High Speed Rail: HS2 Phase 2b Preferred Route

Sustainability Statement including Post Consultation Update

Appendix C9 – Health Analysis

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LEADERS IN ENVIRONMENT, PLANNING & SUSTAINABILITY.

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CONTENTS

1. INTRODUCTION

1.1.1. This report has been prepared to support the HS2 Phase 2b Sustainability Statement including Post Consultation Update report, which describes the extent to which the Government's preferred route for HS2 Phase 2b supports objectives for sustainable development. This document is a technical appendix which summarises the methodology and conclusions for the health analysis and the key findings that inform the Sustainability Statement main report. The Sustainability Statement places emphasis on the known key impacts only at this stage in the design, prior to commencing the Environmental Impact Assessment.

1.1.2. The report is structured as follows:

- Section 2 outlines the scope and method of the analysis;
- Section 3 summarises the literature review undertaken for the appraisal;
- Section 4 presents the health baseline for local authorities whose boundaries fall within 350m of the preferred route;
- Section 5 outlines the health analysis findings; and
- Section 6 summarises the high level conclusions of the analysis.

2. SCOPE AND METHOD

2.1. Overview

2.1.1. This report draws on the sustainability appraisal work carried out to date as part of the Appraisal of Sustainability (AoS), and is designed to identify the relevant issues that a future health assessment for Phase 2b should consider and assess in more detail.

2.1.2. It is a update of the 2013 health analysis published as an appendix to the 2013 Sustainability Statement. The analysis has been updated for new data and for the preferred route.

2.2. Defining Health

2.2.1. Health, or more importantly what constitutes good health, is difficult to define and measure in all its aspects for a population, not least because perceptions regarding health and expectations of good health vary. Following best practice, this analysis takes the definition of the World Health Organization (WHO), which states that health is:

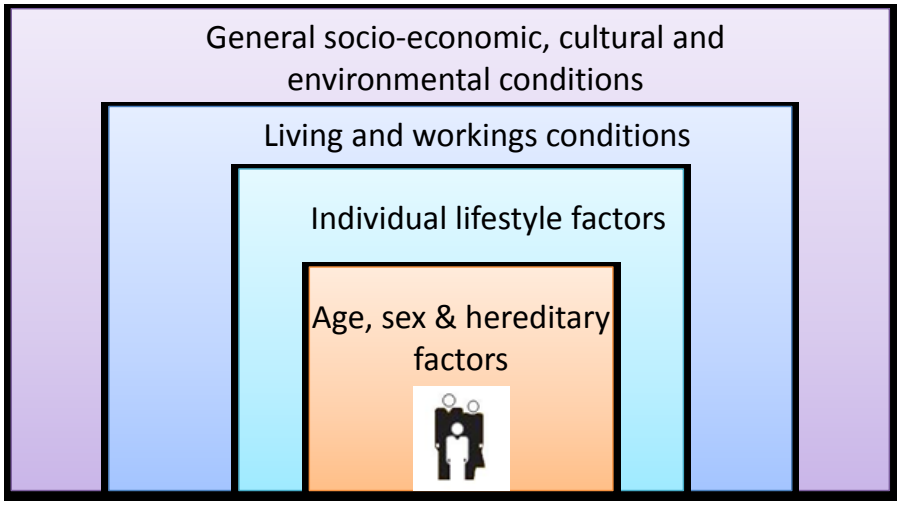
'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity' (WHO, 1948).

2.2.2. As a consequence of adopting the WHO definition, the basis of this analysis is a broad socio-economic model of health. For any individual, health is determined by a multitude of factors. There are individual factors that relate to age and genetics, which cannot be changed. In addition, there are lifestyle factors, such as levels of physical activity, alcohol consumption and tobacco smoking. Beyond these factors, a multitude of external factors play a significant part in determining health. These reflect the wider environment and encompass many aspects of the socio-economic context in which individuals live and work. For example, social and community networks are considered to be important for a person's health and wellbeing, along with good housing, access to medical services, transport and being employed. The physical environment (e.g. air quality) also has a part to play in the

health of populations. Differences in these factors can contribute to health inequalities between communities.

2.2.3. A common way of summarising these factors is shown in **Figure 2-1**, which illustrates a model of the 'determinants of health'.

Figure 2-1 - Socio-economic model of health[1]



2.3. Policy and guidance framework

2.3.1. Transport has an important role in ensuring the health and wellbeing of people and communities. The key objective identified in WHO's *Collaboration between health and transport sectors in promoting physical activity* report (2006) is to increase the provision of sustainable travel to improve the health and wellbeing of citizens. Although this refers principally to walking and cycling, rail provides an opportunity to support these modes through the integration of stations with cycle and pedestrian networks and provision of facilities such as cycle parks.

2.3.2. While there are policy drivers around health, there is currently no specific legislation in the UK which relates to assessing health impacts in the context of planning and new developments. This will change once the European Union Environmental Impact Assessment (EIA) Directive 2014/52/EU is transposed into UK legislation (the Government has until 16 May 2017 to do this)[2]. EIA Directive 2014/52/EU aims to achieve high levels of protection for human health in addition to environmental protection. Any direct and indirect significant effects on human health would need to be identified, described and assessed in an appropriate manner, in the light of each individual case. This includes the interaction of human health with other factors.

2.3.3. Although considering health as part of the AoS is not a legislative requirement, it is considered to be good practice and also to be in line with precedents set by other major transport projects.

[1] Modified from Dahlgren, G., and M. Whitehead. (1995). Tackling Inequalities: A Review of Policy Initiatives. In Tackling Inequalities in Health: An Agenda for Action, eds. M. Benzeval, K. Judge, and M. Whitehead. London: Kings Fund Institute.

[2] At the time of writing, following the EU referendum vote for the UK to leave the EU, it is understood that it is the Government's intention is to transpose EU legislation into UK law. Subsequent to the transposition, various elements of the EU sourced legislation may be amended. In this context, it has been assumed that EU legislation referred to in this document will be transposed to UK law and will remain relevant.

2.3.4. This report presents an initial analysis of the potential health effects and vulnerabilities along the preferred route. At this relatively early stage of scheme development, this analysis is not a full health assessment but takes into consideration the following guidance:

- NHS Executive's *A Short Guide to Health Impact Assessment Informing Healthy Decisions* (August 2000);
- London Health Urban Development Unit (HUDU) *Watch Out for Health: A checklist for assessing the health impact of planning proposals*; and
- WHO Guidance on Health Impact Assessment (HIA).

2.3.5. A health assessment will be undertaken for the scheme at a later stage of development. The initial analysis reported here identifies relevant issues for a future health assessment to consider.

2.4. Methodology and criteria

2.4.1. The overarching approach to this analysis has been to identify the potential impacts on health and wellbeing (both positive and negative) that may need to be investigated in more detail at a later stage of scheme development. Potential impacts have been identified based on desk-based evidence from published literature, a health baseline and the results of the AoS.

2.5. Literature review

2.5.1. A focussed literature review has been undertaken to collect evidence on the potential health impacts associated with the scheme. This was based on a review of literature on health effects associated with the various elements of the scheme and included a review of completed HIAs on rail projects.

2.6. Health baseline

2.6.1. The health baseline has been developed in relation to local authorities whose boundaries fall within 350m of the centreline of the preferred route[3]. Baseline data collected includes local authority health profiles from 2015 generated by Public Health England and mapping of the English Indices of Deprivation 2015 health data. The combination of statistics and mapping has helped develop a picture of existing community health susceptibilities and inequalities, including pockets of relative deprivation or affluence which is useful in informing the analysis and identifying vulnerable groups.

2.7. Limitations of the analysis

2.7.1. There are a number of baseline data limitations which could affect the findings of the health analysis. It is recognised that the English Indices of Deprivation datasets represent a snapshot view of dynamic spatial information; therefore this data is considered to be a useful indicator rather than representing fixed, long-term or absolute spatial distributions. In addition, local authority Health Profiles for 2015 include data as old as 2010 in some cases. Furthermore, it is possible that properties that have been identified as commercial, industrial or another classification and which may be subject to demolition may provide community services.

2.7.2. The analysis is partly spatially-specific (identifying the location of possible impacts where relevant), and partly scheme-wide (where impacts relate to the scheme as a whole, and

[3] The 350m buffer represents a broad approximation of the area within which scheme impacts are likely to be felt; however, the health analysis will consider the likely extent of each impact according to its nature.

broad conclusions can be made). A brief justification for the findings is provided, although detailed analysis is not appropriate at this stage of scheme development.

2.7.3. While there are some limitations as described above, the level of detail of the scheme design information and the nature of the baseline data are considered sufficient for the purposes of undertaking an initial analysis to identify relevant issues for a future health assessment to consider.

3. LITERATURE REVIEW

3.1. Overview

3.1.1. This section sets out the findings of the literature review. The possible health effects of a rail project such as the preferred route have been reviewed in terms of the following topics:

- access to housing, community facilities, education, healthcare facilities, public transport, and green spaces and physical activity;
- community severance or isolation;
- safety;
- landscape and visual;
- noise and vibration;
- air quality;
- socio-economic impacts; and
- rail projects and public health case studies.

3.1.2. The information is provided under these headings for ease of reading. However, it should be noted that a number of these elements can interact to affect the health of individuals.

3.2. Access to housing

3.2.1. Demolition, resulting in loss of homes can cause stress and anxiety to individuals thereby impacting on wellbeing whether replacement housing has been identified or not. In addition, the process of relocation itself can cause stress which can lead to adverse effects on health. Relocation can also cause community severance as residents are moved away from their communities and social networks as well as facilities and services.

3.2.2. Housing quality can affect long-term health, with those who have experienced overcrowded, cold or damp housing conditions, either as adults or children, being more likely to become ill. This is especially true for vulnerable groups such as children, those with respiratory problems and the elderly[4]. As well as decreased risk of illness, there are also wellbeing and mental health benefits associated with experiencing an improvement in housing conditions and new housing development in deprived areas can therefore bring general wellbeing benefits.

3.2.3. New housing, or improved access to transport, may also trigger gentrification[5] in some areas. House prices can be adversely impacted by the introduction of new infrastructure into areas if there is a perceived reduction in amenity value, which can be a cause of stress for residents and reduce wellbeing.

[4] Marsh A, Gordon D, Pantazic C and Heslop P, The Policy Press (1999). Home sweet home? The impact of poor housing in health.

[5] Gentrification is a controversial notion generally considered to refer to adverse effects on communities associated with affluent middle-class households becoming established in working-class, 'de-invested' areas.

3.3. Access to community facilities

3.3.1. Community facilities can have beneficial impacts for health as they promote wellbeing and social inclusion through promoting a sense of control in one's life and self-worth[6]. They can also result in increases in social capital which may play a complex role in health and wellbeing through access to social and cultural events. Networks and connections can act as a buffer against deprivation, providing access to health resources, support and information[7]. Better social support is associated with lower levels of anxiety and depression, reduced likelihood of common mental illness and increased likelihood of recovery from mental illness[8].Therefore the removal of existing community facilities can have a negative impact on health. This is often felt more strongly by the most deprived in a community who often depend more upon the facility to maintain their quality of life.

3.4. Access to education

3.4.1. Education is a key influencing factor for health. Levels of education influence a range of additional determinants of health including employment opportunities, levels of income, housing, lifestyle and coping skills. Those who achieve a high standard of education are more likely to find stable, well paid employment and associated benefits such as higher incomes, access to better housing, and a higher quality of life. Poor education is also associated with health inequalities and the cycle of health inequalities. Any factor which increases education will help break the cycle of health inequalities related to poor education leading to poor unemployment[9].

3.5. Access to healthcare facilities

3.5.1. Access to healthcare facilities is a key determinant of health allowing people to seek treatment when suffering from ill health, thereby improving health outcomes and providing reassurance. When access to healthcare is poor or delayed, health outcomes tend to be worse and wellbeing is affected[10,11].

3.6. Access to public transport

3.6.1. Transport plays an important role in promoting health and wellbeing, directly by providing communities with access to a range of services and amenities required to treat ill health, manage and promote healthy living, and indirectly through enabling and maintaining social and family networks which provide emotional, professional and social support aspects of good health and wellbeing, and by enabling access to employment opportunities. Improved rail and access to other modes of transport can also lead to health benefits such as reduced stress due to a reduction in congestion on the road networks, improved social networks and reduction in community severance due to busy roads. These positive health impacts are likely to be felt most strongly by those who currently live in areas where there is poor access from most modes of transport.

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[6] Health Impact Assessment for Regeneration Projects, Volume 2, Selected Evidence Base, Cave et al., Queen Mary University and Breaking the Cycle, East London and the City Health Action Zone.

[7] (HDA, 2004). Campbell, 1999, Gillies, 1998, cited in Investigating the links between social capital and health using the British Household Panel Survey.

[8] HDA, (2004). Investigating the links between social capital and health using the British Household Panel Survey.

[9] DFEE (2004). 'Youth Cohort Study: the activities and experiences of 16 year olds: England and Wales' Department for Education and Employment Statistical Bulletin, issue no. 8/97, June, London: The Stationery Office.

[10] Julia C Prentice and Steven D Pizer; Delayed Access to Health Care and Mortality Health Services Research. 2007 April; 42(2): 644–662.

[11] Joel S. Weissman, PhD; Robert Stern, MD; Stephen L. Fielding, PhD; and Arnold M. Epstein, MD, MA. Delayed Access to Health Care: Risk Factors, Reasons, and Consequences: Ann Intern Med. 1991; 114(4):325-331.

3.7. Access to green spaces and physical activity

3.7.1. Regular physical activity provides people of all ages and conditions with a wide range of physical, social and mental health benefits. Physical activity (including walking and cycling) plays a role in reducing obesity as well as diseases such as diabetes, heart disease and high blood pressure all of which are major public health problems in the UK[12].

3.7.2. A low level of physical activity is a major risk factor for ill health and mortality from all causes. The benefits from physical activity are transient; therefore exercise is needed throughout life in order to minimise the risk of developing disease.

3.7.3. Proximity to green space has been found to affect the level of usage and, in turn, health benefits[13]. Green spaces benefit people in terms of providing a space for rest and relaxation and enable restoration, aiding both mental and physical health. Access to these spaces and increased green space is beneficial to health and wellbeing[14].

3.8. Community severance or isolation

3.8.1. Community severance is a term used to describe the separation of different areas within a community and the breaking of networks, leading to loss or decreased access to support networks and decreased social capital.

3.8.2. As well as enhancing connectivity between members of social groups and networks, development of new transport systems, including railways, have the potential to disrupt social networks through the creation of barriers which can prevent or reduce community interaction. The risk and severity of health effects arising from community severance is dependent upon a number of factors and can only be appraised qualitatively.

3.8.3. Rail projects can also create areas of isolation, if the line of a route encloses areas which are already partially bounded by existing infrastructure, residents of dwellings within these areas may experience negative mental health effects associated with a sense of isolation. Older people in particular may be vulnerable to adverse impacts associated with this type of impact.

3.9. Safety

3.9.1. Those in more deprived socio-economic groups are at higher risk of being involved in road traffic accidents, especially children. This can be explained in part by higher traffic volumes and speeds in poorer areas, as well as increased exposure as pedestrians for families that do not own a car. Children are a particularly vulnerable group, with one in three accidents involving a person under 25[15].

3.10. Landscape and visual

3.10.1. Changes in townscape and landscape character and views can become a focus for concern and anxiety. The built environment can impact on public health and the way that people utilise their environment including decreased physical activity. If visual environments

[12] Department of Health (2011). Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers.

[13] Bateman, I, Day, B, Georgiou, S and Lake, I. (2006). The aggregation of environmental benefit values: Welfare measures, distance decay and total WTP, Ecological Economics, 60, 450–460.

[14] Nielson, T and Hanson, K (2007). Do green areas affect health? Results from a Danish survey on the use of green areas and health indicators, Health and Place 13(4) 839-850.

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

deteriorate, so too can the physical and mental health of the people that live in them[16]. Equally, some changes to townscape and public realm may have a positive impact on health and wellbeing.

3.10.2. Light pollution from the built environment can also have a negative health impact through annoyance, discomfort and loss of visual environment and visibility. Artificial lighting, emitted from premises so as to be prejudicial to health or a nuisance, is considered a statutory nuisance under the Environmental Protection Act 1990.

3.10.3. Vulnerable receptors include those living in areas where the landscape is currently undisturbed or where there are high levels of deprivation where people are likely to experience decreased satisfaction in the area they live.

3.11. Noise and vibration

3.11.1. Noise has the potential to affect health in a variety of ways. Some effects can be auditory, resulting in damage to the ear and occur as a direct impact of noise. Acoustic limiting values are recommended to avoid inner ear damage. There are also a range of non-auditory health effects associated with exposure to environmental noise, such as annoyance, night time effects and mental health impacts including anxiety and stress.

3.11.2. Annoyance is the most reported non-auditory health effect associated with noise. Vibration can also cause annoyance to those experiencing it. Sleep disturbance associated with noise can cause decreased day time efficiency and cause long-term health impairment.

3.12. Air quality

3.12.1. Exposure to outdoor air pollution is associated with both acute and chronic health effects. Particulate matter[17] (PM) mainly generated from engine emissions and construction activities, can adversely affect human health in varying degrees depending on its size, composition, origin and the length of exposure. The public health implications of the long-term effects of exposure to PM are an order of magnitude greater than those of the short-term effects, as measured by life years lost, although it is difficult to disentangle the two entirely. A strong body of epidemiological evidence provides compelling evidence of the association between long-term exposure to $PM_{2.5}$ and cardiovascular disease, with consequent implications for mortality.

3.12.2. Groups that are particularly vulnerable to exposure from air pollution include foetuses, young children, the elderly and those with cardio-respiratory disease, as well as those who are socially or economically deprived.

3.12.3. Dust emissions and subsequent deposition arising from construction activities can cause annoyance. Dust can also irritate the eyes and aggravate pre-existing respiratory problems, such as asthma.

3.12.4. Construction sites can cause a localised and temporary increase in exposure to pollutants for those in close proximity. Exposure to nitrogen dioxide (NO_2) and particulate matter (PM_{10}) at sufficiently high concentrations causes inflammation to airways. $PM_{2.5}$ can cause respiratory and cardiovascular effects in those exposed.

[16] Richard Jackson and Chris Kochtitzky, Creating a healthy environment: the impact of the built environment on public health, Centre for Disease Control and Prevention.

[17] Particulate matter is the term used to describe particles found in the air, including dust, dirt, soot, smoke and liquid droplets and are classified according to their diameter – PM2.5 refers to particles less than 2.5 micrometres in diameter and PM10 refers to particles less than 10 micrometres in diameter.

3.13. Socio-economic impacts

3.13.1. Employment and income are regarded as the key determinants of health, influencing where an individual lives, the education received, access to healthcare and even lifestyle and behaviour.

3.13.2. Ethnic minorities, young people and disabled people generally face the highest levels of unemployment. These groups are more likely to be found in more insecure employment and be poorly paid, therefore having low socio-economic status. Impacts on inequalities are addressed in the Equality Analysis (**Appendix A**).

3.13.3. Unemployment is associated with poor health, with unemployed individuals being more likely to report poor physical health and injury as well as worse mental health including depression and feeling demoralised[18]. Health outcomes associated with unemployment include physical health effects, mental health effects, suicide, reduced wellbeing, reduced role functioning (understanding of role in society), poor self-reported health and increased mortality.

3.13.4. Increased employment opportunities, can have a positive influence on health through increasing social contact, involvement in a collective effort or activity and by forming social relationships. All of these contribute to wellbeing. In addition, those in insecure employment are more likely to have poorer mental health than those in secure employment. It has also been found that those in routine occupations are nearly four times more likely to become ill than those in professional and managerial roles[19].

3.13.5. Employment and income together contribute to a person's socio-economic status. In broad terms, the greater the income, the better the health; however, this relationship is not strictly linear[20,21]. Above a certain level, higher income is less proportionally related to improved health. Employment-related health benefits will be greatest for those who are currently unemployed, who are in short term temporary employment or who are living in more deprived areas.

3.13.6. Limited health benefits may be felt by employees who gain temporary employment during construction of a scheme. Construction-related employment is unlikely to confer long-term health benefits on individuals or the community as a whole.

3.14. Rail project case studies

3.14.1. A number of HIAs have been carried out on rail infrastructure developments previously and their findings are summarised and presented in **Table 3-1**. These findings provide an indication of the types of health impacts which may arise from the scheme. However, the analysis set out in this report takes account of the differences between these rail projects and the current scheme.

[18] Mathers C.D. and Schofield DJ (1998). The health consequences of unemployment: the evidence. Medical Journal of Australia 168; 178-182.

[19] Bartley M and Owen C (1996). Relation between socioeconomic status, employment and health during economic change 1973-93 British Medical Journal: 445-449.

[20] Marmot M (2002). The influence of income on health: views of an epidemiologist. Health Affairs; 31-46.

[21] Ecob B, Davey Smith G (1999). Income and health: what is the nature of the relationship? Social Science and Medicine; 48: 693-705.

Table 3-1 – Key findings from rail HIAs

Scheme	Potential health impacts identified
Mersey Tram	**Adverse impacts** Increased temporary work-related accidents and injury during construction. Increased noise levels in other areas during construction and operation. Increase in air pollutants and dust during construction. **Beneficial impacts** Increased temporary employment during construction. Increased mobility during operation. Improved access to all services increased including health services during operation. Reduced noise levels in some areas during operation. Marginal decease in air pollution during operation.
Tees Valley Metro	**Adverse impacts** Decrease in local air quality. Increase in noise. General disruption to communities in proximity to the rail corridor. **Beneficial impacts** Improved access linking communities to employment, housing, health care, social network, recreation and leisure opportunities. Environmental improvements brought on by a modal shift away from roads (air quality, noise and road safety). Increased opportunities for physical activity. Regeneration.
Crossrail	**Adverse impacts** Reduced environmental quality during demolition and construction. Dust generation and emissions during construction. Noise generation during construction. Increased risk of accident from construction traffic on roads. Land required for construction of the scheme resulting in a temporary loss of green space and services. **Beneficial impacts** Improved perception of local urban and natural environment. Increased access to education and training. Increased employment opportunities. Increased access to facilities, amenities and services. Increased accessibility to affordable housing. Reduced long-term local levels of depression, anxiety and mental illness. Improved quality of life and wellbeing. Increased level of community participation, community development and the strengthening of community groups.

Scheme	Potential health impacts identified
High Speed 2 Phase 1	**Adverse impacts** Adverse health impacts from loss and displacement of jobs particularly around the proposed station locations. Health effects linked to relocation of homes, and in some locations, changes to social environment and loss of social networks for remaining communities. Effects on sports and leisure facilities and community facilities. Effects on public rights of way. Changes to access of services during construction. Increase in demand for health services during construction as a result of temporary workers. Perception of a more stressful and poor quality environment from visual effects, particularly during construction, may contribute to adverse health effects. Traveller stress during construction from road closures and diversions. Road safety implications of increased heavy goods vehicles during construction. Community isolation. Reduction in areas of public open space. Fear of crime and antisocial behaviour. Noise during construction and operation. Increase in dust and emissions during construction. **Beneficial impacts** Health benefits from increased employment and access to employment, particularly around stations. Better and more comfortable journey experience and reduced traveller stress during operation.

4. HEALTH BASELINE

4.1. Baseline

4.1.1. Evidence suggests that different communities have varying susceptibilities to health impacts and benefits as a result of ethnicity, social and demographic structure and relative deprivation. This health baseline provides an insight to how potential impacts might act disproportionately upon some communities and vulnerable people. The aim of the baseline review is to understand the differing susceptibilities to health impacts of communities located along the preferred route as a result of variations in social and demographic factors and relative deprivation in communities. The baseline review has informed the analysis of impacts set out in **Section 4**.

4.2. Summary of health profile data

4.2.1. **Table 4-1** provides a summary of the health statistics for key indicators provided in the Health Profiles of the local authorities which lie within 350m of the preferred route (local authority boundaries outlined in **Figure 4-1** and **Figure 4-2**). Those numbers in **Table 4-1** that are highlighted in red correspond to the indicators for which local authorities have a significantly poorer profile than England as a whole, as defined by Public Health England. The numbers highlighted in green correspond to the indicators for which local authorities have a significantly better profile than England as a whole. The numbers which are not highlighted relate to health indicators that are in line with the average for England[22].

4.2.2. Along the western leg it can be seen that Manchester, Salford and Wigan are more deprived in terms of a number of key health statistics than England and the rest of the local authorities along the route. Manchester and Salford in particular have extremely high levels of deprivation, children living in poverty and early deaths from heart disease and stroke. The health profiles along the eastern leg are more varied, again with the areas to the north performing more poorly in some key health statistics. In particular, Nottingham, Chesterfield, Doncaster, Barnsley and Leeds all have significantly worse health profiles than the England average for all indicators.

[22] The colour coding is worked out based on the confidence intervals around the point value for an area – a lower 95% confidence interval and higher 95% confidence interval. These are compared to a reference value (in this case the value for England). If the range of values between each interval coincides in any way with the average for England, then the value is not significantly different. If the range of values is completely above or below the average for England then the value is either significantly worse or better depending on whether higher or lower values are a good outcome.

Table 4-1 – Local Authority key health profile indicators[23] [24]

Local authority	Deprivation[25]	Proportion of children in poverty[26]	Life expectancies[27]		Early deaths: heart disease and stroke[28]	GCSEs achieved (5A*-C including English and Maths)[29]	Long term unemployment[30]
			Men	Women			
England average	20.4	19.2	79.4	83.1	78.2	56.8	7.1
Western Leg							
Cheshire East	7.7	11.9	80.4	83.6	70.0	61.4	3.8
Cheshire West and Chester	15.5	15.4	79.2	83.3	71.9	58.2	3.8
Warrington	17.3	14.5	78.3	81.8	83.6	55.9	6.2
Trafford	11.2	14.1	79.9	83.5	83.4	72.2	5.2
Manchester	65.1	33.9	75.5	80.0	137.0	51.5	10.5
Salford	47.2	26.8	76.6	80.4	115.9	47.3	8.9
Wigan	30.3	19.5	77.7	80.9	98.2	58.0	8.6
Eastern Leg							
North Warwickshire	5.2	13.9	79.0	82.2	95.4	57.0	3.4
Tamworth	13.8	18.6	79.8	82.6	68.2	39.5	1.9

[23] All figures taken from 2015 Local Health Profiles produced by Public Health England. Red indicates figures that are significantly worse than the England average while green indicates figures that are significantly better.

[24] There are some differences between local authorities in the thresholds for significantly worse or better than the England average. This is because of different confidence intervals around a particular value for a local authority. For example, there is uncertainty as to whether the value for life expectancy for women for North West Lincolnshire is significantly different from the England value – thus it is not assigned a colour; whereas with Cheshire East, which has the same value, there is a higher level of confidence in the value that the value is significantly better.

[25] % people in this area living in 20% most deprived areas in England, 2013.

[26] % children (under 16) in families receiving means-tested benefits & low income, 2012.

[27] At birth, 2011-2013.

[28] Directly age standardised rate per 100,000 population aged under 75, 2011-2013.

[29] % key stage 4, 2013/14.

[30] Crude rate per 1,000 population aged 16-64, 2014.

Local authority	Deprivation[25]	Proportion of children in poverty[26]	Life expectancies[27]		Early deaths: heart disease and stroke[28]	GCSEs achieved (5A*-C including English and Maths)[29]	Long term unemployment[30]
			Men	Women			
North West Leicestershire	3.2	13.4	78.9	83.6	83.7	54.9	4.8
Rushcliffe	0.0	7.3	81.4	84.6	52.7	70.6	3.2
Erewash	16.2	18.9	79.8	83.5	69.1	46.1	6.8
City of Nottingham	51.9	33.7	77.0	81.7	108.0	44.1	16.5
Broxtowe	5.5	15.2	80.7	83.6	73.6	57.1	5.0
Ashfield	24.1	23.2	78.2	82.1	86.0	51.6	8.6
Bolsover	27.4	21.5	78.1	82.2	85.4	48.1	5.7
Chesterfield	25.9	21.0	78.2	82.2	97.8	53.6	7.9
North East Derbyshire	10.3	14.8	80.0	83.4	75.9	60.0	5.7
Rotherham	33.4	22.8	78.1	81.4	88.8	57.3	13.6
Doncaster	37.5	23.8	77.5	81.7	90.2	49.4	11.4
Barnsley	32.7	23.8	78.1	81.6	98.5	47.1	11.1
Wakefield	28.7	20.6	77.9	81.8	88.6	58.2	9.0
Leeds	28.7	21.6	78.3	82.1	91.1	51.0	11.2
Selby	1.6	11.6	79.0	83.7	72.2	56.3	4.0

4.3. Summary of English Indices of Deprivation maps

4.3.1. The English Indices of Deprivation 2015 provide a ranking of small areas in England using a range of information across a number of subject domains, including health and disability deprivation. This measure is made up of four indicators about a range of health issues to give an overall score for the level of health deprivation experienced in a small area[31]. **Figure 4-1** and **Figure 4-2** map this deprivation indicator in the local authorities within 350m of the western and eastern leg and provides additional context to the information in **Table 4-1**.

4.3.2. **Figure 4-1** shows that the majority of the western leg has generally low levels of health deprivation. However, the preferred route passes through a number of areas in the 20% most deprived in England, within Crewe and then where the route terminates at Wigan and Manchester, with the whole district of Manchester being in the 20% most deprived areas in England.

4.3.3. **Figure 4-2** highlights that the key areas of health deprivation along the eastern leg are Nottingham, Chesterfield, Rotherham, Doncaster, Barnsley, Wakefield and Leeds. All these local authorities include a high number of small areas in the 20% most deprived relative to England in terms of health. All other local authorities show a more mixed picture, with all having some areas in the 20% most deprived except Broxtowe.

[31] The Health Deprivation and Disability Domain includes the following indicators: years of potential life lost (an age and sex standardised measure of premature death); comparative illness and disability ratio (an age and sex standardised morbidity/disability ratio); acute morbidity (an age and sex standardised rate of emergency admission to hospital); and, mood and anxiety disorders (a composite based on the rate of adults suffering from mood and anxiety disorders, hospital episodes data, suicide mortality data and health benefits data).

Figure 4-1 – Western Leg Health Deprivation and Disability (2015)

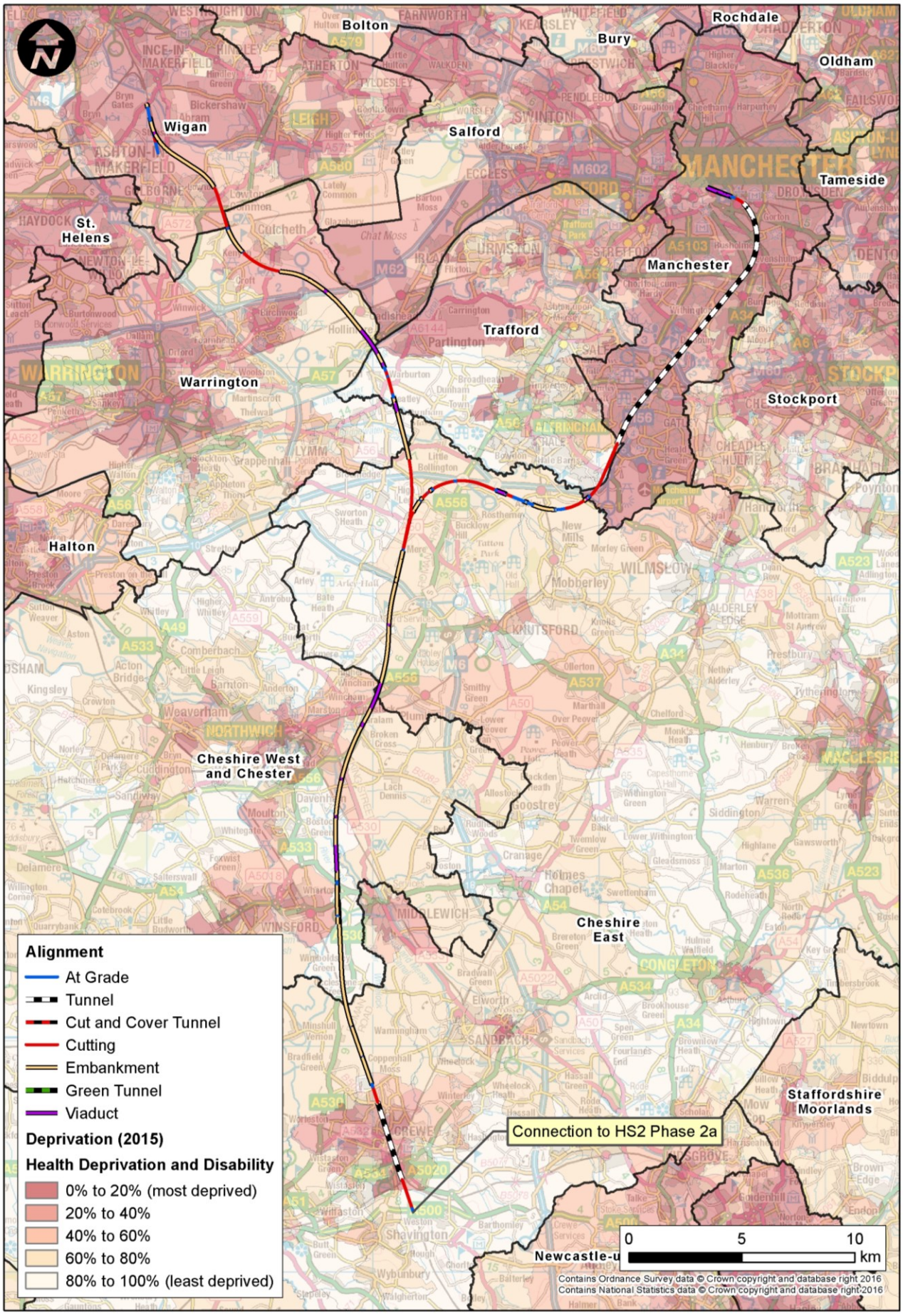
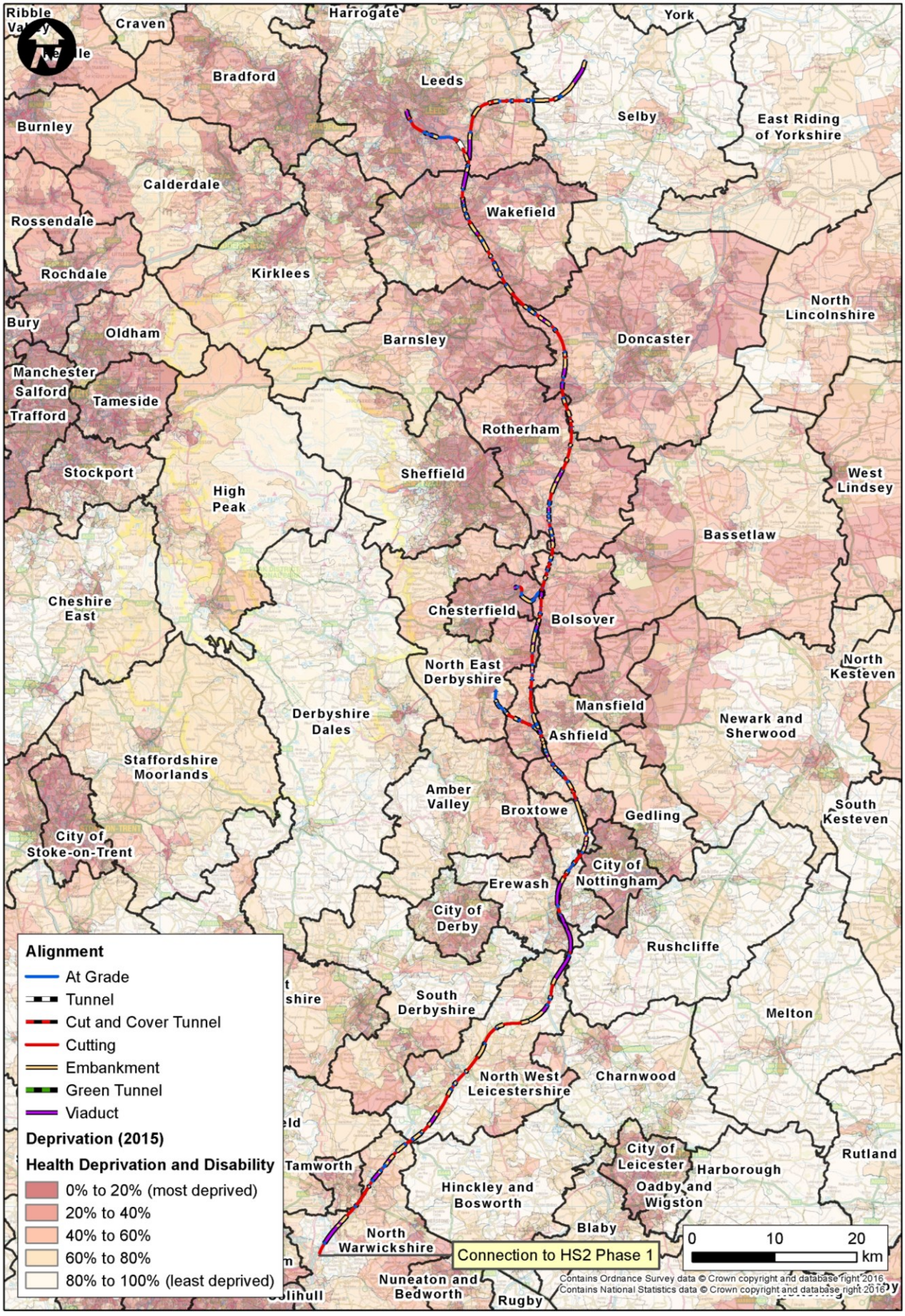


Figure 4-2 – Eastern Leg Health Deprivation and Disability (2015)



5. FINDINGS

5.1. Table

5.1.1. Potential impacts on health and wellbeing that could be associated with the preferred route are outlined in **Table 5-1**. The table sets out, for each topic, the potential implications for health of different elements of the scheme.

Table 5-1 – Health analysis findings

Topic	Scheme feature	Analysis
Access to housing	Demolition of dwellings and potential for new dwellings	**Demolition of dwellings (direct dwelling impacts)** Western Leg Demolition of an estimated 111 dwellings on the western leg, the majority of which would be associated with the spur into Manchester and into Manchester Piccadilly station. Of these, an estimated 48 dwellings would be demolished on Chapeltown Street as part of the new Manchester Piccadilly station, north of the existing station. Other clusters of residential demolitions include those located south and north of Lostock Green and at the proposed Manchester Airport station. Eastern Leg Demolition of an estimated 144 dwellings The majority of these are either at or approaching East Midlands Hub station where there are a total of 76 residential demolitions in two clusters, north and south of Station Road. **Potential for new dwellings (indirect dwelling impacts)** Western Leg Up to 4,100 new dwellings are expected to be supported around Manchester Piccadilly station, as a result of the preferred route. Eastern Leg Up to 4,950 new dwellings are expected to be supported around the two new stations on the eastern leg (up to 350 around East Midlands Hub and up to 4,600 around Leeds station). There are likely to be some adverse health impacts arising from the preferred route due to stress and anxiety associated with demolition of dwellings. Displaced residents near Manchester Piccadilly station on the western leg and at Long Eaton on the eastern leg are likely to be particularly vulnerable to these effects as there are high levels of health deprivation in these areas. Overall, however, there are likely to be substantially more new houses provided as a result of the scheme than the number of houses expected to be demolished. Provision of new houses in relatively deprived areas could provide health benefits for local residents, if people currently experiencing poor housing standards are able to access improved housing conditions as a result.

Topic	Scheme feature	Analysis
Access to community facilities	Demolition of community facilities	Western Leg Potential demolition of a chapel near Manchester Piccadilly station [32]. Eastern Leg Potential demolition of a Children and Family Court Advisory and Support Service (Cafcass) centre in Leeds[33]. The extent of any negative health impacts associated with the demolition of community facilities would depend on the nature of the services provided by these facilities, and whether services were replaced. Manchester in particular has high levels of health deprivation therefore adverse impacts may be felt particularly strongly in this location.
Access to education	Improved access to higher education facilities and demolition of educational facilities	Entire Route Improved train connections and increased rail capacity between London, Birmingham, Crewe and Manchester, and London, Birmingham, the East Midlands (from Toton) and Leeds, along with improved connections to Sheffield and South Yorkshire. Connections to the East Coast and West Coast Main Lines would enable HS2 services to travel onwards on the existing network. Western Leg The AoS process has not identified any schools/ educational facilities that are likely to be demolished on the western leg. Eastern Leg The AoS process has not identified any schools/ educational facilities that are likely to be demolished on the eastern leg. In general, the preferred route is not likely to make a difference to people's access to education on a daily basis (such as daily journeys to and from school). The scheme, however, may deliver some health benefits in this regard by improving accessibility and increasing rail capacity to centres of learning such as universities, business schools and other higher education establishments in the cities served by the preferred route, as well as wider locations through connections with the high speed rail network.
Access to health centres	Demolition of healthcare facilities	Western Leg The AoS process has not identified any healthcare facilities that are likely to be demolished on the western leg. Eastern Leg Potential demolition of the NHS England West Yorkshire Area team centre. The extent of any negative health impacts associated with the demolition of healthcare facilities along the route will depend on the nature and extent of current usage, and any re-provision by the local authority, NHS or other provider. Where such facilities are required it is likely that they would be re-provided.

[32] Community facilities differ slightly from those in the Sustainability Statement including Post Consultation Update (2016) due to different criteria used for classifying community facilities.

[33] Community facilities differ slightly from those in the Sustainability Statement including Post Consultation Update (2016) due to different criteria used for classifying community facilities.

Topic	Scheme feature	Analysis
Access to public transport	Provision of new stations, improving access to other existing modes of transport	Western Leg Manchester Piccadilly station would offer direct interchange with the National Rail network and the Metrolink at Manchester Piccadilly. It would create new opportunities for pedestrian routes through the undercroft, reducing severance, and would open up the northern end of the station with a new access road. Manchester Airport station would improve access to the airport, while also linking with existing transport systems, including the M56 and the Metrolink. Eastern Leg The East Midlands Hub station would provide an opportunity for interchange with National Rail services into Nottingham, Derby, Leicester and Loughborough and has the potential to accommodate an extension of the Nottingham Express Transit (NET) tramway. Leeds station would offer interchange with the national rail network for regional destinations and destinations further away including Newcastle upon Tyne, Edinburgh and Liverpool. The existing Leeds station includes a bus interchange, providing connections to the city's extensive bus network, and access to highways including a link to the M621. Overall, it is likely that there would be potential beneficial health effects associated with improved transport interchanges at all new stations, by offering increased access to services and facilities and increased capacity on the rail network. The benefits of improved interchange would be felt over a wide area around each station; associated health benefits would be greatest in areas of health deprivation surrounding all four new stations.
Community severance or isolation[34]	Isolation or severance of residential properties	Entire Route HS2 Ltd would aim to avoid closing or removing the legal status of existing rights of way where possible, and to maintain access across the railway through the on-going design of the scheme. This would involve working with local people, local authorities and relevant organisations to determine the best way of achieving this where feasible. Western Leg A sense of isolation may affect an estimated three dwellings at three different locations: Broken Cross (Rudheath), North of Rostherne Mere and North Golborne. The AoS process has not identified any areas that are likely to experience severance on the western leg. Eastern Leg A sense of isolation may affect an estimated 209 dwellings, most notably at Whateley (also affected by severance), Worthington, Long Eaton, Netherthorpe, Crofton, Methley Lanes and Church Fenton. The extent of any adverse impacts that may be experienced during scheme construction would need to be assessed at a later stage. A sense of isolation may be experienced at a number of locations on both the western and eastern legs, and may have a particular adverse impact on disabled and older people in these areas. As set out in the Equality Analysis (**Appendix A**), the areas listed above do not correspond to the areas where individual clusters of older people have been identified, therefore adverse impacts associated with this are likely to be limited. Adverse health impacts associated with community severance and isolation are expected to be avoided during the operational stage through the maintenance of access roads and paths or provision of alternative arrangements, where possible. However, a perception or sense of isolation or severance could still affect residents.

[34] Severance could occur when settlements are divided by the route, leaving some people separated from certain community facilities. Isolation could occur where areas become enclosed between the route and other existing infrastructure (such as motorways or railways) or large linear features, such as main rivers. Details of

Topic	Scheme feature	Analysis
Access to green spaces and physical activity	Intersection of cycle paths, footpaths and green spaces	Entire Route HS2 Ltd would aim to avoid closing or removing the legal status of existing rights of way where possible, and to maintain access across the railway through the on-going design of the scheme. This may be achieved through diversion or reinstatement (subject to agreement with the local authority), although there would be disruption to these routes temporarily during construction. Western Leg Two open access areas are intersected by the preferred route, one to the north of Lowton and one to the west of Abram (both to the south-east of Wigan). Eastern Leg There are no intersections of open access areas on the eastern leg. Adverse health impacts associated with reduced access to green spaces, or reduced opportunity for physical activity as a result of footpath or cycle path severance are expected to be avoided during the operational stage through the reinstatement or diversion of access roads and paths, where possible. Adverse impacts associated with direct impacts on open access areas will be reduced or mitigated as far as possible by careful design of the preferred route at later stages.
Safety	Operational safety implications	Entire Route The scheme is expected to encourage a modal shift from road to rail, which is likely to have a positive impact in terms of a reduction in fatalities as rail is a safer transport option. There may, however, be an increased risk of injury to pedestrians and cyclists associated with increased traffic around station areas. Careful station design would reduce this risk.
	Risk of injury associated with scheme construction	Entire Route During construction, the likelihood of construction site injury or accident involving a member of the public is low, as the majority of construction activities will take place within site boundaries with limited access to non-project employees. The risk of accidents associated with construction traffic is likely to be greater, although it is not possible to assess this at this stage. It is recommended that consideration be given to the ways in which risk of accidents associated with construction vehicle movements can be minimised. Similarly, it is not possible at this stage to assess the risk of injury to rail users and workers; assessment of this would need to be undertaken at a later stage in scheme design.
Landscape and visual impacts	Landscape and visual impact during construction	Entire Route Locations where construction activity is likely to be highly visible are not defined at this stage. It is not possible to assess the landscape and visual impacts of construction at this stage. It is recommended that consideration be given to the ways in which visual impacts could be limited, such as through the use of appropriate and well-designed hoarding or other shielding devices. In particular, consideration should be given to the visual impacts of station construction, to minimise potential adverse effects on the wellbeing of people living in adjacent areas that already experience high levels of health deprivation.

the methodology for assessing severance and isolation are provided in Sustainability Statement including Post Consultation Update: Appendix E6 – Community Integrity.

Topic	Scheme feature	Analysis
	Landscape and visual impact from the operational scheme	Entire Route The locations where the likely key adverse landscape or visual impacts may be experienced are set out in the Sustainability Statement including Post Consultation Update. On-going design and appraisal will consider use of mitigation measures (such as blending aspects of the scheme into the landscape as far as possible) and will follow the landscape mitigation philosophy adopted for Phase One and Phase 2a. These measures will serve to minimise or reduce impacts on the landscape and visual environment as much as possible. This will also reduce the likelihood of potential adverse health and wellbeing impacts.
Noise and vibration	Noise and vibration during operation	Entire Route It is not expected that any adverse impacts associated with vibration would arise during the operational phase of the scheme, since any potential significant impacts would be mitigated. The locations where residual adverse noise impacts are likely to be experienced are set out in the Sustainability Statement including Post Consultation Update. Receptors that are more susceptible to health impacts associated with noise will be dwellings and noise-sensitive facilities located closest to the route. Any adverse effects are likely to be felt in particular by young children at school although measures would be taken to mitigate adverse noise effects on learning.
Air quality	Increased levels of dust and vehicle/plant emissions during construction	Entire Route The air quality appraisal (set out in the Sustainability Statement including Post Consultation Update) suggests that the potential for adverse impacts on residential receptors will be primarily associated with construction dust at stations. Standard dust suppression measures employed during construction would help to control dust levels and therefore reduce any potential negative health impacts. Good practice measures would also be used to control emissions from plant used on construction sites and to minimise the effects of emissions from construction traffic. This issue will be assessed further at a later stage of scheme design when more information is available on construction sites, methods and mitigation.

Topic	Scheme feature	Analysis
Socio-economic impacts	Direct and indirect job creation during construction and operation	Entire Route Estimates by HS2 Ltd of direct employment have been prepared for HS2 as a whole (Phase One, 2a and 2b). The operational scheme is expected to require an estimated 3,000 permanent jobs. The equivalent of 25,000 permanent jobs are expected to be created by the construction of HS2, with over 1,000 people each year being trained at the new National College for High Speed Rail in Birmingham and Doncaster from 2017. Western Leg Net increase of up to 700 jobs potentially supported indirectly through regeneration associated with the Manchester Airport station. Net increase of up to 42,900 jobs potentially supported indirectly through regeneration associated with the new station at Manchester Piccadilly. Eastern Leg Net increase of up to 9,900 jobs potentially supported indirectly through regeneration associated with the East Midlands Hub. Net increase of up to 19,800 jobs potentially supported indirectly through regeneration associated with Leeds station. The potential extent of jobs supported with both construction and operation of the preferred route is likely to provide health benefits associated with employment. Consideration will be given at a later stage to the ways in which new jobs could be made accessible to people living within areas of deprivation such as those around Manchester Airport station, Manchester Piccadilly station and Leeds station. Health benefits are likely to be greatest in relation to jobs created as a result of operation which are more likely to be permanent.
	Displacement of jobs where business premises are demolished[35]	Entire Route Estimated demolition of 199 commercial or retail properties and ten industrial properties associated with the whole scheme. Western Leg Estimated demolition of 91 commercial or retail properties and two industrial properties on the western leg. Eastern Leg Estimated demolition of 108 commercial or retail property and eight industrial properties on the eastern leg. The number of jobs estimated to be displaced as a result of the potential demolition of commercial/retail and industrial premises is much lower than the number of jobs that could be supported by the preferred route. The effect of job losses is nonetheless potentially significant. Although displaced jobs are expected to be taken up elsewhere, job losses are likely to be associated with anxiety and stress in the short term for those affected. Displaced organisations may need to move out of the area to find suitable alternative premises which may displace some jobs and, if a company does not re-establish operations at all, adverse health effects may be experienced by employees. Compensation will be paid to facilitate the relocation of businesses to minimise job losses and associated health effects. It is not necessarily the case that those people losing their jobs would find new employment as a direct result of the preferred route. Areas of high deprivation where the impact of job displacement would be expected to be particularly large include the vicinities of Manchester Piccadilly station and Leeds station.

[35] Demolition numbers differ slightly from those in the Sustainability Statement including Post Consultation Update due to different criteria used for classifying commercial and retail properties.

6. SUMMARY

6.1.1. The preferred route passes through a number of areas with high levels of health-related deprivation. The western leg is less deprived in terms of health as a whole, although in the north of the route the areas of Manchester, Salford and Wigan are extremely deprived. The eastern leg has mixed levels of health deprivation with greatest deprivation levels experienced in Nottingham, Chesterfield, Rotherham, Doncaster, Barnsley, Wakefield and Leeds.

6.1.2. The initial analysis set out in this report indicates that there is the potential for both positive and negative health impacts to arise around the new stations. The main potential negative health impacts relate to displacement of jobs, noise during construction and demolition of housing and community facilities. Positive health impacts relate to increased access to employment, new housing and access to transport which in turn can increase access to education, services and facilities. Both positive and negative health impacts are likely to be felt most strongly by the most vulnerable people (people living in socio-economically deprived areas, older people and young people).

6.1.3. Further health assessment work will be undertaken on the preferred route, as part of the EIA (see **Section 2-3** for details of likely future changes to EIA legislation), so that this can inform the development of the scheme taken forward. A key part of a future health assessment will be to undertake stakeholder engagement to understand people's concerns and perceptions so that these can be taken into account in assessing the potential health impacts of the scheme.

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