the neighbourhood level'¹⁰⁷. Furthermore, 'sometimes a neighbourhood can be tipped into a low social capital equilibrium by some ... factor, such as urban clearance, disruption by infrastructure, and strong inward migration or social mixing'.

10.3 Crime

10.3.1 Social capital is considered a strong determinant of crime rates in a community, as strong social networks strengthen communities and deter crime and antisocial behaviour¹⁰⁷. Crime is in turn an important determinant of health and wellbeing¹⁰⁸, so increasing social capital can serve to decrease the adverse health and wellbeing impacts associated with crime.

10.4 Vulnerable groups

10.4.1 Some population groups are believed to be at particular risk of social exclusion, including minority ethnic groups, disabled people, lone parents, older people, carers, asylum seekers and refugees and ex-offenders.

11 Vulnerable groups

11.1.1 According to the Government's Transport Analysis Guidance¹⁰² 'the impact of transport is more fundamental to health for certain sectors of society than others. Vulnerable groups include children, the elderly, disabled, women, those suffering from long-term illnesses, and the financially disadvantaged, who are less likely to have access to a private vehicle and suffer from any lack of public transport. Those in lower socio-economic class are also shown to experience a disproportionately greater numbers of road casualties.'

¹⁰⁶ Health Development Agency, 2005, Making the case: improving health through transport, National Health Service

¹⁰⁷ Performance and Innovation Unit, 2002, Social Capital, A Discussion Paper, The Cabinet Office

¹⁰⁸ Greater London Authority, 2005, Review of the London Health Strategy High Level Indicators, London Health Commission

11.2 Overview of vulnerable groups

- 11.2.1 Vulnerable groups comprise those sections of the population that for certain reasons may be disproportionately affected (either positively or negatively) by the Proposed Scheme. Specific sensitivities have been identified within the evidence base presented above. The section below provides an overview and summary of key vulnerable groups. Further discussion of vulnerable groups and potential health inequalities is provided within the relevant assessment sections of the HIA.

11.3 Older people

- 11.3.1 Older people comprise an important and growing group in society with multiple sensitivities to the negative health impacts of development projects. The elderly are a vulnerable group because they are generally physically less able to cope with impacts on air quality, noise and other environmental factors than young and middle aged adults.
- 11.3.2 Older people are also more likely to face difficulties in accessing health and social services as well as local services such as supermarkets, due to issues such as physical mobility, lower income, greater reliance on public transport, and fear of crime and antisocial behaviour. Older people are therefore likely to be disproportionately affected by impacts such as disruption to public transport services, footpath diversions, and permanent or temporary loss of local facilities. They are also likely to find it more difficult to adapt to changes.
- 11.3.3 These issues may lead to behavioural changes with adverse health consequences, such as a decrease in social interaction, reduced levels of exercise, deterioration in diet and a lower use of health and social care facilities.

11.4 Children and adolescents

- 11.4.1 Children and adolescents are a vulnerable group because they are physically more sensitive than young and middle aged adults to air pollution, noise, odour and other environmental factors.
- 11.4.2 Children are also more likely to be involved in road traffic accidents. The barriers to physical activity created by heavy traffic are especially restrictive for children.
- 11.4.3 Children from low income families and/or living in deprived areas are particularly sensitive to health and wellbeing impacts associated with social, economic and environmental changes.

11.5 Disabled people and long-term illness sufferers

- 11.5.1 Long term illness sufferers are likely to be more sensitive to environmental changes, and in particular are likely to suffer from the detrimental effects of increased noise and air emissions.
- 11.5.2 People with impaired mobility or sight may be more vulnerable to the disruptive effects of construction, such as footpath diversions and increased traffic flows, as well as the permanent or temporary loss of local facilities necessitating additional travel.
- 11.5.3 Both groups are likely to be more dependent on health and social care services, and therefore more susceptible to disruption in access to these services.

11.6 Low income/lower socio-economic groups

- 11.6.1 People living on low incomes and/or living in deprived communities generally live in cheaper but poorer quality neighbourhoods both in terms of higher levels of environmental pollution, air, noise and visual impacts; as well as poorer availability of and access to services and amenities and poorer quality housing.
- 11.6.2 Low income groups and those living in deprived areas are shown to experience a disproportionately greater numbers of road casualties. Traffic volumes and the proportion of vehicles exceeding speed limits are also generally higher in less affluent areas.
- 11.6.3 For those living in social housing, the impact of moving house, which is considered to be a stressful, health damaging life-event, can be compounded by a lack of opportunity to negotiate with the housing authority regarding control of the move.
- 11.6.4 Low income groups are more dependent on public transport and therefore more likely to be affected by restricted access to services and facilities and/or community severance when services are interrupted or delayed. This can affect people's ability to access health and social care services, and basic facilities.
- 11.6.5 These communities also tend to have a higher incidence of health damaging behaviours such as smoking and poor diet. All of these result in lower levels of baseline health and wellbeing and reduced resilience.

11.7 Minority ethnic groups

- 11.7.1 There are few instances where particular ethnic groups are more physically susceptible to health impacts. However, links between areas of high deprivation and high levels of ethnic diversity mean that minority ethnic groups are more likely to have elevated vulnerability associated with social and economic disadvantages.
- 11.7.2 Other factors such as language and lifestyle may also influence the way in which different ethnic groups are affected by impacts on health determinants.
- 11.7.3 Non-English speakers may face barriers to accessing information about the works or expressing their concerns.

Contents

HS2 Health Impact Assessment Report	1
Appendix 5 Existing baseline	1
1 Introduction	3
1.2 Community profiles	3
1.3 Environmental and socio-economic baseline	3
2 Euston	5
2.1 Community profile	5
2.2 Employment and economy	7
2.3 Housing	8
2.4 Noise	9
2.5 Local environment	10
2.6 Physical activity	11
2.7 Access to services	11
2.8 Traveller stress	12
2.9 Social capital	13
3 London Corridor and Old Oak Common	14
3.1 Community profile	14
3.2 Employment and economy	17
3.3 Housing	17
3.4 Noise	18
3.5 Local Environment	20
3.6 Access to services	21
3.7 Traveller stress	22
3.8 Social capital	23
4 Country South Corridor	24
4.1 Community profile	24
4.2 Employment and economy	26
4.3 Housing	26
4.4 Noise	27

4.5	Local environment	30
4.6	Physical activity	30
4.7	Access to services	32
4.8	Traveller stress	33
4.9	Social capital	34
5	Country North Corridor	35
5.1	Community profile	35
5.2	Employment and economy	38
5.3	Housing	38
5.4	Noise	39
5.5	Physical activity	40
5.6	Access to services and health care	41
5.7	Traveller stress	41
5.8	Social capital	42
6	West Midlands Corridor and Birmingham Interchange	43
6.1	Community profile	43
6.2	Employment and economy	46
6.3	Housing	47
6.4	Noise	48
6.5	Local environment	50
6.6	Physical activity	51
6.7	Access to services and health care	52
6.8	Traveller stress	53
6.9	Social capital	53
7	Curzon Street Station	55
7.1	Community profile	55
7.2	Employment and economy	57
7.3	Housing	57
7.4	Noise	58
7.5	Local environment	58
7.6	Physical activity	59
7.7	Traveller stress	60
7.8	Social capital	60

HS2 Health Impact Assessment Report

Appendix 5 Existing baseline

1 Introduction

1.1.1 Information has been gathered from a variety of published sources in order to provide a profile of the existing communities along the route, including socio-economic, demographic and health characteristics. This information has provided a baseline against which to assess the potential health effects of Phase One of HS2.

1.1.2 For the purpose of the baseline description, the route of the Proposed Scheme has been divided into six study areas, which correspond to the Community Forum Areas as referenced in the ES. These are:

- Euston Station;
- London and Old Oak Common;
- Rural areas:
 - Country South;
 - Country North;
- West Midlands and Birmingham Interchange; and
- Curzon Street Station.

1.2 Community profiles

1.2.1 The community profiles have used detailed information available from publically accessible sources. The granularity of data varies between different data sets used, ranging from regional level data to small localised areas (lower super output areas). LSOAs are small geographical areas with populations of between 1000 and 1500, which are used to report small area statistics in England and Wales.

1.2.2 Where reasonably practicable, as part of the community health profiling exercise, available information on existing vulnerable groups within the communities along the route has been collated. This has focused on:

- Communities that are vulnerable due to existing deprivation; and
- Groups of people who may be particularly susceptible due to characteristics such as age or disability.

1.3 Environmental and socio-economic baseline

1.3.1 Baseline data on the following health determinants has been gathered from a range of publically accessible sources:

- Employment and economy
- Housing
- Social capital
- Noise

- Local environment
- Physical activity
- Access to services and health care
- Transport

1.3.2 Relevant baseline data from the ES has also been reviewed, including information on:

- existing community facilities;
- the existing noise environment; and
- local environmental features (including green and open spaces and landscape characteristics).

2 Euston

2.1 Community profile

Demographic profile

Population trends

- 2.1.1 The population of Camden has grown rapidly over the 5 year period from 2005 – 2010, by approximately 7.8%, compared with a London average of 4.5%¹. The 2010 mid-year population estimates for Camden put the current population at 235,400.
- 2.1.2 In terms of age structure, Camden has a relatively young population, with a higher proportion of residents within the 15-29 and 30-44 age groups than the London or national average. However, those wards in closest proximity to the route, Regent's Park and St Pancras and Somers Town, are more aligned with the average age structure for London (albeit with significantly higher proportions of the 15-29 age group)².

Indices of multiple deprivation

- 2.1.3 The English indices of multiple deprivation (IMD)³ measures relative levels of deprivation at LSOA level, and is made up of seven 'domains' of deprivation (income; employment; health; education, skills and training; barriers to housing and services; crime; and living environment).
- 2.1.4 The area around Euston Station shows a mixed pattern of deprivation, which is typical of inner London. The Regent's Park Estate and Somers Town, immediately west and east of Euston Station respectively, have relatively high levels of deprivation, falling within the 20% most deprived LSOAs in England. The area around Harrington Street to the west of the station approach lines and within the Regent's Park Estate is the most deprived area in the locality, falling just within the top 10% most deprived LSOAs in England. This area falls directly within the Proposed Scheme footprint and a number of properties here are proposed to be demolished.
- 2.1.5 The areas surrounding the Regent's Park Estate and Somers Town such as Camden to the north, Regent's Park to the far west, and Holborn to the south, have much lower levels of deprivation.

Ethnicity

- 2.1.6 ONS data ⁴ indicates that 30% of Camden's overall population is estimated to be from a minority ethnic background, which is the same as the average across London and considerably higher than the figure of 14% for England as a whole.
- 2.1.7 The largest ethnic minority group in Camden is 'Asian or Asian British' (16.1%).with Bangladeshis making up 5.7% and Indians 2.8% of total population. A significant Asian

¹ ONS (2010), Mid-Year Population Estimates

² ONS (2011) Age structure

³ Department for Communities and Local Government (2010). Indices of Deprivation

⁴ ONS (2011) Ethnic Group, 2011.

community is centred on Drummond Street, to the west of Euston Station. This LSOA also has a significant Chinese population at 8.7%, compared with a London average of 1.5%.

- 2.1.8 A large Bangladeshi community also exists, around Harrington Street, where most of the demolition of social housing will take place. In this location Bangladeshis account for 28.1% of the population. There is also a fairly high proportion of 'Black/African/Caribbean/Black British: African' people in this LSOA, at 9.1 %, compared with 7% for London as a whole.

Social grade

- 2.1.9 There is a significant percentage (23.9%) of the population in Regent's Park ward within the lowest social grade 'DE' (Semi-skilled and unskilled manual occupations, Unemployed and lowest grade occupations).
- 2.1.10 On the east side of Euston Station, in the ward of St Pancras and Somers Town, there is an even higher percentage of residents within the lowest social grades 'DE' at 33.1% which is significantly higher than the Camden, London and national averages of 17.7%, 22.4% and 25.5% respectively.

Health profile

IOD health deprivation and disability

- 2.1.11 The IOD for health deprivation and disability measures health deprivation based on years of potential life lost, illness and disability, acute morbidity and mood and anxiety disorders⁵. Those LSOAs closest to Euston Station and the proposed works all fall within the 20% most deprived on the IOD domain for health. The area around Park Village East to the north west of Euston Station and close to the Park Street tunnels falls within the 10% most deprived on the IOD for health deprivation and disability.

Rates and incidence of disease

- 2.1.12 In terms of the rates and incidence of disease, statistics from the Association of Public Health Observatories (APHO) show that Camden has a higher rate of heart disease and stroke, at 133.6 per 100,000 population compared with a London average of 118.6 and an England average of 114.5.
- 2.1.13 Rates for cancer and respiratory disease in Camden are on or around the London and national averages⁶.

Obesity

- 2.1.14 Obesity levels amongst children in Camden are just above the London and England average, but obesity levels amongst adults are significantly lower than both the London and England averages.

⁵ Department for Communities and Local Government, Indices of Deprivation (2010): IOD for Health deprivation and disability

⁶ APHO (2012), Health Profiles

Mental health

- 2.1.15 According to the APHO community mental health profile, the residents of Camden generally experience very good mental health, with below England average levels of depression amongst adults, low levels of emergency admissions for self-harm and low mortality rates for suicide and undetermined injury.

Life expectancy

- 2.1.16 Life expectancy provides an indicator of the general health of a population and the differences in health between different populations and socio-demographic groups. The ONS (2010) indicates that average life expectancy at birth 2008-2010 in England for males is 79.4 and for females, 82.4⁷. In Camden, life expectancy for males is lower than this, at 78.5, but for females is higher at 83.8.

Vulnerable groups

- 2.1.17 The following groups have been identified as being particularly vulnerable to health impacts within the Euston area.

Ethnic minority groups

- 2.1.18 Many of the capital's ethnic minority communities suffer elevated levels of poverty, violence, unemployment and ill health⁸. Most of the city's ethnic minority groups are likely to experience unemployment rates at twice the national average, with direct impacts upon wealth and socio-economic class. There is a strong link between poverty and well-being. Those in high-risk groups for poverty are also more likely to suffer health problems.

Lower social grades

- 2.1.19 Differences in social grade are linked to health inequalities. As outlined above, the area immediately around Euston Station contains a high proportion of people within the lowest social grades, with high numbers of residents being either on state benefit or unemployed lowest grade workers. The majority of those in the lowest social grades are living within social housing on the Regent's Park and Somers Town estates.

Children

- 2.1.20 The Maria Fidelis secondary school is located on two sites either side of Euston Station. The Lower School site is close to the works boundary on North Gower Street.

2.2 Employment and economy**Existing conditions**

- 2.2.1 In Camden, levels of employment amongst both men and women are just below the national average. Youth unemployment in Camden is relatively low, employment levels for those in the youngest age group (16-24) are significantly below the England and London averages⁹ due to the high student population.

⁷ <http://www.ons.gov.uk/ons/rel/lifetables/interim-life-tables/2008-2010/sum-ilt-2008-10.html>

⁸ www.london.gov.uk

⁹ ONS (2011), Annual Population Survey. As a proportion of working age population (16-64) by age and gender.

- 2.2.2 Levels of employment in the area surrounding Euston Station are relatively high compared with the England average, although there are a number of areas of low employment¹⁰. The area around Harrington Street on the Regent's Park Estate ranks within the 5% most deprived LSOAs for income, and 20% most deprived for employment. Additionally, most of the LSOAs in the Somers Town area fall within the 10% most deprived for employment.
- 2.2.3 The proportion of people classified as working in the construction industry in Camden is relatively low, at 2.1% compared with the London average of 6.6%. This figure rises to 3-5%¹¹ in the areas of Somers Town and the southern part of the Regent's Park Estate. In the Harrington Street area, which is most directly affected by the works, the proportion of construction workers is around 1%.

2.3 Housing

Existing conditions

- 2.3.1 The area to the immediate west of Euston Station around Cobourg Street, Euston Street, Drummond Street and Melton Street is generally characterised by three-storey terraced properties of a range of ages. Starcross Street is generally characterised by four storey flats
- 2.3.2 Somers Town to the east of Euston Station is characterised by medium rise blocks of local authority housing, progressing to high rise blocks on the Ampthill Square Estate.
- 2.3.3 The Regent's Park district to the west of Euston Station has a large quantity of social housing, primarily in and around the 1950s Regent's Park Estate. The estate is of relatively low density for a social housing estate, with a number of buildings, ranging from 3-8 storeys in height, located around squares, gardens and other open spaces.
- 2.3.4 To the north west of Euston Station, a mix of low rise housing including new detached houses to the north and five storey flats to the south, are located on Park Village East.
- 2.3.5 In terms of the IOD domain 'barriers to housing and services'¹², the area on the eastern edge of the approach lines to Euston Station and the area around Harrington Street on the Regent's Park Estate, both fall just within the 20% most deprived. All other areas on the Regent's Park Estate and Somers Town fall outside the 20% most deprived. However, in terms of the sub-domain 'wider barriers', which looks at only the housing element (including household overcrowding, homelessness and housing affordability) areas within the Regent's Park Estate generally fall within the 5-15% most deprived; areas on the Ampthill Estate fall within the 10% most deprived; and LSOAs within Somers Town fall within the 5-10% most deprived, indicating that there are significant issues in terms of access to high quality housing in and around the area of Euston Station.
- 2.3.6 Camden has a significant proportion of local authority owned housing (23,596 properties) as well as housing association owned property (11,389 properties). This

¹⁰ Department for Communities and Local Government, Indices of Deprivation (2010)

¹¹ ONS (2011) Industry, 2011

¹² Department for Communities and Local Government, Indices of Deprivation (2010)

equates to approximately 36% of all housing in Camden being social housing. This is significantly more than the 25% in the adjacent borough of Westminster, but significantly less than the 43% in the adjacent borough of Islington¹³.

- 2.3.7 Housing waiting lists indicate that in Camden in 2011 there were 17,052 households on the waiting list (excluding households looking for transfers). This represented 15.9% of all households in the borough. This was significantly more than in the neighbouring borough of Westminster where 7.3% of all households were on the housing waiting list; and more than the adjacent borough of Islington where 12.7% of all households were on the waiting list¹⁴. This indicates that demand for social housing within the borough outweighs availability.
- 2.3.8 London Borough of Camden undertook a housing needs survey¹⁵ of households potentially affected by HS2.
- 2.3.9 The housing needs survey reports that there are:
- 121 children living within the safeguarded area and 222 children living adjacent to the safeguarded area;
 - 8% of tenants will need disability alterations if rehoused;
 - four tenants will be interested in sheltered accommodation; and
 - other requirements that will be met by providing homes to a Lifetime Homes Standard.

2.4 Noise

Existing conditions

- 2.4.1 The existing baseline sound environment for this area is typical of urban central London.
- 2.4.2 Sound levels are high in close proximity to busy multi-lane roads, such as Euston Road, where daytime sound levels are typically around 75 dB¹⁶. However, due to the screening provided by buildings and other structures, sound levels can be much lower (typically 55 to 60dB) on side roads away from the major thoroughfares.
- 2.4.3 To the north of Euston Station, sounds from existing trains (including 'wheel squeal'), traffic on Hampstead Road and other local roads contribute to the prevailing sound environment. Here, daytime sound levels are typically 65 to 70dB.
- 2.4.4 To the east of the station, sound from traffic on the A4200 Eversholt Street, a relatively busy road, dominates the sound environment and daytime sound levels are typically around 70dB. Side roads away from the station have lower sound levels, due to the screening effect of buildings and other obstacles between these locations and

¹³ GOV.uk. Table 100 Dwelling stock: Number of Dwellings by Tenure and district: England; 2011

<http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/stockincludingvacants/livatables/>

¹⁴ Table 600 Rents, lettings and tenancies: numbers of households on local authorities' housing waiting lists, by district: England 1997-2011.

<http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/stockincludingvacants/livatables/>

¹⁵ London Borough of Camden (2013) Housing Needs Survey for properties affected by the High Speed Two (HS2) plans in Camden

¹⁶ Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,16hr}$.

the main road traffic sound sources, resulting in daytime sound levels of typically 55 to 60dB.

- 2.4.5 Located to the south of the station is the A501 Euston Road, which is a very busy cross London route. Local to this road, traffic movements, including many buses and HGV, generate sound levels during the day of around 75dB. Further to the south, smaller side roads can be screened from the busy main roads typically experiencing sound levels around 65dB. Local traffic still dominates the sound environment.
- 2.4.6 To the west of the station, at St James's Gardens and adjacent areas, sound levels are relatively low for an urban environment. Daytime levels are typically around 55dB, due to the screening of the main road traffic sound by buildings and other obstacles. The playground of Maria Fidelis (Lower) School borders St James's Gardens and also experiences existing sound levels which are relatively low for such an urban location.
- 2.4.7 Night-time sound levels¹⁷ across the area are 2 to 4dB lower than the daytime level where it is dominated by road traffic on busy main roads and 5 to 8dB lower in locations further away from these roads.

2.5 Local environment

Existing conditions

Local Character

- 2.5.1 The immediate area around Euston Station is currently characterised by the large scale of the station building and the depots and warehouses along Cardington Street and Barnby Street, and the high-rise offices to the front of the station.
- 2.5.2 Somers Town to the east of Euston Station is characterised by medium and high rise blocks of local authority housing, as well as Camden High Street and the Georgian terraces at Mornington Crescent to the north.
- 2.5.3 The Regent's Park district, to the west of Euston Station is characterised by a relatively low density for a social housing estate, with a number of buildings, ranging from 3-8 storeys in height, located around a variety of squares, gardens and other open spaces.

Green spaces

- 2.5.4 Key areas of green space likely to be affected by the proposed works include:
- St James's Gardens to the west of Euston Station;
 - Euston Gardens to the immediate south of Euston Station;
 - Eskdale Play Area on the Regent's Park Estate, located to the west of Stanhope Street; and
 - Hampstead open space on the west side of Hampstead Road – including a children's playground.

¹⁷ Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr}$.

- 2.5.5 Other areas of open space in close proximity to the works include:
- Cumberland Market, Munster Square, Clarence Gardens, Hope Gardens on the Regents Park Estate; and
 - Tolmers Square between North Gower Street and the Hampstead Road.

2.6 Physical activity

Existing conditions

Levels of physical activity

- 2.6.1 Within Camden, levels of physical activity amongst adults (i.e. those participating in 30 minutes moderate intensity sport) is just below the London and England average¹⁸.
- 2.6.2 Amongst children, levels of physical activity (percentage of school children who participate in at least 3 hours of high quality PE and school sport within and beyond the curriculum) are just above the London and England average¹⁹.
- 2.6.3 Existing opportunities for exercise within the works area include:
- A multi-use games area, including a basketball/five-a-side football court in the eastern corner of St James's Garden Open Space;
 - Eskdale Play Area on Stanhope Street in the north of the Regent's Park Estate;
 - Hampstead Road Open Space on the west side of Hampstead Road – including children's playground; and
 - A children's playground on Lancing Street to the north of Wellesley House.

2.7 Access to services

Existing conditions

- 2.7.1 Services available in the local area include:
- a range of food and retail outlets within Euston Station and a number of food and drink establishments on the plaza to the south of the main station building;
 - a range of convenience stores, specialist ethnic food shops, pubs and restaurants on Drummond Street to the immediate west of the existing Euston Station;
 - numerous shops, restaurants and public houses;
 - small parade of shops and restaurants on Hampstead Road;
 - small parade of shops on Stanhope Street on the Regent's Park Estate; and
 - shops and services along Parkway, just to the east of the route, including a

¹⁸ APHO (2010), Health Profiles.

¹⁹ APHO (2010), Health Profiles.

cinema, bank and several public houses.

- 2.7.2 There is also an educational establishment in the local area, which is the Maria Fidelis School on North Gower Street.

IOD geographical barriers sub-domain (barriers to housing and services)

- 2.7.3 No LSOAs in the Euston area fall within the 5%-20% most deprived in terms of the geographical barrier sub-domain within the barriers to 'housing and services' IOD. Two LSOAs (that cover the station and the roads to the west around Euston St, Cobourg St and Drummond St and the west side of Euston Station)) fall within the 5% least deprived, the Amptill Estate area north of Euston Station falls within the 10% least deprived and the east side of Euston Station falls within the 20% least deprived²⁰.

2.8 Traveller stress

Existing conditions

Road networks

- 2.8.1 Key road routes crossing the proposed works and likely to be directly affected by them include:
- A501 Euston Road which runs along the front of Euston Station;
 - A400 Hampstead Road which crosses the railway just north of Euston Station;
 - Granby Terrace which crosses the railway just north of the Hampstead Road Crossing;
 - Mornington Street;
 - A4201 Parkway; and
 - A4200 Eversholt Street.

Public transport networks

- 2.8.2 Euston Station is a major transport interchange and a terminus for intercity and local trains. The station is served by two London Underground Limited (LUL) lines. These are the Victoria and the Northern Line (both Charing Cross and Bank branches). Euston Square underground station, which is served by the Circle, Hammersmith & City and Metropolitan Lines, is about 300m from Euston Station, west along Euston Road. There is a bus station served by 12 bus routes at the front of the station and a taxi rank under the station.

²⁰ Department for Communities and Local Government (2010) 'LSOA level sub-domain scores for the Barriers to Housing and Services domain from the Indices of Deprivation

2.9 Social capital

Existing conditions

- 2.9.1 'Social capital' comprises connections between individuals within and between communities, and the inclination that arises through these networks for individuals to feel valued, to feel a sense of belonging, to have companionship and to tangibly support each other.

Community facilities

- 2.9.2 The key community facilities in the area directly affected by the proposed works are The Old Tenants Hall on Harrington Street in the Regent's Park Estate and the Bree Louise public house on Euston Street.
- 2.9.3 Other community facilities are located within 500m of the proposed works but they are not affected by the proposed works.

Social capital

- 2.9.4 A 2008 survey of social capital in Camden looked at trust and reciprocity; perception of and identification with neighbourhood; control and self-efficacy; participation, social engagement and commitment; social interaction, social networks and social support; and cohesion, respect and diversity.
- 2.9.5 The survey identified that there appears to be a strong sense of social cohesion amongst residents, with the majority of residents (56%) agreeing that their neighbourhood is a place where people from different cultures and religions get on well together. Nearly nine in ten (87%) of residents are satisfied with their neighbourhood as a place to live, which is higher than the national average of 78%. Furthermore, residents generally agree that they feel part of the local neighbourhood (74%).
- 2.9.6 However, there appears to be a slight degree of contradiction in perceptions, as the survey results indicate that there has been a decline of six percentage points since 2005 in terms of the proportion of residents who agree their neighbourhood has a good sense of community (from 73% to 67%). Similarly, more residents in 2008 now believe that most people are trying to move out of their area (20% in 2008 compared to 14% in 2005), and that nobody cares about the neighbourhood (19% compared to 17%).

3 London Corridor and Old Oak Common

3.1 Community profile

- 3.1.1 The community profile is based on available data at local authority, ward and Lower Super Output Area (LSOA) level.

Demographic profile

Population trends

- 3.1.2 The age structure profiles²¹ of the local authorities within this area are broadly similar to the London Region averages.
- 3.1.3 The Westminster and Camden have had the highest population growth²² (8.1% and 7.8% respectively) between 2005 and 2010. In LB Ealing population growth in this period was 3.6%. The LBs of Brent, Hammersmith & Fulham and Kensington and Chelsea have all had less than 1% growth over the same period.

Hammersmith & Indices of multiple deprivation

- 3.1.4 In terms of IMD areas along the London Corridor show a mixed pattern of deprivation. In areas where potential impacts may occur such as around construction compounds and ventilation shafts, eight LSOAs have been identified as experiencing relatively high levels of deprivation; one in the 5% most deprived in England (south east of Queen's Park London Underground station and Salusbury Road ventilation shaft), one in the 10% most deprived (south west of Queen's Park London Underground station and Salusbury Road ventilation shaft) and six in the 20% most deprived around Camden Town and location of Juniper Crescent construction compound; north west of South Hampstead London Underground station, around Camley Street construction compound; north of Queen's Park London Underground station and location of Salusbury Road ventilation shaft; north of Willesden Euro Terminal and Atlas Road construction compound) and the area south west of Wormwood Scrubs centred around Wulfstan Street.
- 3.1.5 South of the West Ruislip Portal construction compound is the only LSOA within the London corridor in the 20% least deprived in England.
- 3.1.6 Other IOD domains are described in the relevant sections below.

Ethnicity

- 3.1.7 The London Corridor has a high level of ethnic diversity, typical of London generally. The proportion of people in the 'White British' ethnic group ranges between 30.4% and 52.5%²³ across the area. 'Asian or Asian British' is the largest ethnic minority group in the London Boroughs of Brent, Camden, Westminster, Kensington and Chelsea, Ealing and Hounslow, and in Islington and Hammersmith & Fulham the largest minority group is 'Black or Black British'²³. There are a large number of people

²¹ ONS (2011), Age Structure

²² ONS (2010), Mid-Year Population Estimates. Population Past Trends

²³ ONS (2011), Ethnic Group.

in the 'Arab' group in Westminster, at 7.2% compared to the London and England average of 1.3% and 0.4% respectively.

- 3.1.8 Ward level data shows that there are large populations of specific ethnic minority groups in some wards affected by the Proposed Scheme. For example there are a high number of 'Bangladeshi' people in Haverstock ward (the location of the Camden tunnel portal and Adelaide ventilation shaft) and Queen's Park ward in Westminster (the area south and west of Salusbury Road ventilation shaft) at 8.4% and 6.7%, compared to the London average of 2.7%. There are higher than average proportions of 'Arab' people in Hanger Hill (the location of Westgate ventilation shaft) and Queen's Park ward, at 6.9% and 7.2% compared to the London average of 1.3%²³. The largest ethnic minority group within the College Park and Old Oak ward, east of Old Oak Common Lane, is 'Black/African/Caribbean/Black British' with a population of 21.1% which is higher than the Hammersmith & Fulham and London averages of 9.1% and 18.4% respectively. Within the East Acton ward 'Asian/ Asian British' is the largest ethnic minority group with a population of 17.3% but is lower than the Ealing and London averages of 29.6% and 18.4%.

Social grade

- 3.1.9 There is a relatively low proportion of the lowest social grade (DE Semi-skilled and unskilled manual occupations, Unemployed and lowest grade occupations) in Kensington and Chelsea (14.8%) and a higher proportion (28.2) in the London borough of Brent, compared to the London average of 22.4%.

Health profile

IOD health deprivation and disability

- 3.1.10 The (IOD) for health deprivation and disability measures health deprivation based on years of potential life lost, illness and disability, acute morbidity and mood and anxiety disorders²⁴. Three LSOAs within the area fall within the 20% most deprived in terms of 'Health and Deprivation and Disability'²⁵. These are in the areas south East of Queen's Park London Underground station and Salusbury Road ventilation shaft; south west of Queen's Park London Underground station and Salusbury Road ventilation shaft and west of Alexandra Place ventilation shaft.

Rates and incidence of disease

- 3.1.11 Statistics from the APHO in terms of rates and incidence of disease show that five local authorities have a higher rate of early death from heart disease and stroke²⁶ compared to the London region average of 118.6 and England average of 114.5 per 100,000 population. These are the Brent at 120, Camden at 133.6, Ealing at 121.9 and Hammersmith & Fulham at 119.8 per 100,000 population. Islington is significantly higher at 150.7 per 100,000 population.
- 3.1.12 The local authorities along the route fall equally above and below the London region average for rates of early deaths from cancer. Islington has a significantly higher rate

²⁴ Department for Communities and Local Government, (2010) Indices of Deprivation: IOD for Health deprivation and disability

²⁵ Department for Communities and Local Government, (2010) Indices of Deprivation: IOD for Health and Deprivation and Disability

²⁶ APHO, (2012) Local health Profiles: Early Deaths from Heart Disease and Stroke. Early Death from Heart Disease and Stroke

at 135.5 per 100,000 population compared to the London Region and England averages of 106.1 and 110.1²⁷.

- 3.1.13 Kensington and Chelsea, Westminster and Hammersmith & Fulham have low rates of respiratory disease, at 52.9%, 62.2% and 82.8% observed deaths as a percentage of expected deaths, based on figures for England as a whole. Two local authorities, Brent and Islington, have higher than expected observed rates of respiratory disease²⁸.

Obesity

- 3.1.14 Statistics for obesity in children (age 0-16) show that obesity levels within Brent (23.7%), Camden (22.5%), Hammersmith & Fulham (23.7%) and Westminster (22.8%) are above the London Region and England averages of 21.9% and 19%²⁹. In contrast, obesity in adults (those above the age of 16) within all local authorities except for Brent and Hillingdon are below the London region (20.7%) and England (24.2%) averages. Kensington and Chelsea and Hammersmith & Fulham are significantly lower at 13.9% and 15.6%²⁹.

Mental health

- 3.1.15 According to the APHO community mental health profile³⁰, all local authorities in the area have relatively good statistics on mental health. All local authorities have below England average levels of emergency hospital admissions for self-harm and depression amongst adults (18 years and above) except for Islington which has a slightly higher level of depression amongst adults (12.41%) compared to the England average (11.19%). Three local authorities have above England average (100) levels of mortality rate for suicide and undetermined injury: Ealing at 119.50, Hammersmith & Fulham at 124.15 and Islington at 169.89. The mortality rate for suicide and undetermined injury for Islington, at 170.00, is close to the England worst of 173.65.

Life expectancy

- 3.1.16 Life expectancy provides an indicator of the general health of a population and the differences in health between different populations and socio-demographic groups.
- 3.1.17 The ONS (2011)³¹ indicates that all local authorities within this area have higher life expectancies at birth (2009-2011) than the England averages of 78.9 years for males and 82.9 years for females.

Vulnerable groups

- 3.1.18 The following groups have been identified as being particularly vulnerable to health impacts within the London Corridor area.

Lower socio-economic groups

- 3.1.19 There is a significant percentage (21.9%) of the population in the lowest social grade (DE Semi-skilled and unskilled manual occupations, Unemployed and lowest grade

²⁷ APHO, (2012) Local Health Profiles: Early Deaths from Cancer

²⁸ APHO, (2012) SMR for Respiratory Disease in persons of all ages

²⁹ APHO (2012) Health Profile. Obesity rates Children (0-16) and Adults

³⁰ APHO, Community Mental Health Profiles (2012). Community mental health profile

³¹ ONS, (2011), Male and Female Life Expectancy 2009-2011

occupations) in the College Park and Old Oak ward, where Old Oak Common station will be located.

3.2 Employment and economy

Existing conditions

- 3.2.1 The area south east of Queen's Park London Underground station and the Salusbury Road ventilation shaft falls within the 5% most deprived in terms of 'Employment'³² and the areas south west of Queen's Park London Underground station and the Salusbury Road Ventilation shaft falls within the 10% most deprived. The area in Camden Town around the Juniper Crescent construction compound, the area where Camley Street construction compound is located, the area north of Willesden Euro Terminal and Atlas Road construction compound and the area south west of Wormwood Scrubs Park, bounded by Old Oak Common Lane to the west and the A40 Westway to the south all fall within the 20% most deprived in terms of 'Employment'.
- 3.2.2 The areas south east and south West of Queen's Park London Underground station and the Salusbury Road ventilation shaft fall within the top 5% most deprived in terms of 'Income'³³. The area in Camden Town around the Juniper Crescent construction compound and the area where the Camley Street construction compound is located fall within the 10% most deprived in terms of 'Income'. The area west of Adelaide Road ventilation shaft, the area north west of South Hampstead London Underground station, and the three LSOAs that cover areas to west of Old Oak Common and north of Willesden Euro Terminal and Atlas Road construction compound, all fall within the 20% most deprived in terms of 'Income'.
- 3.2.3 Levels of employment amongst both men and women in Brent, Camden, Hammersmith & Fulham, Kensington and Chelsea and Westminster are below the London and England averages. Employment in Ealing for both men and women is higher than the London and England averages³⁴.
- 3.2.4 Employment levels differ between ethnic minority groups, with the lowest levels being amongst the 'Pakistani / Bangladeshi' ethnic group in Brent (60.7%), Hammersmith & Fulham (33.3%) and Hillingdon (61%).

3.3 Housing

Existing conditions

- 3.3.1 The HS1-HS2 link section of the route runs through an urban environment comprised largely of Victorian terraced housing around the historic core of Camden.
- 3.3.2 Moving westwards, the route runs in tunnel through areas comprised of Georgian and Victorian terraces in the Primrose Hill area before changing to further terraced housing and the extensive high rise blocks of the South Kilburn Estate as the route heads towards Old Oak Common.

³² Department for Communities and Local Government, Indices of Deprivation (2010): IOD for Employment

³³ Department for Communities and Local Government, Indices of Deprivation (2010): IOD for Income

³⁴ ONS (2011), Annual Population Survey. As a proportion of working age population (16-64) by age and gender. Economically Active by Gender and Age Group

- 3.3.3 Around Old Oak Common, high densities of housing are located within 20m to the east of the construction site boundary on Stephenson Street and two communities, at Wells House Road and Midland Terrace, are partially encircled by construction sites. At Wells House Road, there is a triangle-shaped area of 121 residential properties bordered by existing railway lines and the construction site at Victoria Road, accessed via Old Oak Common Lane.
- 3.3.4 Beyond Old Oak Common the area is predominantly suburban in nature, generally characterised by streets of inter-war housing, and becomes more rural in character north and north-west of Ickenham.
- 3.3.5 In terms of the IOD 'Barrier to Housing and Services'³⁵ the area south east of Queen's Park London Underground station, the area around Acton London Underground Station and the area around Wells House Road fall within the 5% most deprived. The area north and south west of Queen's Park London Underground station and the Salusbury Road ventilation shaft, the area around West Gate ventilation shaft, the areas west of Old Oak Common Lane and the area south west of Wormwood Scrubs Park (fall within the 10% most deprived. Six other LSOAs fall within the 20% most deprived.
- 3.3.6 All local authorities are dominated by 'Private Sector' housing³⁶. However LB Camden, Hammersmith & Fulham and Islington have significant proportions of local authority housing and housing association property equating to approximately 36%, 32% and 43% respectively of all housing in these local authorities.

3.4 Noise

Existing conditions

- 3.4.1 Through the section of the route linking HS2 to HS1, the existing baseline sound environment is typical for a central London urban environment with significant contributions from the existing rail sources and roads.
- 3.4.2 As with the majority of central London, even on less-frequented side roads there is a fairly constant sound level from road traffic, which means that baseline levels tend to remain relatively high in most locations. Sound levels are typically high at receptors located close to busy roads, where daytime sound levels are typically around 70dB, however, due to the screening provided by buildings and other obstacles sound levels are typically around 10dB lower on side roads away from main traffic routes.
- 3.4.3 With the exception of the vent shaft at Salusbury Road, the station at Old Oak Common and the Victoria Road crossover box, the Proposed Scheme runs in tunnel from Kilburn to the Old Oak Common area and from Old Oak Common to West Ruislip. Therefore the existing baseline sound assessment is focused around the vent shafts at Adelaide Road, Alexandra Place, Salusbury Road, Westgate, Greenpark Way and Mandeville Road, and South Ruislip; around the proposed station at Old Oak

³⁵ Department for Communities and Local Government, Indices of Deprivation (2010). : IOD for Barriers to Housing and services

³⁶ Department for Communities and Local Government. Table 100 Number of Dwellings by Tenure and district: England; 2011. Dwelling Stock Tenure

Common; and around the West Ruislip portal and locations adjacent to the surface sections of the line between West Ruislip and Ickenham.

- 3.4.4 In the area around the Adelaide Road vent shaft the baseline sound environment is dominated by road traffic on the B509 Adelaide Road and other surrounding roads. Typical daytime sound levels of around 70dB along the B509 Adelaide Road reducing to around 55dB in locations screened from the major roads.
- 3.4.5 In the area surrounding the Alexandra Place vent shaft the dominant sound source is traffic on the surrounding roads and daytime sound levels are typically 55dB. Sound from trains on the nearby rail lines is also intermittently audible in this area.
- 3.4.6 The existing baseline sound environment around the vent shaft site at Salusbury Road is typical for an urban situation with busy main roads and nearby railways. Daytime sound levels are typically 65 to 70dB in the vicinity of the railway bridge, where existing sound levels are determined by the nearby NLL railway, B413 Kilburn Lane and Salusbury Road.
- 3.4.7 The existing baseline sound environment around the proposed Old Oak Common station site consists of a mixture of transport, industrial and commercial sources. In much of the area, the soundscape is dominated by nearby road and rail traffic, with distant road traffic from the A40 audible in some locations. This leads to a large variation in sound level dependent upon location, and daytime sound levels typically range between 55dB and 75dB. During less busy periods of road and rail traffic flow, natural sound sources are more apparent.
- 3.4.8 In the area around the Westgate vent shaft, the sound environment is dominated by the sound of road traffic on the A40 Western Avenue and other nearby roads (daytime sound levels are typically 76dB for properties near the A40 Western Avenue and 60dB for properties off Westgate).
- 3.4.9 The main sound sources in the area surrounding the Greenpark Way vent shaft are trains running on the nearby LUL Central line and local road traffic (daytime sound levels are typically 53dB for properties on Greenpark Way and Conway Crescent). Sound from nearby commercial and industrial activities is also audible in some locations.
- 3.4.10 In the vicinity of the Mandeville Road vent shaft the main sound sources are traffic on the A312 Mandeville Road and trains on the Central line (daytime levels are typically 49dB to the rear of properties on Carr Road and 53dB to the rear of properties on Belvue Road).
- 3.4.11 To the west of the area, road traffic from Harvil Road, Breakspear Road South and the B466 Ickenham Road and railway traffic from the Chiltern Main Line and Central line are the principal sound sources giving rise to daytime sound levels of typically around 65dB.
- 3.4.12 In Ickenham, to the south of the Central line, the area is mainly residential. Close to the B466 Ickenham Road and Breakspear Road, traffic on these roads dominates the soundscape and daytime sound levels are typically around 60dB. Close to the Central line, the sound of trains adds to that of road traffic that has been screened by

buildings, resulting in similar daytime sound levels of around 60dB. Further into the residential area, lower levels of sound are audible from the distant busier roads. This is added to by sounds from traffic on local roads. Intermittent sound from aircraft is audible in most of these locations and daytime sound levels are typically 50 to 55dB.

- 3.4.13 In West Ruislip, to the north of the Central line, road traffic is the dominant sound at the majority of locations. Close to the B466 Ickenham Road daytime sound levels are typically around 75dB. Further away from this busy road in the residential area around Hill Lane, Glenhurst Avenue and Woodville Gardens, the constant sound of distant road traffic adds to intermittent local road traffic, high-altitude aircraft, distant trains and community activities, resulting in typical daytime sound levels of around 55dB.
- 3.4.14 There are some relatively isolated properties along Harvil Road and traffic on this route is the dominant sound source at these properties. Properties closer to the road experience higher sound levels (typically around 75dB), than properties set further back from the road (55 to 60dB).
- 3.4.15 The sound from large vehicles travelling to and from the waste transfer station at New Years Green are noticeable at properties on New Years Green Lane, adding to the sound of distant road traffic. Typical sound levels in this location are 55 to 60dB.
- 3.4.16 In the majority of locations, night-time sound levels, away from main roads, are generally 5 to 10 dB lower than daytime. Night-time sound levels in the HS1 link area are typically 3 to 4dB lower than those during the day in locations where the sound environment is dominated by busy main roads. In more remote residential areas, at the western end of the area, levels are approximately 10 to 15dB lower.

3.5 Local Environment

Existing conditions

Spatial layout

- 3.5.1 The London Corridor is densely populated and predominately urban in nature, and characterised by residential, commercial and some industrial development which lines the majority of the proposed route.
- 3.5.2 The Camden section of the route the area largely comprises Victorian terraced housing, some Georgian terraced housing around Primrose Hill, and estates originally built by local authorities, notably the Alexandra and Ainsworth Estate on Loudoun Road. There is some industrial and modern residential development adjacent to the mainline railway, along with the Regent's canal and some main roads. The topography is generally flat, with the exception of Primrose Hill.
- 3.5.3 Kilburn and Queen's Park is primarily terraced housing with the extensive South Kilburn Estate to the south. The Grand Union Canal and Kensal Green Cemetery lie to the south with the open space area of Queen's Park and Paddington Cemetery to the north.
- 3.5.4 Old Oak Common is an extensive area of railway infrastructure with isolated pockets of mainly 19th century housing within a largely industrial and commercial setting.

- 3.5.5 The Northolt corridor to Ickenham area is predominantly suburban in character and includes a large business park at Park Royal with large areas of light industry and commercial use. Horsenden Hill and Sudbury golf course lie to the north providing open space. West Action includes large areas of late 19th and early 20th Century terraced housing. As well as the Grand Union Canal, the River Brent flows east to west crossing the route in the vicinity of Manhattan Business Park.
- 3.5.6 The area from South Ruislip to Ickenham becomes more rural in character and has a mixed pattern of residential properties, industry, open space, farmland, and road and rail links. Residential estates at Ruislip Gardens and Ruislip Manor comprise large areas of terrace housing with some light industry on Victoria Road. Ruislip Gardens is occupied by RAF Northolt and Northolt Aerodrome. Ickenham mainly comprises inter-war housing with wide streets.

Open spaces

- 3.5.7 The principal open space areas in the London Corridor area include:
- Camden Gardens, the Baynes Street Nature Reserve, the Adelaide Road Local Nature Reserve; the linear open space associated with the Regent's Canal and open space on Leybourne Street, are adjacent to the route within LB Camden; and
 - around Old Oak Common there is open space at Victoria Gardens, which includes a children's play area. In addition, open space is also located at Cerebos Gardens, a strip of grass directly north-east of Victoria Gardens.

3.6 Access to services

Existing conditions

Access to services

- 3.6.1 Shops and services are present throughout the HS1 link area and are focused on A502 Camden High Street and A400 Kentish Town Road (both crossed by the route). Camden Market, centred on Camden Lock and Camden High Street, is an important local and district resource which attracts large numbers of visitors. There are also a number of important cultural facilities located close to the Proposed Scheme, such as the Roundhouse arts venue on A502 Chalk Farm Road adjacent to the route.
- 3.6.2 Around the Alexandra Place ventilation shaft in LB Camden, there is a parade of shops and restaurants on Loudoun Road / Langtry Walk. There are three places of worship within 250m of the Proposed Scheme: South Hampstead Synagogue and St Saviours Parish Church on Eton Road; and St Mary the Virgin Church on Elsworthy Road. St Paul's Church of England Primary School is located on Elsworthy Road and the Ready Steady Go Nursery is on Alexandra Road. St John's Wood Care Home is located to the south-west of the vent shaft at Alexandra Place.
- 3.6.3 Shops and services are located on Kilburn Lane approximately 300m from the Salusbury Road ventilation shaft within LB Brent. There are a number of educational facilities on Kilburn Road including Salusbury Primary School and Bales College independent sixth form college. Kilburn Library is located on the Kilburn Road and

Hope Hall Community Centre is located on Kilburn Lane. New Life Bible Presbyterian Church on Salusbury Road is the closest place of worship to this site.

- 3.6.4 Around Old Oak Common there is a local convenience store located on Old Oak Lane opposite Channel Gate Road, and Old Oak Café on the junction of Old Oak Lane and Old Oak Common Lane,. The main shops and services located closest to Old Oak Common are located on Harrow Road (approximately 600m away), and College Road (just over 1km away), to the north east of Old Oak Common.
- 3.6.5 Within the LB Ealing, within 1km of Mandeville Road ventilation shaft, there are shops located on Station Parade to the south Northolt Leisure Centre, Northolt Library and Northolt Baptist Church to the north east. There are a selection of shops and services on Ashbourne Parade, Hanger Lane Abbey Parade and Connell Crescent all within 1km of the West Gate ventilation shaft. The Westway Retail Park is located on Greenpark Way and a range of shops near Greenford Station within 400m of the Green park Way ventilation shaft.
- 3.6.6 In the South Ruislip to Ickenham area, the main shops and services are located on Civic Way, Stonefield Way, Ruislip High Street and the High Road in Ickenham. In addition, neighbourhood shops are located throughout the residential parts of the area.

IOD geographical barriers sub-domain (barriers to housing and services)

- 3.6.7 In terms of the geographical barriers IoD sub-domain (within the barriers to 'housing and services' IOD), one LSOA –covering the area south west of Salusbury Road ventilation shaft falls within the 5% least deprived, three LSOAs (at the location of Salusbury Road ventilation shaft, covering the northern tip of Willesden Euro Terminal and Atlas Road construction compound and to the west of Adelaide road ventilation shaft fall within the 10% least deprived²⁰.

3.7 Traveller stress

Existing conditions

Road networks

- 3.7.1 Key roads that interact with the proposed works and that are likely to be directly affected by the works include:
- Granby Terrace;
 - Hampstead Road Bridge;
 - Mornington Street Bridge;
 - A501 Euston Road (between Churchway and Dukes Road);
 - A501 Euston Road/A400 Tottenham Court Road;
 - A501 Euston Road/A4200 Eversholt Street/A4200 Upper Woburn Place;
 - A4200 Eversholt Street/Lidlington Place;
 - A501 Euston Road/A5202 Pancras Road; and

- A400 Hampstead Road/Drummond Street.

Public transport networks

- 3.7.2 A large number of day-time and night-time buses provide services across much of the area.
- 3.7.3 The North London Line which is part of the London Overground railway network includes stations at Camden Road, Kilburn High Road and South Hampstead
- 3.7.4 London Underground stations within the area include Camden Town and Chalk Farm for the Northern Line, Finchley Road, Swiss Cottage and St John's Wood for the Metropolitan and Jubilee Lines, a number of stations for the Bakerloo Line and Hanger Lane, Perivale, Greenford, Northolt, South Ruislip, Ruislip Gardens and West Ruislip on the Central Line
- 3.7.5 Network Rail stations include Greenford, South Ruislip and West Ruislip.
- 3.7.6 Willesden Junction station, which is served by London Underground, London Overground and main line trains, is located just to the north of the Willesden EuroTerminal and Atlas Road construction compound at Old Oak Common. North Acton underground station lies approximately 500m to the west of the proposed Old Oak Common Station location. Existing bus connections to and from the proposed Old Oak Common Station site are limited

Cycling

- 3.7.7 There is a cycle hire docking station near Chalk Farm Road and several streets in the area are on the London Cycle Network, with many routes on streets to the north of the Regent's Canal.

3.8 Social capital

Existing conditions

- 3.8.1 The London Corridor is densely populated and predominately urban in nature, with a large number of communities potentially affected by the Proposed Scheme.

Community facilities

- 3.8.2 Community facilities in the area directly affected by the Proposed Scheme include:
- the Nadi Park Royal Mayfair Islamic Centre at the northern end of Old Oak Common Lane;
 - West Ruislip Golf Club; and
 - West Ruislip Rifle Club.

4 Country South Corridor

4.1 Community profile

- 4.1.1 The community profile is based on available data at local authority, ward and Lower Super Output Area (LSOA) level.

Demographic profile

Population trends

- 4.1.2 The age profile of all local authorities in the area is broadly similar to the regional averages, with the exception of LB Hillingdon, which has a high proportion of people in the 60-74 age bracket, 11.3% compared to the London region average of 4.2%. The Chiltern and South Northamptonshire districts have lower proportions of the 15-29 age group of 14% and 14.3% respectively compared to their respective regional averages of 18.6% and 19.5%³⁷
- 4.1.3 South Buckinghamshire district and LB Hillingdon have had the largest population growth figures³⁸ of 6.1% and 5.7% between 2005 and 2010. Wycombe and the Chiltern districts have had the lowest population growth (1.9% and 1.7% respectively).

Indices of multiple deprivation

- 4.1.4 No LSOAs along the HIA area for this section of route fall within the 20% most deprived in terms of the IMD.
- 4.1.5 Ten LSOAs fall within the 20% least deprived in terms of the IMD. These are generally located in Aylesbury Vale and the Chiltern area.
- 4.1.6 Other IOD domains are described in the relevant sections below.

Ethnicity

- 4.1.7 LB Hillingdon has a higher proportion of non-'White British' residents than the rest of the area. The percentage of 'White British' people in this authority is 52.2%, compared to the other districts along the route which range from 76% to 94.1%³⁹. The largest ethnic minority group across all districts in the Country South area is 'Asian or Asian British'.

Social grade

- 4.1.8 The Chiltern, South Buckinghamshire, Three Rivers and South Northamptonshire districts all have lower proportions of the lowest social grade (DE Semi-skilled and unskilled manual occupations, Unemployed and lowest grade occupations) at 12.4%, 11.7%, 15% and 15.1% respectively compared to their respective regional averages of 19.9% for the South East, 22.8% for the East of England and 27.9% for the East Midlands⁴⁰.

³⁷ ONS (2011) Age Structure

³⁸ ONS (2010), Mid-Year Population Estimates. Population Past Trends

³⁹ ONS (2011), Ethnic Group

⁴⁰ ONS (2011), Census. Social Grade.

Health profile

IOD health deprivation and disability

- 4.1.9 No LSOAs fall within the 20% most deprived in terms of health deprivation and disability⁴¹.

Rates and incidence of disease

- 4.1.10 Statistics from the APHO show that all but the Wycombe district has a lower rate of early death from heart disease and stroke⁴² compared to their respective regional and England averages. Wycombe has a rate of 95.8 per 100,000 population, which is slightly higher than the South East region rate of 95.5 per 100,000 population.
- 4.1.11 All but the Cherwell district have lower rates of early death from cancer⁴³ than their respective regional and England averages. Cherwell has a rate of 106.3 per 100,000 population which is higher than the South East Region rate of 102.5 but still lower than the England rate of 110.1 per 100,000 population.
- 4.1.12 All local authorities have lower rates of respiratory disease observed as a percentage of expected deaths respectively compared to the England average of 100 except for Aylesbury Vale which higher rate of respiratory disease of 111.4⁴⁴.

Obesity

- 4.1.13 Obesity in children (age 0-16) within all districts except LB Hillingdon is below the associated regional and England averages. However child obesity in LB Hillingdon (23.2%) is above the England average of 19%⁴⁵.
- 4.1.14 Obesity in adults (those above the age of 16) within the majority of the districts is below the associated regional and England averages except for the Cherwell district and LB Hillingdon. Cherwell has an adult obesity level of 24% whereas the South East Region level is 23.7%. LB Hillingdon has an obesity level of 23.2% whereas the London Regional level is 20.7. Obesity levels in both areas however are still lower than the England average.

Mental health

- 4.1.15 According to the APHO community mental health profile⁴⁶, the residents in the local authorities across the area have a mixed pattern of mental health. All local authorities have above England average percentage of depression amongst adults (18 years and above) apart from Hertfordshire which has 11.11% compared with an England average of 11.19%. All local authorities have lower than the average England standardised rate for emergency hospital admissions for self-harm except for Northamptonshire which has a rate of 245.31 compared to the England average of 211.07. Two local authorities, Buckinghamshire (123.59) and Oxfordshire (105.61) have above the England average standardised mortality rate (100) for suicide and undetermined injury.

⁴¹ Department for Communities and Local Government, Indices of Deprivation (2010). : IOD for Health and Deprivation and Disability

⁴² APHO, (2012) Local health Profiles: Early Deaths from Heart Disease and Stroke. Early Death from Heart Disease and Stroke

⁴³ APHO, (2012) Local Health Profiles: Early Deaths from Cancer

⁴⁴ APHO, (2012) SMR for Respiratory Disease in persons of all ages

⁴⁵ APHO (2012), Health Profile. Obesity rates Children (0-16) and Adults

⁴⁶ APHO (2012), Community mental health profiles

Life expectancy

- 4.1.16 Life expectancy provides an indicator of the general health of a population and the differences in health between different populations and socio-demographic groups. All local authorities within the area have a higher than average life expectancy compared to the England averages

Vulnerable groups

- 4.1.17 No specific groups have been identified as being particularly vulnerable to health impacts within the Country South area.

4.2 Employment and economy

Existing conditions

- 4.2.1 No LSOAs in the Country South area are within the 20% most deprived in terms of the IOD for 'Income'⁴⁷.
- 4.2.2 One LSOA, covering the area south of Chalfont St Peter ventilation shaft and satellite construction site and includes the northern area of Chalfont St Peter falls within the 10% most deprived in terms of 'Employment'⁴⁸.
- 4.2.3 Levels of employment amongst men in the districts in the area are generally above the associated regional and England averages, except for the Three Rivers District, which has 78.8% male employment compared to 86.2% and 83.5% for the East of England and England. All but three districts have lower levels of female employment than their respective regions and England average. The Cherwell, Chiltern and South Northamptonshire districts have higher than average levels of female employment⁴⁹.
- 4.2.4 Employment in the 'Construction' Industry is equal to or higher than the England average of 7.7% in the LB Hillingdon (8.1%), Three Rivers (9%), South Buckinghamshire (7.8%), Aylesbury Vale (7.7) and the South Northamptonshire (7.9%) districts but slightly lower in the Chiltern, Cherwell and Wycombe districts, which have 7%, 7.4% and 7.2% respectively.

4.3 Housing

Existing conditions

- 4.3.1 Housing in the outer London suburbs and satellite conurbations, such as Ickenham and Ruislip at the southern end of the area is relatively dense compared with the rest of the area. However once outside of the M25, housing densities, reduce in areas such as Denham and Chalfont St Peter.
- 4.3.2 Further north-west along the route the properties include a high proportion of large detached properties and semi-detached properties within villages such as Hyde End, Chipping Warden, Dunsmore, South Heath, Stoke Mandeville and Thorpe Mandeville. There are also a number of individual properties in rural locations.

⁴⁷ Department for Communities and Local Government, Indices of Deprivation (2010). : IOD for Income

⁴⁸ Department for Communities and Local Government, Indices of Deprivation (2010). : IOD for Employment.

⁴⁹ ONS (2011), Annual Population Survey. As a proportion of working age population (16-64) by age and gender. Economically Active by Gender and Age Group

- 4.3.3 There is a greater mix of housing types within the larger towns such as Amersham, Wendover, Aylesbury and Brackley.
- 4.3.4 In terms of the IOD domain 'Barrier to Housing and Services'⁵⁰ seven LSOAs in the Country South area fall within the 20% most deprived, of which three are in the 10% most deprived, including the South Heath area north east of the route an area around the western section of the Thames Valley Viaduct, close to numerous construction sites, and the western section of the Greatworth green tunnel and associated construction sites. Seven of the LSOAs fall within the 5% most deprived in terms of 'Barrier to Housing and Services'. These include the area surrounding Colne Valley viaduct and Cone Valley Viaduct satellite construction and storage site; the area around the Leather Lane overbridge satellite construction site and Wendover Dean Viaduct satellite site and area to the north east of these locations; the area surrounding Greatmoor; the area west of West Street overbridge main construction compound and temporary workers accommodation and west of School Hill green overbridge satellite construction site; the northern section of the Westbury Viaduct, Westbury Viaduct launch, Brackley Road overbridge and Turweston green overbridge satellite construction sites; the area around the Nashlea Road overbridge satellite construction site and area predominately south and south west of this location and the location of Newton Purcell, London Road overbridge, Featherbed Lane overbridge satellite construction sites and a small section of the Westbury Viaduct in the south.

4.4 Noise

Existing conditions

- 4.4.1 The composition of the sound environment in the Colne valley area is typical of a mixture of settlements and isolated properties on the periphery of West London. Locations close to M25, A40 and M40 and the relatively busy A412 Denham Way/North Orbital Road daytime typically experience sound levels of 75 to 80dB
- 4.4.2 The distant North Orbital Road as well as local traffic gives rise to levels of around 55dB during the day reducing by around 7dB at night at Wyatt's Covert, 50dB reducing by around 7dB at night at Denham Grove (De Vere Hotel), 50 55dB reducing 6dB at night at the Savay Lake (north of Denham green) and 60dB for some properties within Denham Green reducing to around 45dB for properties set back into the village reducing by 5 to 10dB lower at night. Community activity contributes to soundscape at Denham Grove and around the lake at Savay Lake.
- 4.4.3 The gravel works located by the River Colne give rise to sound levels on the west side of South Harefield of around 55dB and 5dB lower at night. At other times the sound of aircraft is a regular feature.
- 4.4.4 The small residential settlement at Sunnyhill Road on Chalfont Lane towards West Hyde experience daytime levels around 60dB (and are typically 9dB lower at night) from distant road traffic from the M25 and occasional local vehicles, occasional aircraft over flights and natural sounds.

⁵⁰ Department for Communities and Local Government, Indices of Deprivation (2010). : IOD for Barriers to Housing and Services

- 4.4.5 Around the vent shafts in the Chalfont's and Amersham, sound levels vary from around 55 to 60dB on Chesham Lane close to the Chalfont St Peter vent shaft, 45 to 50dB around the Chalfont St Giles vent shaft and 65dB surrounding Amersham vent shaft reducing between 5 to 10dB at night (5dB in the quieter areas) Motorways, main roads and intermittent local traffic are the main contributors to the sound environment except at Chalfont St Giles vent shaft where natural sources dominate and the sounds of aircraft flying overhead can also sometimes be heard.
- 4.4.6 Around the proposed vent shaft north of Kennel Farm, the sound levels are 50 to 55dB with the environment characterised by road traffic from the A413. Trains on the nearby Marylebone to Aylesbury Line can be heard as well as occasional aircraft. Mantle's Farm further north is subjectively quiet; around 50dB with occasional sounds from local traffic on the track serving the farm.
- 4.4.7 Residential properties situated directly along the B485 Chesham Road in Hyde Heath are exposed to higher sound levels around 65dB. In locations further from the road daytime sound levels are typically 45 to 50dB. Road Traffic is also the dominant for some residential properties on Potters Row, Frith Hill/Ballinger Road and Sibley's Coppice with levels around 45 to 50dB. Distant road traffic mixed with natural sounds and occasional aircraft over-flights is also a contributor.
- 4.4.8 Throughout the Central Chilterns night-time sound levels reduce as a result of lower road traffic flows on main and local roads up to 10dB lower than daytime levels.
- 4.4.9 Traffic on main roads dominates the sound source for much of Wendover with daytime sound levels close to busy roads typically at 55 to 60dB dropping to 50 to 55dB at night. Trains on the Marylebone to Aylesbury line and intermittent over-flying aircraft also contribute to the sound levels. Away from busy roads, the daytime sound environment reduces to around 50dB during the daytime and lowers to around 45dB at night.
- 4.4.10 On the periphery and areas further away from Wendover the acoustic sound of distant road traffic still dominates and in some locations, agricultural activities. Daytime sound levels in these areas are typically 45 to 50dB, dropping to around 40dB overnight. RAF Halton lies to the north east of Wendover and military helicopters are occasionally heard.
- 4.4.11 On the outskirts of Aylesbury, whilst road traffic on the main roads remains the dominant noise source, this is perceived as being 'distant' and at relatively low level, and natural and agricultural sounds are more prevalent with daytime sound levels typically around 45 to 50dB varying between approximately 35 and 45dB at night. In the less populated areas sound levels are typically 43dB to 50dB with night-time levels around 5dB to 10dB lower.
- 4.4.12 In Stoke Mandeville the main source of sound is traffic on Risborough Road and other local roads. Daytime sound levels in locations close to Risborough in Stoke Mandeville Road are typically around 65dB with increased sound levels at locations very close to the road and lower levels of 50dB further away from the road reducing to around 45dB at night.

- 4.4.13 Properties in Waddesdon close to the A41 which is a busy main road, running through the centre experience relatively high daytime values of up to 75dB reducing to 50dB at locations in the village further away and typically dropping by 7 to 10dB during the night. Moving north towards Quainton levels are around generally 50-60dB. There are also a number of farmhouses in this area which typically experience the sound from distant road traffic at relatively low levels along with intermittent sounds from farm equipment, natural sound, and the steam railway. Daytime sounds are typically around 50dB and typically 6 to 7dB lower at night. Levels reduce to 45 and 55dB in the more remote areas where the sound environment includes vehicles using local roads, the sound of occasional aircraft over-flights, natural sources and agricultural activities. Night-time sound levels are typically around 8 to 10dB lower than the daytime levels.
- 4.4.14 Daytime sound levels in Twyford are typically around 45 to 50dB reducing by 5 and 10dB lower at night. Twyford the sound environment generally comprises natural sounds. Occasional light aircraft fly overhead and there are intermittent sounds from local road traffic and community activities
- 4.4.15 Properties around the perimeter of Calvert experience daytime sound levels are typically around 45dB from the landfill south of the village and from the Bicester to Bletchley rail line used by the landfill. Daytime sound levels in locations in the north of Calvert, close to School Hill Road, are typically between 56 to 63dB. In locations further from School Hill Road, sound levels are lower. Night-time sound levels in Calvert vary considerably from 35 to 55dB. Local road traffic is an intermittently dominant sound source, with contributors from natural sounds and the existing railways may also be heard occasionally.
- 4.4.16 In the area around Chetwode, there are several isolated working farms and residential properties. Daytime sound levels are approximately 40 to 50dB. Natural sounds dominate and occasional local road traffic and aircraft over flights is audible
- 4.4.17 Daytime sound levels around Newton Purcell range from around 45 to 70dB primarily due to the busy A4421 which runs through the village. Levels are generally lower, around 45 to 50dB further north in Turweston where sound from the local road network, occasional aircraft over flights, agricultural activities and natural sounds dominate. Night time levels reduce by around 5dB as a result of reduced road traffic flows.
- 4.4.18 At the villages of Radstone and Mixbury and at isolated farmhouses within this area, a relatively quiet, natural soundscape predominates. Daytime levels are typically around 45dB reducing to 35 to 40dB at night at Radstone and 40dB at Mixbury.
- 4.4.19 The baseline for the final stretch of the area varies significantly with location. Traffic noise gives rise to sound levels of around 45-50 dB in the north eastern part of Greatworth are typically dropping to 35 to 45dB due to reduced traffic volumes at night. Similar levels of 45dB reducing by 5dB at night are experienced in the neighbouring villages of Thorpe Mandeville and Aston-le-Wells from distant and local road noise and occasional overflying aircraft and agricultural activities.
- 4.4.20 Due to the A361 Byfield Road, Chipping Warden experiences relatively high daytime levels of around 65 to 70dB reducing to 50dB further away. Sound level reduce at

night typically 60dB close to the A361 Byfield Road and 40 to 45dB at locations screened from the main traffic sound sources. Relatively high levels are also experienced around Lower Boddington due to road traffic resulting in daytime sound levels typically approaching 60dB near to the road, and 45dB further afield reducing to 5 to 10dB lower at night.

4.5 Local environment

Existing conditions

Local character

- 4.5.1 The route of the Proposed Scheme commences in the suburban fringe of London where agricultural land is interspersed with urban development linked to commuter towns and villages, and continues in a north-west direction through areas which are primarily rural in character with agriculture being the main land use. The agricultural land is interspersed with small villages, isolated dwellings and farmsteads.

Open spaces and rural routes

- 4.5.2 The Proposed Scheme will pass through the south-western section of Glyn Davies Wood nature reserve (part of Fox Covert) west of Upper Boddington.

4.6 Physical activity

Existing conditions

Levels of physical activity

- 4.6.1 Levels of physical activity amongst adults (i.e. those participating in 30 minutes moderate intensity sport) in the South Buckinghamshire (17.5%), South Northamptonshire (17.7%) and Three Rivers (17.5%) districts are above their associated regional averages at 16.5%, 15.3% and 15.8% respectively whereas the other districts in the area are below the regional averages⁵¹.
- 4.6.2 Levels of physical activity amongst children (i.e. percentage of school children who participated in at least 3 hours of high quality PE and school sport in 2009/10) amongst the majority of local authorities in the area are lower than their associated regional averages, with the exception of Aylesbury Vale and Chiltern districts, which have levels of 54% and 58.7% respectively compared to the South East region of 53.77%⁵².

Formal exercise opportunities

- 4.6.3 Facilities crossed by the Proposed Scheme, which provide opportunities for exercise, include:
- Within the Cone Valley area, the Hillingdon Outdoor Activity Centre is a water sports and activity centre for all ages located on the eastern side of the Colne Valley lakes. Buckinghamshire Golf Course is located to the east of Denham;
 - Located on the same road as Chalfont St Peter ventilation shaft is a playing

⁵¹ APHO (2010), Health Profiles. Adult participation in 30 minutes, moderate intensity sport.

⁵² APHO (2010), Health Profiles. Physically Active Children.

field with a cricket pavilion, Harewood Downs Golf Course near Pollards Wood and the Chalfont Valley Equestrian Centre at Upper Bottom House Farm is located in the location of the proposed Chalfont St Giles ventilation shaft;

- Within the Central Chilterns there is a cricket club located on Hyde Heath Common and the Weights and Measures Gym located on Frith Hill;
- In and around Wendover there are two cricket grounds, Wendover Cricket Club ground and pavilion and a cricket pitch in Wendover 800m south in Witchel as well as Wendover Rifle Range;
- Opportunities for exercise within Aylesbury include Aylesbury Park Golf Club which hosts an 18-hole course and a 9-hole short course, along with a driving range and tuition and children's activities and the Fairford Leys centre which is used for fitness classes and also has football pitches; and
- Around the Brackley area there are a number of cricket pitches (including cricket net provision and pavilion), four tennis courts and an athletics track surround the Beachborough Independent School at Westbury. The Westbury Cricket Club lies just south of Brackley Road as it enters Westbury and there is a playing field at Turweston which includes a cricket ground, football pitch and a basketball court.

Informal exercise opportunities

- 4.6.4 There are a number of PRoW, trails and walking routes in the Colne Valley area including the Colne Valley Trail, the Old Shire Lane Circular Walk and PRoW. The Mid Colne Valley SSSI (including Broadwater Lake), Savay Lake, the Grand Union Canal, Northmoor Hill Wood Nature Reserve, Frays Nature Reserve and Denham Country Park also provide opportunities for informal exercise.
- 4.6.5 Around Chalfont St Peter, Chalfont St Giles and Amersham there are a number of PRoW and footpaths, notably the Chiltern Way and South Buckinghamshire Way and the Milton Route,
- 4.6.6 Within the Central Chilterns area opportunities include Sibley's Coppice woodland near South Heath, keepers wood (including a footpath) at Little Missenden, the 'Mid Chiltern Villages' regional cycle route along Chesham Road, a national cycle route (57) along Frith Hill Road and a number of footpaths in Mantle's Wood, Farthings Wood and Hedgemoor.
- 4.6.7 A number of PRoW and footpaths provide opportunities for informal exercise in the Dunsmore, Wendover and Halton area, notably the Chiltern Link, the Ridgeway, and the Aylesbury Ring, which passes through central Wendover.
- 4.6.8 There are several PRoW footpaths and bridleways connecting villages within the Stoke Mandeville and Aylesbury area, notably the Round Aylesbury Walk, three bridleways, the Round Aylesbury Walk and the North Buckinghamshire Way/ Midshires Way, and the Thame Valley Walk.
- 4.6.9 Opportunities for informal exercise around Waddesdon include the Midshires Way/Swan's Way, the Aylesbury Ring and the Bernwood Jubilee Way. A number of

PRoW link the open spaces of Grendon and Doddershall Woods with other ancient and historic woodlands including Sheephouse Wood and Finemere Wood.

- 4.6.10 Between Newton Purcell and Brackley opportunities for exercise are primarily by way of PRoW and bridleways notably the Westbury Circular Ride and footpaths and bridleways that branch from this route connecting local villages.
- 4.6.11 Along the Greatworth to Lower Boddington section of the route there are a number of PRoW, trails and walking routes, notably the Battlefields Walk and Battlefields Trail long-distance walking routes, the Macmillan Way and the Chipping Warden Circular walking routes, the Jurassic Way long distance walking route and the Boddington to Oxford Canal Route

4.7 Access to services

Existing conditions

Local shops and services

- 4.7.1 There are a number of centres providing local shops and services in the towns and villages close to the route, including:
- the market town of Amersham is split into two distinct areas. Both centres provide a range of shops, public houses and restaurants for both the town and the local villages such as Coleshill to the south;
 - the villages of Hyde Heath and South Heath both have village shops. South Heath also has a post office on Ballinger;
 - the large village of Great Missenden to the south-west of the Proposed Scheme has a range of shops and services and provides a range of services for villages such as South Heath and Hyde Heath to the north-east of the route and Little Missenden to the south;
 - the market town of Wendover provides a range of shops and other services for local villages such as Weston Turville to the north-west and the town of Halton Camp to the north;
 - the village of Stoke Mandeville lies to the south-east of Aylesbury and has a small range of services including a village shop and pub;
 - the county town of Aylesbury to the north of the Proposed Scheme provides an extensive range of shops and services for both the town and neighbouring villages; including the villages of Stone and Stoke Mandeville to the south of Aylesbury and the Proposed Scheme;
 - the village of Waddesdon to the north-west of Aylesbury has a small range of local facilities;
 - the village of Steeple Claydon adjacent to the IMD has a range of services including a number of public houses, village shop, bakery and post office;
 - the village of Calvert to the immediate south of the route has no services and

residents are likely to rely on services in neighbouring villages such as Steeple Claydon on the other side of the Proposed Scheme and Twyford to the west; and

- the village of Twyford to the south of the route in Aylesbury Vale has limited services with a public house, one general store and Post Office.

IOD geographical barriers sub-domain (barriers to housing and services)

- 4.7.2 Eight LSOAs fall within the 5% most deprived in terms of the 'Geographical Barriers' IOD sub-domain (within the 'Barriers to Housing and Services' IOD), which include areas near the South Heath green tunnel; near the Leather Lane and Wendover Dean Viaduct satellite construction sites; –at the location of the western section of the Thames Valley Viaduct and several construction sites; near West Street overbridge main construction compound; location of Nashlea Road satellite construction site and area predominately south and south west of this location; location of Newton Purcell, London Road, Featherbed Lane satellite construction sites and a small section of the Westbury Viaduct in the south; and includes the western section of the Greatworth green tunnel several satellite construction sites and the eastern section of the Edgcote viaduct. The area includes Thorpe Mandeville and Culworth and South; and location of the Chipping Warden green tunnel main construction compound and two satellite construction sites.
- 4.7.3 Seven LSOAs fall within the 10% most deprived in terms of the geographical barrier sub-domain within the barriers to 'housing and services' IOD, these include: the area surrounding Colne Valley viaduct and satellite construction site; location of Little Missenden ventilation shaft and satellite construction site, and the Chiltern tunnel north portal satellite construction site. location of West Street overbridge main construction compound, and School Hill overbridge satellite construction site; location of Chetwode satellite construction site and includes Chetwode and surrounding area; and includes the northern section of the Westbury Viaduct and two satellite construction sites; location of Brackley main construction site and Radstone Road satellite construction site; and includes eastern section of the Greatworth green tunnel, the satellite construction site and areas surrounding the site including Greatworth.

4.8 Traveller stress

Existing conditions

Road network

- 4.8.1 The principal roads running through the Country South area that will be affected by the proposed route include the A412 Denham Way/North Orbital Road, A413, which connects a number of towns and villages near to the route such as Denham, Chalfont St Peter, Chalfont St Giles, Amersham, Great Missenden, Wendover, Stoke Mandeville and Aylesbury.
- 4.8.2 Further north, main roads close to the route include the A41 from Aylesbury through Waddesdon to Bicester; the A418 from the M40 in to Aylesbury; the A421 through

Finmere and Mixbury; the A43 into Brackley; the A422 linking Banbury to Brackley; and the A361 through Chipping Warden.

4.8.3 The area is also crossed by numerous small rural roads and lanes.

Public transport networks

4.8.4 Bus services operate along many of the main roads and smaller roads close to the Proposed Scheme. Those bus services affected include public transport users of the Calvert, Steeple Claydon, Twyford and Chetwode area and the specific bus services that will be diverted from Appletree Lane, Helmdon Road and Culworth Road

4.9 Social capital

Existing conditions

4.9.1 In Country South, the following types of settlement are affected:

- suburban communities at the southern end of the area;
- rural communities comprising individual houses and small hamlets, where people rely on travel by car or bus to access social networks;
- villages, many of which include community facilities such as churches, community halls and public houses. These are likely to have strong communities, but residents will also access wider social networks in other areas; and
- towns with local centres including a variety of community facilities. These larger settlements are likely to be less vulnerable to the effects of severance and isolation.

Community facilities

4.9.2 Community facilities in close proximity to the Proposed Scheme include: St Leonard's (Church of England) Church in Grendon Underwood which provides a range of community services; Edgcott village hall in Edgcott; the Church of St John the Baptist on Banbury Lane in Thorpe Mandeville; Thorpe Mandeville Village Hall on The Warren (Banbury Lane); The Three Conies public house on The Warren (Banbury Lane); Chipping Warden Primary School on the A361 Byfield Road, which currently has approximately 60 pupils; and the Carpenters Arms public house on the corner of Hill Road and Banbury Road in Lower Boddington.

5 Country North Corridor

5.1 Community profile

- 5.1.1 The community profile is based on available data at local authority, ward and Lower Super Output Area (LSOA) level.

Demographic profile

Population trends

- 5.1.2 Much of the Country North area has an age structure weighted towards the older age groups. According to ONS estimates⁵³, the Stratford-on-Avon, North Warwickshire and Lichfield local authority areas generally have lower than average proportions of the population across the 0-14, 15-29 and 30-44 age groups. Contrary to this trend, Coventry has a high proportion of 15-29 year olds, 25.5% compared to the national figure of 20%.
- 5.1.3 The percentage increase in population across all the authorities in the area is 18.3%, which is above the averages for the West Midlands region and England as a whole.

Indices of deprivation

- 5.1.4 IMD data suggests there are relatively low levels of overall deprivation within the area, with few LSOAs in the 20% most deprived. Areas of deprivation are limited to residential areas to the west of the route on the approach into Birmingham and around the triangular (delta) junction west of Coleshill. The Bacon's End estate, is in the 5% most deprived. Areas, which cover the eastern edge of Smith's Wood ward nearest the delta junction of the Proposed Scheme and the M6, are within the 10% most deprived.
- 5.1.5 Elsewhere along the route, there are areas of very low deprivation (i.e. within 20% least deprived). Areas around Southam and Bascott Heath, where the Proposed Scheme enters Long Itchington Green Tunnel; Offchurch and near Coleshill in North Warwickshire where the delta junction is proposed, all lie within the 20% least deprived LSOAs.
- 5.1.6 Cubbington (the northern section of the village) and Burton Green (where the route enters a tunnel under Burton Green,) are in the 10% least deprived. Kenilworth (where the route passes to the north of Kenilworth Golf Club) lies within the 5% least deprived.

Ethnicity

- 5.1.7 ONS data⁵⁴ shows that most of the authorities along the route, bar Coventry, have a lower proportion of ethnic minority residents and a higher proportion of 'White British' residents than the regional and national averages of 79.2% and 79.8%.

⁵³ ONS Census (2011), Age Structure

⁵⁴ ONS (2011), Ethnic Group

- 5.1.8 Coventry has a high proportion of ethnic minority residents at 33.3%. The main two minority ethnic groups are 'Asian/Asian British; Indian' and 'White; Other White'.
- 5.1.9 The proportion of 'Asian British – Indian' and 'Asian/Asian British; Pakistani' people in the West Midlands as a whole is relatively high at 3.9% and 4.1%, compared with 2.6% and 3.1% for England. However the authorities along the route show significant variation. Warwick, Coventry and Solihull are particularly high for 'Asian/Asian British; Indian' and Coventry for 'Asian/Asian British; Pakistani'.

Social grade

- 5.1.10 The proportion of 'DE' 'Semi-skilled and unskilled manual occupations unemployed and lowest grade occupations' in these areas is slightly lower than average, at 17.2% for Stratford-on-Avon and 17.4 for Warwick, compared to a regional average of 29.3% and an England average of 25.5%. However, Coventry has a higher than average proportion of grade 'DE' (32.1%) workers

Health profile

IOD health deprivation and disability

- 5.1.11 The IOD for health deprivation and disability measures health deprivation based on years of potential life lost, illness and disability, acute morbidity and mood and anxiety disorders⁵⁵. The area has no extremes of deprivation with regard to this IOD domain. There are no LSOAs in the 10% most deprived, although some LSOAs experience modest levels of deprivation.
- 5.1.12 The area around Coleshill Junction, particularly the area to the south and west of the Birmingham section of the delta junction, experiences relative health deprivation, with some areas in the 20% most deprived (focused on the area to the east of Smith's Wood including Auckland Drive and Greenfinch Road) and the western half of Bacon's End estate along the River Cole.

Rates and incidence of disease

- 5.1.13 APHO⁵⁶ data show that most authorities in the area have lower rates of early deaths from cancer than the regional and national rates of 112.4 and 110.1 per 100,000 population⁵⁷. However, Coventry is significantly above both the regional and national rates at 123.4.
- 5.1.14 Most authorities also have lower rates of early deaths from heart disease and stroke than the regional and national rates of 70.3 and 67.3 per 100,000 population. Coventry is the exception, being well above the average at 75.6.
- 5.1.15 Most authorities have rates of early deaths from respiratory disease below the national rate of 100 per 100,000 population⁵⁸. However North Warwickshire and Coventry however have higher than average rates, at 106.2 and 107.2.

⁵⁵ Department for Communities and Local Government, Indices of Deprivation (2010): IOD for Health deprivation and disability

⁵⁶ Direct age-standardised mortality rates using a European Standard Population.

⁵⁷ Local Health Profiles: Early Deaths from Cancer, APHO, (2012)

⁵⁸ Standardised Mortality Ratio for Respiratory Disease in persons of all ages, APHO, (2012)

Obesity

- 5.1.16 The West Midlands has higher rates of obesity for children and adults, at 10.11% and 26.38%, than England as a whole (9.60% and 24.16% respectively)⁵⁹.
- 5.1.17 One authority in the area, Coventry, exceeds the regional and national levels of obese children, at 10.59%.
- 5.1.18 For adults, Coventry (25.63%), North Warwickshire (27.33%) and Lichfield (24.96%) perform worse than the national average of 24.16%, and Solihull, Stratford-on-Avon and Warwick are slightly better than average at 23.82%, 23.33% and 21.93%.

Mental health

- 5.1.19 Depression (aged 18+), hospital admissions for 'self-harm and suicide, and undetermined injury' may be used as an indicator of mental health. Compared to the national average, most authorities in the area are above average in one or more indicators. Staffordshire, however, performs better than England as a whole across all three indicators.

Life expectancy

- 5.1.20 Life expectancy provides an indicator of the general health of a population and the differences in health between different populations and socio-demographic groups.
- 5.1.21 The ONS (2011)⁶⁰ indicates that average life expectancy at birth in 2009-2011 in England for males is 78.91 years and for females, 82.89 years. For the West Midlands, life expectancy for males is 78.4 and for females 82.6. The lowest life expectancy in the area is within Coventry, males (77.6) and females (81.6).
- 5.1.22 In the rest of the area life expectancy for males is generally higher than the England average, with the exception of North Warwickshire which has a figure of 78.3. For females, the majority of the authorities in the area have lower life expectancy than the England average. The exceptions are Stratford on Avon (84.5) and Warwick (84.5).

Vulnerable groups

- 5.1.23 The following vulnerable groups have been identified as being particularly vulnerable to health impacts within the Country North area.

Older people

- 5.1.24 The area is largely rural with a population profile generally weighted towards older age groups. Older people are potentially more vulnerable to the effects of the Proposed Scheme.

Lower socio-economic groups

- 5.1.25 Levels of deprivation are low across the majority of the area. However, there are higher proportions of people in lower socio-economic groups in Coventry, and in some

⁵⁹ Health Profiles, APHO, 2012

⁶⁰ ONS Census 2011: Life expectancy at birth and at age 65, England and Wales, 1991-93 to 2009-11

areas of Birmingham and Solihull. As demonstrated by the data, people in these groups are more likely to experience high levels of deprivation and poor health.

5.2 Employment and economy

Existing conditions

- 5.2.1 The majority of the authorities in the area experience higher than average levels of economic activity amongst males. Stratford on Avon (84.2%), Warwick (83.1%) and North Warwickshire (84.7) exceed both the regional (80.8%) and England (82.6%) averages for the percentage of males that are economically active. However, Coventry (78.2%) and Lichfield (77.9%) are both under the regional and England averages, whilst Solihull (82.8%) is higher than the regional but lower than the national averages.
- 5.2.2 Most authorities exceed the regional (66.8%) and England (69.9%) averages for economically active females, except Coventry which, at 63.5%, is below both averages. Coventry also has the highest level of unemployment for males in the area, above both the regional and English average (11.5% compared to 10.3 and 8.6%)⁶¹.
- 5.2.3 All the authorities in the area, except Coventry (81.2%), have a higher proportion of economically active people aged 25-49 years (86.6 93.1%) than the England average (85.1%). The same pattern holds for economically active people aged 50-64 years, with the exception of Coventry which, at 62.7%, is below the England average of 68.1%.
- 5.2.4 There are areas of high employment deprivation⁶² amongst LSOAs. These are focused on the more urban areas of the area around the Coleshill Junction, centred on Smith's Wood ward and Bacon's End. The rest of the area is less deprived in terms of the employment domain.

5.3 Housing

Existing conditions

- 5.3.1 Housing within this area is generally sparsely distributed, although there are areas of higher density residential use as the route approaches Birmingham (Coleshill Junction) and where it skirts larger villages and towns, e.g. to the west of Southam, Stoneleigh, Kenilworth and Handsacre.
- 5.3.2 There are a number of LSOAs along the route that experience significant deprivation in regard to the 'Barriers to Housing and Services' domain on the IoD, including the area around Stoneleigh Deer Park and Kings Hill, lies within the 5% most deprived; as do parts of Coventry.

⁶¹ Annual Population Survey, ONS, 2011

⁶² Department for Communities and Local Government, Indices of Deprivation (2010)

5.4 Noise

Existing conditions

- 5.4.1 In rural parts of the area, the sound environment is dominated by natural sound sources with contributions from distant traffic and the occasional contribution from farming equipment. In some areas, sporadic aircraft over-flights contribute to the sound environment. The typical daytime sound levels in rural areas are 45 to 55 dB during the day, increasing up to 60 or 65 dB in close proximity to major roads. In particularly quiet rural locations, which are not close to major traffic routes, sound levels are well below 50 dB.
- 5.4.2 In villages and on the edges of settlements such as Southam, the soundscape is characterised by local road traffic with contributions from distant traffic, and occasional noise from human activity. Within villages and on the edges of larger settlements, baseline sound levels are generally around 55 to 60dB during the day. Towards the centre of the larger settlements, levels increase up to around 65dB. Night-time levels are typically around 5 to 10dB lower than daytime.
- 5.4.3 The area around Coleshill junction and Water Orton is predominantly urban and suburban in character, separated by small strips of green belt that flank the major transport routes. The M42 and the M6 run north-south through the area with a major west-east interchange to the south of Water Orton. The A452 runs alongside to the M6, past the Chelmsley Wood and Smiths Wood areas, and the A446 runs parallel to the M42 along the edge of Coleshill. The sound environment in this area is generally dominated by continuous road traffic noise. Due to these dominant sources, night-time sound levels generally remain high. Local neighbourhood sound sources and agricultural sources are also audible in some parts of this area. In Water Orton, the passage of trains on the Birmingham to Nuneaton line also contributes to the sound environment.
- 5.4.4 Daytime sound levels are around 55-60dB in Water Orton and 60-65 dB in residential areas of Coleshill. The rural land between the M6 and M42 has daytime levels of around 65-70dB. In this area, sound levels typically drop by around 5dB during the night.
- 5.4.5 Further north around Curdworth noise from major roads continues to dominate, together with aircraft flying to/from Birmingham Airport and industrial development such as the Hams Hall Distribution Park and Coleshill Sewage Treatment Works. Daytime sound levels of around 60 dB are typical, rising to 65 dB close to main roads. Sound levels drop by around 5 dB at night.
- 5.4.6 Moving into the rural areas north of Birmingham, background sound levels return to levels of around 45 to 55 dB during the day, with distant traffic noise, natural sounds, community and agricultural sounds the main contributors. Night time noise levels drop to around 35 to 40 dB. Away from the main roads, the sound environment is dominated by natural sound sources, with some areas such having little or no appreciable manmade sound. Daytime sound levels in these areas are generally well below 50 dB.

- 5.4.7 In the residential area of Streethay, the sound environment is characterised by transport noise sources and the South Staffordshire Line which bounds the southern edge of the village. To the south of Fradley, the sound environment is dominated by industrial and transport noise. In the residential areas of Handsacre, the sound environment is dominated by noise from the presence of trains along the West Coast Main Line together with community noise. Typical baseline noise levels in these areas are 55 to 60dB during the day and 50 to 55dB at night.

5.5 Physical activity

Existing conditions

Levels of physical activity

- 5.5.1 Based on figures for the proportion of adults participating in 30 minutes of sport or active recreation per week, levels of physical activity in the West Midlands region are lower than in England as a whole, at 10% and 11% respectively⁶³. Within the area, the areas with the lowest levels of activity are Coventry and Solihull, with 9.1% and 8.9% respectively. Stratford-on-Avon, North Warwickshire and Lichfield are between the regional and national averages at 10.1%, 10.2% and 11.%. Warwick has the highest levels of physical activity at 13%.
- 5.5.2 The West Midlands also performs worse than England as a whole for levels of activity in children, based on the 'percentage of school children who participate in at least 3 hours of high quality PE and school sport within and beyond the curriculum', at 48.4% and 49.6% respectively. Warwick, North Warwickshire and Lichfield all exceed the regional and England averages for physically active children, at 50.9%, 53.3% and 55.2%. Stratford on Avon, Coventry and Solihull fall below both the regional and England averages at 46.6%, 45.3% and 44.4%.

Formal exercise opportunities

- 5.5.3 Facilities offering opportunities for exercise directly affected by the Proposed Scheme include:
- Old Saltleians Rugby Football Club near Water Orton;
 - Dunton Stables, close to the Lea Marsdon Hotel, and north from here, Middleton Equestrian Centre and Weeford Stables; and
 - Whittington Heath Golf Club.

Informal exercise opportunities

- 5.5.4 The study area includes a number of opportunities for informal exercise including recreation grounds, canals, parks, estates and halls. There are also cycle routes, public footpaths and allotments, and a number of areas such as woodlands, which provide opportunities for physical exercise.
- 5.5.5 PRoW crossed by the Proposed Scheme include:

⁶³ Sport England (2013) Active People Survey 7. Available at: http://www.sportengland.org/media/162187/01_1x30_overall_factsheet_aps7q2-final.pdf

- Shakespeare’s Avon Way and Millennium Way;
- Connect2 Kenilworth public footpath, bridleway and cycleway;
- Kenilworth Greenway;
- The Millennium Way public footpath;
- Coventry Way/Centenary Way; and
- The Heart of England Way.

5.6 Access to services and health care

Existing conditions

Indices of deprivation

- 5.6.1 There are thirteen LSOAs in the area that have high levels of deprivation (i.e. those within the 20% most deprived areas) with regard to the 'Geographical barriers' sub-domain. These are distributed across all the authority areas with the exception of Stratford-on-Avon and Solihull.

Local services

- 5.6.2 Local services within the area include the following:
- Kenilworth is a moderate sized town with a wide range of services and healthcare facilities serving the local areas to the south of Coventry. Nearby Stoneleigh and Burton Green have no shops or post offices. Most villages in this area rely primarily on Kenilworth for accessing services.
 - Coleshill has a high street with a range of services including shopping, banking and leisure facilities. Water Orton has a small parade of shops and an active sports club. Both Coleshill and Water Orton have a range of GP surgeries and dentists.
 - The large village of Curdworth has a limited range of services which includes a post office and convenience store.
 - The villages of Curdworth, Bodymoor Heath, Middleton and Hints do not have any healthcare facilities and are dependent on nearby towns and villages such as Tamworth, Dosthill and Kingsbury.

5.7 Traveller stress

Existing conditions

Road networks

- 5.7.1 The Proposed Scheme crosses a number of local roads within the area. It also passes over the M42 and M6, close to Coleshill.

Public transport networks

- 5.7.2 Bus services currently operate along 13 roads in the vicinity of the Proposed Scheme. There are 31 bus routes that use these roads that may be directly affected by the scheme.

5.8 Social capital

Existing conditions

- 5.8.1 In Country North, the following types of settlements are affected:
- dispersed rural communities comprising individual houses and small hamlets. These communities will rely on travel by car or bus to access family and social networks.
 - villages, many of which include some community facilities such as churches, community halls and public houses. These are likely to have strong social links between village residents, but will also rely on wider social networks in nearby towns and rural areas. Many of these communities are likely to be well established with a low turnover of residents, and may be sensitive to changes in local demographics.
 - towns with local centres including a variety of community facilities, as well as areas on the outskirts of Birmingham and Coventry. These larger settlements are likely to be less vulnerable to the effects of severance and isolation.

Community facilities

- 5.8.2 Of particular interest for social capital are areas where community members can meet informally and formally, such as churches, community centres and public houses, which provide focal points for communities.
- 5.8.3 The only community facility in Country North likely to be affected by the Proposed Scheme is Burton Green Village Hall. The hall lies immediately adjacent to the route and is used on a daily basis for a range of activities, including sports and craft classes, Women's Institute meetings, local organisation meetings, Parish Council and residents' association meetings and as a place of worship.

6 West Midlands Corridor and Birmingham Interchange

6.1 Community profile

- 6.1.1 The community profile is based on available data at local authority, ward and Lower Super Output Area (LSOA) level.

Demographic profile

Population trends

- 6.1.2 In terms of age structure, Solihull generally reflects the national and regional averages. There are some variations at local level, for example in the Meriden ward, where the 45+ age groups all exceed the regional and national averages, whilst the 15-29 year old group is significantly lower than average at 13.3% (compared to 20% for both West Midlands and England)⁶⁴.
- 6.1.3 In terms of age structure, Birmingham has a higher proportion of people under 45 (66.5%) than the West Midlands (58%) and England (58.3%) averages. Again there are local variations, with a relatively high proportion of older age groups in Castle Bromwich, and Hodge Hill.
- 6.1.4 Birmingham experienced a 7% rise in population from 2005 – 2011. This is more than both the regional and England increases of about 5% and much more than the Solihull figure of 2.8%.

Indices of deprivation

- 6.1.5 In Balsall Common, at the southern end of the area, overall deprivation is low with a number of LSOAs falling in the 5% least deprived on the IMD (around Balsall Common east of the A452 Kenilworth Road and Balsall Common station). The area around Hampton-in-Arden also falls within the 20% least deprived.
- 6.1.6 The levels of deprivation generally increase towards the north of the area. The area around Castle Bromwich Business Park is within the 15% most deprived LSOAs on the IMD. The area to the south of the M6 focused on Riddfield Road and Berrandale Road, approximately 100m south of the Proposed Scheme, the area centred on Chillinghome Road, Wanderer Walk and Tame Valley Academy bounded by the Proposed Scheme at the north and residential areas at Castle Vale approximately 500m north of the Proposed Scheme are all within the 5% most deprived in the country.
- 6.1.7 Birches Green, to the north of the route, includes two LSOAs in the 5% most deprived, (approximately 700m north of the Proposed Scheme, containing residential properties north of A38 Tyburn Road around Bromford Lane) and (approximately 100m north of the M6, containing Gravelly Industrial Park and residential properties south-west of Weelwright Road).

⁶⁴ ONS (2011), Age Structure

Ethnicity

- 6.1.8 The ONS data (2011) indicates that Solihull has an ethnic make-up broadly in line with the regional and national average, with a slightly higher proportion of people classed as 'White British' (85.85%) than both the West Midlands (79.2%) and England (79.8%) averages. This contrasts with the neighbouring authority of Birmingham, where there is a higher proportion of ethnic minority groups.
- 6.1.9 The ONS data (2011) indicates that Birmingham has an ethnic make-up that differs significantly from the regional and national averages, with a much lower 'White British' population (53.1%) than both the West Midlands (79.2%) and England (79.8%). The proportion of 'mixed White and Black Caribbean' people is nearly three times the England average and the proportion of 'Indian' people within the population of Birmingham is twice that of England as a whole. Birmingham has a high 'Asian/Asian British; Pakistani' population (13.5%), considerably higher than both the regional (4.1%) and England figures (2.1%)⁶⁵.

Social grade

- 6.1.10 Birmingham is characterised by a significant percentage of the population (34.3%) falling in the lower two social grades (D – 'Semi-skilled and unskilled manual workers' and E – 'On state benefit unemployed lowest grade workers' compared with the West Midlands (29.3%)) and England (25.5%) averages.

Health profile

IOD health deprivation and disability domain

- 6.1.11 This IOD domain covers years of potential life lost, illness and disability, acute morbidity and mood and anxiety disorders⁶⁶. This area contains contrasts in levels of health deprivation. The areas around Wootton Green near Balsall Common have low levels of deprivation with regard to health, with one LSOA falling in the 5% least deprived in the country. The area around Hampton Arden is also within the 5% least deprived.
- 6.1.12 Around the Birmingham Interchange area, there are no LSOAs in the 5% most deprived, although four LSOAs are within the 20% most deprived, including areas on the eastern edge of Chelmsley Wood.
- 6.1.13 On the eastern approach to Washwood Heath there are residential areas that experience high levels of health deprivation, particularly to the north of the route. This includes residential areas at Castle Vale (centred on Farnborough Road Play Area, the area around the Vale Stadium and the Port Centre, and the area crossed by the route near Castle Bromwich Business Park which contains residential properties south of Tangmere Drive which all lie within the 10% most deprived.

Rates and incidence of disease

- 6.1.14 The APHO figures for 'cancer', 'heart disease and stroke' and 'respiratory disease' indicate that Solihull residents are less likely to suffer early deaths from these diseases

⁶⁵ ONS (2011) Ethnic Group

⁶⁶ Department for Communities and Local Government, Indices of Deprivation (2010): IOD for Health deprivation and disability

than the population of England and the West Midlands as a whole. Rates of early death from cancer are 110.42 per 100,000 population⁶⁷, heart disease and stroke 67.51⁶⁸ against the national figures of 113.96 and 74.80 respectively.

- 6.1.15 In Birmingham, residents are more likely to suffer early deaths from these diseases than the population of England and the West Midlands as a whole. Rates of early death from cancer are 123.19 per 100,000 population⁶⁹, heart disease and stroke 96.76⁷⁰ against national figures of 113.96 and 74.80 respectively.
- 6.1.16 For rates of respiratory disease, Solihull experienced 85 observed deaths as a percentage of expected deaths, which is considerably lower than the England rate of 100⁷¹. For rates of respiratory disease, Birmingham experienced 111.2 observed deaths as a percentage of expected deaths, which is higher than the England rate of 100⁷².

Obesity

- 6.1.17 Solihull performs relatively well for both adult (23.82%) and childhood (8.77%) obesity, being below the England figures for both (24.16% and 9.60% respectively). This is against a backdrop of the regional figures for the West Midlands where both adult (26.38%) and childhood (10.11%) obesity are above the England figure⁷³.
- 6.1.18 Birmingham performs marginally worse than the regional and national averages for both adult and childhood obesity, being marginally above the West Midlands and England figures for both. For children, 10.70% are obese in Birmingham compared to 10.11% in the West Midlands and 9.60% in England, whilst for adults Birmingham has a rate of 26.77% compared to 26.38% in the West Midlands and 24.16% in England⁷⁴.

Mental health

- 6.1.19 Depression (aged 18+), hospital admissions for 'self-harm and suicide, and undetermined injury' may be used as an indicator of mental health. APHO data indicates that Solihull has slightly elevated levels of depression, but lower levels of self-harm and suicide and undetermined injury compared to the national average. APHO data indicates that Birmingham has slightly lower levels of depression and suicide and undetermined injury than England, but higher levels of self-harm⁷⁵.

Life expectancy

- 6.1.20 Life expectancy provides an indicator of the general health of a population and the differences in health between different populations and socio-demographic groups. The ONS (2011)⁷⁶ indicates that the average life expectancy at birth 2009-2011 in England for males is 78.9 and for females 82.9. Life expectancy in Solihull is above average for both males and females at 81 and 84.6 respectively. In contrast, life

⁶⁷ APHO, (2012) Local Health Profiles: Early Deaths from Cancer

⁶⁸ APHO, (2012) Local health Profiles: Early Deaths from Heart Disease and Stroke

⁶⁹ APHO, (2012) Local Health Profiles: Early Deaths from Cancer

⁷⁰ APHO, (2012) Local health Profiles: Early Deaths from Heart Disease and Stroke

⁷¹ APHO, (2012) SMR for Respiratory Disease in persons of all ages

⁷² APHO, (2012) SMR for Respiratory Disease in persons of all ages

⁷³ APHO (2012), Health Profiles

⁷⁴ APHO (2012), Health Profiles

⁷⁵ APHO, Community Mental Health Profiles (2012)

⁷⁶ ONS Census 2011: Life expectancy at birth and at age 65, England and Wales, 1991-93 to 2009-11

expectancy in Birmingham, for both males (77.3) and females (82), are below both the regional and national average.

Vulnerable groups

- 6.1.21 The following groups have been identified as being particularly vulnerable to health impacts within the West Midlands area.

Children particularly those with special needs

- 6.1.22 The boundary of the Proposed Scheme will be approximately 250m from 'The Island Project School' at Diddington Hall, Meriden, Nr Coventry, whilst the construction site boundary will be approximately 130m from the school site. 'The Island Project School' at Diddington Hall is an independent school that serves children with autism from ages 6 to 19.

- 6.1.23 People with autism can have sensory sensitivity which can impact on how they experience and cope with different environments.

Older people

- 6.1.24 There are a number of care homes for the elderly within close proximity to the Proposed Scheme in this area, including Berwood Court Care Home which is off Cadbury Lane, Castle Vale, and is adjacent to an area of temporary land take to the north of the route; and Bromford Lane Care Home on Fairholme Road, Washwood Heath, which is about 100m south of the temporary land take area.

Lower socio-economic groups

- 6.1.25 Birmingham is characterised by a significant percentage of the population falling in the lower two social grades, with the wards Hodge Hill and Tyburn, close to the Washwood Heath RSMD having particularly high proportions of residents in the lowest social grade.

Minority ethnic group – Gypsies and Travellers

- 6.1.26 There is a Gypsy and Traveller site within the area, located to the south of the Castle Vale estate, within the Castle Bromwich Business Park on Tameside Drive. The site is owned by Birmingham City Council, and provides a total of 15 transit pitches. The site is within an area of land required for the Proposed Scheme.

6.2 Employment and economy

Existing conditions

- 6.2.1 In Solihull 82.8% of the male population is economically active, which is slightly higher than the West Midlands average of 81.1%, but slightly lower than the England figure of 83.1%. For women the Solihull figure (73.9%) is higher than both the West Midlands (67.6%) and England (70.4%) figures⁷⁷.
- 6.2.2 Within Birmingham 75.6% of the male working age population is economically active, which is lower than the West Midlands average of 81.1%, and lower than the England

⁷⁷ ONS (2011), Annual Population Survey

average of 83.1%. For women the Birmingham figure (56.2%) is much lower than both the West Midlands (67.6%) and England (70.4%) figures⁷⁸.

- 6.2.3 In terms of economic activity, by age, Solihull has a higher proportion in all age groups compared to the West Midlands and England averages.. Birmingham on the other hand has a lower proportion of economically active people than the West Midlands and England averages in all age groups.
- 6.2.4 In terms of ethnicity, the Indian population is the most economically active ethnic group in Birmingham – 76.6% against the West Midlands 77% and England 76.6%⁷⁹. This is also the most economically active ethnic group in Solihull, at 93%.
- 6.2.5 Employment deprivation generally increases from south to north across the area. In the south of the area, the area around the proposed Balsall Common Viaduct, including Wootton Green and Balsall Common Station is within the 5% most deprived in terms of employment deprivation. The area around Carol Green and Kenilworth Green is in the 10% most deprived.
- 6.2.6 In the middle of the area, there are a number of areas falling within the 20% most deprived in terms of employment deprivation. Predominantly these are residential areas extending out to the east of Chelmsley Wood.
- 6.2.7 At the northern end of the area employment deprivation is split between the areas to the south of the Proposed Scheme (including Haywards Industrial Park to the north west and Park Hall School and Lanchester Park in the south east) and the north and west of the route (including Farnborough Road, The Fort Industrial Park, Bromford and the Bromford Tunnel). The areas to the south have average levels of employment deprivation, being mainly in the 60-80% most deprived LSOAs. The area to the north and west has higher levels of employment deprivation and includes areas which fall within the 5% most deprived.

6.3 Housing

Existing conditions

- 6.3.1 The route in this area is predominantly in a rural environment, though where development does occur it is primarily industrial land uses. Areas where the route passes through or close to residential areas include Balsall Common, Hampton-in-Arden, and the eastern edge of Birmingham around Chelmsley Wood, Castle Bromwich and Bromford.
- 6.3.2 In terms of the 'Barriers to Housing and Services' domain, no LSOAs in the Balsall Common to Hampton-in-Arden section of the area fall within the 20% least or 20% most deprived.
- 6.3.3 In the northern part of the area around Castle Bromwich and Bromford, which is characterised by industrial, commercial and high density residential development, deprivation in terms of barriers to access and services is more marked. The area

⁷⁸ ONS (2011), Annual Population Survey

⁷⁹ ONS (2011), Annual Population Survey

around Park Hall Nature Reserve, the River Tame and commercial buildings at Water Orton Lane and Midpoint Way is in the 5% most deprived in the country in terms of barriers to access and services and the route crosses through the southern section of this LSOA. Moving west, the area around Hodge Hill Girl's School, Hodge Hill Primary School, Hodge Hill Sports and Enterprise College and Bromford Central, and the Arden Industrial Estate is within the 10% most deprived in the country in terms of barriers to access and services and is also crossed by the Proposed Scheme.

6.3.4 There is a Gypsy and Traveller site within the area, located to the south of the Castle Vale estate, within the Castle Bromwich Business Park on Tameside Drive. The site is owned by BCC, and provides a total of 15 transit pitches. The site is within an area of land required for the Proposed Scheme.

6.3.5 Housing directly affected by the Proposed Scheme during construction includes:

- Nursery Cottage a two storey brick residential and single storey brick garage; and properties on the eastern edge of Chelmsley Wood, Bluebell Drive, Lyecroft Avenue and Yorkminster Drive.
- properties on Truggist Lane, Old Waste Lane and Diddington Lane.

6.4 Noise

Existing conditions

6.4.1 The existing sound environment for this area reflects the mix of usage and activity in the area ranging from the larger residential communities of Balsall Common, Hampton-in-Arden, Chelmsley Wood, Castle Bromwich and Bromford to a number of smaller communities, such as Berkswell, and relatively isolated residences and farms in rural areas. The existing sound environment also includes the commercial area of Birmingham Business Park and the extensive estate of the National Exhibition Centre (NEC) with its associated hotels and car parks. To the north of the M6/rail corridor, the west of the area contains industrial and commercial premises including a large car factory (Jaguar Land Rover Limited) and The Fort Shopping Park.

6.4.2 The major transport sound sources in the area are the M42, the M6; the A45 Coventry Road, the A452 Kenilworth Road, the Rugby to Birmingham line, and the overflying aircraft using Birmingham Airport. Away from these major sources the sound environment consists of local road traffic, agricultural activities and, in quieter areas, natural sounds, although few areas escape occasional aircraft noise.

6.4.3 In the vicinity of Balsall Common, baseline sound levels are mixed. Close to the A452 Kenilworth Road, sound from this road dominates and daytime sound levels are typically around 60dB. Away from this road, local sources are more significant, including traffic on local roads and the Rugby to Birmingham line in areas around Berkswell station. During the night-time, the same sources are generally present, but night-time sound levels are approximately 10dB lower in areas away from the major roads.

- 6.4.4 Within Berkswell village, existing sound levels are generally low, typically 45 to 50dB, with agricultural sound sources and local road traffic being the main contributors to the soundscape.
- 6.4.5 Near the A452 Kenilworth Road to the north of Balsall Common, sound from this road is generally dominant and typical daytime levels are around 60dB. At the numerous more isolated properties away from this road, daytime sound levels are around 10dB lower. Locations to the south west of the railway embankment carrying the Rugby to Birmingham line are generally shielded from traffic on the A452 Kenilworth Road by this embankment.
- 6.4.6 Within Hampton-in-Arden, the sound environment is dominated by distant road traffic from the A452 Kenilworth Road and M42. Typical daytime sound levels are around 55dB, with traffic on the main roads through the village (particularly the B4102 Meriden Road), also contributing. As the Rugby to Birmingham line is located in a cutting through the village, this generally only contributes significantly to baseline sound levels close to the railway itself. Aircraft approaching/departing from Birmingham Airport are also regularly audible within Hampton-in-Arden, although these are rarely the dominant sound source.
- 6.4.7 To the north of Hampton-in-Arden, existing sound levels are dominated by the major roads which run in this area, specifically the M42, the A45 Coventry Road and the A452 Kenilworth Road. Typical daytime levels at the nearest properties are around 60dB. In these areas the reduction in sound levels during the night-time is generally less than it is in more rural locations due to the continuous nature of these sound sources. Typical night-time levels in this area are around 55dB.
- 6.4.8 The south and east of the area is more rural with a few small communities and some relatively isolated residences and farms. The significant roads that cross the area are: the M42; the M6; the A45 Coventry Road; the A452 Chester Road and the A446 Stonebridge Road. Daytime sound levels at properties close to the M6 and A452 Chester Road are typically around 65 to 70 dB.
- 6.4.9 To the south of the area, existing baseline sound levels are dominated by road traffic on the A45 Coventry Road, M42 and to some extent the A452 Chester Road. In areas away from these roads, daytime sound levels are typically around 55 to 60dB, with the traffic on these major roads still the dominant source of sound. Night-time sound levels are generally slightly lower than those during the daytime, although in many locations this reduction is small in magnitude (up to around 5dB lower).
- 6.4.10 Through Birmingham Business Park, where the existing sound environment is dominated by traffic on the A452 Chester Road, typical daytime sound levels are around 55dB. Natural sounds become more notable as the sound levels reduce at greater distances from this road.
- 6.4.11 Within Chelmsley Wood, existing daytime sound levels are dominated by traffic on the A452 Chester Road and the M6 and are typically 65dB at the locations closest to these roads. At greater distances from these roads, where intervening houses provide significant screening, typical daytime sound levels are around 50dB and the sound environment includes traffic on local roads and natural sounds. Close to the major

roads, night-time sound levels are only slightly lower than those during the daytime (up to around 5dB lower), though at greater distances from the roads, this difference is larger (typically 10dB).

- 6.4.12 Other main arterial roads in the area are the A452 Chester Road and the A47 Fort Parkway. Daytime sound levels at residential properties close to the M6 and A452 are typically 65 to 70dB reducing to typically around 55dB further into the residential areas.
- 6.4.13 The reduction in sound level between daytime and night-time sound levels is relatively small (typically less than 5dB) due to the continuous nature of sound from the M6 and other major roads.

6.5 Local environment

Existing conditions

Local character

- 6.5.1 The southern part of the area is predominantly rural in character, with agriculture being the main land use, interspersed with small villages and a scattering of dwellings and farmsteads. The main residential areas are Balsall Common and Hampton-in-Arden, the latter of which is designated as a conservation area, in a largely undeveloped area of agricultural land known as the 'Meriden Gap'. Within the wider rural area there are a number of historic villages, including Berkswell (approx. 1km north of the route), Barston (approximately 2km south of the route) which are also designated as conservation areas.
- 6.5.2 The Birmingham Interchange area contains predominantly employment and transport uses including Birmingham Airport, Birmingham International railway station, the NEC, Birmingham Business Park and Packington Landfill. Residential areas include Chelmsley Wood (a large residential estate) to the north-west and the small historic settlements of Middle Bickenhill to the immediate east and Bickenhill to the south west.
- 6.5.3 The part of the area around Castle Bromwich and Bromford on the eastern outskirts of Birmingham is predominantly urban in character, but its southern end lies on the rural fringe. The rural and open areas around the B4118 Birmingham Road and Park Hall nature reserve at Water Orton are located at the southern end of this section with the rest of the area generally dominated by light industrial and commercial or infrastructure uses through Castle Vale, Castle Bromwich and Bromford. The commercial/industrial areas make use of lower lying land close to the River Tame and also the historical infrastructure corridor that follows the line of the valley. The main residential areas are generally on higher ground, away from the valley bottom, although the residential area of Bromford is closer to the Proposed Scheme.

Green spaces

- 6.5.4 The proposed scheme affected a number of areas including the Kenilworth Greenway, which is designated as an area of open space, providing recognition of the importance to the community of this linear route.

- 6.5.5 Marsh Lane Nature Reserve, Meriden, Warwickshire is crossed by the Proposed Scheme at its eastern extent and attracts large number of visitors, including the West Midlands Bird Club, on this basis.
- 6.5.6 In the area of the Birmingham Interchange station, Heath Park provides grassed football pitches and amenity parkland.
- 6.5.7 To the north of Castle Bromwich and the M6, Park Hall nature reserve is an important local resource, to which visitor access is by prior appointment, with weekly volunteering activities and guided walks. The nature reserve plays a role in educating people about the natural environment as well as providing a recreational resource.
- 6.5.8 To the south-east of the Castle Vale estate is a large park accessed off Farnborough Road, which includes the Castle Vale Football Stadium, Castle Vale Nature Conservation Area (Farnborough Fields) and Farnborough Road Public Open Space. The park provides several grassed football pitches and a local children's play area.

6.6 Physical activity

Existing conditions

Levels of physical activity

- 6.6.1 Within Birmingham the level of physical activity amongst adults is 8.67%, below the West Midlands (10.07%) and England (11.25%) averages⁸⁰. Within Solihull, levels of physical activity amongst adults are also below the West Midlands and England average at 8.9%⁸¹.
- 6.6.2 Amongst children in Solihull, levels of physical activity (percentage of school children who participate in at least three hours of high quality PE and school sport within and beyond the curriculum) are just below the West Midlands and England average at 47.10⁸². In Birmingham the level of physical activity among children is 44.37%, also below the West Midlands (48.44%) and England (49.62) averages⁸³.

Opportunities for exercise

- 6.6.3 Existing opportunities for formal and informal exercise within the area include:
- Kenilworth Greenway which is directly affected by the Proposed Scheme;
 - Berkswell Clay Pigeon Club located at Old Lane, Berkswell;
 - Marsh Lane Nature Reserve, which lies adjacent to and in the flood plain of the River Blythe at Berkswell;
 - Heath Park, to the north of the Bluebell Recreation Ground, provides grassed football pitches and amenity parkland;
 - The Olympia Motorcycle Track, off Middle Bickenhill Lane; and

⁸⁰ APHO (2010), Health Profiles.

⁸¹ APHO (2010), Health Profiles.

⁸² APHO (2010), Health Profiles

⁸³ APHO (2010), Health Profiles

- Farnborough Road Open Space, located in the Castle Vale area.

6.6.4 The southern section of the area contains a well-established network of public footpaths and bridleways which provide connections between the villages in the area and a recreational facility for walkers, horse riders and cyclists. Notable public right of ways (PRoW)⁸⁴ include:

- Heart of England Way a 100 mile long distance walking route from Milford Common on Cannock Chase to Bourton on the Water in the Cotswolds; and
- The Kenilworth Greenway a permissive bridleway that runs along the line of an old railway between Berkswell to Kenilworth Junction.

6.6.5 Around the location of the proposed Birmingham Interchange station, there are a limited number of Public Rights of Way (PRoW). The most notable PRoW are located in close proximity to Melbicks Garden and Leisure Centre, connecting the A452 Chester Road and the A446 Stonebridge Road, and a short section close to Diddington Farm, connecting a track with the A45 Coventry Road.

6.7 Access to services and health care

Existing Conditions

IOD geographical barriers sub-domain (barriers to housing and services)

6.7.1 Regarding the 'Geographical Barriers' sub-domain of the 'Barriers to Housing and Services' domain of deprivation, there are three LSOAs that fall within the 20% most deprived, these are areas which includes the Bromford Tunnel element of the Proposed Development, and the area around Balsall Common, to the north and west⁸⁵. The latter two of these are also within the 10% most deprived.

6.7.2 Local services available in close proximity to, and potentially affected by, the Proposed Scheme include:

- Within Berkswell, located to the east of the route, there is a church, village store, tea rooms and a pub. Within Meriden (> 1 km east of the route) there are local village shops and a pub;
- Within Balsall Common local centre located to the west of the route, on the A452 Kenilworth Road, there is a range of convenience shops, services and recreational facilities including banks; a post office; pharmacy; hairdressers; pubs and cafes; restaurants; a public house; and a library; and
- Within Hampton-in-Arden, located to the west of the route, there are two churches, local village shops and a public house.

⁸⁴ Public right of ways (PRoW) are footpaths, bridleways, roads or byways that the public have the right to use.

⁸⁵ Department for Communities and Local Government (2010) :LSOA level sub-domain scores for the Barriers to Housing and Services domain from the Indices of Deprivation

6.8 Traveller stress

Existing conditions

Road networks

- 6.8.1 There are several strategic highways that pass through the area and are affected by the proposed scheme.
- 6.8.2 In the Balsall Common area the A452 Kenilworth Road, which runs in a north/south orientation providing access to Hampton-in-Arden and Meriden, and Park Lane are affected by the proposed scheme.
- 6.8.3 In the Birmingham Interchange area, roads affected by the proposed scheme are the M42, between junction 5 and the M6 on-slip roads; M42 junction 6 southbound on-slip; A45 Coventry Road between M42 junction 6 and Oak Lane; A45 Coventry Road westbound on-slip and eastbound off-slip at Stonebridge Island; A446 Stonebridge Road between M6 junction 4 and Stonebridge Island; A452 Chester Road, between Packington Lane and Stonebridge Island and the A45 Coventry Road, off-slip at M42 junction 6.
- 6.8.4 In the Castle Bromwich and Bromford area, no strategic roads are affected by the works, but Kelsey Lane and Waste Lane are likely to be used for construction haul routes.

Public transport networks

- 6.8.5 There are local railway stations at Hampton-in-Arden, Berkswell and Tile Hill (on the eastern boundary of the area). The stations provide access to local services between Coventry and Birmingham, and national rail services via Birmingham New Street, Birmingham International and Coventry.
- 6.8.6 National and local rail services are accessible via Birmingham International railway station. Marston Green railway station is located on the northwest boundary of this area providing access to local services between Coventry and Birmingham

6.9 Social capital

Existing conditions

- 6.9.1 The southern section of the area around Balsall Common and Hampton-in-Arden is predominantly rural in character, with agriculture being the main land use, interspersed with small rural communities and a scattering of dwellings and farmsteads.
- 6.9.2 Within the wider areas of countryside there are a range of recreational facilities, which reflect the rural environment and agricultural diversification including shooting clubs, fisheries, nature reserves, golf clubs and riding schools. Pubs and community halls within Balsall Common, Berkswell and Hampton-in-Arden provide a focus for social gatherings and for some village events.
- 6.9.3 Due to the nature of the Birmingham Interchange area, which comprises predominantly agricultural and industrial land, interspersed with a significant quantity

of transport infrastructure, there is very little residential development and/or associated community facilities within close proximity to the proposed works. The small historic settlements of Middle Bickenhill and Bickenhill are located within the Birmingham Interchange area but to the south of the footprint of the proposed Birmingham Interchange station itself.

- 6.9.4 The northern part of the area through Chelmsley Wood, Castle Bromwich and Bromford is predominantly urban in character, but its eastern end lies on the rural fringe. The areas of Chelmsley Wood, Castle Bromwich, Castle Vale and Bromford are distinct residential settlements served by a range of local facilities.

Community facilities

- 6.9.5 The key community facilities identified as likely to be affected within the area are as follows:

- at the southern end of the area, along Truggist Lane, there is a cluster of community facilities on the outskirts of Balsall Common. This includes the Railway Inn, the Balsall Common Royal British Legion and the Balsall Common Health Centre.
- to the north, adjacent to Lavender Hall Farm is the Berkswell Clay Pigeon Club. The club is used on a weekly basis by members.
- Berkswell village lies to the north of Balsall Common and the proposed route and provides local community facilities including a church and a public house.
- Hampton-in-Arden village lies to the west of the Proposed Scheme and the village centre provides several community facilities including a village hall, cricket club, church and a number of public houses; all of which are outside of the area.
- The Heart of England Aeromodellers site to the south of the B4102 Meriden Road and adjacent to Marsh Lane Nature Reserve will be within the footprint of the Proposed Scheme. The site is used daily by the Heart of England Aeromodellers Club, with members from across the West Midlands region.

7 Curzon Street Station

7.1 Community profile

- 7.1.1 The community profile is based on available data at local authority, ward and Lower Super Output Area (LSOA) level.

Demographic profile

Population trends

- 7.1.2 In terms of age structure, Birmingham has a higher proportion of people under 45 (66%) than the West Midlands (58%) and England (58.3%) averages. All wards in the area have a relatively high proportion of people in the 0-29 age groups. Washwood Heath has 57.3% in this age range, Nechells 59.6% and Hodge Hill 48.6%, compared to a regional and national average of 38%)⁸⁶.
- 7.1.3 Birmingham experienced a 7% rise in population from 2005 – 2011. This is more than both the regional and England increases of about 5% and much more than the Solihull figure of 2.8%.

Indices of deprivation

- 7.1.4 The area around Washwood Heath is predominantly industrial in nature and has relatively high levels of deprivation, with a number of LSOAs in the 5% most deprived. These cover areas south-east of the route including Heartlands Park and the RSDM), south of the route and the RSDM and the area around Saltley Business Park) are in the 5% most deprived LSOAs.
- 7.1.5 The area around Curzon Street Station is urban in character and has mixed levels of deprivation. Those LSOAs that fall within the 5% most deprived are located some way from the Proposed Scheme.

Ethnicity

- 7.1.6 The ONS data (2011) indicates that Birmingham has an ethnic make-up that differs significantly from the regional and national averages, with a much lower 'White British' population (53.1%) than both the West Midlands (79.2%) and England (79.8%). The proportion of 'mixed White and Black Caribbean' people is nearly three times the England average and the proportion of 'Indian' people within the population of Birmingham is twice that of England as a whole. Birmingham has a high 'Asian/Asian British; Pakistani' population (13.5%), compared with both the regional (4.1%) and England figures (2.1%)⁸⁷.
- 7.1.7 Local variations occur, for example with a low proportion of ethnic minority groups in the Castle Bromwich ward, and large Pakistani and Caribbean populations in the Hodge Hill area⁸⁸.

⁸⁶ ONS Census (2011), Age Structure

⁸⁷ ONS (2011) Ethnic Group

⁸⁸ ONS (2009), Resident Population by Ethnic Group

Social grade

- 7.1.8 A significant percentage of the Birmingham population (34.3%) falls in the lowest social grade (DE – 'Semi-skilled and unskilled manual occupations, Unemployed and lowest grade occupations') compared with the West Midlands and England. According to the 2011 data all the wards in the area have high proportions of residents in the lowest 'DE' category. In close proximity to the Washwood Heath RSMD, the wards of Hodgehill (45.15%) and Washwood Heath (58.50%) have a higher proportion of people in this grade than the West Midlands (29.3%) and England (25.5%) averages. The Nechells Ward, where Curzon Street Station will be located, has 46.83% of the population in the 'DE' grade⁸⁹.

Health profile

IoD health deprivation and disability domain

- 7.1.9 This domain covers years of potential life lost, illness and disability, acute morbidity and mood and anxiety disorders⁹⁰. The area to the north of Curzon Street Station, is in the 10% most deprived as are the area near Washwood Heath RSMD

Rates and incidence of disease

- 7.1.10 The APHO figures for cancer, heart disease and stroke, and respiratory disease all indicate that Birmingham residents are more likely to suffer early deaths from these ailments than the population of West Midlands and England as a whole. Rates of early death from cancer are 123.19 per 100,000 population⁹¹, heart disease and stroke 96.76⁹² against national figures of 113.96 and 74.80 respectively. For rates of respiratory disease, Birmingham experienced 111.2 observed deaths as a percentage of expected deaths against an England rate of 100⁹³.

Obesity

- 7.1.11 Birmingham performs marginally worse than the regional and national averages for both adult and childhood obesity, being marginally above the West Midlands and England figures for both. For children, 10.70% are obese in Birmingham compared to the 10.11% in the West Midlands and 9.60% in England, whilst for adults Birmingham has a rate of 26.77% compared to 26.38% in the West Midlands and 24.16% in England⁹⁴.

Mental health

- 7.1.12 Depression (aged 18+), hospital admissions for 'self-harm and suicide, and undetermined injury' may be used as an indicator of mental health. APHO data indicates that Birmingham has slightly lower levels of depression and suicide and undetermined injury than England, but higher levels of self-harm⁹⁵.

⁸⁹ ONS (2011), Approximated social grade, Ward in England and Wales

⁹⁰ Department for Communities and Local Government, Indices of Deprivation (2010): IOD for Health deprivation and disability

⁹¹ APHO, (2012) Local Health Profiles: Early Deaths from Cancer

⁹² APHO, (2012) Local health Profiles: Early Deaths from Heart Disease and Stroke

⁹³ APHO, (2012) SMR for Respiratory Disease in persons of all ages

⁹⁴ APHO (2012), Health Profiles

⁹⁵ APHO, Community Mental Health Profiles (2012)

Life expectancy

- 7.1.13 Life expectancy provides an indicator of the general health of a population and the differences in health between different populations and socio-demographic groups. Life expectancy for males (78.4) and females (82.6) in the West Midlands is slightly below the national average of males (78.91) and for females (82.89). Within Birmingham the figures for both males (77.3) and females (82) are also below the regional and national figures⁹⁶.

Vulnerable groups

- 7.1.14 The following groups have been identified as being particularly vulnerable to health impacts within the Curzon Street area.

Lower socio-economic groups

- 7.1.15 The areas immediately around both the proposed Curzon Street Station and the Washwood Heath depot have high levels of deprivation, with a number of LSOAs falling within the 5% most deprived LSOAs in the country.

Ethnic minority groups

- 7.1.16 Birmingham has high levels of ethnic diversity compared to the West Midlands and England, with particularly high populations of 'White and Black Caribbean' and 'Indian' people.

7.2 Employment and economy

Existing conditions

- 7.2.1 Within Birmingham, 75.6% of the male population is economically active, which is lower than the West Midlands average of 81.1%, and lower than the England figure of 83.1%. For women the Birmingham figure (56.2%) is much lower than both the West Midlands (67.6%) and England (70.4%) figures⁹⁷.
- 7.2.2 In terms of the population of Birmingham economically active by age, Birmingham has a lower proportion in all age groups compared to the West Midlands and England.

7.3 Housing

Existing conditions

- 7.3.1 Where it occurs, housing along the route in this area is high density (i.e. terraced housing developments). The housing is generally located around the urban centres of Washwood Heath, Nechells, Nechells Green and Bordesley on the outskirts of Birmingham City.
- 7.3.2 In terms of the 'Barriers to Housing and Services' domain, the Proposed Scheme runs through three LSOAs which are within the 15% most deprived. This includes the area to the north of Curzon Street, an area to the south-east of the route including Heartlands Park and the RSDM and to the south of the RSDM

⁹⁶ ONS Census 2011: Life expectancy at birth and at age 65, England and Wales, 1991-93 to 2009-11

⁹⁷ ONS (2011), Annual Population Survey

- 7.3.3 Housing directly affected by the Proposed Scheme includes 12 terraced houses 127-149 Common Lane, Washwood Heath

7.4 Noise

Existing conditions

- 7.4.1 The existing baseline sound environment for this area is mixed, although as a heavily urbanised area, transport sound sources dominate in most areas. There are a number of major railway routes, running into Birmingham New Street, Birmingham Moor Street, and Birmingham Snow Hill stations.
- 7.4.2 The M6 cuts through the north of the area, and the existing sound levels within the area are also influenced by a number of major A-roads and very busy B-roads (typical daytime sound levels close to these major roads are 65 dB^[13]). To the east of the area, there is some influence from aircraft movements from Birmingham Airport though this is never a dominant sound source.
- 7.4.3 The area includes a mix of residential areas, some of which are very high density, and areas of intense industrial and commercial activity bringing significant local industrial sound sources. Towards the city centre there are major educational institutions including Aston University, Birmingham City University and Matthew Boulton College and major entertainment, leisure and shopping areas, including current and proposed development in the Birmingham Eastside area. Further from major roads and industrial sound sources, typical daytime levels reduce to 55 dB, and 50 dB in the quietest locations within this area.
- 7.4.4 Few locations experience low existing baseline sound levels due to the large number of major transport sound sources, although sound levels drop significantly during the night time, particularly in more residential areas (reductions of 10 dB are common away from the city centre and major roads, whilst where sound from major roads is dominant, reductions are generally closer to 5 dB).

7.5 Local environment

Existing conditions

Local character

- 7.5.1 The area is entirely urban, with land use through Washwood Heath, Nechells, Saltley and Vauxhall Green, comprising light industrial and commercial areas mainly located around infrastructure such as road and rail, with residential areas beyond.
- 7.5.2 The Washwood Heath area is predominantly an area of industry, which includes: warehousing, rail infrastructure, mail depots and sidings. Curzon Street is characterised by retail (the Bull Ring development), academic, medical, local government and legal facilities.

^[13] Quoted dB values refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, L_{pAeq,16hr}.

Green spaces

- 7.5.3 Although Birmingham generally has a relatively large amount of public open space, the Nechells and Hodge Hill wards have a deficiency. Two open space areas have been identified that will be affected directly by the Proposed Scheme, which are:
- Eastside Park that wraps round the northern and western sides of the Curzon Street station area, separated from the proposed construction area by New Canal Street and Curzon Street. The park was opened in March 2013 and includes a kid's park and science garden. The masterplan for the Eastside Park considered the possible future development of the area for the HS2 Curzon Street station; and
 - Park Street Gardens which connect to the southern end of the Eastside Park and lie to the west of the proposed Curzon Street Station.
- 7.5.4 Two areas of canal are crossed by the proposed scheme but are not significantly affected. These are the Grand Union Canal that runs parallel to the proposed route and is crossed by the route in the Vauxhall/Saltley area; and the Digbeth Branch Canal that is crossed by the route near Curzon Street.

7.6 Physical activity

Existing conditions

Levels of physical activity

- 7.6.1 Within Birmingham, levels of physical activity amongst adults i.e. those participating in 30 minutes moderate intensity sport (8.67%) is below the West Midlands (10.07%) and England average (11.25%)⁹⁸.
- 7.6.2 Amongst children, levels of physical activity percentage of school children who participate in at least 3 hours of high quality PE and school sport within and beyond the curriculum (44.37%) are below the West Midlands (48.44%) and England average (49.62)⁹⁹.

Opportunities for exercise

- 7.6.3 Informal areas for exercise include Park Street Gardens and Eastside City Park adjacent to the proposed Curzon Street Station; and the canal towpaths of the Grand Union Canal and Digbeth Branch Canal which are both crossed by the scheme.
- 7.6.4 National Cycle Network (NCN) route 53, generally runs from north to south through the area, and is a traffic free cycle route. In the vicinity of the proposed Curzon Street station, there are several advisory cycle routes, including the Digbeth Branch Canal which links with the Birmingham and Fazeley Canal at Aston Junction and the Grand Union Canal.

⁹⁸ APHO (2010), Health Profiles.

⁹⁹ APHO (2010), Health Profiles

7.7 Traveller stress

Existing conditions

Road networks

- 7.7.1 Key road routes crossing the proposed works and likely to be directly affected by them include:
- Park Street;
 - Saltley Viaduct;
 - Duddeston Mill Road; and
 - Aston Church Road.
- 7.7.2 Footpaths likely to be affected by the proposed work include: Saltley Viaduct, Duddeston Mill Road, Viaduct Street, St James Place, Lawford Close, Banbury Street, New Canal Street, Bartholomew Street, Fazeley Street, Park Street and the footpath link across Banbury Street, Bartholomew Street.

Public transport networks

- 7.7.3 Over 50 bus routes are accessible within close proximity of the proposed station, with most services operating at a high frequency throughout the day and at weekends.

7.8 Social capital

Existing conditions

- 7.8.1 'Social capital' comprises connections between individuals within and between communities, and the inclination that arises through these networks for individuals to feel valued, to feel a sense of belonging, to have companionship and to tangibly support each other.
- 7.8.2 The area is entirely urban in character. Although the areas immediately adjacent to the proposed Scheme are predominantly industrial in nature, they are interspersed with residential areas in the communities of Washwood Heath, Nechells, Saltley, Vauxhall and Duddeston. All of these communities are characterised by high levels of ethnic diversity and populations with a high proportion of residents in the lowest social classes.

Community facilities

- 7.8.3 Key community facilities in the area that may potentially be affected (including through demolition, land take, reduced access or amenity) by the proposed works include: the Arya Samaj Vedic Mission on Inkerman Street on the eastern edge of Birmingham; the Polish Centre on Bordersley Street; and the Masjid Ali Mosque on the corner of Aston Church Road with Arley Road.

Contents

HS2 Health Impact Assessment Report	iii
Appendix 6 - Quantitative noise and vibration information from the ES	iii
1 Introduction	5
1.1 Management and control of sound, noise and vibration impacts	5
2 Operational noise and vibration	11
2.2 Airborne noise	11
2.3 Combined noise and vibration effects (surface sections)	15

HS2 Health Impact Assessment Report

Appendix 6 - Quantitative noise and vibration information from the ES

1 Introduction

- 1.1.1 The assessment of health effects arising from noise or vibration during the construction and operation of the Proposed Scheme is reported in Section 5.6 of the main report.
- 1.1.2 The ES provides quantitative information in support of its assessment of the likely significant noise and vibration effects arising from the construction and operation of the Proposed Scheme. This information is presented in tabular form and on maps in the Appendices at Volume 5 of the ES.
- 1.1.3 Evidence for the links between noise and health, and specifically high speed rail noise compared to aviation noise for example, is presented in Appendix 4. This Appendix summarises the ES quantitative information for noise and vibration forecast to arise from the operation of the Proposed Scheme in the context of the evidence in Appendix 4.

1.2 Management and control of sound, noise and vibration impacts

General approach

- 1.2.1 The Proposed Scheme seeks to manage and control the impact of noise and vibration, in so far as is reasonably practicable:
 - by avoiding or reducing significant noise effects; and
 - where there are opportunities to do so, by reducing existing exposure to noise or vibration through the provision of mitigation.
 - Mitigation of likely significant adverse noise or vibration effects has, where practicable, been incorporated into the Proposed Scheme in the following order:
 - at source: the project has the opportunity to design and specify a complete railway system including quieter trains, track and their maintenance to reduce noise emission;
 - by noise barriers: Delivered, for example, as fence barriers or constructed cuttings using landscape earthworks or as a combination of both; and lastly
 - by reducing noise entering property.
- 1.2.2 The approach is consistent with the HS2 Sustainability Policy and Government noise policy¹. The aims of the Government's noise policy are outlined in the box below:

¹ Department for the Environment, Food and Rural Affairs (2010), Noise Policy Statement for England. DEFRA.

UK Government Noise Policy Aims

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

1. avoid significant adverse impacts on health and quality of life;
2. mitigate and minimise adverse impacts on health and quality of life; and
3. where possible, contribute to the improvement of health and quality of life.

1.2.3 In its aims the Policy uses the key phrases “significant adverse” and “adverse”. In clarifying what these mean the Policy notes that: “...there are two established concepts from toxicology that are currently being applied to noise effects, for example, by the WHO”. They are:

- NOEL – No Observed Effect Level
 - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level
 - This is the level above which adverse effects on health and quality of life can be detected.

1.2.4 The Policy extends these concepts to include:

- SOAEL – Significant Observed Adverse Effect Level
 - This is the level above which significant adverse effects on health and quality of life occur.

1.2.5 These terms are adopted in the Government’s emerging national planning guidance² on noise. The guidance links them directly, in increasing severity, to four levels of effect:

- effect;
- adverse effect;
- significant adverse effect; and
- unacceptable adverse effect.

² Department for Communities and Local Government (DCLG) (2013) Emerging National Planning Practice Guidance – Noise. ID 30-004-130729. <http://planningguidance.planningportal.gov.uk>.

1.2.6 This is on the premise that once sound or vibration becomes perceptible, the effect on people and other receptors increases as the level of sound increases. The noise policy notes that triggers should be defined for the onset of adverse effects (LOAELs) and significant adverse effects (SOAELs) in terms of total levels of exposure. Also that these trigger values should reflect the nature of the noise source, the sensitivity of the receptor and local context.

1.2.7 The envisaged mitigation identified through the process of the Environmental Statement serves to mitigate and minimise adverse effects on health and quality of life from the Proposed Scheme, consistent with the first and second aims of the Government's Noise Policy. The proposed approach is described in the following sections.

Control of construction noise

1.2.8 Construction noise and vibration will be controlled and managed in accordance with the draft Code of Construction Practice (CoCP). The principles of these control and management processes are:

- Best Practicable Means (BPM) as defined by the Control of Pollution Act 1974 (CoPA) and Environmental Protection Act 1990 (EPA) will be applied during construction activities to minimise noise (including vibration) at neighbouring residential properties;
- as part of BPM, mitigation measures are applied in the following order:
 - noise and vibration control at source: for example the selection of quiet and low vibration equipment, review of construction methodology to consider quieter methods, location of equipment on site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings; and then
 - screening: for example local screening of equipment or perimeter hoarding;
- where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary re-housing will be offered in accordance with the draft CoCP's noise insulation and temporary re-housing policy;
- lead contractors will seek to obtain prior consent from the relevant local authority under Section 61 of CoPA for the proposed construction works. The consent application will set out BPM measures to minimise construction noise, including control of working hours, and provide a further assessment of construction noise and vibration including confirmation of noise insulation or ultimately temporary re-housing provision;
- contractors will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to and be reviewed by the Nominated Undertaker and will be made available to the local authorities; and

- contractors will be required to comply with the terms of the CoCP and appropriate action will be taken by the Nominated Undertaker as required to ensure compliance.

- 1.2.9 Noise insulation will be offered for qualifying buildings as defined in the draft CoCP's Noise Insulation and Temporary Re-housing Policy. Noise insulation or ultimately temporary re-housing will avoid residents being significantly affected by levels of construction noise inside their dwellings.
- 1.2.10 The Draft CoCP's noise insulation and temporary rehousing policy expressly identifies that the Nominated Undertaker will consider at its discretion applications supported by evidence for noise insulation or temporary rehousing from occupiers who may have special circumstances, such as those with a medical condition which will be seriously aggravated by construction noise, and provide noise insulation or temporary housing where it is demonstrated that this is necessary.
- 1.2.11 Qualification for noise insulation and temporary re-housing will be identified as part of seeking prior consent from the local authorities under Section 61 of the Control of Pollution Act. Qualifying buildings will be identified early enough so that noise insulation can be installed, or temporary re-housing provided, before the start of the works predicted to exceed noise insulation or temporary re-housing criteria. Noise insulation, where required, will be installed as early as possible to reduce internal sound levels from construction activities and also when the Proposed Scheme comes into operation.

Operation

- 1.2.12 The development of the Proposed Scheme has, as far as reasonably practicable, kept the alignment away from main communities and low in the ground. These avoidance measures have protected many communities from likely significant noise or vibration effects.

Airborne noise

- 1.2.13 HS2 trains will be quieter than the relevant current European Union specifications. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia. The track will be specified to reduce noise, as will the maintenance regime. Overall these measures would reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on the new track. Further information is provided in the Environmental Statement, Volume 5: Appendix SV-001-000.
- 1.2.14 To avoid or reduce significant airborne noise effects, the Proposed Scheme incorporates noise barriers in the form of landscape earthworks, noise fence barriers and / or 'low-level' barriers on viaducts. Noise barrier locations are shown in the Environmental Statement, Volume 2: Map Book - Sound, noise and vibration Map series SV-05.
- 1.2.15 Generally, the assessment has been based on noise barriers having a noise reduction performance equivalent to a noise fence barrier with a top level 3m above the top of

the rail, which is acoustically absorbent on the railway side, and which is located 5m to the side of the outer rail. In practice, barriers may differ from this description, but will provide the same acoustic performance. For example, where noise barriers are in the form of landscape earthworks they will need to be higher above rail level to achieve similar noise attenuation to a 3m barrier because the crest of the earthwork will be further than 5m from the outer rail.

- 1.2.16 The Proposed Scheme incorporates 'low-level' noise barriers into the design of viaducts. Where needed to avoid or reduce significant airborne noise effects, these barriers are designed to provide noise reduction that is equivalent to a 2m high absorptive noise barrier located on the parapet of the viaduct. Locating these 'low-level' barriers close to the rail also reduces visual impact and limits the mass of the viaduct itself.
- 1.2.17 Noise effects are reduced in other locations along the line by landscape earthworks provided to avoid or reduce significant visual effects and engineering structures such as cuttings and safety fences on viaducts (where noise barriers are not required). The location of these barriers is shown in the Environmental Statement, Volume 5: Map Book - Sound, noise and vibration, Map series SV-05.
- 1.2.18 The Proposed Scheme includes taller barriers in some locations to avoid or further reduce significant adverse noise effects. Such mitigation was determined taking account of:
- its benefit compared to cost;
 - engineering practicability;
 - other environmental effects caused by the further noise mitigation; and
 - response from consultation and stakeholder engagement.
- 1.2.19 Tunnel portals will be designed to avoid any significant airborne noise effects caused by the trains entering the tunnel.
- 1.2.20 Significant noise effects from the operational static sources such as line-side equipment will be avoided through their design and the specification of noise emission requirements. Further information is provided in the Environmental Statement, Volume 5: Appendix SV-001-000.
- 1.2.21 Noise insulation measures will be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996³ (the Regulations). Qualification for noise insulation under the Regulations will be identified and noise insulation offered at the time that the Proposed Scheme becomes operational.
- 1.2.22 Where required, as well as improvements to the noise insulation of windows facing the railway, ventilation will be provided so that windows can be kept closed to protect internal sound levels.

³ Her Majesty's Stationery Office (1996), *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations*, London.

- 1.2.23 Following Government's emerging National Planning Practice Guidance⁴, where the noise from the use of the Proposed Scheme measured outside a dwelling exceeds the Interim Target defined by the WHO Night Noise Guidelines for Europe⁵, residents are considered to be significantly affected by the resulting noise inside their dwelling. The effect on people at night due to the maximum sound level as each train passes has also been assessed⁶. The Interim Target is a lower level of noise exposure than the Regulations trigger threshold for night noise. In these particular circumstances, where night-time noise levels for the use of new or additional railways authorised by the Bill are predicted following the methodology set out in the Regulations to exceed 55dB⁷, or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion²¹, noise insulation will be offered for these additional buildings..

Ground-borne noise and vibration

- 1.2.24 Significant ground-borne noise or vibration effects will be avoided or reduced through the design and maintenance of the track and track-bed.

⁴ National Planning Practice Guidance – Noise <http://planningguidance.planningportal.gov.uk>

⁵ World Health Organization, Night-time Noise Guidelines for Europe, 2010

⁶ During the night (2300-0700) a significant effect is also identified where the Proposed Scheme results in a maximum sound level at the façade of a building at or above: 85db LpAFmax (where the number of train pass-bys exceeding this value is less than or equal to 20); or 80db LpAFmax (where the number of train pass-bys exceeding this value is greater than 20).

⁷ Equivalent continuous level, LpAeq,23:00-07:00 measured without reflection from the front of buildings"

2 Operational noise and vibration

- 2.1.1 The management and control of sound, noise and vibration impacts from the Proposed Scheme is set out in the main report, together with a description of the envisaged avoidance and mitigation measures for operations.

2.2 Airborne noise

Annoyance

- 2.2.1 By comparison to existing ambient sound levels, exposure to noise from the Proposed Scheme during the daytime will be comparatively small⁸. This reflects the amount of mitigation that has been incorporated into the Proposed Scheme.
- 2.2.2 Railway noise from the Proposed Scheme might be expected to increase overall annoyance if it is close to or equal to existing ambient noise levels (an increase of 3db would occur if the noise level from the Proposed Scheme was equal to the existing ambient noise level) and if exposure is above 50dB⁹. A comparison of observed ambient daytime sound levels with those predicted from the Proposed Scheme is presented in Figure 6.1. This information is presented cumulatively in Figure 6.2. In locations where noise levels from the Proposed Scheme are lower than existing noise levels, a person's overall level of noise annoyance is likely to be dominated by the existing noise levels.
- 2.2.3 The environmental assessment has identified about 1,850 residential properties that would be adversely affected and would experience a noise change of 3db or more, and will be exposed to levels above 50db from the Proposed Scheme (around 100 properties in Euston; 400 in the London Corridor; 850 in Country South; 100 in West Midlands; 350 in Country North; and 60 at Curzon Street). Of these, about 250 residential properties will experience a noise change of 3db or more and be exposed to levels above 60db from the Proposed Scheme.
- 2.2.4 Inhabitants of these properties would experience a potential increase in overall annoyance from noise. It is important to appreciate that only a proportion of the total number of people exposed to these noise increases would be expected to become annoyed or experience an increase in annoyance. For example, the noise exposure and annoyance response relationships for railway sound (refer to the evidence base in

⁸ An assessment of existing ambient sound levels undertaken throughout 2012 and 2013 as part of the Environmental Statement identified that (45,850 out of a total of 56,800) residential properties within the airborne sound study area (defined as 1km either side of the railway in rural areas and 500m either side in urban areas) are currently exposed to daytime (0700-23-00) levels above 50db (quoteddb values for the daytime refer to the 16 hour daytime (07.00 to 23.00) equivalent continuous sound pressure level, $L_{pAeq,16hr}$). Below 50db sound from transportation (railways, road traffic and aircraft), although potentially noticeable, would not generally be expected to give rise to an observed adverse effect (refer to Appendix 4). Taking account of the envisaged avoidance and mitigation measures incorporated into the Proposed Scheme, the assessment has identified about 6,050 residential properties where noise from the Proposed Scheme (total noise due to train movements on the Proposed Scheme and noise resulting from changes in traffic patterns on existing roads or railways that result from the operation of the Proposed Scheme) would be above 50db and about 500 residential properties where noise from the Proposed Scheme would be above 60db.

⁹ Below 50db sound from transportation (railways, road traffic and aircraft), although potentially noticeable, would not generally be expected to give rise to an observed adverse effect. The WHO 1999 Guidelines for Community Noise identify 50 L_{pAeq} [outdoor noise level], as representing "daytime levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed, respectively." On this last matter, page 144 of the Community Noise guidelines states that "Available data indicate that daytime sound pressure levels of less than 50db L_{pAeq} cause little or no serious annoyance in the community". The dose response curves on page 100 of the same document suggest about 5% of the population is annoyed at 55db" - i.e. the majority referred to in the annoyance guideline value is about 95% of the population

Appendix 4) suggest that about 5% and 10 % of people would be highly annoyed at levels around 50 and 60db respectively.

Figure 6.1: Distribution of observed ambient daytime sound levels and predicted HS2 exposure levels.

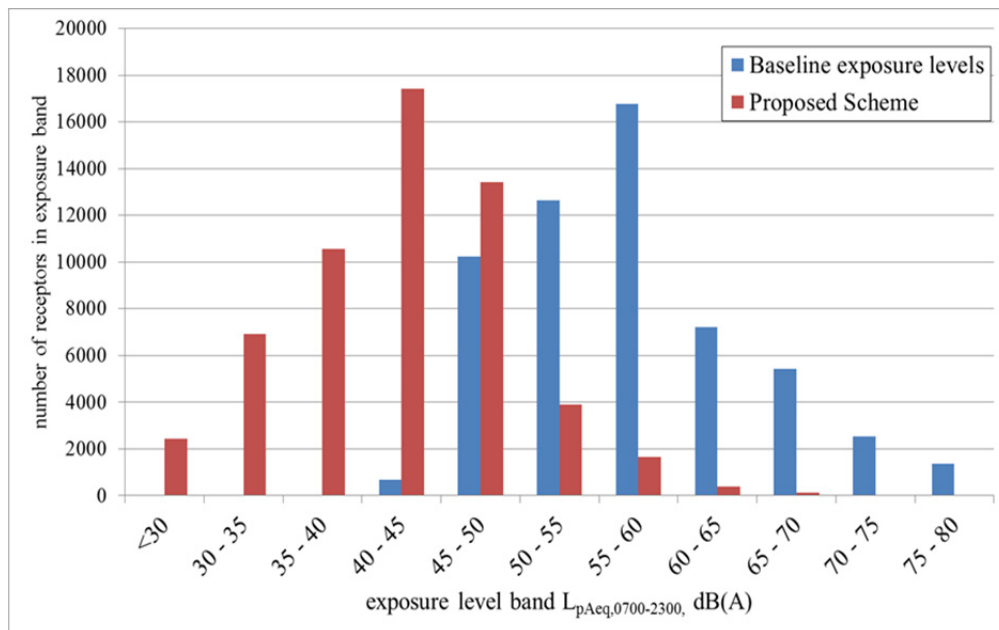
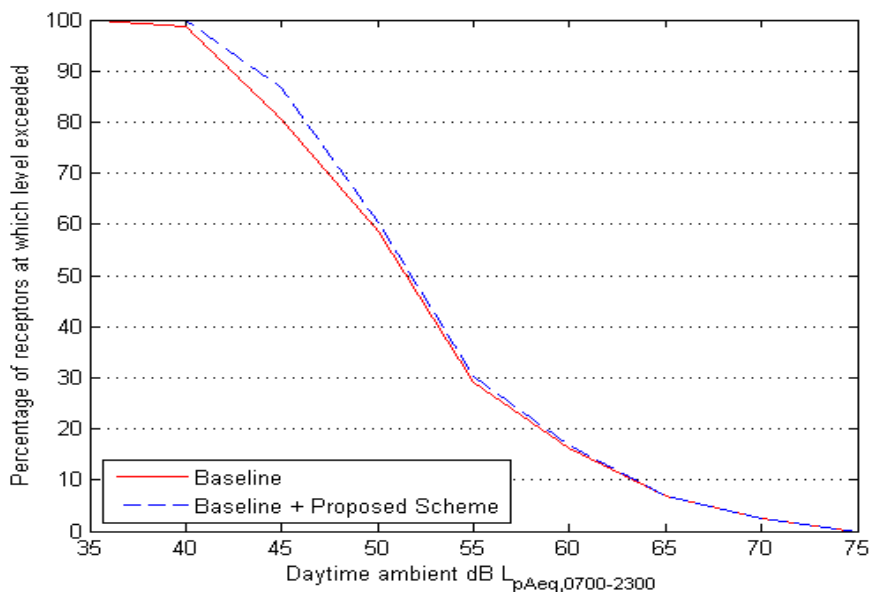


Figure 6.2: Cumulative distribution of observed ambient daytime sound levels and predicted HS2 exposure levels.



Sleep disturbance

- 2.2.5 By comparison to existing ambient sound levels, exposure to noise from the Proposed Scheme at night will be comparatively small¹⁰. This reflects the amount of mitigation that has been incorporated into the Proposed Scheme and the service patterns¹¹.
- 2.2.6 Disturbance at night resulting from different sources of transportation noise could potentially be additive. In general the overall level of disturbance at night is unlikely to increase if railway noise is lower than existing levels. Railway noise from the Proposed Scheme might be expected to increase the risk of non-awakening sleep disturbance if it is close to or equal to existing ambient noise levels (an increase of 3db would occur if the noise level from the Proposed Scheme was equal to the existing ambient noise level) and if exposure is above 40dB at night¹². A comparison of observed ambient night-time sound levels with those predicted from the Proposed Scheme is presented in Figure 6.3. This information is presented cumulatively in Figure 6.4.
- 2.2.7 The environmental assessment has identified about 1,450 residential properties that will experience a noise change of 3db or more, and will be exposed to levels above 40db at night from the Proposed Scheme (around 60 properties in Euston; 100 in the London Corridor; 850 in Country South; 80 in West Midlands; 300 in Country North; and 60 at Curzon Street).

¹⁰ An assessment of baseline noise levels at night (23:00-07:00) undertaken throughout 2012 and 2013 as part of the Environmental Statement identified that (52,650 out of a total of 56,800) residential properties within the airborne sound study area are currently exposed to night-time noise levels above 40db (quoted db values for the night period refer to the 8-hour night (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr}$). This is the level below which the World Health Organisation (2009) Night Noise Guidelines for Europe suggests there is generally no adverse effect at night. The World Health Organisation Europe (1999) Guidelines for Community Noise criterion of 40db (23:00-07:00) is defined as an equivalent continuous sound pressure level. As such it considers the level, number and timing of 'events' occurring at night, including the maximum noise levels exhibited by each train pass.

¹¹ Passenger services on the Proposed Scheme would start at or after 05.00hrs, and would start to run at the maximum hourly service pattern after 07:00 and up to 21:00. The number of services would then progressively decrease after 21:00 and the last service would arrive at terminal stations by 24:00. As a consequence there would be up to 36 passenger train movements each night (23:00-07:00) on the main sections of the route.

¹² Below 40db $L_{pAeq,8hr}$ outdoors sound from transportation (railways, road traffic and aircraft) would not generally be expected to give rise to an observed adverse effect at night (refer to Appendix 4).

- 2.2.8 Inhabitants of these properties would experience a potential increase in reported sleep disturbance. This does not mean that increased adverse effects on sleep will necessarily occur where the exposure is at this level and there is a change in noise levels at night of around 3db. The level of risk from the increase will depend upon a number of factors including how maximum noise levels, the number of noise events, and the character of the noise will change as a result of the Proposed Scheme. Also how the level, composition and character of the noise at night will change as a result of the Proposed Scheme. In general, there is a greater risk of adverse effects at higher noise levels. Therefore, it is expected that the risk of adverse effects on sleep will be greater when an increase in noise level occurs at higher levels of noise exposure.

Figure 6.3: Distribution of observed ambient night time sound levels and predicted HS2 exposure levels.

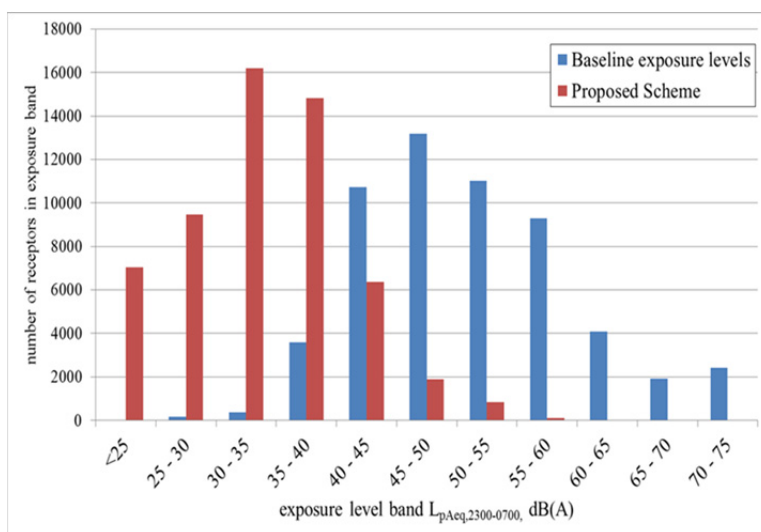
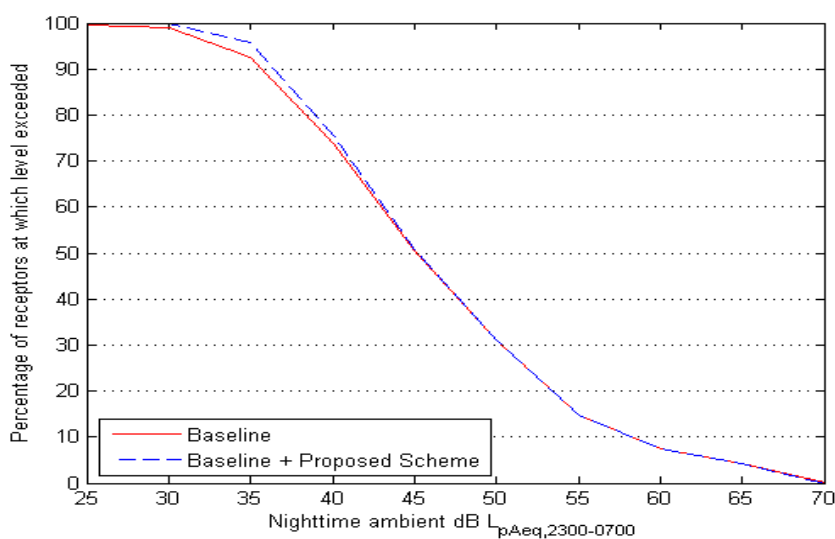


Figure 6.4: Cumulative distribution of observed ambient night time sound levels and predicted HS2 exposure levels.



Cardiovascular effects

- 2.2.9 Assessment of higher levels of noise exposure, and a change of 3db or more, can give a broad indication of risk of cardiovascular health effects (Refer to Appendix 4). By comparison to existing ambient sound levels, exposure to higher levels of noise (above 60db) from the Proposed Scheme will be small¹³.
- 2.2.10 The environmental assessment has identified around 250 residential properties that will experience a noise change of 3db or more, and will be exposed to levels above 60db from the Proposed Scheme. Given the small fraction of the population within the study area exposed to levels above 60db due to the Proposed Scheme, and the risks of cardiovascular effects due to railway noise exposure relative to the level of risk that exists without exposure to noise (refer to Appendix 4), it is highly unlikely that the Proposed Scheme will result in an increase in cardiovascular diseases within the study area.

Cognitive impairment in children

- 2.2.11 The environmental assessment has identified one school (Booker Park School, Aylesbury), which would experience a noise change of 3db or more, and will be exposed to noise levels above 50db from the Proposed Scheme (refer to Appendix 4). These conditions are only just exceeded at the school boundary, but can be used to indicate the risk of cognitive impairment in schoolchildren. As a result there is a small risk that noise from the Proposed Scheme at this school could disturb outdoor teaching activities, or teaching activities inside when the windows are open.
- 2.2.12 Booker Park School caters for children with special needs who may be more sensitive to changes in the environment including changes in noise levels. HS2 Ltd will continue to engage with stakeholders regarding this school, to fully understand its use characteristics and the benefit of the envisaged mitigation measures. The outcome of these activities will be reflected in the Environmental Minimum Requirements.

2.3 Combined noise and vibration effects (surface sections)

- 2.3.1 The environmental assessment has identified about 50 residential properties that are very close to the route that would be adversely affected by ground-borne vibration. This is where the forecast vibration in the centre of floor would be above $0.2\text{ms}^{-1.75}$ during the day or $0.1\text{ms}^{-1.75}$ at night.
- 2.3.2 These properties will also be exposed to noise levels from the railway exceeding 50db during the day or 40dB during the night. About 10 of these will be eligible for noise insulation (refer to Appendix 4). If the offer of noise insulation is accepted, there will be 40 residential properties whose inhabitants could experience higher annoyance than that expected if either noise or vibration was present in isolation (refer to Appendix 4).

¹³ An assessment of existing ambient sound levels undertaken throughout 2012 and 2013 as part of the Environmental Statement identified that 16,500 residential properties within the airborne sound study area are currently exposed to daytime levels above 60db. Taking account of the envisaged avoidance and mitigation measures incorporated into the Proposed Scheme, the assessment has identified about 500 residential properties where noise from the Proposed Scheme would be above 60db.

Effects along tunnelled sections

- 2.3.3 Taking account of the envisaged avoidance and mitigation measures incorporated into the Proposed Scheme, the environmental assessment has identified about 15 residential properties where minor adverse vibration effects are likely to occur (the forecast vibration at the centre of floors will be above $0.2\text{ms}^{-1.75}$ ¹⁴ during the day or $0.1\text{ms}^{-1.75}$ at night), and around 10 residential properties near the tunnel sections that will be exposed to low ground-borne noise adverse effects (forecast levels near the centre of rooms will be above 35dB).
- 2.3.4 Observed adverse effects¹⁵ would not generally be expected below these levels of ground-borne noise or vibration.

¹⁴ Quoted vibration levels in $1\text{ms}^{-1.75}$ refer to the frequency weighted Vibration Dose Value for the respective day and night periods

¹⁵ High Speed Two Ltd for Department for Transport, Impacts of Tunnels in the UK, 2013.
<http://assets.hs2.org.uk/sites/default/files/inserts/Impacts%20of%20tunnels%20in%20the%20UK.pdf>