In Parliament – Session 2021 - 2022

HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix TR-001-00000

Traffic and transport

Transport Assessment Part 1

M276

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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.

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1.1 Transport Assessment structure

1.1.1 The Transport Assessment (TA) addresses the wider transport impacts of the Proposed Scheme. For the purpose of the Environmental Statement (ES), the Proposed Scheme is divided into Community Areas (CA). This TA considers each CA in turn from south to north:

- Hough to Walley's Green (MA01);
- Wimboldsley to Lostock Gralam (MA02);
- Pickmere to Agden and Hulseheath (MA03);
- Broomedge to Glazebrook (MA04);
- Risley to Bamfurlong (MA05);
- Hulseheath to Manchester Airport (MA06);
- Davenport Green to Ardwick (MA07); and
- Manchester Piccadilly Station (MA08).

1.1.2 In the Manchester region, where there is a degree of commonality between MA06, MA07 and MA08, the affected community areas have been considered together in the assessment section.

1.1.3 This TA also includes an assessment of route-wide impacts and off-route stations as well as any combined construction impacts with HS2 Phase 2a. The off-route assessment considers the impact of:

- construction works at off route stations or off route depots; and
- changes in passenger footfall at stations that are not part of the Proposed Scheme, including HS2 Phase One stations.

1.1.4 This section provides an overview of the approach adopted, which is considered in greater detail in subsequent sections. This TA is structured into four parts dealing with CA and the route-wide and off-route assessments:

- Part 1: (this document) sets out the context, methodology and mitigation;
- Part 2: sets out the baseline and future baseline conditions;
- Part 3: set out the impacts for each of the CA either individually or in combination in station areas; and
- Part 4: sets out the route-wide and off-route impacts.

1.1.5 In Part 3 where impacts in MA06 – MA08 are set out in a combined chapter, the CA in which the impact occurs is identified.

1.1.6 In addition, the Background Information and Data (BID)[1] report Transport assessment policy and data (BID TR-004-00001) includes additional information that is used to inform the TA.

1.2 Background

1.2.1 High Speed Two (HS2) is a new high speed railway proposed by the Government to connect major cities in Britain (see Figure 1-1). It will transform intercity and long distance passenger rail travel in the UK, providing the first major increase in intercity rail capacity for over a century and freeing up substantial capacity for rail travel and freight on the conventional rail network. London, Birmingham, Manchester and cities in the Midlands, the North and Scotland will be served by high speed trains running at speeds of up to 360kph (225mph) on HS2 lines and on the existing conventional rail network. As part of the Proposed Scheme, new stations will be built at Manchester Piccadilly and Manchester Airport, in addition to the new stations in London and the West Midlands included in HS2 Phase One.

1.2.2 HS2 will be built in phases. The hybrid Bill for Phase One of the HS2 network, between London and the West Midlands, received Royal Assent in February 2017. The main works on Phase One commenced in April 2020. The hybrid Bill for Phase 2a of the HS2 network, between the West Midlands and Crewe, received Royal Assent in February 2021.

1.2.3 The full Phase 2b scheme comprises the route from:

- Crewe to Manchester (approximately 85km (52 miles) in length), with a connection onto the West Coast Main Line (WCML) (referred to as the 'Phase 2b Western Leg'); and
- the West Midlands to Leeds via the East Midlands and South Yorkshire (referred to as the 'Phase 2b Eastern Leg'). The Phase 2b Eastern Leg is not the subject of the Bill for the Proposed Scheme.

1.2.4 The Proposed Scheme comprises:

- the HS2 Western Leg from Crewe to Manchester, including:
  - new stations at Manchester Airport and Manchester Piccadilly;
  - a depot north of Crewe;
  - maintenance facilities north of Crewe and at Ashley; and
  - a connection onto the WCML near Bamfurlong;
- the Crewe Northern Connection, connecting the route of the Proposed Scheme with the WCML and enabling future NPR services to connect with HS2;
- provision for the NPR London to Liverpool, Manchester to Liverpool, and Manchester to Leeds junctions, to enable these future NPR routes to connect with HS2; and

[1] High Speed Two Ltd (2022), High Speed Rail (Crewe - Manchester), *Background Information and Data*. Available online at: https://www.gov.uk/government/collections/hs2-phase-2b-crewe-manchester-environmental-statement.

- a number of works at locations beyond the Western Leg route corridor, referred to as 'off-route works' which include:
  - works to enable HS2 trains to call at existing stations further north on the WCML; and
  - construction of depots to provide overnight stabling for HS2 trains serving the north of England and Scotland.

1.2.5 The Proposed Scheme will connect with Phase 2a at Hough, to the south of Crewe.

1.2.6 Construction of the Proposed Scheme is assumed to commence in 2025, with operation assumed to start in 2038.

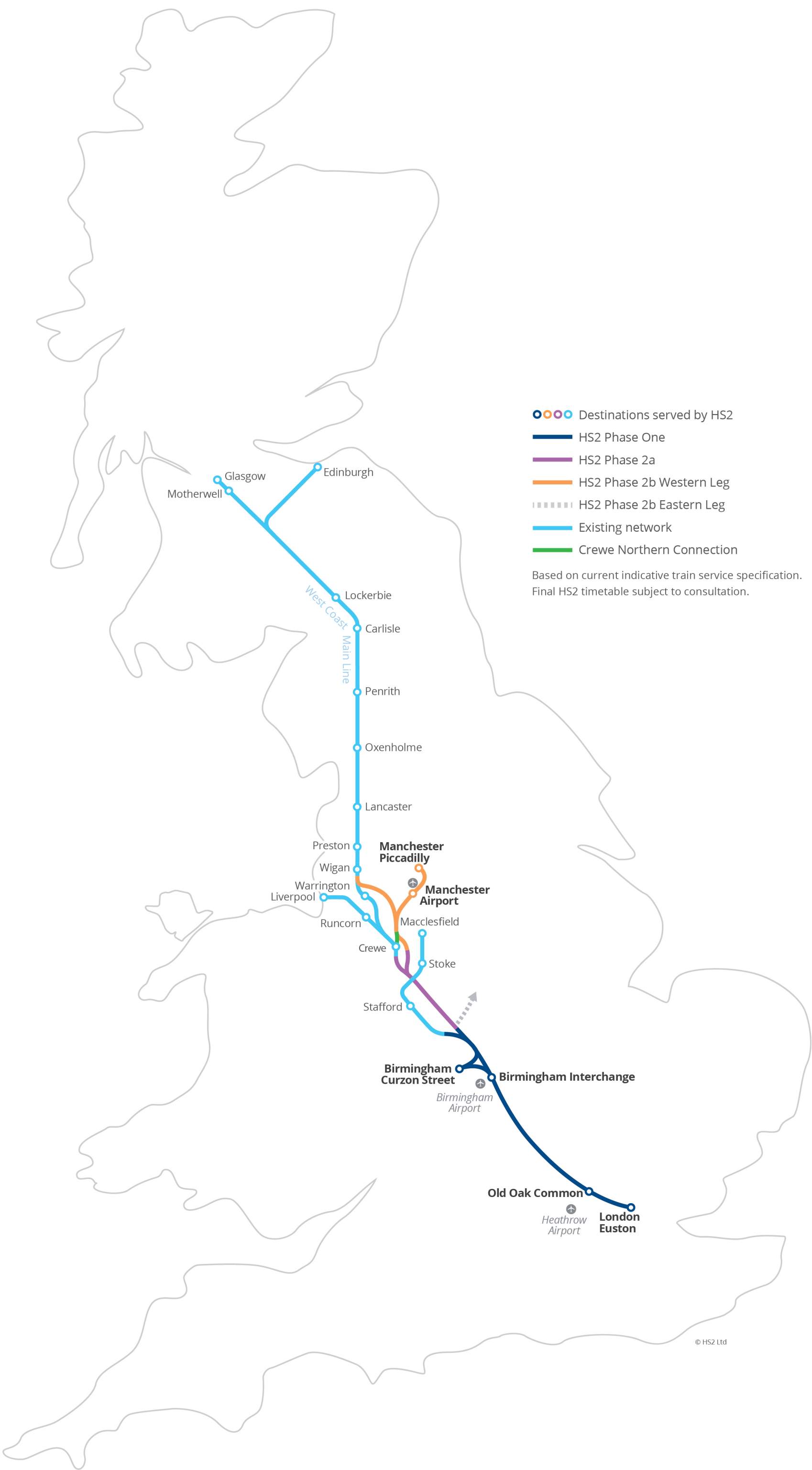
1.2.7 During construction of the Proposed Scheme, there will be potential impacts of construction activities including: movement of the workforce, construction material and excavated material; and the potential impacts of changes to road and non-motorised user routes, either temporarily or permanently. There may also be wider impacts due to required changes to Network Rail infrastructure and conventional rail services.

1.2.8 The nature of HS2 is that there are likely to be wider transport impacts of its services beyond the immediate areas directly affected. For example, many of the users of HS2 will be diverted from other rail services or car or air trips. In addition, and as a consequence of the introduction of HS2, train paths on the WCML will become available for use by other services (and there will be subsequent changes in demand for existing rail services). These impacts are also captured and considered in this TA.

1.2.9 The TA has been developed in accordance with the National Planning Policy Framework (NPPF)[2]. It also seeks to follow local guidance where appropriate. These are considered in Section 2 and are covered in detail in the Transport assessment policy and data report, (BID TR-004-00001).

[2] Department for Communities and Local Government (2019), *National Planning Policy Framework*. Available online at: https://webarchive.nationalarchives.gov.uk/ukgwa/20210708211349/https://www.gov.uk/government/publications/national-planning-policy-framework--2. At the time of assessment, the relevant version of the NPPF was Department for Communities and Local Government (2019). This is explained further in Volume 1 in the context of the updated July 2021 NPPF published by Ministry of Housing, Communities and Local Government.

Figure 1-1: The HS2 network and Crewe Northern Connection



1.2.10 The Environmental Impact Assessment (EIA) Scope and Methodology Report (SMR) (see Volume 5, Appendix CT-001-00001) sets out the necessary topics that must be addressed in considering the environmental effects of the Proposed Scheme. The TA addresses all of the relevant traffic and transport topics identified in the SMR and ensures that, where thresholds are set within the SMR, the analysis is sufficient, as a minimum, to address all potential relevant impacts.

1.2.11 The TA should be read in conjunction with the following Volumes to understand the environmental effects:

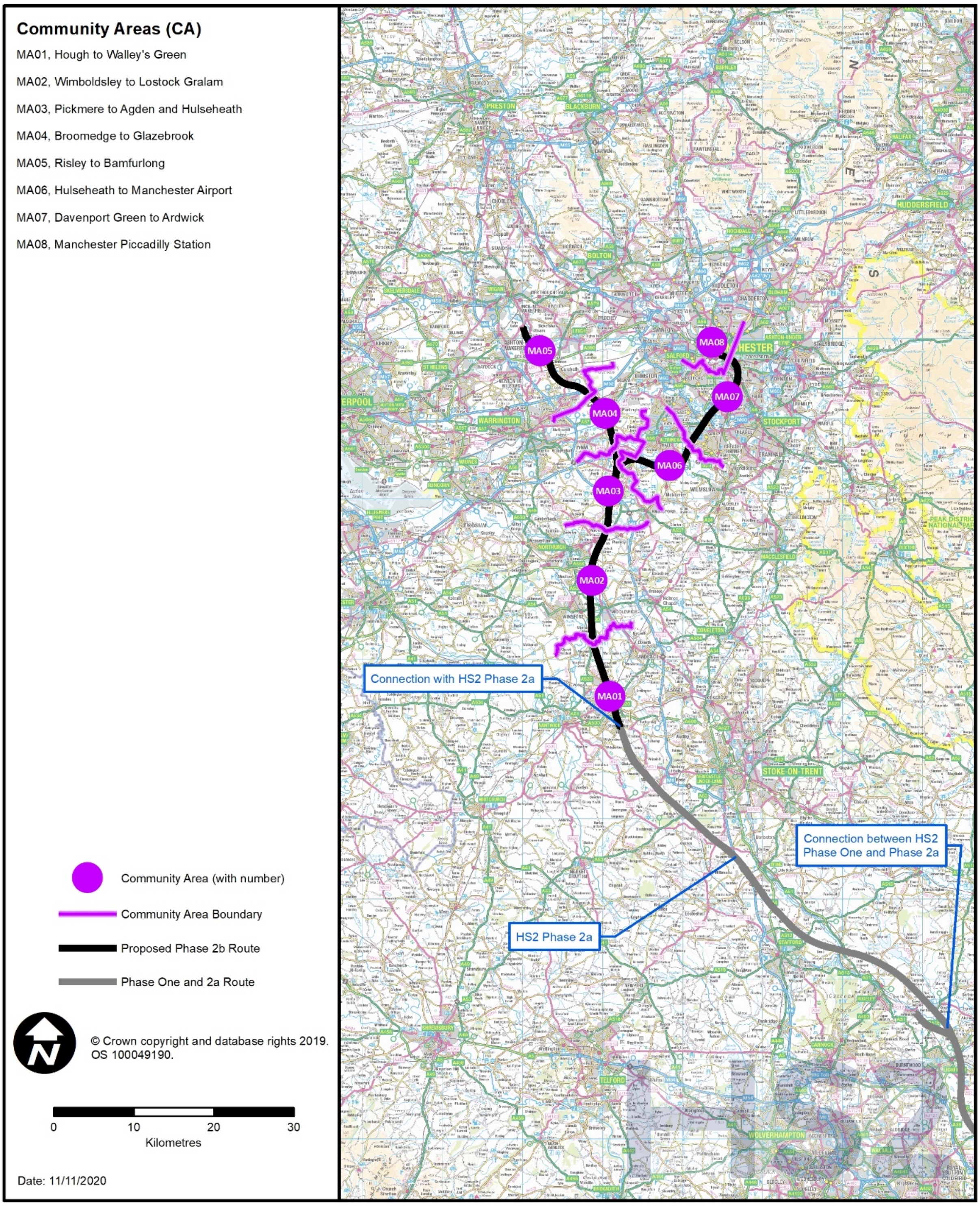
- Volume 2, Community Area reports;
- Volume 3, Route-wide effects;
- Volume 4, Off-route effects; and
- Volume 5, Appendices.

1.2.12 In this TA, the Proposed Scheme has been assessed at a CA level as well as at a route-wide and off-route level. The CA are set out in Table 1-1 and shown in Figure 1-2. MA06, MA07 and MA08 have been presented together as a regional group for Greater Manchester, where the assessment of impacts in one CA is substantially affected by activities in the neighbouring CA. Whilst these CA are grouped for the purpose of the assessment, each CA is clearly identified and reported. This ensures that stakeholders are given a clear local picture of the likely impacts, together with the adopted approach to the design of permanent way and infrastructure. This also ensures consistency with the overall ES structure.

Table 1-1: Community Areas for Proposed Scheme Transport Assessment

Route section	Community Areas
Proposed Scheme	MA01: Hough to Walley's Green
	MA02: Wimboldsley to Lostock Gralam
	MA03: Pickmere to Agden and Hulseheath
	MA04: Broomedge to Glazebrook
	MA05: Risley to Bamfurlong
Proposed Scheme (Manchester area)	MA06: Hulseheath to Manchester Airport
	MA07: Davenport Green to Ardwick
	MA08: Manchester Piccadilly Station

Figure 1-2: Community Areas



1.2.13 The Proposed Scheme has been assessed for both the construction and operational stages. In both cases, the basis for the assessment assumes existing and committed development in the local area, with forecast growth in population and development using appropriate methods in each area, providing, in effect, a cumulative assessment. For both the construction and operational assessments for MA01, this assessment also considers the impact of the Proposed Scheme in combination with HS2 Phase 2a.

1.2.14 The study area focuses on the immediate route corridor of the Proposed Scheme and the wider areas around stations and depots but has been extended where necessary to include key roads and junctions further afield and public transport networks, where circumstances indicate that impacts have the potential to be significant.

1.2.15 During construction of the Proposed Scheme, the greatest effects are likely to occur as a result of construction traffic and the movement of excavated material or fill to/from the wider road network. In the operational phase, the largest effects in the vicinity of HS2 stations are likely to be associated with passenger dispersal on the wider highway and public transport networks, resulting in the potential for increased traffic flows and congestion and in increased crowding on public transport. In other areas, operational impacts are mostly the result of reconfigured highways or non-motorised routes.

1.2.16 The construction and operational assessments have been based on the following scenarios:

- construction – 2030, impacts are considered against this single year for individual or overlapping activities regardless of timing. All over-lapping construction activities are considered in combination;
- operation – 2038, opening year with operation of the Proposed Scheme; and
- operation – 2046, a further operational year with the Proposed Scheme.

1.2.17 Generally, the TA focuses on the impacts in the AM (08:00-09:00) and PM (17:00-18:00) week-day peak hours where impacts are likely to be greatest, but with consideration of whether other periods require assessment. The Proposed Scheme has been assessed through a combination of strategic and detailed local modelling and more direct assessment of impacts. As discussed in the methodology section, the specific approaches vary according to the different sections of the route and the nature of the impact. The assessment ensures that the impacts of construction and operation are robustly considered.

1.2.18 Having identified the impacts of the Proposed Scheme, the TA considers transport mitigation measures that might be necessary to address the more substantial impacts. Where reasonably practicable the Proposed Scheme has 'designed out' the impacts, with mitigation an integral part of the design.

1.2.19 Mitigation measures should be proportionate to the potential impact. For necessary off-site mitigation, the general approach has been to identify a feasible and effective option (or options) that would appropriately address the mitigation need. Alongside aspects of design, important elements in the overall approach to mitigation are set out in Section 14 of the draft Code of Construction Practice (CoCP) (see Volume 5, Appendix CT-002-00000) including the commitment to a Framework travel plan (FTP) providing for construction and operational travel plans.

1.3 Engagement with relevant parties

1.3.1 Extensive consultation has been undertaken as part of the SMR consultation and the TA scoping consultation[3] together with regular ongoing dialogue with local authorities covering available data, assessment methodology and scheme design.

1.3.2 HS2 Ltd has liaised with local authorities and Highways England, together with their consultants, regarding the use and further development of strategic models used in the TA.

1.4 Structure

1.4.1 The TA considers issues and impacts at a route-wide, regional and individual CA level, depending on the aspect being reported. For example, mitigation measures are covered at a route-wide level (including the draft CoCP and the Framework travel plan (see TA Part 4, Volume 5, Appendix: TR-005-00000, Annex A), a regional level for the Manchester Airport and Manchester Piccadilly high speed station areas and at a CA level for all other issues.

1.4.2 Background information can be found in the Transport assessment policy and data, (BID TR-004-00001[1]). This includes a summary of policy and guidance that has influenced the design of the Proposed Scheme and development of this TA; and a summary of transport surveys and information (including baseline traffic surveys and Public Right of Way (PRoW) surveys), that were used in the assessment of traffic impacts. The Framework travel plan and model performance reports for the strategic transport models used in the assessment are included in TA Part 4 (Volume 5, Appendix: TR-005-00000), Annexes A – G.

1.4.3 Due to the size of TA, it has been split into 19 separate documents across four Parts in Volume 5, plus BID, as follows:

- Transport Assessment Part 1 (this document, Volume 5, Appendix TR-001-00000);
- Transport Assessment Part 2 (baseline and future baseline):
  - MA01 (Volume 5, Appendix TR-002-00001);
  - MA02 (Volume 5, Appendix TR-002-00002);
  - MA03 (Volume 5, Appendix TR-002-00003);
  - MA04 (Volume 5, Appendix TR-002-00004);
  - MA05 (Volume 5, Appendix TR-002-00005);
  - MA06 – MA08 Report 1 of 3 (Volume 5, Appendix TR-002-00006);
  - MA06 – MA08 Report 2 of 3 (Volume 5, Appendix TR-002-00006); and

[3] SMR consultation between July 2017 - September 2017, Transport Assessment Scoping report consultation between August - September 2017.

  - MA06 – MA08 Report 3 of 3 (Volume 5, Appendix TR-002-00006).
- Transport Assessment Part 3 (assessment of the Proposed scheme):
  - MA01 (Volume 5, Appendix TR-003-00001);
  - MA02 (Volume 5, Appendix TR-003-00002);
  - MA03 (Volume 5, Appendix TR-003-00003);
  - MA04 (Volume 5, Appendix TR-003-00004);
  - MA05 (Volume 5, Appendix TR-003-00005);
  - MA06 – MA08 Report 1 of 4 (Volume 5, Appendix TR-003-00006);
  - MA06 – MA08 Report 2 of 4 (Volume 5, Appendix TR-003-00006);
  - MA06 – MA08 Report 3 of 4 (Volume 5, Appendix TR-003-00006); and
  - MA06 – MA08 Report 4 of 4 (Volume 5, Appendix TR-003-00006).
- Transport Assessment Part 4 (route-wide and off-route) (Volume 5, Appendix TR-005-00000);
- Transport assessment policy and data (BID TR-004-00001); and
- Annexes to the TA are set out in Part 4 comprising the Framework travel plan (Annex A), and Model performance reports (Annexes B – G) for each of the strategic models discussed in the TA.

2 Policy and guidance

2.1 Introduction

2.1.1 This TA has been developed in the context of national and local policy priorities and requirements. As a national scheme to be considered by Parliament through the hybrid Bill process, the most relevant policies are national. However, as far as practicable, the Proposed Scheme and this TA have been developed to respect regional and local policies and priorities.

2.1.2 Transport assessment policy and data (see BID TR-004-00001) provides an overview of the relevant transport aspects of policy documents and guidance that have been considered in the design of the Proposed Scheme and preparation of this TA.

2.1.3 While international and European policy and guidance is not directly relevant, except where it has been implemented in UK legislation and policy, it should be noted that the European Union (EU) has a transport infrastructure policy (Trans-European Transport Network (TEN-T) policy, 2014)[4] that connects the continent from east to west and north to south. The TEN-T policy is supported by a series of maps and documents, which identify the 'core' and 'comprehensive' network for each member state. The core network is expected to be completed by 2030 and the comprehensive network by 2050. At present, the TEN-T network maps include HS2 Phase One in the core network and HS2 Phase Two in the comprehensive network.

2.2 National policy

2.2.1 The relevant sections of the following policy and guidance documents have been taken into account and are summarised in BID TR-004-00001:

- National Planning Policy Framework;
- National Planning Practice Guidance;
- National Policy Statement for National Networks;
- Department for Transport (DfT), Transport evidence bases in plan making and decision taking;
- DfT single departmental plan (2015-2020);
- HS2 Plus – a report by David Higgins;
- Rebalancing Britain – from HS2 towards a national transport strategy;
- High Speed Two: east and west – the next steps to Crewe and beyond;
- Highways England, The Strategic Road Network – Planning for the Future;

[4] European Union (2014), *EU Infrastructure Policy*. Available online at: https://ec.europa.eu/transport/themes/infrastructure/news/ten-t-corridors_en.

- Road investment strategy: 2015 to 2020; and
- Network Rail – Route Utilisation Studies.

2.3 Regional and local planning and transport Policy

2.3.1 Regional and local planning and transport planning policies and guidance along the route of the Proposed Scheme have been reviewed together with relevant local plan policies.

2.3.2 Policy and guidance documents from the following local planning and highway authorities have been taken into account and relevant sections summarised in BID TR-004-00001:

- Transport for Greater Manchester: Greater Manchester Transport Strategy 2040, Greater Manchester Transport Strategy 2040: Draft Delivery Plan (2020-2025);
- Liverpool City Region Combined Authority: Liverpool City Region local transport and planning policy and guidance, A Transport Plan for Growth;
- Manchester City Council: Adopted Manchester Core Strategy Development Plan 2012, Saved policies of the adopted Unitary Development Plan for the City of Manchester;
- Salford City Council: Transport in Salford 2025, Salford Unitary Development Plan (2006);
- Trafford Council: Trafford Local Plan, Core Strategy (2012-2026);
- Oldham Council: Adopted Oldham Joint Core Strategy and Development Management Policies Development Plan Document 2011, Adopted Oldham Unitary Development Plan (saved policies) 2006;
- Tameside Metropolitan Borough: Adopted Tameside Unitary Development Plan (saved policies) 2004;
- Stockport Metropolitan Borough: Adopted Stockport Core Strategy Development Plan Document 2011, Adopted Stockport Unitary Development Plan Review (saved policies) 2006;
- Wigan Metropolitan Borough: Wigan Local Plan, Core Strategy 2013: Wigan Replacement Unitary Development Plan 2006;
- Warrington Borough Council: Warrington Local Transport Plan 4 (2019), Warrington Local Plan Core Strategy (2012-2027);
- St Helens Council: St. Helens Local Plan Core Strategy 2012, St. Helens Unitary Development Plan 2007;
- Cheshire East Council: Cheshire East Local Transport Plan 2019-2024, Cheshire East Local Plan Strategy 2010-2030;
- Borough of Crewe and Nantwich: Borough of Crewe and Nantwich Replacement Local Plan 2011;
- Congleton Borough: Congleton Borough Local Plan First Review 2005;
- Macclesfield Borough: Saved policies of the adopted Macclesfield Borough Local Plan;

- Cheshire West and Chester Council: Cheshire West and Chester Local Transport Plan (2017-2030), Cheshire West and Chester Local Plan (Part One) 2015;
- Lancashire County Council: Lancashire Local Transport Plan 2011-2021;
- Preston City Council: Preston City Transport Plan 2011-2021;
- Cumbria County Council: Cumbria Transport Plan 2011-2026;
- Carlisle City Council: Carlisle District Local Plan 2015-2030; and
- Dumfries and Galloway Council: Dumfries and Galloway Council Local Development Plan 2.

3 Methodology

3.1 Introduction

3.1.1 This section sets out the overarching route-wide methodology and assumptions adopted in the preparation of the TA for the Proposed Scheme. It also considers where methodology or assumptions vary between areas.

3.1.2 The TA presents an assessment of the impacts of the Proposed Scheme on all transport users, including non-motorised users, road users and public transport passengers. The Proposed Scheme has been assessed for both construction and operation.

3.1.3 For construction, impacts have been assessed in relation to the construction activities, including movement of materials and workforce, together with the impact of temporary closures of, or disruption to, transport infrastructure. The peak impacts of these in each particular location have been assessed against a common assessment year of 2030 irrespective of when in the construction programme the impact is expected to occur. The year 2030 is reasonably representative of when peak construction activity, notably movement of excavated materials, is expected to occur. Where impacts overlap in location and timing they are assessed in combination.

3.1.4 The assessment takes account of HS2 Phase One and Phase 2a which are included as committed developments in the future baseline. In addition, an assessment of the Proposed Scheme in combination with HS2 Phase One and Phase 2a has been carried out, with a comparison against a baseline with no HS2. The operational assessment considers the years 2038 (year of opening of the Proposed Scheme network) together with a further assessment year of 2046.

3.1.5 The future baseline includes demand from existing and committed development in the areas local to the Proposed Scheme, with future growth taken either from local planning projections and models or from the DfT's transport forecasting Trip End Model Presentation Program (TEMPro[5]). These include wider growth and proposed developments that have not yet been approved but which are included in the Local Plans, TEMPro and local transport models. In addition, where there are relevant committed schemes that are not included in Local Plans, TEMPro or models, or where their local impact is not adequately represented, these are added to the future baseline. As such, the assessment considers the cumulative impact of the Proposed Scheme with other development. It should be noted that this additional projected development is likely to require a range of local transport improvements to mitigate its impact. Where these improvements are currently unknown,

[5] TEMPro, the Trip End Model Presentation Program, is designed to allow detailed analysis of pre-processed trip-end, journey mileage, car ownership and population/workforce planning data from the National Trip End Model (NTEM).

this assessment cannot take them into account and consequently represents a robust worst-case in relation to future pressure on transport networks.

3.1.6 The traffic and transport impacts of the Proposed Scheme have been assessed using a combination of strategic and detailed local models, together with more direct assessments of impacts (such as for diversion of PRoW). The specific approaches taken vary according to the different sections of the route and the nature of the impact, as appropriate. In particular, areas with complex transport networks or more complex impacts have been addressed with more comprehensive modelling approaches compared to where the networks are simpler or the impacts are unlikely to be widespread. Hence a different, simpler approach has been adopted for some of the 'country' sections of the route compared with those in metropolitan areas.

3.1.7 The modelling and assessment work ensures consideration of the potential impacts of the construction and operation of the Proposed Scheme and has been used to:

- inform the engineering design for both the construction and operational phases;
- provide substantive analysis for the TA and transport elements of the ES;
- establish the likely impact and inform the potential need for traffic and transport mitigation;
- support the ES by providing traffic data to inform sound, noise and vibration, air quality and human health impacts, together with community severance, climate change and major accidents and disasters; and
- inform engagement with highway authorities and other stakeholders during scheme development and throughout the passage of the Bill.

3.1.8 The modelling and assessment work undertaken for the TA is robust because it has:

- been undertaken in accordance with applicable guidance;
- used appropriate and suitably robust tools, taking the variety of demand generation and responses into account as appropriate;
- been subject to appropriate quality assurance checks; and
- used an objective methodology to reach conclusions.

3.1.9 Where detailed transportation modelling[6] has been undertaken using models owned by the respective local authorities, Highways England and other organisations, the models have been used, updated and enhanced as necessary in cooperation with them. Where public transport and highway assignment models have been used, each model has been reviewed and considered sufficiently robust for the assessment of the Proposed Scheme.

[6] Including one or all of demand modelling together with public transport and highway assignment modelling.

3.1.10 A TA scoping exercise has been undertaken with Highways England and relevant local transport and highway authorities to facilitate a consistent approach in each CA and comparable assessments along the whole route.

3.2 Areas of consideration and key impacts

3.2.1 The study area has been discussed with relevant parties and includes locations further afield from the Proposed Scheme where impacts could potentially be significant. The TA assesses the traffic and transport impacts wherever they are expected to arise, without a fixed geographic scope.

3.2.2 Respecting guidance, the following impacts were considered in the assessment of the construction and operational stages of the Proposed Scheme:

- public transport delays and changes to services;
- station/interchange impacts;
- traffic delays to vehicle occupants;
- impacts on vulnerable road users (traffic related severance, non-traffic related severance and amenity and ambience);
- accident and safety;
- parking and loading;
- waterways; and
- air transport.

3.2.3 Whilst public transport services are considered, the assessment does not include direct impacts upon school and community bus services. Similarly, emergency services, are not separately considered. These topics are not assessed individually because they are subject to demand responsive changes to routes, operate no differently to and are affected in the same way as general traffic or, in the case of emergency services during construction, will be specifically addressed in construction traffic management plans.

3.2.4 Key traffic and transport changes brought about by the Proposed Scheme include:

- road layouts, road closures/diversions/widening/alterations (including stopping and passing places), junction changes and diversions of PRoW;
- journey times, journey distances and delays for users of private and commercial vehicles;
- changes in traffic and non-traffic related severance and amenity and ambience for non-motorised road users and waterway users;
- traffic, public transport, pedestrian and cyclist flows;
- accessibility, journey times, distances or frequencies for stations, interchanges and changes to public transport infrastructure and routes;
- change in accident risk; and
- change in parking and servicing.

3.3 Assessment years

3.3.1 The following scenarios were used to assess the Proposed Scheme:

- current baseline – generally 2017 or 2018 depending on year of data collection although data from other sources has been used;
- future baseline – 2030, 2038 and 2046 (to inform the construction and operational assessments);
- construction – compared to a future baseline of 2030;
- operation – 2038 (opening year of the Proposed Scheme) with Proposed Scheme infrastructure and services; and
- operation – 2046 (a further forecast year corresponding to an appropriate mid-census year date) with Proposed Scheme infrastructure and services.

Baseline

3.3.2 The baseline, covered in TA Part 2, includes a commentary on the existing transport network in terms of roads, public transport, pedestrian, cycle, equestrian and waterways/canals, as well as critical links and junctions on the existing highway and public transport networks, as appropriate. Local conditions at locations where the Proposed Scheme can be expected to have an impact are reported.

3.3.3 A summary of the baseline survey information which has been collected to inform the assessment is provided in BID (BID TR-004-00001), which includes a review of national and local policies and guidance, traffic survey data, PRoW survey data and accident data.

Future baseline

3.3.4 Future baseline scenarios for 2030, 2038 and 2046 were determined either from local authority models or using growth factors for population and development forecasts based on recognised good practice sources that are generally used for this purpose by planning and transport authorities. In addition, committed and planned developments and committed transport schemes were discussed with local authorities and taken into account, as appropriate, where of particular relevance to the assessment.

3.3.5 The peak level of construction traffic activity is expected to be 2030 and the opening year to be 2038. The forecasts used in the assessment have been produced prior to the development of a full understanding of the likely impact of COVID-19 on economic growth and travel behaviour. The full impact of COVID-19 is not yet known but is considered likely to result in lower travel demand in the medium term than the forecasts used in the assessment for background traffic and rail, including HS2.

3.3.6 Consequently, the assessment is considered to overstate travel demand for both construction and operation scenarios and therefore to present a robust case for traffic and transport. This also means that the operational assessment for 2046 is likely to include a level of growth more representative of 2048 or later, representing likely impacts at least 10 years post-opening of the Proposed Scheme.

Construction

3.3.7 The construction assessment considers peak individual construction traffic activity at each location whenever it may occur. This is compared to 2030 future baseline demands. The common baseline year provides a consistent basis on which to compare and assess construction impacts across the entire Proposed Scheme. Where construction routes serve more than one construction compound, the combined vehicle movements during the busiest period for each section of each route have been assessed. This also recognises potential overlaps with other activities such as temporary traffic management or road closures.

3.3.8 Assessment of the data has been undertaken to identify the peak hours for traffic and public transport in each area. However, the periods 08:00-09:00 and 17:00-18:00 are the periods when HS2 construction traffic movements and workforce arrivals and departures would have the maximum impact. In areas where the peak hours for transport are outside the 08:00-09:00 and 17:00-18:00 peak hours, the percentage difference between the observed peak hour and the assessment hour has been estimated and reported. The percentage difference is generally small and, consequently, 08:00-09:00 and 17:00-18:00 have been used as the assessment hours representing a reasonable worst-case.

3.3.9 For those areas where transport models are utilised, the models generally cover the peak hours of 08:00-09:00 (AM peak hour) and 17:00-18:00 (PM peak hour); therefore, the construction transport impact assessment addresses the periods when HS2 construction traffic movements and workforce arrivals and departures would have the maximum impact.

Operation

3.3.10 The operational assessment years are 2038 and 2046. Both operational assessments consider the expected changes to travel patterns at and near to Proposed Scheme stations and the consequential impacts on public transport and traffic together with the impacts of changes to the transport network across the route of the Proposed Scheme. The changes resulting from the Proposed Scheme have been overlaid on the future baseline flows. For the relevant year, as with the construction assessment, 08:00-09:00 and 17:00-18:00 have been used as the assessment hours representing a reasonable worst-case.

3.4 Data collection

3.4.1 Baseline transport surveys have been undertaken along the entire route of the Proposed Scheme, together with at relevant off-route stations and stabling facilities, to establish a baseline for existing conditions. The surveys undertaken have been proportionate to the expected type and location of impact. Surveys of pedestrian, cyclist and equestrian users have also taken account, as appropriate, of greater levels of use at weekends. Surveys of rail passengers have also been undertaken to inform passenger characteristics for HS2 stations.

3.4.2 The TA scoping discussions undertaken with transport and highways authorities covered the identification of the data required for the TA. This considered both existing data and new data to be collected as part of the TA.

3.4.3 Existing data have also been obtained from transport authorities, Highways England and the DfT, including count data and accident data. In addition, traffic models, outputs from traffic models including growth rates, as well as signal timing data, have also been obtained and used in the assessment.

3.5 Background traffic growth

3.5.1 In areas where robust network traffic models do not exist and the impacts of HS2 are not expected to require network modelling, traffic growth factors were directly obtained from TEMPro version 7.2 which uses the most up to date versions of the National Trip End Model (NTEM 7.2) dataset and the National Transport Model (NTM) 2015. NTEM datasets are long-term forecasts, representing the DfT's best estimate of long-term response to demographic and economic trends. The latest version of TEMPro has been updated with economic data based on recent Gross Domestic Product (GDP) forecasts. The NTM traffic forecasts take account of forecast changes in fuel costs and changes in trip length over time, which are not included in NTEM.

3.5.2 TEMPro inherently incorporates future planned development, being based on approved plans, irrespective of whether it is approved, committed, or simply included in approved plans. It includes all economic and population growth forecasts, and assumes growth in housing and commercial development, therefore providing a prediction of traffic growth by area. However, there is no explicit assumption concerning precisely which particular developments do or do not go ahead in the derivation of TEMPro planning data. Consequently, a review of committed development has been undertaken as part of this TA that has identified, where possible, specific developments that would not have been included in local plans, together with those in close proximity to the Proposed Scheme that should be given explicit consideration in the quantification of background traffic growth.

3.5.3 The identification of specific developments in proximity to the Proposed Scheme reflects DfT Guidance on Transport Assessments (2007). Whilst this has been withdrawn, it is still best practice. The approach to this involved:

- a desk-top review of relevant local planning policy emerging from local development frameworks and local plans;
- a review of planning applications within 1km of the centreline of the Proposed Scheme; and
- engagement with local authorities to identify specific committed developments for consideration.

3.5.4 Traffic generation from committed developments has only been added to background traffic growth where it is likely to have a direct impact on the transport impacts of the Proposed Scheme and is not considered to be adequately reflected in the background traffic growth from local development already assumed by TEMPro or local traffic models. This minimises the extent of double counting in the traffic growth forecasts.

3.5.5 In a number of CA, the use of TEMPro forecasts were replaced with, or supplemented by, transport models that were used to assess the implications of the Proposed Scheme. These models comprise:

- the Greater Manchester Transport Model comprising separate demand, highway assignment and public transport models;
- the A500 Crewe Model;
- the Winsford and Middlewich Model;
- the Northwich Traffic Model;
- Highways England's M6 J19 Model; and
- the Warrington Western Link Road Model[7].

3.5.6 These models incorporate future year assessment scenarios that take into account growth forecasts using planning data from a variety of sources, including (and generally restricted to) TEMPro, but providing a greater degree of disaggregation and more accurate reflection of local circumstances. As with the use of TEMPro, consideration has been given to whether specific developments are adequately represented and, as necessary, these have been added to the baseline.

3.5.7 The strategic modelling for Greater Manchester has been developed by Transport for Greater Manchester (TfGM) and its consultants and includes forecast year models using agreed assumptions on relevant forecast years, planning data for housing and employment and committed highway and public transport schemes. The Greater Manchester models comprise a demand model to estimate demand for travel from planning data and separate highway assignment and public transport models.

3.6 Proposed Scheme trip generation and distribution

Construction

3.6.1 Construction related trips include worker trips to and from construction compounds, together with construction vehicles transporting excavated and construction materials. Trip generation estimates have been calculated by considering the following:

[7] The Warrington Western Link Road Model was used for the derivation of growth factors.

- the number of construction vehicles (including heavy goods vehicles (HGV)) travelling to/from a site on a daily basis for the identified assessment periods;
- the number of worker/person trips travelling to/from a site on a daily basis for the identified assessment periods exclusive of travel plan impacts;
- assumptions for modal share for construction workers to/from the site; and
- assumptions for vehicle occupancies for cars/vans.

3.6.2 The distribution and assignment of construction trips have then been determined taking the following into account:

- assumptions regarding construction traffic (HGV) routeing, in particular the expected requirement for and generation of excavated materials;
- the potential matches between surpluses and deficit of materials within the Proposed Scheme that can be transferred on site haul roads along the route of the Proposed Scheme and reduce external traffic movements; and
- likely catchment areas for construction workers.

3.6.3 The construction assessment is based on the average HS2 traffic levels in the peak month of construction traffic activity in each location. This provides a consistent and 'maximum most likely' basis against which to compare and assess construction impacts across the entire route. Where construction sites are in close proximity, in-combination impacts of construction traffic from the various sites have been assessed.

3.6.4 In most locations the most intensive periods for construction traffic are related to the movement of excavated materials, for example, excavation of cuttings or tunnels or construction of earthworks.

Operation

3.6.5 In the vicinity of Manchester Piccadilly and Manchester Airport high speed stations, the main operational trip generation will arise from a combination of changes in rail passenger demand and consequent changes in travel to/from stations, workforce, servicing and delivery and changes to the highway networks. Operational trip generation estimates for stations associated with the Proposed Scheme have been calculated by considering the following:

- forecasts of total peak period and daily trip generations for the identified assessment years, related to passengers for the proposed HS2 rail services together with workforce;
- identification of the person trips which are newly generated and/or transferred (from other modes, services or stations);
- modal shares for passengers and staff, travelling to and from stations and depots;
- likely changes/adjustments to trip generations and trip patterns through modal shift; and
- vehicle occupancies for cars and taxis.

3.6.6 In many areas, the operational traffic associated with the Proposed Scheme will be low and the main impacts will be the result of changes to the transport networks such as road or PRoW diversions and reconfiguration associated with the Proposed Scheme.

3.6.7 Operational trip distribution and assignment for HS2 stations have been determined taking the following into account:

- likely catchment areas for passengers; and
- likely distributions of trips by mode.

3.6.8 Changes in passenger demand are informed by the PLANET model assessment, which is described in more detail below. The PLANET model predicts weekday daily (16-hour working day) total passenger demand, with further analysis used to determine peak hour use of different access modes at stations together with route-wide and off-route impacts.

3.7 Construction assessment assumptions

Construction vehicles

3.7.1 Each 'design element' of the Proposed Scheme has been assigned to a construction compound along the route and the transport-related trip generation calculated. The quantities of materials required to construct each element of the Proposed Scheme, the volumes of fill required or excavated material to be removed, together with the equipment necessary for construction of each element, have been identified as part of the design process.

3.7.2 The quantities of materials and equipment have been converted to vehicle loads using construction and logistics assumptions on appropriate vehicle capacities[8], in terms of either weight or volume, depending on which of these represents the maximum payload capacity constraint for the material being delivered. The total number of construction vehicles forecast to be generated by each compound has been calculated by adding together the forecast number of vehicles estimated to be generated by each 'design element' assigned to any one compound.

3.7.3 The proposed construction programme identifies when each 'design' element of the Proposed Scheme is forecast to be constructed. This has enabled the number of vehicles generated per day over the duration of construction to be calculated for each compound. From this, the average trip generation per day over each month and each compound has been calculated over the whole construction period, assuming an average of 20 working days per month. It has been assumed that 10% of the daily construction-related traffic movements occur during the morning peak hour (08:00-09:00) and 10% during the evening

[8] Excavated material (un-bulked) = 8.5m^3; Concrete = 6m^3 (or 8m^3, depending on availability of larger vehicles in particular circumstances); Demolition = 10 tonnes per vehicle; and Steel reinforcement = 30 tonnes per vehicle.

peak hour (17:00-18:00), although it is possible that arrivals will be higher in the morning peak and departures correspondingly lower, with the reverse applying in evening peak hour.

3.7.4 Vehicle trips generated by deliveries of construction materials and equipment have been assigned to the proposed HGV routes linking the construction compounds to the strategic road network (SRN). Where a lorry route serves a single construction compound, the average trip generation during the peak month of construction activity for the compound served has been assigned to that route. Where a lorry route serves more than one construction compound, the flows from the different compounds have been combined and assigned to that route. Where there is not one specific destination and the proposed lorry routes divide, providing a choice of routes, the vehicle trip generation has been split between the route choices available. Professional judgment has been used to determine routes that vehicles generated by a particular compound would take to ensure they reflected likely origins and destinations and that they would be using the shortest appropriate route to and from the strategic road network. Where there is no obvious preferred route, they have been generally split equally between route options.

3.7.5 The HGV routes have been reviewed using professional judgement, based on both desk-top and site observations to select the most suitable routes and in relation to their physical capability and capacity and the potential impact on local communities. It is noted that the routes do not take account of trips between compounds during the day, with some vehicles using haul routes rather than the highway network.

Construction workforce

3.7.6 The forecast workforce required at each construction compound over the construction programme has been estimated on a monthly basis from the construction activities associated with each 'design' element assigned to each compound.

3.7.7 The assessment is based on all workers travelling to the site each day, which will provide a worst-case robust assessment. In particular, the provision of designated accommodation within the larger compounds will reduce the impact of worker travel compared to the levels assessed in this TA.

3.7.8 The working hours for the majority of construction compounds will be 08:00-18:00 on Mondays to Fridays and 08:00-13:00 on Saturdays in line with the draft CoCP, with site staff and workers generally arriving before the morning peak hour and departing after the evening peak hour. HS2 Ltd will require its contractors to adhere to these core working hours for each site, insofar as reasonably practicable or unless otherwise permitted. Activities such as major concrete pours may involve extended working hours for reasons of engineering practicability. Tunnelling and directly associated activities may be carried out on a 24-hour, seven days a week basis. However, workers will mostly arrive and depart outside of the peak traffic hours.

3.7.9 The potential for use of non-car modes at each construction compound has been assessed based on a review of its accessibility by public transport and active modes. Based on this review, each compound has been allocated to one of four accessibility categories, namely rural, suburban, urban and urban with high levels of public transport accessibility:

- for compounds in rural areas, all of the workforce is assumed to travel to work by car or large goods vehicle (LGV) with an average car/LGV occupancy of 1.2 assumed;
- for compounds in suburban areas, 75% of workforce is assumed to travel to work by car, with the remaining 25% travelling by public transport or active modes;
- for compounds in urban areas such as Crewe, 60% of workforce is assumed to travel to work by car, with the remaining 40% travelling by public transport or active modes; and
- for compounds in urban areas of Greater Manchester, 25% of workforce is assumed to travel to work by car except for those areas of central Manchester within easy walking distance of a major bus or rail services where 10% of the workforce is assumed to travel to work by car, with 90% travelling by public transport or active modes.

3.7.10 To represent a reasonable worst-case scenario, it has been assumed that, where 24-hour shift working is not in operation, 50% of the workforce arrive within the 08:00-09:00 peak hour and 50% of the workforce depart within the 17:00-18:00 peak hour.

3.7.11 Where car will be used as a mode of transport, a gravity model approach has been used in order to determine the likely locations that the workforce will travel from.

3.7.12 A construction workforce travel plan (CWTP) will be implemented covering each compound, which will seek to reduce the overall vehicle trip generation, especially during the morning and evening peak periods. This is explained in more detail later in this section and in the Framework travel plan in TA Part 4, Annex A. However, the workforce trip generation methodology and assessment described above does not take account of this and consequently traffic impacts may be overstated.

Excavated materials

3.7.13 The Proposed Scheme design identifies where there is forecast to be either a surplus or shortfall of material along the route and the most practical and efficient approach to re-using excess excavated material in locations where there is a shortfall. It also identifies the quantity of excavated material that needs to be moved by road where it is not practical to move it by any other means (for example by rail or via a site haul road along the route of the Proposed Scheme).

3.7.14 The quantity of material to be moved has been converted to vehicle loads using typical vehicle capacities with a contingency for inclement weather conditions which could result in reduced earthworks productivity during periods of adverse weather. This is factored into the construction programme and the assessment is based upon the peak level of activity taking this into account. This has enabled the number of vehicle trips generated per month to be calculated for each location.

3.7.15 The vehicle trips generated by the movement of excavated material have generally been assigned to the shortest suitable route between identified origins and destinations via the proposed construction traffic routes and the SRN. Where material will not be reused as part of the Proposed Scheme, it is assumed that this will take the shortest suitable route to the nearest junction on the SRN.

3.7.16 Where excavated material is moved by road from one compound to another, the movements are assessed in both the origin and destination CA.

Borrow pits

3.7.17 The Proposed Scheme will require high quality aggregate (usually comprising sand and gravel) to construct railway embankments. This material will be provided, in part, through excavation of cuttings and other works (for example, tunnels or balancing ponds) along the route of the Proposed Scheme, where the quality is appropriate. However, at some locations along the route there is anticipated to be a shortfall of high-quality material for use in railway embankment construction.

3.7.18 Obtaining material from commercial quarries would require its transportation by HGV, which would generally result in impacts on the local road network and communities. Similarly, surplus excavated material would be transported off-site, increasing HGV movements that are likely to lead to impacts on the local road network and communities.

3.7.19 In order to reduce these impacts, the Proposed Scheme includes the use of borrow pits, which will reduce the impact of construction traffic on the local and strategic road network. These have been used to enable construction material to be obtained locally. Following excavation of construction material, the borrow pits will be backfilled with materials generated from the construction of the Proposed Scheme, thereby reducing the wider potential impacts on the road network of disposal of surplus excavated material. The use of borrow pits, compared to the alternative of moving materials from quarries reduces the impact of heavy good vehicles on the road network by reducing the vehicle-kilometres travelled.

3.8 Modelling approach

3.8.1 The assessment of the traffic and transport impacts of the Proposed Scheme has used relevant modelling tools, together with more direct assessments of impacts (such as for the diversion of PRoW). The specific approach taken varies according to the different sections of the route and the nature of the impact. Urban areas with HS2 stations, have generally been assessed using different methods to more rural areas. This is largely due to the complexity of the highway networks in these areas and also the availability of existing strategic transport and traffic assignment models.

3.8.2 To support development of the strategic models in the Greater Manchester area for use by HS2 Ltd a Transport Assessment Modelling Working Group (TAMWG) was created to guide development and the use of strategic models comprising Transport for Greater Manchester

(TfGM), Manchester City Council, Trafford Borough Council, Cheshire East Council, Transport for the North (TfN) and Highways England.

3.8.3 In other areas, the modelling approach has been discussed with the relevant local transport and highway authorities and, where appropriate, Highways England.

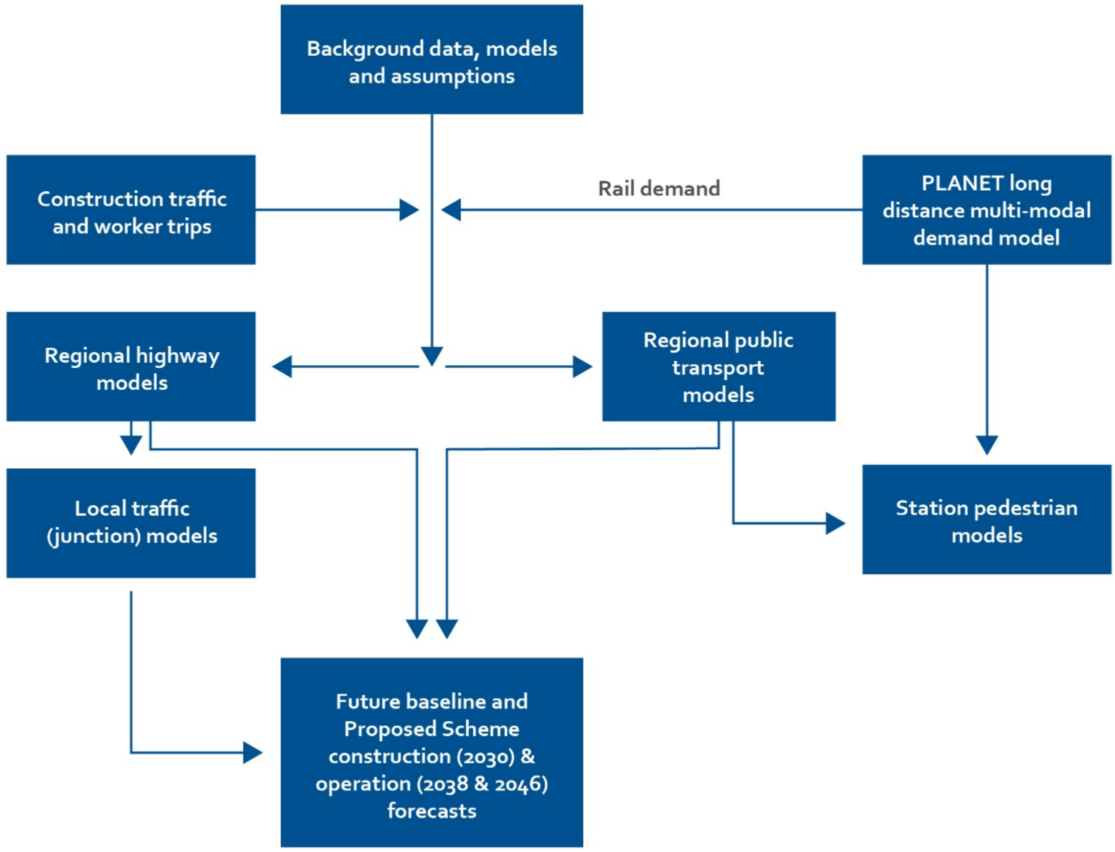
3.8.4 The following sections outline the approach used to assess the Proposed Scheme. This considers the overall modelling approach and structure, the development and performance of the strategic modelling used in urban areas and sets out the approach to local modelling.

Modelling framework

3.8.5 The modelling framework for the Proposed Scheme is shown in Figure 3-1. The key forecasting elements that have been incorporated are:

- sources of estimates of the current baseline travel demands in the area of the Proposed Scheme for both highway and public transport as necessary based on background data, transport models and underlying assumptions;
- estimates of the trip generation and changes to travel patterns as a result of the Proposed Scheme for both construction and operation;
- use of regional highway and public transport modelling tools to establish the travel patterns for future baseline and the Proposed Scheme for 2030 (construction) and 2038 and 2046 (operation); and
- as necessary, detailed modelling tools to investigate very local impacts.

Figure 3-1: Modelling framework for the Proposed Scheme



3.8.6 The characteristics of the models and sources that have been used can be summarised as:

- strategic long-distance rail modelling, to assess the impacts of the Proposed Scheme in operation, for future baseline and the Proposed Scheme using the PLANET Framework Model (PFM) comprising PLANET Long Distance, PLANET Midlands, PLANET South, PLANET North and the PLANET Station Choice Model (SCM);
- regional multi-modal transport modelling comprising TfGM's demand model GMVDM, strategic highway model GMSM and public transport model GMPTM to provide future baseline and Proposed Scheme travel demands;
- highway-only assignment models including the Highways England M6 J19 Model, the A500 Crewe model, the Warrington Western Link Road model, the Northwich Traffic model and the Winsford and Middlewich Model to provide future baseline and Proposed Scheme travel demands;
- DfT's TEMPro to provide growth factors for individual road types and relevant wards or use of local stakeholders' models to provide growth factors;
- micro-simulation and local junction modelling as required to assess local impacts and to supplement higher level modelling; and

- pedestrian simulation modelling at Manchester Piccadilly and Manchester Airport high speed stations.

3.8.7 This has enabled the impacts to be assessed through:

- regional public transport modelling/analysis of detailed public transport use and impacts of the Proposed Scheme compared to future baseline;
- regional highway assignment modelling to provide future baseline traffic flows and congestion/delays and changes as a result of the Proposed Scheme;
- micro-simulation model where relevant; and
- baseline counts, TEMPro and local modelling.

3.8.8 Regional highway assignment models represent complex patterns of travel movement so, while in most locations traffic flows will increase between later future baseline years, there may be some locations where traffic flows decrease. The strategic nature of these models means that they do not include every road or represent every point of access to the road network. As a result of this simplified representation of the road network, the use of some local roads may not be precisely reflected in the models. However, it is not considered that this will affect the conclusions of the assessment.

3.8.9 As indicated in Figure 3-1, the public transport and highway assignment models incorporate an HS2 overlay comprising either construction trips or, in operation, changes to forecast travel patterns.

3.8.10 The modelling has been undertaken using industry-standard modelling packages including the SATURN modelling suite for strategic highway modelling, Cube Voyager for public transport modelling. Local junction modelling packages including TRANSYT, Junctions 9 and LinSig have also been used. In a number of cases these models are already established and have been provided by Highways England or local highway authorities. Legion has been used for detailed pedestrian simulation modelling at Manchester Piccadilly and Manchester Airport high speed stations. VISSIM micro-simulation modelling has been used as a design tool to test junction proposals.

3.8.11 The baseline and future baselines are provided in the modelling hierarchy by the respective demand models for each area which provide background travel demands and growth (including economic, land-use and other scheme impacts) for the regional highway and public transport modelling.

3.8.12 Importantly, all of the demand models, including TEMPro, are driven by comparable data sources for population, employment and economic activity. Inevitably, as the assessment moves from the macro UK-wide forecasts to the micro local level, more specific local estimates of development are used.

3.8.13 DfT's Transport Analysis Guidance (TAG[9]) and Design Manual for Roads and Bridges (DMRB[10]) provide advice concerning a variety of issues that modelling exercises should consider and address as appropriate. Table 3-1 indicates where the most important of these issues are accommodated in the HS2 modelling framework. Importantly, all of the issues, including demand responses, are accommodated at some point in the modelling framework. More detailed descriptions of the component models, including performance details, are provided below. The PLANET model is discussed first and the role and use of other models are then considered.

Table 3-1: Transport Assessment modelling framework approach to modelling issues

Modelling issue		Manchester MA06-MA08	MA01-MA05
1	**Scale/extent**	All Proposed Scheme TA modelling	
2	**Abstraction from other modes/services**	HS2 PFM demand estimates and impacts on air, car and rail for operation	N/A
3	**Generation from Proposed Scheme**	HS2 construction traffic and workforce estimates	
		HS2 PLANET demand estimates (inclusive of ultimate trip origins and destinations) for operation	N/A
4	**Distribution**	Gravity model approach for construction workforce distribution	
		HS2 PFM demand estimates (inclusive of ultimate trip origins and destinations), and TfGM models and surveys for operation	N/A
5	**Mode Choice/split**	Based upon HS2 and TfGM surveys at Manchester Piccadilly and Stockport and TfGM suite of models and surveys for operation	N/A
6	**Assignment**	TfGM Suite of models for construction and operation	Highways England and local authority models and manual for construction and operation
7	**Traffic operations and conditions**	TfGM Suite of models, local junction and micro-simulation models for construction and operation	Highways England and local authority models, local junction and micro-simulation models for construction and operation
8	**Background growth**	TfGM Suite of models for construction. PFM and TfGM suite of models for construction and operation	Highways England and local authority models and TEMPRo TfGM suite of models for construction and operation
9	**Variable demand responses**	Only used in relation to background demand as the impact of HS2 is not considered likely to have a wider impact on travel demand at a local level	N/A
10	**Convergence**	All Proposed Scheme TA modelling where convergence is relevant	
11	**Validation**	All Proposed Scheme TA modelling where validation is relevant	

[9] TAG Units M2.1, M3.1 and M3.2.

[10] Design Manual for Roads and Bridges (now withdrawn).

PLANET

3.8.14 The PLANET Framework Model (PFM) has been developed by HS2 Ltd from a suite of models originally developed by the DfT and Strategic Rail Authority (SRA). PFM has evolved over a number of years and builds on existing model components. Its aim is to provide forecasts of demand and 'generalised costs' to drive the appraisal of HS2. As is standard in transport modelling, generalised cost is a combination of monetary costs and travel time components. PFM is the most appropriate modelling tool to be used in terms of forecasting the demand for the Proposed Scheme at stations and the resultant changes compared to the future baseline. Its strategic capability covers all long-distance rail, car and air movements across England, Scotland and Wales.

3.8.15 In addition to modelling HS2 Phase One, Phase 2a and the Proposed Scheme, DfT has used PFM to assess the strategic alternatives to HS2. Versions of PLANET have previously been used by the former SRA and DfT to support the SRA high speed lines study, the Eddington Review[11], and the Thameslink business case[12].

3.8.16 The PFM has been developed with extensive quality assurance (QA), undertaken in accordance with the DfT guidance. This has included extensive developer QA, peer reviews and independent implementation audit.

3.8.17 The PFM demand forecasts for the Proposed Scheme are based on the latest outline service specifications, which are consistent with the HS2 Ltd Business and Economic Cases. The PFM model has been updated since the HS2 Phase 2a assessment. The version used for Phase 2a was PFMv7.1; the version used for this assessment of the Proposed Scheme is PFM9.6.

3.8.18 The key elements of the PFM forecasting process can be described as follows:

- derivation of base year (2018) demand patterns for rail, road and air;
- growth of base year demand to future year[13];
- demand response to changes in the provision of future baseline rail services; and
- demand response to changes in the provision of new high speed rail services and associated changes to rail services on the existing network.

3.8.19 Demand for HS2 services will be a mixture of demand transferring from other modes and additional ('generated') demand. This means that PFM needs to represent the supply and demand for those other modes which may transfer to HS2. Thus, within PFM, different model components cover different geographic areas and markets:

- PLANET Long Distance (PLD), providing the long-distance demand for rail, air and car;

[11] The Eddington Transport Study (2006), *The case for action: Sir Rod Eddington's advice to Government.*

[12] National Audit Office (2017), *Update on the Thameslink programme*. Available online at: https://www.nao.org.uk/wp-content/uploads/2017/11/Update-on-the-Thameslink-programme.pdf.

[13] Based on exogenous (i.e. non-rail) growth factors (population, car ownership, GDP, fuel costs etc.) forecast using DfT's EDGE program.

- Station Choice Model (SCM), providing boardings and alightings at individual stations in the areas covered by PLANET Long Distance, PLANET Midlands (PM) and PLANET North (PN); and
- PLANET South (PS), PM and PN – regional rail only models used to model local rail journeys providing the shorter distance rail demand with these regions.

3.8.20 The PFM provides an overall 'framework' linking the components above in a consistent way. The PFM is conventional in the sense that it contains a multi-modal supply representation based on networks, together with a multi-modal demand model, which is segmented by different types of travel and responds to changes in generalised cost.

3.8.21 The PFM takes into account a wide range of impacts on travel behaviour such as journey time, train service frequency, interchange (both between modes and within modes), crowding and station access/egress times. In the integrated framework, the interaction between long-distance and local demand is represented.

3.8.22 Other than from the service characteristics, no special recognition is given to HS2 services. The choice between HS2 and conventional rail services is made as part of the general route choice in the PLD rail assignment model. The introduction of HS2 leads to improvements for rail in general, thus increasing overall demand for rail.

3.8.23 The PFM provides rail, HS2 demand forecasts and air/car long-distance changes in trips. Practically speaking, PFM is exogenous to the TA modelling, supplying outputs to inform the assessments, including for Proposed Scheme stations, route-wide and off-route.

3.8.24 The PLANET model has been run for the future baseline, Phase One, Phase 2a and the Proposed Scheme. As part of the TA, impacts derived from PLANET have been considered for both the Proposed Scheme with Phase One and Phase 2a in the future baseline and for the Proposed Scheme in combination with Phase One and Phase 2a with no HS2 services in the baseline. However, for the operational assessment of Proposed Scheme stations, the primary focus is the comparison with the future baseline without HS2.

Strategic transport models

Introduction

3.8.25 Regional multi-modal transport modelling has been used to assess the impacts of the Proposed Scheme across relevant transport modes in the Greater Manchester area (MA06, MA07 and MA08). In other community areas, local authority transport models have been used to derive traffic data or forecast growth in traffic. These models, along with ownership details, are shown in Table 3-2.

Table 3-2: Strategic local transport models utilised for the Transport Assessment for the Proposed Scheme

Community Area	Transport model	Model ownership
MA01	The A500 Crewe Model	Cheshire East Council
MA02	Winsford and Middlewich Model	Cheshire West and Chester Council and Cheshire East Council
MA02	The Northwich Traffic Model	Cheshire West and Chester Council
MA03 and MA06	M6 J19 Model	Highways England
MA04 and MA05	The Warrington Western Link Road Model	Warrington Borough Council
MA06, MA07 and MA08	Greater Manchester demand model (GMVDM), strategic highway model (GMSM) and public transport model (GMPTM)	Transport for Greater Manchester

3.8.26 The following sections provide an overview of each of the models set out in Table 3-2. Summary model performance reports for highway and public transport are included in Annex B to G.

Overview of strategic models

Greater Manchester suite of models (MA06, MA07 and MA08)

General approach

3.8.27 Regional multi-modal transport modelling for the Greater Manchester area (MA06, MA07 and MA08) comprises a demand model plus strategic highway and public assignment models. The future baseline scenario from these models takes into account a set of committed development and scheme assumptions considered appropriate by the Manchester TAMWG.

3.8.28 The approach to modelling the Proposed Scheme in Greater Manchester has been to take the demand model outputs from appropriate future baseline models and then to overlay HS2 demand assumptions and network supply changes. Future year model assignments have been developed for HS2 construction and operation assessment years.

3.8.29 The trip generations for the Proposed Scheme in construction are based on forecasts of HS2 construction traffic and highway-based workforce trips. Highway network changes, relating to the construction of the Proposed Scheme, have been included in the model. In order to capture a reasonable worst-case, snapshots of HS2 construction traffic and network changes have been taken and are represented by a number of model scenarios. The distributions of construction workforce trips have been derived using a gravity model approach. HGV and other construction vehicles have been assigned along fixed routes as explained in Section 3.7.

3.8.30 The trip generations for the Proposed Scheme in operation for the future years of 2038 and 2046 have been derived from forecasts taken from PFM9.6. Forecasts were provided from the 16-hour PLANET model and have then been converted to a 24-hour daily flow using data profiles from MOIRA (the rail industry's standard demand forecasting model). Trip generation for individual hours has been calculated from applying MOIRA hourly profiles to the PFM data. Trip generation for the AM and PM peak hours has then been input into the highway and public transport assignment models. The trip distribution for Manchester Piccadilly and Manchester Airport high speed stations has derived from information from the rail station user surveys and the Greater Manchester models. The derivation of the HS2 passenger mode shares are set out for each station in the TA Part 3.

3.8.31 The trips relating to the Proposed Scheme in operation have been applied to the highway and public transport matrices and the proposed highway network changes have been coded into the highway networks. Any committed changes to public transport services have also been included in the public transport models. The models have then been run in assignment mode to develop forecasts for the Proposed Scheme for the 2038 and 2046 assessment years.

Greater Manchester model

3.8.32 The Greater Manchester Transport Model has been utilised for the assessment of the transport impacts of the Proposed Scheme in the Greater Manchester area. The model has been developed by TfGM to assess strategic transport impacts of transport schemes and local plan development proposals. It was agreed by the Manchester TAMWG that the model was the most appropriate tool to assess the highway and public transport impacts of the Proposed Scheme in the Manchester Piccadilly and Manchester Airport areas.

3.8.33 The Greater Manchester Transport Model comprises a demand model (GMVDM), a highway assignment model (GMSM) and a public transport model (GMPTM). HS2 Ltd has used the AM (08:00-09:00) and PM (17:00-18:00) highway and public transport assignment models for the assessment of the Proposed Scheme. The GMSM highway model has been developed in SATURN and includes a detailed simulation area representing junction queues and delays covering the Greater Manchester conurbation. The model was updated by TfGM to represent 2017 base year traffic conditions in order to support the proposed Terminal 2 Metrolink Extension – Strategic Outline Business Case. This version of the model has been used to assess the impacts of the Proposed Scheme.

3.8.34 HS2 Ltd has carried out a review of the suitability of the Greater Manchester assignment models for assessing the impacts of the Proposed Scheme. In the case of the highway assignment model, enhancements have been made to the local highway network and zonal detail within the local HS2 study areas of Manchester Piccadilly and Manchester Airport. HS2 Ltd has also carried out a series of supplementary traffic counts which were used for a targeted matrix estimation exercise within the local HS2 study areas.

3.8.35 The GMSM model results for the Piccadilly area following the HS2 Ltd recalibration show a substantial improvement with modelled flows meeting DfT's TAG screenline flow criteria (total screenline flow within 5% of observed flow) in both the AM and PM peak periods. The modelled flows also meet the individual flow criteria in at least 85% of cases for existing screenlines and ad hoc supplementary counts in the AM and PM peak periods.

3.8.36 A total of 63% of modelled routes in the AM peak and 75% of modelled routes in the PM peak meet the journey time validation criteria of within one minute or 15% of the observed values.

3.8.37 The GMSM calibration model results for the Manchester Airport area following the HS2 Ltd recalibration show that the modelled flows are close to the DfT TAG screenline flow criteria (total screenline flow within 5% of observed flow) in both the AM and PM peak periods. The modelled flows meet the individual flow criteria in at least 85% of cases for individual screenline counts and ad hoc supplementary counts in the AM and PM peak periods.

3.8.38 A total of 50% of modelled routes in the AM peak and 50% of modelled routes in the PM peak meet the highway journey time validation criteria of within one minute or 15% of the observed values. As a result, there is an underestimation of traffic queues and delays, although the comparison of observed and modelled traffic flows shows a good correlation across the area of interest. This will be taken into account when considering mitigation, where appropriate.

3.8.39 The model performance on the screenlines used in the original TfGM validation has also been reviewed. The validation results for the wider model area show that the results following the HS2 Ltd model update were 89% for the AM, 92% for the IP and 84% for the PM peak hours. This compares to the validation prior to the model update of 93% for the AM, 93% for the IP, and 86% for the PM peak hours. This demonstrates that the model updates have not adversely impacted the overall model validation.

3.8.40 In conclusion, the updated GMSM model provides an appropriate basis for forecasting to support the assessment of the Proposed Scheme impacts within the local study areas of Manchester Piccadilly and Manchester Airport high speed stations.

3.8.41 The GMPTM 2017 base year public transport model provided by TfGM has also been reviewed. It provides a good representation of public transport services and passenger boarding and alighting flows for Metrolink and rail modes for all model time periods, although the validation of bus passenger flows is not as strong as for other modes.

3.8.42 For the highway assessment, the approach to developing the future year baseline has been to take the demand model matrices from the local plan future year models (2025 and 2040) and carry out an interpolation / extrapolation exercise to produce demand matrices for the 2030, 2038 and 2046 baseline years. These matrices have then been assigned to produce future baseline highway model outputs for the respective year of assessment.

3.8.43 The forecasts from these models include Greater Manchester Spatial Framework transport demand and supply assumptions; these are considered to be ‘near certain’ or ‘more than likely’ in accordance with DfT TAG.

3.8.44 For the assessment of the Proposed Scheme in construction, HS2 construction traffic has been overlaid onto future baseline model forecasts as preloaded traffic assigned to fixed routes with construction workforce traffic added to the demand matrices and assigned in the same way as general traffic. A construction traffic modelling assessment has been carried out for each of the defined construction stages.

3.8.45 For the assessment of the Proposed Scheme in operation, any proposed network changes associated with the Proposed Scheme have been included, together with highway demand associated with the Proposed Scheme, including Manchester Piccadilly High speed station and Manchester Airport High Speed station, added as an overlay.

3.8.46 A similar exercise has also been undertaken for the assessment of public transport conditions utilising the Greater Manchester Public Transport Model.

A500 Crewe model (MA01)

3.8.47 The A500 Crewe model has been used to assess the impacts of construction and operation traffic generated by the Proposed Scheme on strategic and local routes within Crewe and the surrounding areas of MA01.

3.8.48 The model has been developed by Cheshire East Council (CEC) and covers an area from Stoke-on-Trent in the south, Bunbury in the west, Kidsgrove in the east and the M6 Junction 18 in the north. The following key strategic routes have been assessed using this model: A500, A534, A530 and the section of M6 between Junction 16 and Junction 17. The model was released to HS2 Ltd in June 2020 by CEC and is representative of a 2017 base year and 2025 and 2040 future years. The model has been used previously as the platform for generating forecasts for the A500 Crewe – Business Case and Local Development Framework Assessments.

3.8.49 The Crewe model framework is comprised of a variable demand model (DIADEM); a local highway model (SATURN); and a local rail model (VISUM); the post-variable demand version of the local highway model has been used for the assessment of the Proposed Scheme.

3.8.50 The detailed modelled study area for the model covers Crewe and surrounding areas and has supporting network and zone system detail to provide representation of external area supply and demand. The local highway model (SATURN) has been applied to assess HS2 construction and operational impacts on the network for the AM peak hour (08:00-09:00) and PM peak hour (17:00-18:00).

3.8.51 HS2 Ltd has carried out a review of the suitability of the local highway model element of the A500 Crewe model. Following this review, the base year model has been rebased to a 2018 base year model with a localised calibration and validation model update.

3.8.52 The updated model shows a substantial improvement in traffic flows in the local study area compared with the original model. The model performance shows that both the AM and PM peak hour time periods exceed the DfT TAG criteria of greater than 85% of link flow comparisons achieving a flow range or GEH less than five.

3.8.53 Based on the model performance, it is considered that the updated model provides an appropriate basis for forecasting to support the assessment of the impacts of the Proposed Scheme within the local study area.

3.8.54 Future year baseline models have been developed to represent forecast traffic conditions for the assessment years of 2030, 2038 and 2046. The latest future year model versions (2025 and 2040) received from CEC include the Crewe Green Roundabout scheme and the Sydney Road Bridge improvement scheme. The future year models also include the proposed A500 improvement scheme between Meremoor Moss roundabout and M6 junction 16 to dual carriageway standard and the North West Crewe Package of Schemes in Leighton. The models also provide a representation of Middlewich Eastern Bypass.

3.8.55 Future year baseline traffic demand has been generated from an interpolation / extrapolation of traffic growth from the 2025 and 2040 demand matrices. This traffic growth has then been applied proportionately to the updated 2018 base year demand matrices to produce new demand forecasts for 2030, 2038 and 2046.

3.8.56 For the assessment of the Proposed Scheme during construction, HS2 construction traffic has been overlaid onto future baseline model forecasts as preloaded traffic assigned to fixed routes with construction workforce traffic added to the demand matrices and assigned in the same way as general traffic. A construction traffic modelling assessment has been carried out for each of the defined construction stages.

Winsford and Middlewich model (MA02)

3.8.57 The Winsford and Middlewich Model has been used to assess the impacts of construction and operation traffic generated by the Proposed Scheme on defined strategic and local routes within Winsford and Middlewich and the surrounding areas of MA02.

3.8.58 The Winsford and Middlewich model has been developed by Cheshire West and Chester Council (CWaC) and covers the area from Bostock Green in the north to Moston Green in the south, and from Winsford in the west to Holmes Chapel in the east. The following key strategic routes have been assessed: A54, A530, A533, together with M6 Junction 18.

3.8.59 This model was released to HS2 Ltd in December 2018 by CWaC; this model has previously been used as a platform for generating forecasts for the Winsford Transport Strategy. This model is a local SATURN highway model with a 2014 base year and 2030 future year.

3.8.60 The detailed modelled study area covers Winsford, Middlewich and surrounding areas; and has supporting network and zone system detail to provide representation of external area supply and demand.

3.8.61 The local highway model has been used to assess HS2 construction and operational impacts on the network for the AM peak hour (08:00-09:00) and PM peak hour (17:00-18:00).

3.8.62 HS2 Ltd has carried out a review of the suitability of the Winsford to Middlewich to M6 local highway model. Following this, the original base year model has been subject to a localised calibration and validation exercise to update the model to 2018 traffic conditions.

3.8.63 The updated model shows an improvement in traffic flow validation in the local study areas compared with the original model. The model performance shows that both the AM and PM peak hour time periods exceed the DfT TAG criteria of greater than 85% of link flow comparisons achieving a flow range or GEH less than five.

3.8.64 Based on the model performance, it is considered that the updated model provides an appropriate basis for forecasting to support the assessment of the impacts of the Proposed Scheme within the local study area.

3.8.65 Future year baseline models have been developed to represent forecast traffic conditions for the assessment years of 2030, 2038 and 2046.

3.8.66 The future year highway network has been updated to take account of the base year network coding updates. In addition, the future year highway network has been reviewed to check that committed (near certain or more than likely) highway schemes are appropriately represented. In particular, the Middlewich Eastern Bypass scheme has been reviewed and the junction coding updated to reflect the latest scheme design.

3.8.67 Future year baseline traffic demand has been generated from an interpolation / extrapolation of traffic growth from the original 2014 and 2030 demand matrices. This traffic growth has then been applied proportionately to the updated 2018 base year demand matrices to produce new demand forecasts for 2030, 2038 and 2046.

3.8.68 For the assessment of the Proposed Scheme in construction, HS2 construction traffic has been overlaid onto future baseline model forecasts as preloaded traffic assigned to fixed routes, with construction workforce traffic added to the demand matrices and assigned in the same way as general traffic. A construction traffic modelling assessment has been carried out for each of the defined construction stages.

3.8.69 For the assessment of the Proposed Scheme in operation, any proposed network changes associated with the Proposed Scheme have been included, together with any demand changes associated with the Proposed Scheme.

Northwich Traffic model (MA02 and MA03)

3.8.70 The Northwich Traffic Model has been used to assess the impacts of construction and operation traffic generated by the Proposed Scheme on defined strategic and local routes within Northwich and the surrounding areas of MA03.

3.8.71 The Northwich Traffic model has been developed by Cheshire West and Chester Council (CWaC) and covers the area from Higher Wincham in the north to Bostock Green in the south, and from Sandiway in the west to the M6 in the east. The following key strategic routes have been assessed: A556, A530, A533, and A559.

3.8.72 This model was released to HS2 Ltd in January 2019 by CWaC and has previously been used as the platform for generating forecasts for the Northwich Transport Study. The model is a local SATURN highway model developed for a 2016 base year and 2030 future year.

3.8.73 The detailed modelled study area for the model covers Northwich and surrounding areas; and has supporting network and zone system detail to provide representation of external area supply and demand. The local highway model has been used to assess HS2 construction and operational impacts on the network for the AM peak hour (08:00-09:00) and PM peak hour (17:00-18:00).

3.8.74 HS2 Ltd has carried out a review of the suitability of the Northwich local highway model and concluded that the original 2016 base year model provided a reliable estimate of base year traffic conditions. This model has been used as a reference model for producing a 2018 baseline model forecast.

3.8.75 The 2018 baseline model shows a good correlation between observed and modelled traffic flows with both the AM and PM peak hour time periods close to meeting the DfT TAG criteria of greater than 85% of link flow comparisons achieving a flow range or GEH less than five with the model showing that 82% and 84% of links meet the specified guidance criteria for the AM and PM peak hour time periods, respectively.

3.8.76 Based on the model performance, it is considered that the updated model provides an appropriate basis for forecasting to support the assessment of the impacts of the Proposed Scheme within the local study area.

3.8.77 Future year baseline models have been developed to represent forecast traffic conditions for the HS2 assessment years of 2030, 2038 and 2046.

3.8.78 The future year baseline model is representative of 2030 traffic conditions with land-use development assumptions representative of the local plan growth scenario. Future year baseline traffic demand has been generated from an interpolation / extrapolation of traffic growth from the original 2016 and 2030 demand matrices. This traffic growth has then been applied proportionately to the 2018 demand matrices to produce new demand forecasts for 2030, 2038 and 2046.

3.8.79 For the assessment of the Proposed Scheme in construction, HS2 construction traffic has been overlaid onto future baseline model forecasts as preloaded traffic assigned to fixed routes, with construction workforce traffic added to the demand matrices and assigned in the same way as general traffic. A construction traffic modelling assessment has been carried out for each of the defined construction stages.

3.8.80 For the assessment of the Proposed Scheme in operation, any proposed network changes associated with the Proposed Scheme have been included, together with any demand changes associated with the Proposed Scheme.

M6 Junction 19 model (MA03 and MA06)

3.8.81 The M6 Junction 19 Highway Model has been used to assess the impacts of construction and operation traffic generated by the Proposed Scheme on the community areas of MA03 and MA06.

3.8.82 The M6 Junction 19 model has been developed by Highways England. This model covers an area from Oughtrington in the north to Pickmere in the south, and from the M56 junction 9 in the west to Rostherne in the east. The following key strategic routes have been assessed: A50, A556, M56 west of Junction 7, and M6 between Junction 18 and Junction 20.

3.8.83 The M6 Junction 19 model was released to HS2 Ltd in November 2017 by Highways England; the model has recently been applied to provide an evidence base for the M6 Junction 19 Improvement scheme and the A556 scheme.

3.8.84 The M6 Junction 19 model is comprised of the following: Variable Demand Model (DIADEM) and Local Highway Model (SATURN). The post-variable demand version of the local highway model has been used for the assessment of the Proposed Scheme.

3.8.85 The detailed model local area for the M6 Junction 19 model covers the M6 / M56 / A556 triangle and has supporting network and zone system detail providing representation of external area supply and demand. The model has been developed for a 2015 base year and future years of 2021, 2036 and 2051.

3.8.86 The local highway assignment model is representative of the following peak hour time periods: Average AM peak hour (07:00-10:00) and Average peak hour (16:00-19:00). The 2015 base year model provided by Highways England has been subject to a localised calibration and validation model update in order for the model to be representative of 2018 peak hour traffic conditions.

3.8.87 The model has been converted from the three-hour average hour models to AM peak hour (08:00-09:00) and PM peak hour (17:00-18:00) models using observed traffic count data to ensure consistency with the assessment years for the Proposed Scheme.

3.8.88 The model has been updated by HS2 Ltd using traffic count survey data collected between 2017 and March 2020 (prior to COVID-19). Traffic count data has been normalised to represent 2018 average weekday traffic conditions.

3.8.89 The updated model shows an improvement in validation of traffic flows in the local study area compared with the original model. The model performance shows that the AM peak hour time periods exceeds the DfT TAG criteria of greater than 85% of link flow comparisons achieving a flow range or GEH less than five; the PM peak hour time period model performance is close to the DfT TAG criteria at 83%.

3.8.90 Based on the model performance, it is considered that the updated model provides an appropriate basis for forecasting to support the assessment of the impacts of the Proposed Scheme within the local study area.

3.8.91 Future year baseline models have been developed to represent forecast traffic conditions for the HS2 assessment years of 2030, 2038 and 2046.

3.8.92 Future year baseline traffic demand has been generated from an interpolation / extrapolation of traffic growth from the original 2021, 2036 and 2051 demand matrices. This traffic growth has then been applied proportionately to the updated 2018 base year demand matrices to produce new demand forecasts for 2030, 2038 and 2046.

3.8.93 For the assessment of the Proposed Scheme in construction, HS2 construction traffic has been overlaid onto 2030 future baseline model forecasts as preloaded traffic assigned to fixed routes with construction workforce traffic added to the demand matrices and assigned in the same way as general traffic. A construction traffic modelling assessment has been carried out for each of the defined construction stages.

3.8.94 For the assessment of the Proposed Scheme in operation, any proposed network changes associated with the Proposed Scheme have been included, together with highway demand associated with the Proposed Scheme, including Manchester Airport high speed station, added as an overlay.

Warrington Western Link Road model (MA04 to MA05)

3.8.95 The Warrington Western Link Road Model has been used as a supplementary dataset to assess the impacts of construction and operation traffic generated by the Proposed Scheme on the community areas of MA04 and MA05.

3.8.96 The model has been developed by Warrington Borough Council (WBC) and covers the Warrington district. The following key strategic routes have been assessed: M6 between Junction 20 and Junction 23; and M62 Junction 10 and Junction 11.

3.8.97 This model was released to HS2 Ltd in February 2019 by WBC. This model has been previously used to support the Warrington Western Link Road Business Case. HS2 Ltd does not have permission from WBC to modify and run this model and is therefore only able to reference existing model outputs.

3.8.98 The model is a local SATURN highway model with a detailed model local area covering Warrington district. It has supporting network and zone system detail to provide representation of external area supply and demand.

3.8.99 The Warrington local highway assignment model has been developed for a 2016 base year and 2026 and 2036 future years. The local highway assignment model represents an average AM peak hour (07:45-09:15) and an average PM peak hour (16:30-18:00).

3.8.100 The area of interest for HS2 transport assessment is on the edge of the detailed model study area for Warrington. The base year model performance within this area shows that both the AM and PM peak hour time periods fall below the DfT TAG criteria threshold of at least 85% of link flow comparisons achieving a flow range or GEH of less than five with 70% of links achieving this in the AM peak period and 80% in the PM peak period.

3.8.101 Nevertheless, as the model is on the edge of the detailed study area and was used solely to derive growth factors rather than forecast traffic flows on links, the model is considered sufficiently robust for use as a supplementary dataset for the assessment of the Proposed Scheme.

3.8.102 HS2 Ltd has carried out an interpolation / extrapolation of existing 2016, 2026 and 2036 model outputs to provide an estimate for a 2018 base year and future year baseline traffic flows for 2030, 2038 and 2046 covering the areas of MA04 and MA05.

3.8.103 HS2 construction traffic has been manually overlaid onto 2030 future baseline model forecasts as preloaded traffic assigned to fixed routes, and construction workforce traffic has also been included. A construction assessment has been carried out for each of the defined construction stages.

3.8.104 HS2 operational traffic assessments for 2038 and 2046 have been undertaken by using the model road network as a referencing system, on to which MWJV survey data has been assigned and traffic changes resulting from the Proposed Scheme manually overlaid.

Local junction models

3.8.105 Local junction modelling has been undertaken at junctions which will be substantially impacted by the Proposed Scheme. In identifying junctions for modelling assessment, consideration has been given to the following impacts:

- increase in traffic volumes as a result of construction activities;
- locations where there are substantial temporary impacts including road closures, realignments, restrictions or diversions, recognising the scale and duration of any impacts with short term or smaller impacts not requiring modelling as part of the TA;
- increase in traffic volume as a result of operation of the Proposed Scheme;
- junctions that will be subject to permanent infrastructure changes due to the Proposed Scheme such as road closures or realignment;
- junctions that will include permanent changes to the operation of traffic control; and
- new junctions that are introduced as part of the Proposed Scheme.

3.8.106 Baseline junction traffic demands have been derived from observed turning counts at junctions or available strategic and local traffic models. To ensure a robust assessment, where data from two or more traffic surveys at the same location differ, the approach has been to use the dataset with the highest traffic volumes.

3.8.107 Where ATC surveys have higher baseline flows than the equivalent classified turning count (CTC) survey, the appropriate turning volumes have been adjusted to reflect the higher volumes.

3.8.108 Junctions 9 software has been used to calculate the existing capacity of priority-controlled junctions and roundabouts within the study area. LinSig software has been used to calculate the existing capacity of signal-controlled junctions.

3.8.109 Junctions 9 calculates the Ratio of Flow to Capacity (RFC) and queue for each approach to a junction. The RFC indicates the likely performance of a junction under a given set of traffic flows and the queue represents a typical queue found at the end of each time segment within the modelled time period. LinSig calculates the Degree of Saturation (DoS) and Mean

Maximum Queue (MMQ) for each approach under a given set of traffic flows, with the MMQ the average maximum queue modelled within each traffic signal cycle. Both the RFC and DoS are very similar to the Volume over Capacity (VoC) measure from the SATURN strategic models.

3.8.110 When junctions are operating below 75% DoS or 0.75 RFC, they are operating well within capacity. Between 75% to 85% DoS or 0.75 to 0.85 RFC, junctions are operating within capacity. At over 85% to 100% DoS or 0.85 to 1.0 RFC, junctions are operating close to capacity and queues are likely to increasingly occur. Consequently, permanent highway infrastructure is generally designed to stay below this level. At over 100% DoS or 1.0 RFC, junctions are over capacity and, if sustained over time, the level of traffic cannot be accommodated. In congested urban areas, junctions often operate at or above capacity for short periods.

3.8.111 Where two DoS values are presented in the results tables, this provides the value for both the approach lane and its respective flare. All queue lengths and traffic flow inputs to both the LinSig and Junctions 9 models are presented in passenger car units (PCU)[14].

3.8.112 All local junction models use PCU as the traffic flow inputs in order to represent the observed composition of vehicles in the traffic flow. Queue length outputs from the model are also presented in PCU.

3.8.113 When local junction modelling has been undertaken for the Proposed Scheme, the junction cycle time has not been altered. Signal optimisation has also not been applied and the green splits are consistent with the baseline and future baseline models. This is to ensure that the effects that are reported are a reasonable worst-case representation of the impact of the Proposed Scheme. The only exception to this is individual junctions that are operating Microprocessor Optimised Vehicle Actuation (MOVA). For these junctions the cycle times has not been altered but the green splits have been optimised to mimic the effect of MOVA.

[14] Typically, a car will represent one PCU, whereas an HGV will be between two to three PCU depending on the average length of HGV included in the junction modelling assessment.

4 Mitigation measures

4.1 Introduction

4.1.1 The overarching aim of the mitigation strategy is to reduce or eliminate adverse traffic and transport impacts and effects on local communities, local infrastructure and the environment, during construction and operation. A comprehensive mitigation strategy has been developed with three major strands which are discussed in more detail in this section:

- mitigation included in scheme design;
- the draft CoCP; and
- the FTP.

4.1.2 Where material adverse impacts are identified, consideration has been given to the implementation of specific mitigation measures which are discussed, as relevant, alongside the assessment for each CA. The general approach will be to facilitate improved access by sustainable modes.

4.2 Mitigation included in scheme design

4.2.1 Mitigation proposals have been included in the Proposed Scheme design and construction methodology, where appropriate and reasonably practicable, in order to 'design out' adverse impacts, both for construction and operation. The TA has therefore been progressed alongside the design process, and mitigation proposals have become an integral part of the design to minimise adverse impacts at an early stage, so far as reasonably practicable.

Mitigation for construction

4.2.2 Mitigation proposals for construction include various transport measures, including but not limited to:

- new highways (roads and PRoW) will be constructed and will be operational prior to the permanent closure of any existing highways, insofar as reasonably practicable;
- the majority of roads crossing the route of the Proposed Scheme will be maintained or locally diverted during construction to limit the need for diversion of traffic onto alternative routes;
- traffic management measures will be implemented to limit any disruption;
- road closures will be restricted to overnight and weekends, insofar as reasonably practicable;
- temporary alternative routes for PRoW will be provided during construction, insofar as reasonably practicable, where either the existing or final proposed route is not available;

- where reasonably practicable, site haul routes will be created adjacent to the route of the Proposed Scheme to transport construction materials and equipment to reduce HGV movements on public roads with access taken via the main road network;
- HGV will be routed, insofar as reasonably practicable, along the strategic and/or primary road network;
- the use of the local road network will, insofar as reasonably practicable, be limited to use for site set-up, access for surveys and on-going servicing (including refuse collection and general deliveries to compounds) during construction;
- the reuse of excavated material along the route of the Proposed Scheme, insofar as reasonably practicable;
- highway measures including junction improvements, passing places and carriageway widening will be provided, as required, to manage the safe and efficient movement of vehicles on construction HGV routes; and
- on-site welfare facilities will be provided, which will reduce daily travel by site workers.

Mitigation for operation

4.2.3 Mitigation proposals for operation at HS2 stations include various transport measures including but not limited to:

- provision for access by sustainable modes, including walking and cycling to promote non-car access;
- provision of dedicated taxi, private hire vehicle and private vehicle drop-off and pick-up facilities sized to accommodate the anticipated future demand;
- changes to the highway and public transport network to accommodate users of the HS2 services; and
- provision of cycle access to the station with additional storage and cycleway facilities.

4.2.4 For HS2 stations or depots, a station or depot travel plan will be developed which will include measures that aim to reduce the impacts and effects of traffic and transport movements.

4.2.5 For operation in areas external to Manchester Piccadilly High Speed station and Manchester Airport high speed station or for non-station CA, mitigation includes various transport measures including but not limited to:

- reinstatement of roads on or close to their existing alignments, where reasonably practicable;
- replacement, diversion or realignment of PRoW; and
- other mitigation measures where appropriate including taxi, pick up/set down, cycle and pedestrian facilities.

4.2.6 Consideration has been given to the provision of further mitigation measures within the relevant CA, with assessment of these as appropriate and necessary.

4.2.7 Where adverse impacts are predicted to occur remotely from the Proposed Scheme, this has been assessed. The need for off-site mitigation has been considered and potential mitigation measures have been assessed, where appropriate. Such measures may include improved pedestrian or cycle facilities, revised bus stop arrangements and junction modifications or traffic signal changes.

4.2.8 For necessary off-site mitigation, the general approach has been to identify an indicative, feasible and effective option that would address the mitigation need. In most instances, rather than detailed prescriptive design options, off-site interventions should be considered in the context of the wider objectives of local authorities and through subsequent dialogue with local highway authorities to enable an improved mitigation plan to be developed. However, in some locations, specific highway works are proposed that will address constraints on highway users (such as inadequate road width to allow safe passing of HGV). These will reduce any potential highway impacts.

4.3 Draft Code of Construction Practice

4.3.1 A draft CoCP (see Volume 5, Appendix: CT-002-00000) has been developed which contains control measures and the standards to be implemented throughout the construction of the Proposed Scheme.

4.3.2 Section 14 of the draft CoCP includes measures that aim to reduce the adverse impacts and effects on local communities and maintain public access. This includes the impacts of deliveries of construction materials and equipment.

4.3.3 The measures in the draft CoCP include controls on vehicle types, hours of site operation and routes for HGV to reduce the impact of road-based construction traffic. In order to achieve this, general and site-specific traffic management measures will be implemented during the construction of the Proposed Scheme on or adjacent to public roads and PRoW affected by the Proposed Scheme.

4.3.4 The draft CoCP includes the requirement to develop local traffic management plans in consultation with the highway and traffic authorities and the emergency services. These will consider the local traffic management strategy including consideration of sensitive receptors, such that adverse impacts will be reduced, insofar as reasonably practicable.

4.3.5 Specific measures include core site operating hours of 08:00-18:00 on weekdays and 08:00-13:00 on Saturdays with site staff and workers generally arriving before the morning peak hour and departing after the evening peak hour. Tunnelling and directly associated activities, as well as works such as concrete pour which will involve extended working hours, will be carried out on a 24-hour, seven days a week basis. However, workers will mostly arrive and depart outside of the peak traffic hours.

4.3.6 The number of private car trips to and from the construction compounds (both workforce and visitors) will be reduced by encouraging alternative sustainable modes of transport or vehicle sharing. This will be supported by an overarching Framework travel plan that will require construction workforce travel plans to be produced that will include a range of potential measures to mitigate the impacts of workers' traffic and transport movements associated with construction of the Proposed Scheme. The travel plans will promote the use of sustainable transport modes as appropriate to the location and types of trip. They will include measures such as: provision of information on and promotion of public transport services; provision of good cycle and pedestrian facilities; liaison with public transport operators; promotion of car sharing; and the appointment of a travel plan coordinator to ensure suitable measures are in place and are effective.

Framework travel plan

4.3.7 An overarching Framework travel plan (FTP) (set out in the TA Part 4, Annex A, see Volume 5, Appendix: TR-005-00000) has been produced that requires travel plans to be used, along with a range of associated potential measures, to mitigate the impact of transport associated with construction, maintenance and operation of the Proposed Scheme, in particular by reducing commuting by single occupancy car and by encouraging the use of sustainable transport.

4.3.8 In relation to construction, the scope of the FTP includes:

- a construction workforce travel plan – the framework will inform site specific plans that will, in particular, seek to reduce workforce commuting by private car, especially sole occupancy car travel and, where practicable, encourage the use of sustainable modes of transport;
- details of the requirements for setting targets for encouraging sustainable travel;
- consideration of maintenance activities; and
- consideration of delivery and servicing and car parking management plans.

4.3.9 In accordance with the Framework travel plan, station and depot travel plans for each station and depot will be developed and will include measures that aim to reduce any adverse impacts and effects of traffic and transport movements.

4.3.10 The scope of the station and depot travel plans will address:

- access and egress to stations for passenger travel;
- employee travel, including rail staff and others working on the site including, as relevant, station or depot staff, retail staff, security and policing, and cleaning contractors; and
- servicing and maintenance including deliveries.

4.3.11 The objectives of the station and depot travel plans can be summarised as:

- to encourage access by walking, cycling and public transport;
- to monitor facilities and infrastructure that support access by walking, cycling and public transport within the station site and its surrounding area;
- to manage car and taxi access by providing and monitoring controlled facilities for pick up and drop off;

- to provide details of the requirements for setting targets for encouraging sustainable travel;
- to consider delivery and servicing and car parking management plans; and
- to work in partnership with the local authority and other stakeholders to develop measures and promotional strategies to encourage sustainable travel.

4.3.12 The impact of any reduction in sole occupancy car travel as a result of these measures has not been considered as part of the TA. Therefore, the TA considers a reasonable worst-case assessment in terms of traffic impacts.

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