



High Speed Two Phase 2b Crewe to Manchester

Route Engineering Report

July 2017





Department for Transport

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HS2 Phase Two

Crewe to Manchester Route Engineering Report

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References

Title	Reference
HS2 Project dictionary	HS2-HS2-PM-GDE-000-000002
HS2 Style guide	HS2-HS2-CO-GDE-000-000001

1 Introduction

1.1 The purpose of this Report

- 1.1.1 Following public consultation, HS2 Ltd undertook a review of the Phase Two route and proposed a number of refinements. These refinements were informed by consultation responses [**Reference Dialogue by Design Report**], lessons learned from the development of the Phase One design, and the developing strategic context as reflected in the reports 'HS2 Plus' and 'Rebalancing Britain'. The drivers for changes to the consultation route are considered in greater detail in the Summary of Route Refinements report [**Reference Summary of Route Refinements Report**].
- 1.1.2 This report provides a detailed route description of the preferred route between Crewe and Manchester (Phase 2b) which extends from the end of the Phase 2a route just south of the existing Network Rail station at Crewe, to Manchester and the West Coast Main Line (WCML) near Golborne. It also includes a description of the stations and depots. For further information on the key issues that HS2 Ltd has considered, and the recommended changes, please see [**Reference HS2 Summary Report 2016**]. For potential impacts on communities and the environment please see the sustainability report [**Reference Temple RSK Sustainability Report 2016**].
- 1.1.3 In autumn 2015, the Secretary of State for Transport announced his intention to move forward with a separate hybrid Bill to deliver a route to Crewe in advance of the rest of the Phase Two route. Building on this recommendation HS2 Ltd brought forward proposals for refinements to the route between the West Midlands and Crewe (Phase 2a), which were published in autumn 2015.
- 1.1.4 The historical work undertaken since the start of the route development in 2010 and presented to the public in a series of Phase Two consultation events in late 2013 can be found on the Department for Transport website (www.gov.uk).
- 1.1.5 The technical requirements for line of route, station and depot design are outlined in this report. For further information on the key issues that HS2 Ltd has considered, and the recommended changes since public consultation in 2013, please see [**Reference HS2 Summary Report 2016**].

1.2 Overview of the Route

- 1.2.1 The preferred route from Crewe to Manchester forms the northern 53 miles (85km) section of the Western Leg on the Phase Two network. This section commences to the south of Crewe, just south of the A500. This is a continuation of the Phase 2a route (West Midlands to Crewe), first published in October 2015.

- 1.2.2 Phase 2b would connect to the end of Phase 2a south of Crewe and continue under the town in twin tunnels. The Phase 2b southern tunnel eye is currently at ch. 2+090.
- 1.2.3 Emerging to the north of the town, Phase 2b would run to the east of the WCML corridor before bearing north, away from the WCML. As HS2 diverges from the WCML a rolling stock depot (RSD) would be provided in the area between HS2 and the existing WCML.
- 1.2.4 The preferred route would continue in a northerly direction passing in between the towns of Winsford and Middlewich. It would run on a series of embankments and viaducts to the west of Lostock Green and east of Rudheath, Lostock Gralam and Higher Wincham, rising up to cross over the M6. To the north of the M6 a junction would be provided, with a spur passing east towards Manchester Airport and the terminus station at Manchester Piccadilly.
- 1.2.5 The Manchester spur would turn east and pass to the north of Rostherne Mere, running broadly parallel to the M56. It would then turn north and pass under the M56 at Warburton Green and into an interchange station near Manchester airport. Just past the station the route would enter twin tunnels under south Manchester, emerging in the Ardwick area, where it would rise onto a viaduct to enter the terminus station at Manchester Piccadilly.
- 1.2.6 The mainline would continue north from the junction with the Manchester Spur. It would cross mainly open countryside, under the M56 and over the Manchester Ship Canal on a viaduct to the east of Hollins Green. Passing over the M62, the route would curve to the south and west of Culcheth, before running between Lowton and Lowton Common. The route would then bear north east before connecting into the WCML at Bamfurlong.

1.3 The Layout and Content of this Report

1.3.1 This report is set out as follows:

- chapter 1 (this chapter) is introductory;
- chapter 2 sets out the technical requirements and assumptions underlying our work;
- chapter 3 describes the line of route;
- chapter 4 describes the stations on the route;
- chapter 5 describes the rolling stock depot;
- chapter 6 discusses ancillary design works; and
- chapter 7 is a glossary of terms.

2 Design methodology

2.1 Overview

- 2.1.1 The route definition and selection process for Phase Two of HS2 commenced in the autumn of 2010 with engagement of engineering and environmental consultancies to deliver the necessary technical design and appraisal input. The methodology applied was in large part the same as that applied to the route selection between London and the West Midlands, taking into account lessons learned during the development of Phase One.
- 2.1.2 HS2 Ltd were asked by the Government to identify a number of possible route and station options¹. This involved a process of identifying a long list with subsequent sifting to reduce the options for consideration down to a handful of alternatives that met the remit set by the Government. At each sift, remaining options were developed and refined to a greater level of detail in order to identify the key differences between options. During these final stages, potential locations for the infrastructure maintenance depots (IMDs) and rolling stock depots (RSDs) were also developed and followed a similar sifting process.
- 2.1.3 The scope for the Manchester leg included Manchester city centre station locations and consideration of the potential for interchange/ intermediate station locations. Connections to the existing West Coast Main Line railway would provide routes further to the North West and Scotland.
- 2.1.4 In March 2012 HS2 Ltd submitted to Government their report “*Options for Phase two of the high speed network*”. This report was part of a suite of documents produced to provide preliminary advice to Government on potential options for phase two of the high speed rail network.
- 2.1.5 In July 2013 the Secretary of State for Transport published proposals for Phase Two of HS2 and initiated a seven-month period of public consultation to gather views on the route and stations proposed in the consultation.
- 2.1.6 Following public consultation, HS2 Ltd undertook a review of the Phase Two route and proposed a number of refinements. These refinements were informed by consultation responses [**Reference Dialogue by Design Report**], lessons learned from the development of the Phase One design, and the developing strategic context as reflected in the reports ‘HS2 Plus’ and ‘Rebalancing Britain’. The drivers for changes to the consultation route are considered in greater detail in the Summary of Route Refinements report [**Reference Summary of Route Refinements Report**].
- 2.1.7 This report provides a detailed route description of the preferred route between Crewe and Manchester (Phase 2b). For further information on the key issues that HS2 Ltd has considered, and the recommended changes, please see

¹ HS2 Ltd’s remit is set out in a number of publicly available remit letters from Government.

[Reference HS2 Summary Report 2016]. For potential impacts on communities and the environment please see the sustainability report [Reference Temple RSK Sustainability Report 2016].

2.2 Technical requirements for line of route

2.2.1 HS2 Ltd has developed a series of 'deliverable approach statements'. These specify the engineering, operational and performance requirements for the route, and set out the engineering design parameters.

Alignment design assumptions

2.2.2 The alignment development work was generally carried out using Ordnance Survey MasterMap data, supplemented with elevation information from five metre resolution terrain data and one metre resolution surface data. This mapping has been used to support the alignment design.

2.2.3 The alignment design was undertaken in accordance with the HS2 Track Alignment Design Specification. Turnouts have been specified in accordance with the HS2 Switch and Crossing Geometric Design specification.

2.2.4 Key alignment parameters from the alignment and switch and crossing specifications include:

- The mainline alignment shall be designed to support an initial maximum operating speed of 360km/h, with the alignment footprint capable of supporting a maximum design speed of 400km/h, where topographical, train performance and sustainability issues permit;
- The Manchester spur alignment shall be designed to support an initial maximum operating speed of 230km/h, where topographical, train performance and sustainability issues permit;
- The line shall be designed to permit trains to maintain consistent high speeds;
- The maximum achievable speed through turnouts is 230km/h; and
- The maximum vertical curve radius shall be 56,000m.

2.2.5 Where possible low points in cuttings are avoided and minimum gradients provided, to allow tracks to drain by gravity.

The width of the railway

2.2.6 For the majority of its length, the new route would be a twin track railway.

2.2.7 The separation between the centrelines of the pair of tracks would be 5.0m where 400km/h maximum design speed was required. The track-bed width would make provision for Overhead Line Equipment (OHLE), walkways, drainage, cable troughs, and fencing. The track-bed width would be 18.9m wide. This has reduced from an allowance of 22m in the Consultation Route and is consistent with assumptions made on Phase One of the project.

- 2.2.8 For cuttings and embankments, at this stage, it is assumed that the side slope of the earthworks would be 1:2.5 (two vertical to five horizontal). As greater detail on ground conditions are established, it may be possible to use steeper cutting slopes. In some areas, shallower cutting and embankment slopes (i.e. a wider footprint) may be required where the ground conditions prove to be less favourable.
- 2.2.9 Where tracks enter tunnels in two separate tunnel bores, the distance between tracks would be dependent on the external tunnel diameter (see 'Tunnelling assumptions' section) but would typically be between 16.5m and 19.2m, dependent on tunnel diameter.
- 2.2.10 As the design develops, the land take required by the railway is expected to increase in order to accommodate highways crossings, power infrastructure, access for maintenance and emergencies, balancing ponds and the diversion of utilities as well as provision for environmental mitigation.
- 2.2.11 Further to this, the construction of HS2 would require some additional temporary land take beyond the corridor footprint, including areas for construction compounds. Worksites would also be required at areas of major works, such as entrances to tunnels.

Track formation

- 2.2.12 At this stage of the design, it is assumed that the track would be on ballast, except in twin tunnels or through stations where there would be track slab.

Constructability and programming

- 2.2.13 At this early design stage, consideration of construction issues has generally included identifying risks and opportunities and identifying typical working methods and techniques.
- 2.2.14 The initial construction phase programme for the works supports the assumption that the Crewe to Manchester route can be constructed between 2024 and 2033, including the commissioning and testing of the route.
- 2.2.15 The programme reflects the current known project scope and outlines a sequence in which the scope can be delivered. The programme identifies the key programme risks and opportunities in project delivery and articulates the basis for associated programme contingencies.
- 2.2.16 Further information on the typical principles of construction can be found in the draft Code of Construction Practice for Phase One [**Reference draft COCP**].

Geotechnical assumptions

- 2.2.17 The geological conditions along the route are variable. At this early stage of design a common side slope has been adopted for earth structures, as indicated in 'The width of the railway' section. Recent work on earthwork

slopes has given greater confidence in the assumption that 1:2.5 side slopes on embankments and cuttings is the most appropriate assumption for the preferred route. There are some areas which might require shallower earthworks slopes, and some areas where steeper slopes could be achieved. Further work in this area will be carried out at the next stage of development to confirm these findings.

2.2.18 The following issues are typical of the engineering influences that have been considered on route selection:

- subsidence associated with the collapse of natural cavities, particularly in soluble formations;
- historical mine workings;
- areas with a known history of landslides or unstable ground;
- compressible deposits, including alluvium, which pose a settlement risk to embankments or structures; and
- known historical or current landfill sites.

2.2.19 The most significant geological hazard is that a large part of the route, from Crewe to south of Manchester Airport, is underlain by soluble rock, halite. Further studies and ground investigations will be undertaken in this area to ensure a full evaluation of the risks is made and the appropriate mitigation designed into the scheme.

Structures assumptions

2.2.20 Sufficient vertical clearance has been provided within the alignment design where HS2 would cross, or be crossed by, roads and other major obstacles including other railways, rivers and canals. Short bridges, such as those used to carry the railway over local roads, or roads over the railway, would likely be straightforward single spans. For longer structures provision of a viaduct structure has been assumed. In particular, viaducts have generally been assumed where the designed rail level would be greater than 15m above existing ground level, or where the feature to be spanned is longer than 60m, for example, where HS2 would cross a flood risk zone.

Tunnelling assumptions

2.2.21 The range of tunnel configurations used is as follows:

- twin bore, single track tunnels (with cross passages where required);
- cut and cover tunnels.

2.2.22 The tunnelling methods considered are:

- tunnel boring machine (TBM) driven tunnels with precast tunnel linings, with the machine type dependent on ground conditions;

- sequentially excavated tunnels, generally utilising sprayed concrete lining (SCL) for initial ground support;
- Cut and cover tunnels; and
- Jacked boxes.

The latter two of these are not used on the Phase 2b preferred route at this stage of design.

- 2.2.23 It is assumed that tunnels would be provided where the track alignment is at least two times the external tunnel diameter below existing ground level. The size of tunnel required would be dependent on design speed and length of tunnel. For operational speeds of 360km/h, the internal diameter would be 8.8m for each bore of a twin bore tunnel. For speeds of up to 230km/h, the internal diameter would be 7.55m for each bore of a twin bore tunnel.
- 2.2.24 Cross passages between twin bore tunnels have been assumed at a spacing of approximately 380m. Cut and cover tunnels would have a central wall between tracks, with connecting door at 380m spacing.
- 2.2.25 The track spacing would widen on the approach to tunnels, to allow for the construction of twin bored tunnels or the central wall between tracks on cut and cover tunnels. This spacing would be dependent on the alignment approaching the tunnel, and would be a minimum of twice the external tunnel diameter for twin bore tunnels and a minimum of 8m for cut and cover tunnels.
- 2.2.26 Vertical intervention shafts are provided for tunnel ventilation and emergency access.

Cut and cover tunnels

- 2.2.27 Where a twin cell cut and cover tunnel is proposed, this would generally be formed by excavating what would be a normal cutting. In the cutting, a box structure would be constructed, before re-filling over its roof slab to restore the original ground level and surface features such as footpaths or roads.

Jacked box tunnels

- 2.2.28 In certain locations where the route crosses beneath roads or railways a box tunnel would be formed by constructing a box type of structure alongside its final position and then jacking it into position whilst excavating out material from the face. This technique is frequently used to minimise disruption to key road and rail routes. The final result is the same as a cut and cover tunnel.

Interfaces with existing transport infrastructure

- 2.2.29 Where HS2 would cross the path of an existing highway or railway the route alignment design would provide sufficient vertical clearance to permit construction of a new bridge.

- 2.2.30 The route encounters major highways, including motorways. Where HS2 crosses highways, either above or below, there may be a requirement to locally modify the highway to accommodate the HS2 structure
- 2.2.31 Where HS2 crosses this infrastructure a bridge or viaduct carrying HS2 would be provided over the existing railway. If appropriate, allowance would be made to future proof for electrification of the existing railway when not currently provided.
- 2.2.32 There are locations along the route where significant modifications to the existing railway network would be required, such as closure and diversion of existing lines or the realignment of tracks, so that HS2 would share an existing and possibly widened corridor.
- 2.2.33 Where the alignment broadly follows an existing transport corridor there may be a requirement to permanently realign the corridor so that HS2 would share the existing and sometimes widened corridor.

Interfaces with watercourses

- 2.2.34 Where HS2 would cross a major watercourse, at this stage of design, sufficient clearance has been provided to allow at least a 1m freeboard above 1:1000 year flood levels. Where a floodplain is present, the floodplain would be crossed by a viaduct. At later stages of the design process, detailed flood modelling will be carried out and may indicate that some or part of these viaducts can be replaced by embankments. Floodplain compensation can be provided. In other cases a viaduct may be extended.
- 2.2.35 Where HS2 crosses over smaller watercourses, culverts would be provided through the embankment crossing the watercourse. In a small number of instances the alignment is such that sufficient clearance may not be available to allow a culvert to be provided. In these instances alternative solutions would be applied such as diverting the watercourse along the line of route to a location it could be returned to a watercourse, or the provision of drop inlet culverts or inverted siphons. These solutions will be developed at the next stage of the design process.
- 2.2.36 Where the alignment is in deep cutting or realigned a watercourse would be diverted to avoid the route, or be designed to cross HS2 in an aqueduct.

Environmental mitigation

- 2.2.37 Mitigation is inherent within the design through the choice and location of the route. Decision making on the choice of route has included a range of considerations including cost, sustainability, engineering and benefits/business case. Opportunities for environmental mitigation will be identified and proposed following the Environmental Impact Assessment (EIA) process as part of the next stage of design. This will include surveying, modelling exercises, analysis and engagement with relevant stakeholders.

2.3 Technical requirements for stations

- 2.3.1 The quality of station design will shape the passenger experience of the HS2 network. The station should promote a positive experience of the network through a design that provides passengers with a smooth, convenient and pleasant passage through the station with effective management of pedestrian throughput.
- 2.3.2 The design of stations and their integration with the surrounding built environment should create the opportunity not only to engender positive experiences of the network, but also to act as catalysts for regeneration and economic growth.
- 2.3.3 The preferred route has two stations;
- a terminus station at Manchester Piccadilly; and
 - a through or intermediate station at Manchester Airport.
- 2.3.4 At this stage of design the stations have been considered in outline, using the following assessment criteria:
- site availability and fit;
 - integration with line of route options and approaches to city centres;
 - impact upon and integration with existing transport infrastructure;
 - constructability;
 - passenger dispersal;
 - cost;
 - demand, as far as location will impact upon demand; and
 - a range of sustainability and environmental considerations.

Station design

- 2.3.5 The station design encompasses a wide range of criteria. This includes designs that enable train dwell times to match service patterns, considerations of passenger comfort and safety, capitalising on commercial opportunities and working within the confines of the budget. Provision for perturbed situations (i.e. when normal service patterns are disrupted due for example to maintenance or inclement weather) and future growth must also be considered.
- 2.3.6 Station design and layout will vary across the network depending on station location, operational requirements, land availability, etc. and therefore the design of each station will be unique. However, whilst recognising the constraints of individual sites, all stations on the high speed network should maintain a common style and standard that feels familiar to passengers, regardless of where the station is.

2.3.7 Station design will be developed to address the following factors, which are critical to station functionality:

- accommodate network operational requirements;
- station capacity planning;
- functional zoning;
- passenger movements, wayfinding and accessibility;
- safety and security;
- interchange with other transport modes; and
- passenger environment.

Technical requirements

2.3.8 The effective length of HS2 station platforms shall be at least 415m with an additional 25m for buffers at terminal platforms. The platforms are designed to GC gauge, the height of such platforms being 760mm above rail level.

2.3.9 Where interchange facilities with the national rail networks are provided the platforms shall be designed to UK national railway standards.

2.3.10 Platform width shall be determined to accommodate expected passengers flows with reasonable practicable allowances made for perturbation of peak flows. The design shall also comply with relevant design standards for minimum clearance to fixed infrastructure. Minimum width of platforms has been assumed to be 12m for double sided island platforms and 8m for single sided platforms.

2.3.11 Tapering at platform ends shall be permitted where there is justifiable reason to do so. Where a taper is applied it should taper from full width to no less than a width of 8m and the radius of platform curvature shall not be less than 1000m radius. The remaining length of the platform shall be straight to facilitate splitting and joining of trains. Platform obstructions shall be kept to a minimum in the tapered section of the platform.

2.3.12 The number of platforms required at each station is determined by the operational requirements that drive the timetable, including the necessary turnaround time to meet that timetable. It is further influenced by the length of the route sections, demand requirements and loading factors.

Terminus stations

2.3.13 Manchester terminus station will make provision for four platform faces.

2.3.14 The approach alignment design attempts to maximise entry and exit speeds to permit unimpeded acceleration and braking of trains.

Through or intermediate stations

- 2.3.15 The intermediate station at Manchester Airport makes provision for two platform faces only. Two through tracks would be provided for non-stopping trains.
- 2.3.16 The through station requires a facility to slow down and stop a train without impeding the passage of a following non-stopping train, and conversely to enable that train to re-join the railway without being impeded by an overtaking train. The lengths of the acceleration and deceleration lanes, or stopping lanes, are defined by the speed and frequency of the service. Invariably, these lanes are much longer than a platform stopping lane would need to be for a slower railway or one that did not have such an intense service pattern.
- 2.3.17 The through station therefore incorporates two through running tracks. Platform faces serve lines that run parallel to the through running lines.
- 2.3.18 The normal two-track route would widen to four tracks for a station with only two platform faces, to allow two platform tracks and two non-stopping tracks.

2.4 Technical requirements for depots

- 2.4.1 The preferred route between Crewe and Manchester includes provision for a rolling stock depot (RSD). RSDs would be used to stable trains overnight, for cleaning and maintenance.
- 2.4.2 Infrastructure maintenance depots (IMDs) would be used as a base from which to carry out engineering activities to inspect, maintain and renew the infrastructure. The preferred route between Crewe and Manchester does not include provision for an IMD. An IMD to serve the western leg of Phase Two was included in the preferred route between the West Midlands and Crewe
- 2.4.3 The depots would be required to operate for 24 hours a day, seven days a week.
- 2.4.4 The depots would provide immediate access to the trunk road network to facilitate access by large goods vehicles. Good transport links will enable a suitable and relatively local workforce, and as such, the potential for access by public transport would be considered.
- 2.4.5 Depots would be designed to allow access to both the HS2 route and the existing railway, where possible.

Requirements for rolling stock depots

- 2.4.6 The RSD would be configured for stabling and light maintenance, with heavier maintenance activities carried out at the Washwood Heath depot proposed for Phase One of the HS2 network.
- 2.4.7 The RSD would be positioned with access to the HS2 route, ideally within ten minutes from the terminus station. Access to the existing rail network, to

facilitate delivery of rolling stock and other materials by rail, is desirable yet not essential.

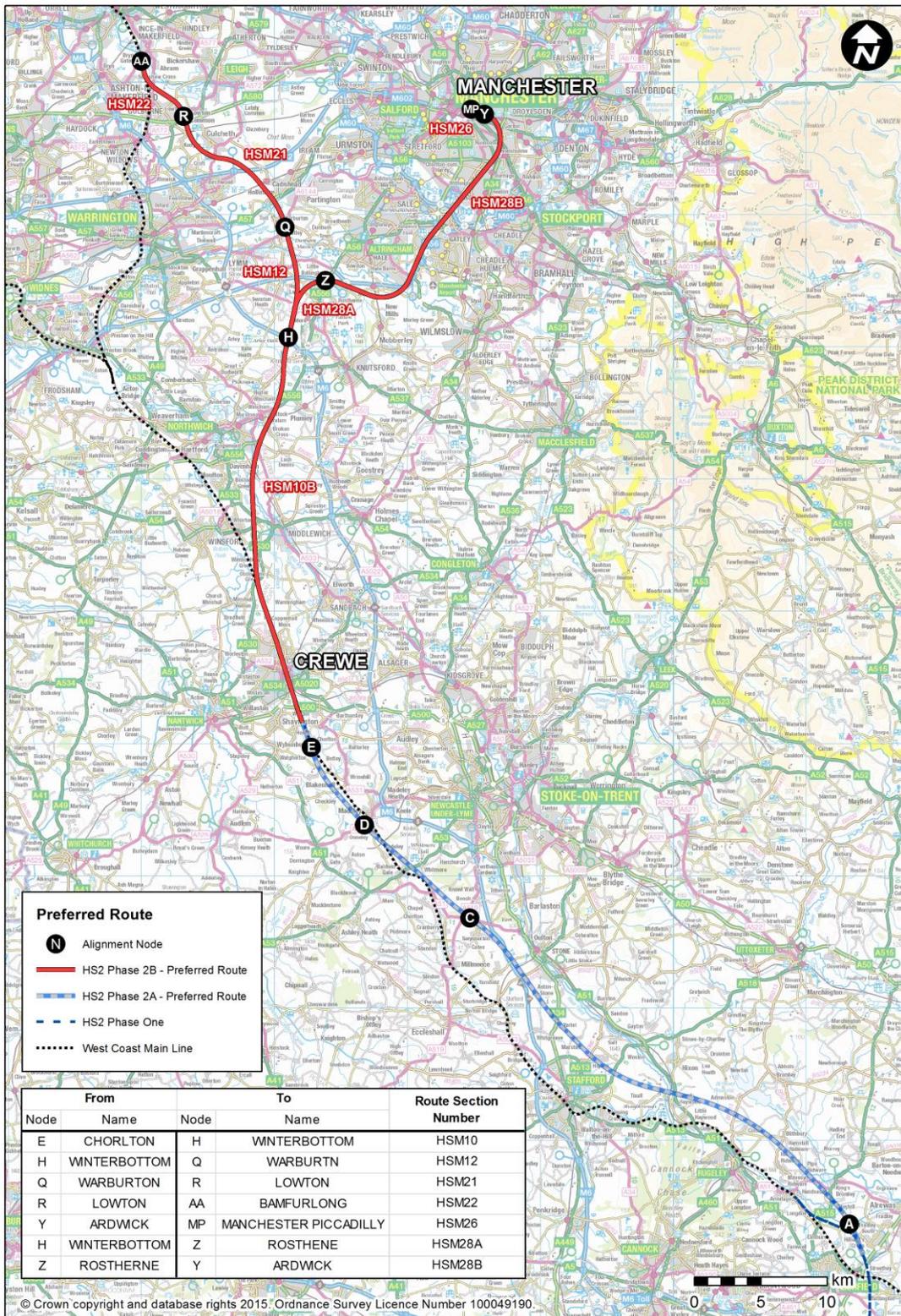
- 2.4.8 The RSD would be configured to be able to routinely deal with 46 train sets and provide stabling for up to 51 sets in exceptional circumstances. This requirement approximates to a footprint approximately 1.8 kilometres in length and an average of 280m wide: an area of approximately 50 hectares. Each train set is up to 200m long. Each depot would handle a mixture of full GC gauge sets and classic compatible sets.
- 2.4.9 The depot would provide a large covered maintenance building and a range of facilities to enable rolling stock inspection, repair, cleaning, light maintenance, re-watering and replenishing of consumables.
- 2.4.10 The maintenance patterns and flow through the depot will be defined to ensure sufficient capacity remains to move trains around the depot and prevent 'gridlock'.

3 Line of route

3.1 Route sections

- 3.1.1 This chapter describes a series of individual route sections, which combined form a continuous route from Crewe to Manchester and the WCML near Golborne. The text also makes reference to station locations in the Greater Manchester area.
- 3.1.2 In November 2015, the Secretary of State announced his intention to accelerate the delivery of the Phase Two route between the West Midlands and Crewe, so that it would open in 2027. This project is known as 'Phase 2a' and will be taken forward with a separate hybrid Bill. HS2 Ltd published advice at the time of this announcement explaining how the design of this section of the route had developed since consultation, and this is available at www.gov.uk. This route would run in a north-south direction from the end of the Phase One route near Lichfield, to just south of Crewe where it joins the WCML. Provision is made at the end of the Phase 2a route to allow the HS2 mainline to continue north, connecting directly into the preferred route from Crewe to Manchester. The section of route from Crewe to Manchester is part of the Phase 2b route and is described in this report.
- 3.1.3 The key plan on the following page presents the individual route sections and provides the reader with the guide to the layout of the rest of the sections of this report. Each route section was given a reference number, such as 'HSM12', covering a discrete geographical length. The report describes these sections. The total length may need to be sub-divided in order to allow a piece of text to be read against a map on the following page; typically, each map presents approximately 7.5 miles (10 - 12km) of route.
- 3.1.4 The plan also shows that the route sections run between 'Nodes', such that the reader can identify the location they are interested in as, for instance, being 'between Node H and Node Q'. These node letters appear in the title of each section. A node defines the beginning (and/or the end) of each of the route sections in which the line of route is divided. Each section of the line of route running from one node to another is uniquely identified with a reference number. The locations of these nodes have been chosen in order to easily appraise the line of route.
- 3.1.5 The plans show numbered features of interest, presented, for example, as **(4)** to allow the reader to study the route alongside a corresponding piece of text. The route sections are:
- HSM10: Chorlton (E) to Winterbottom (H)
 - HSM12: Winterbottom (H) to Warburton (Q)
 - HSM21: Warburton (Q) to Lowton (R)

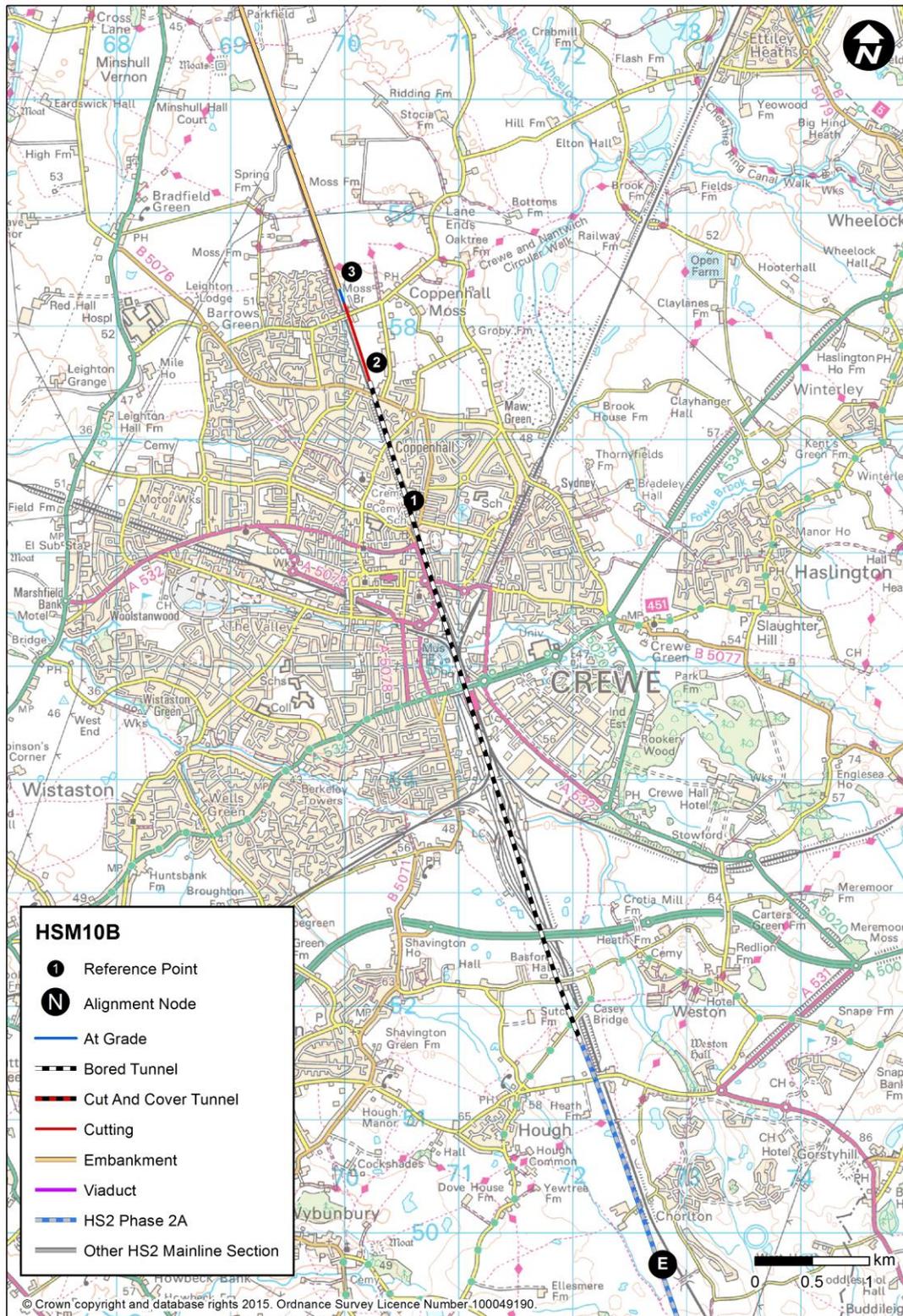
- HSM22: Lowton (R) to Bamfurlong (AA)
- HSM28A: Winterbottom (H) to Rostherne (Z)
- HSM28B: Rostherne (Z) to Ardwick (Y)
- HSM26: Ardwick (Y) to Manchester Piccadilly (MP)



3.2 HSM10B: Chorlton (E) to Winterbottom (H)

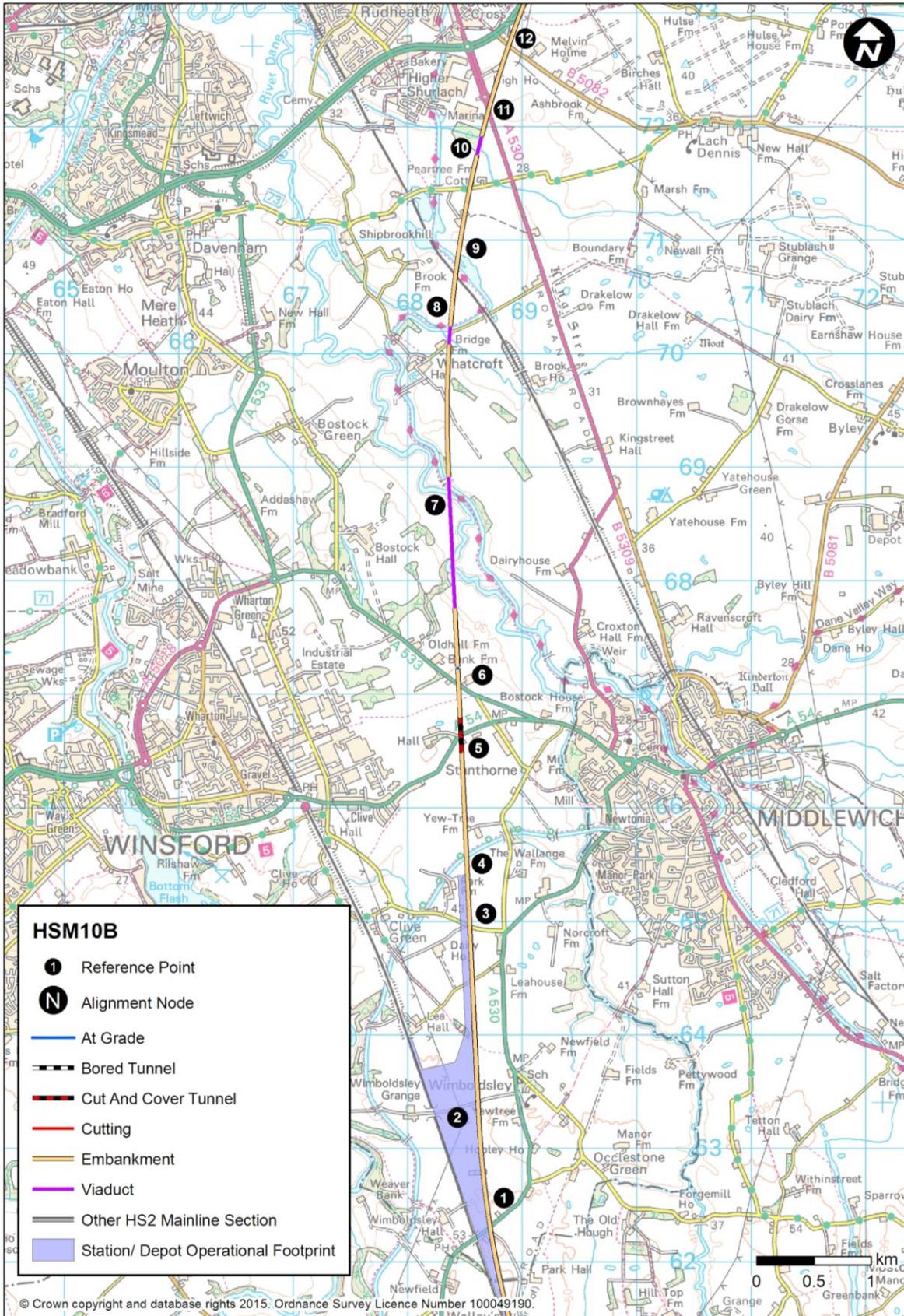
Chorlton to Barrows Green

- 3.2.1 The route section between Chorlton and Winterbottom would be 19.9 miles (32.0km) long. The southern 1.3 miles (2.1km) of this route section would be built as part of the Phase 2a works. The Phase 2a route has been developed to a level of detail such that the Phase 2a route can be presented to Parliament. As a result of design development in Phase 2a, the location of the interface between Phase 2a and Phase 2b has shifted south, extending the length of the tunnel from 3.6km to 6.1km. The following text describes the route as it is currently proposed.
- 3.2.2 As part of Phase 2a the route would be constructed as far as the southern tunnel portal for the twin tunnels under Crewe, located near Casey Lane. The design speed would be 400km/h. A spur is also provided joining HS2 to the WCML.
- 3.2.3 The Phase 2b preferred route would commence with twin tunnels under Crewe. This tunnel would be 3.8 miles (6.1km) long. Further work will be progressed to look at intervention/ventilation shaft locations in more detail during the next stage of design and for hybrid Bill preparation. More information on intervention/ventilation shafts can be seen in section 6.2.
- 3.2.4 The northern tunnel portal would be 600m south of Parkers Road bridge **(2)**. The route would rise from the portal in a retained cutting. Parkers Road would cross over the route and the WCML on a bridge. The route would reach ground level to the north of Parkers road **(3)** and run within 50m of the WCML.



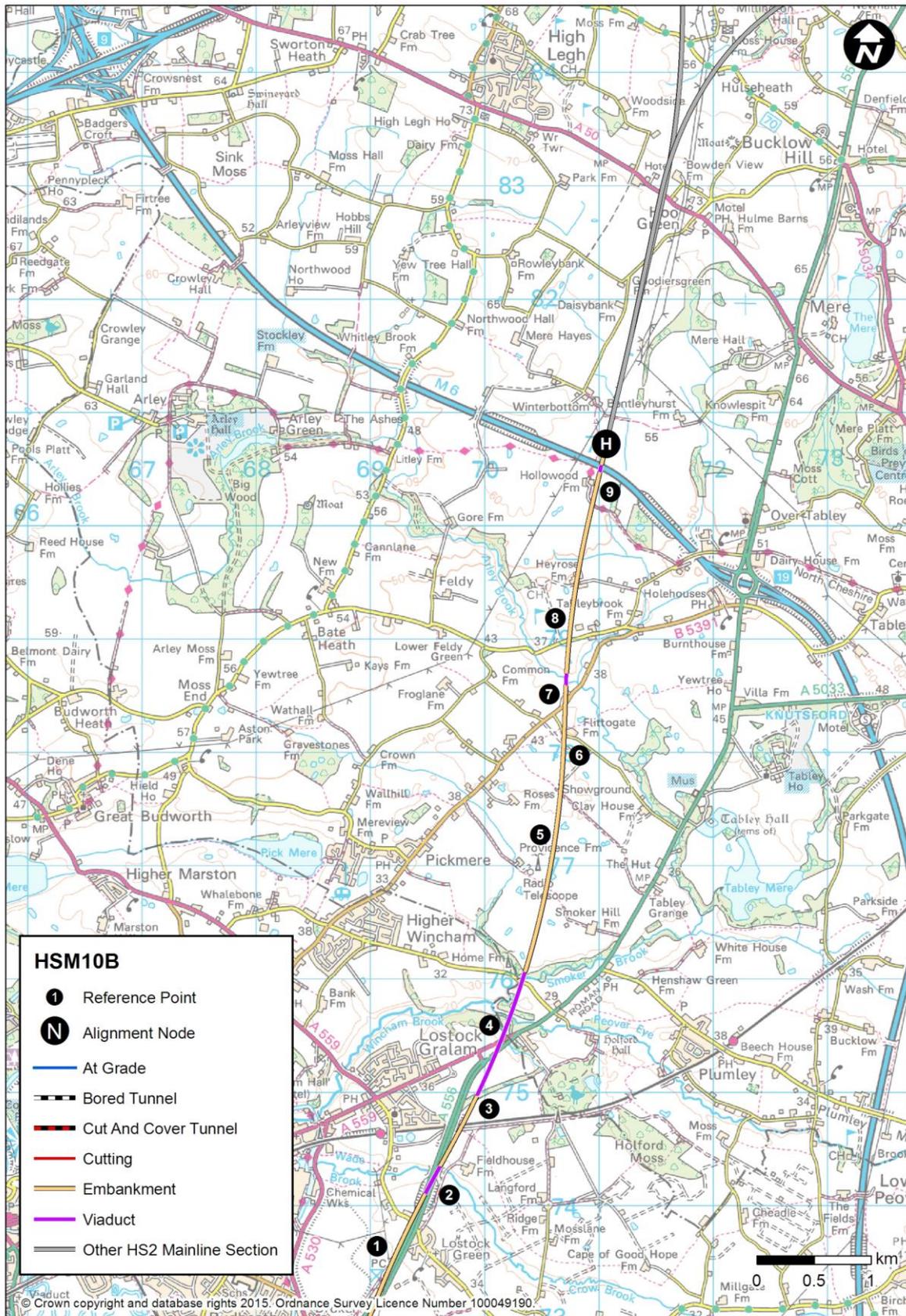
Barrows Green to Rudheath

- 3.2.5 The route would run to the east of the WCML for 1.9 miles (3km) before bearing north. The route would then continue above ground level at a height of up to 5m for 4.3 miles (7km), as it passes the location of the rolling stock depot **(2)** (see section 5.2). The remaining 13 miles (21.0km) of this route section would be over an area of mudstone with soluble deposits with active and historical salt mines (risk of subsidence).
- 3.2.6 The A530 (Nantwich Road) **(1)** would be realigned onto a bridge over the route and the WCML. Clive Green Lane **(3)** would also be realigned onto a bridge over the route.
- 3.2.7 The route would then cross over the Shropshire Union Canal **(4)** at a height of 7m. To the north of this crossing the eastern track (Up line) would spur from the mainline and rise (at a maximum height of 12m) to cross over the route to form the connection to the proposed rolling stock depot. This is shown on the following plan as a cut and cover tunnel, representing the mainline passing under this connection. The A54 **(5)** would be realigned to pass over the route and the A533 **(6)** would be realigned. The route would then pass onto a 0.7 miles (1.16km) long viaduct **(7)** to cross the River Dane floodplain and the Trent and Mersey Canal at a maximum height of 26m.
- 3.2.8 The route would then run on embankment (up to 6m high) for 0.7 miles (1.2km) before crossing the Puddinglake Brook floodplain **(8)** on a 160m long viaduct at a height of 13m. A section of embankment (up to 15m high) follows, with the route crossing over the Sandbach to Northwich railway and the Trent and Mersey Canal **(9)**.
- 3.2.9 The route would then continue on embankment, at a height of 12m, crossing the Gad Brook floodplain on a 170m long viaduct **(10)**, and bridges over the A530 **(11)**, and B5082 **(12)**.



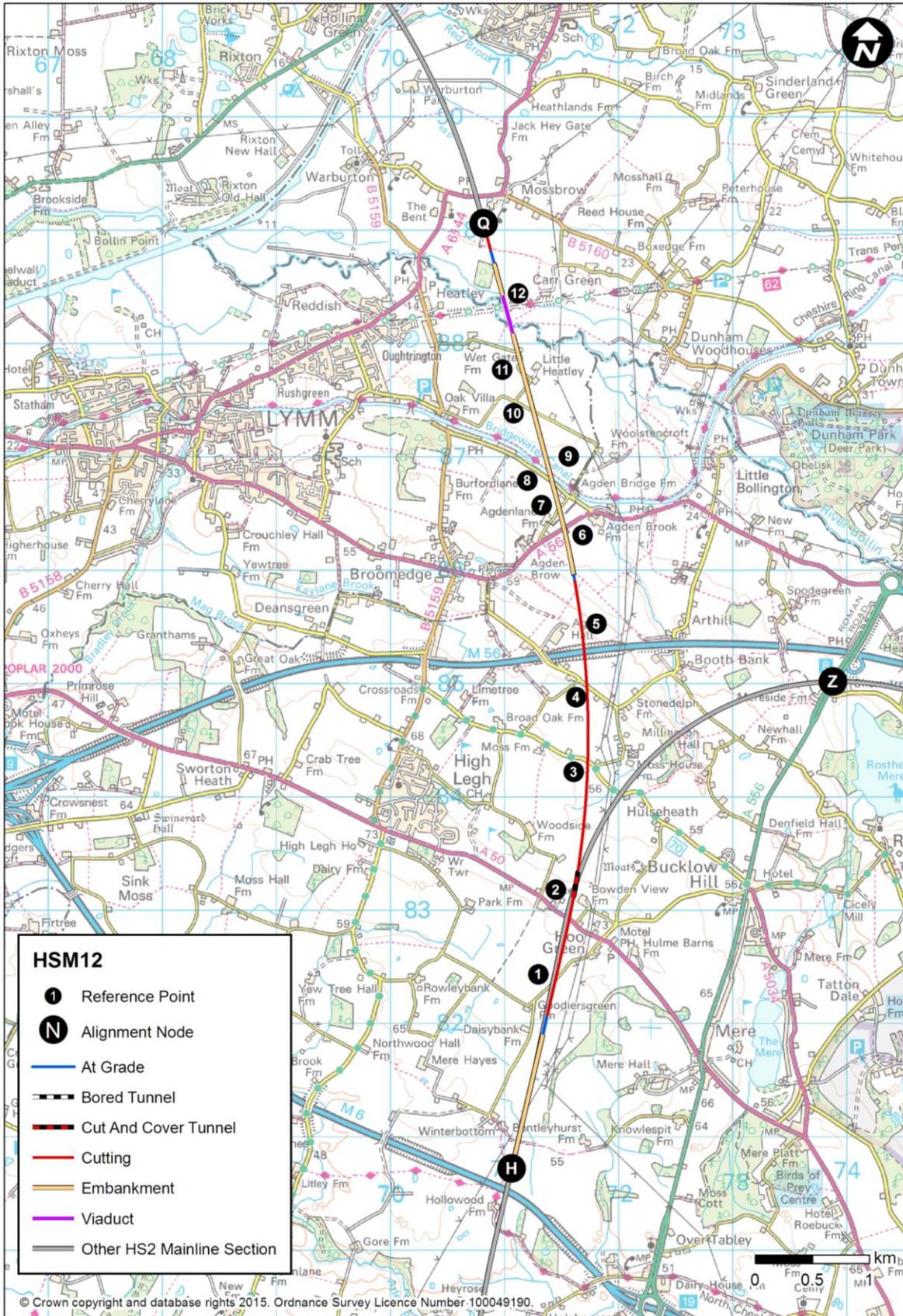
Rudheath to Winterbottom

- 3.2.10 For the next 1.6 miles (2.5km) the route would be on embankment and viaducts (with a maximum height of 18m). The A556 **(1)** would be realigned up to 100m to the west over a length of 1.4 miles (2.2km) to allow the route to pass to the west of Lostock Green. A 270m long viaduct would be provided over the Wade Brook floodplain **(2)**, and the route would bridge over the Altrincham to Chester railway **(3)**.
- 3.2.11 The route would then pass over the A556, A559, and the Peover Eye and Smokers Brook floodplains on a 0.7 miles (1.17km) long viaduct **(4)** (up to 23m high). Following this viaduct, the route would continue through open countryside on embankment (up to 3m high), and past the Pickmere Telescope **(5)**.
- 3.2.12 The route would then cross Flittogate Lane **(6)** which would be realigned, and Pickmere Lane **(7)** and Budworth Road **(8)** which would be realigned to pass under the railway.
- 3.2.13 The route would then continue on embankment, of up to 8m height, and pass over the M6 **(9)**.



3.3 HSM12: Winterbottom (H) to Warburton (Q)

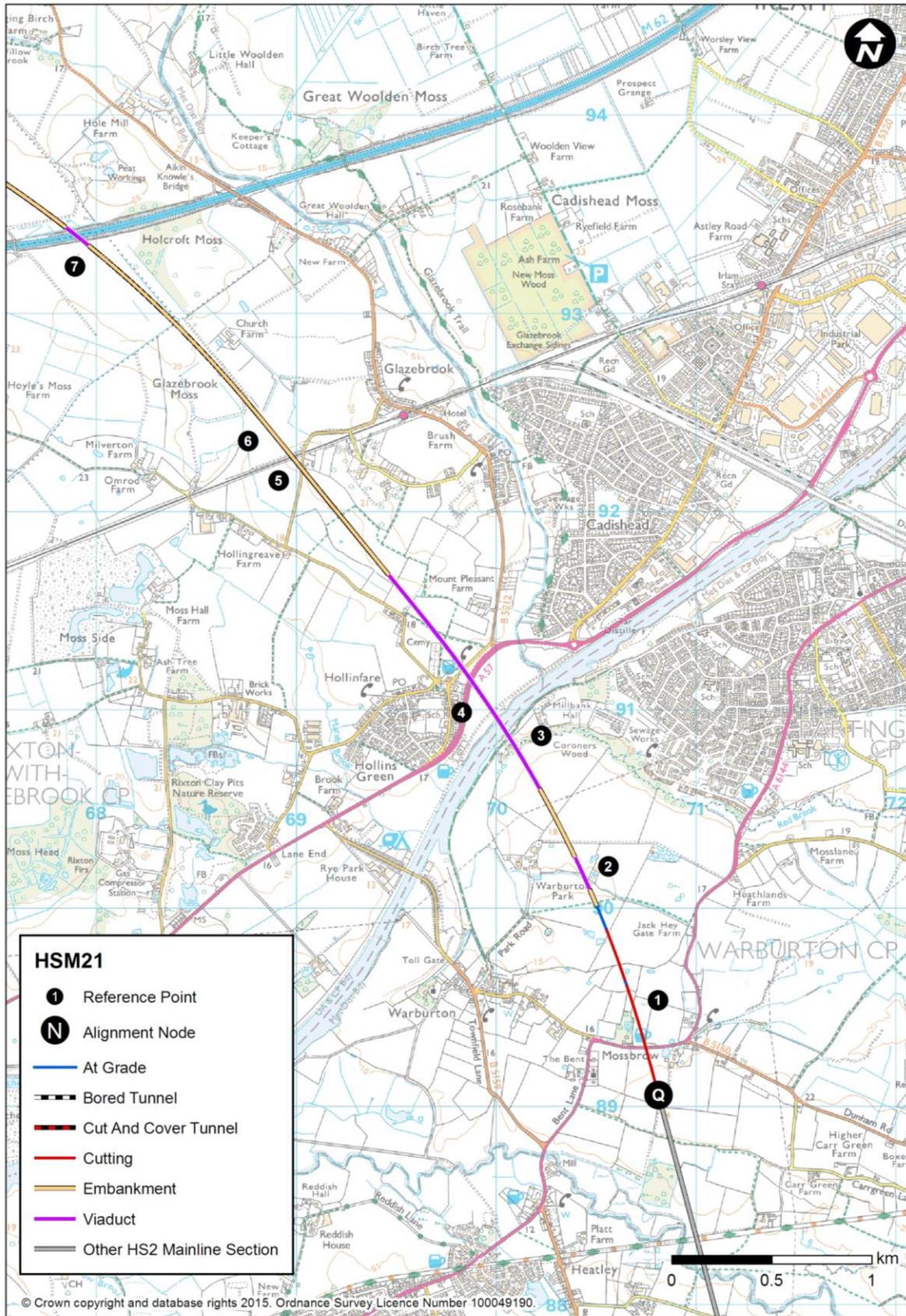
- 3.3.1 The route section between Winterbottom and Warburton would be 5.3 miles (8.5km) long. The design speed for this section of the route is 400km/h.
- 3.3.2 The route would be on an embankment for 0.7 miles (1.2km) with a maximum height of 8m, following which it would fall into cutting (with a depth of up to 18m) for a length of 2.5 miles (4km). Hoo Green Lane **(1)** would be realigned. The A50 **(2)** would be realigned onto a bridge over the route.
- 3.3.3 The route would then spur at this point towards Manchester (see section 3.6), and the mainline continues north in deep cutting. Peacock Lane **(3)** and Agden Lane **(4)** would be realigned onto a bridge over the route.
- 3.3.4 A box structure would be used to carry the railway under the M56 **(5)** before the route moves onto an embankment (maximum height of 9m) for 1.4 miles (2.2km) crossing over the A56 **(6)**. Agden Lane **(7)** and Warrington Lane **(8)** would be realigned to connect into the A56 avoiding the route. There may be requirements for temporary diversions and traffic management on the M56 during construction.
- 3.3.5 For the next 2km the route would be over an area of mudstone with soluble deposits i.e. salt deposits which are subject to natural dissolution and therefore ground subsidence.
- 3.3.6 The route would cross over the Bridgewater Canal **(9)** at a height of 8m. The route would cross over Spring Lane **(10)** (which would be realigned), and Wet Gate Lane **(11)** would be realigned to avoid four crossings. The route would then cross over the River Bollin floodplain **(12)** on a 345m long viaduct at a height of 6m before passing into a cutting with a maximum depth of 7m.
- 3.3.7 At Warburton the route would continue along section HSM21 to Lowton (section 3.4).



3.4 HSM21: Warburton (Q) to Lowton (R)

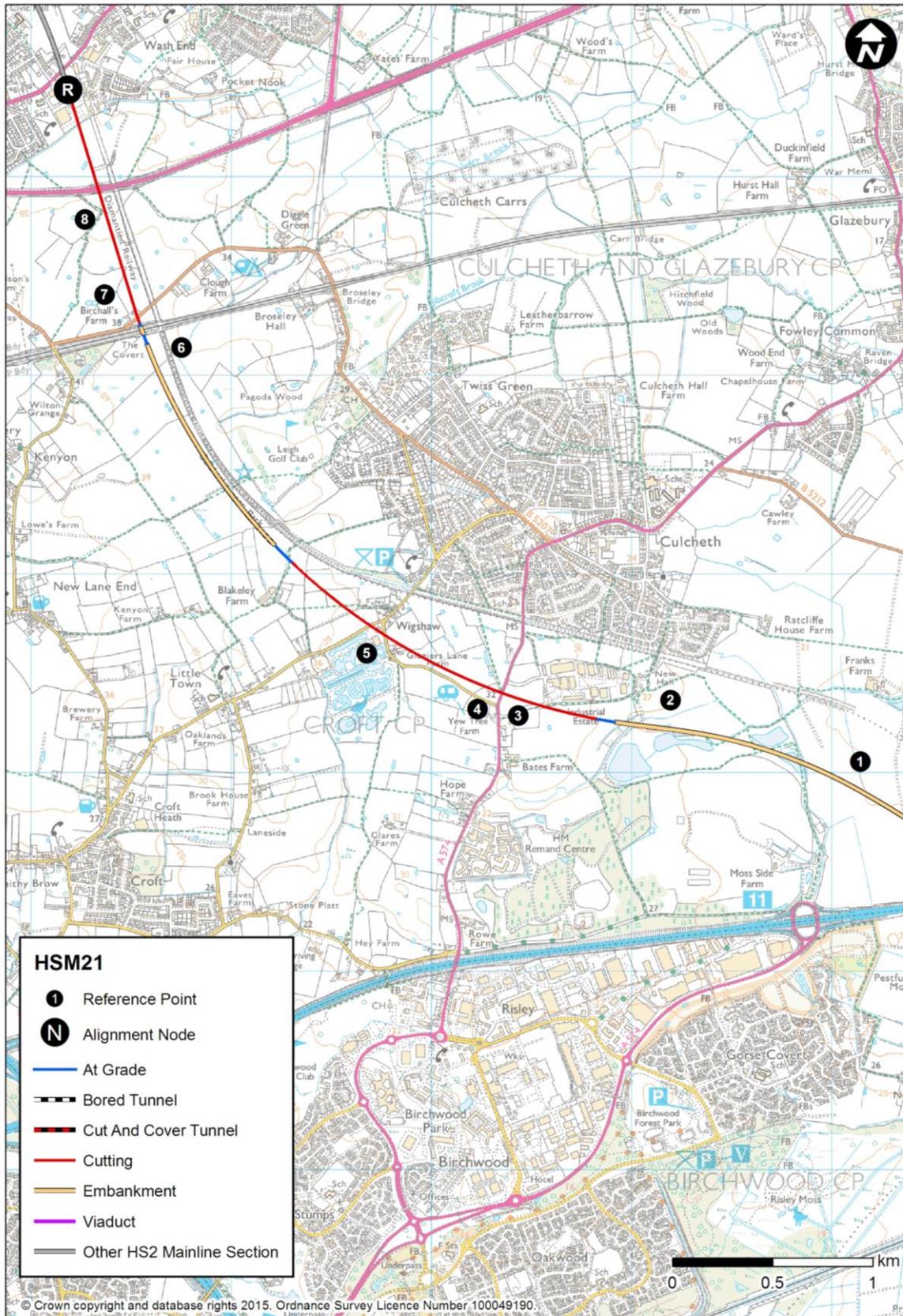
Warburton to the M62

- 3.4.1 The route section between Warburton and Lowton would be 7.5 miles (12.0km) long. The sections of route connecting to Warburton from the south would be HSM12 from Winterbottom (section 3.3)
- 3.4.2 The design speed would be 320km/h then reducing to 230km/h. The speed results from the restrictions on the alignment as it passes over the Manchester Ship Canal between Hollins Green and Cadishead, around the landfill site at Risley, past the west side of Culcheth and through Lowton on the line of the dismantled railway. At the latter part of this section the speed would also be reducing to allow trains to join the WCML near Golborne.
- 3.4.3 The route would be in a shallow cutting with a maximum depth of 4m passing between Mossbrow and Warburton. The A6144 **(1)** would be realigned onto a bridge over the route. It is likely the B5160 would be extended to connect to it.
- 3.4.4 The floodplain **(2)** at Warburton Park would be crossed on a 180m long viaduct at a height of 5m. The route would then rise steeply on an embankment to cross over the Manchester Ship Canal **(3)** between Hollins Green and Cadishead on a 0.8 mile (1.3km) long viaduct, up to a maximum height of 28m in order to achieve navigation clearance. The viaduct would also cross Caldwell Brook, a historical landfill site, the A57 **(4)** and Manchester Road.
- 3.4.5 The route would then continue on embankment for the next 2.2 miles (3.6km) reducing in height and pass through an area of peat. Works to maintain the groundwater regime, including during the removal of peat, would be required during construction. The route would cross over Dam Head Lane **(5)**, the Manchester to Warrington railway **(6)** and the M62 **(7)**.



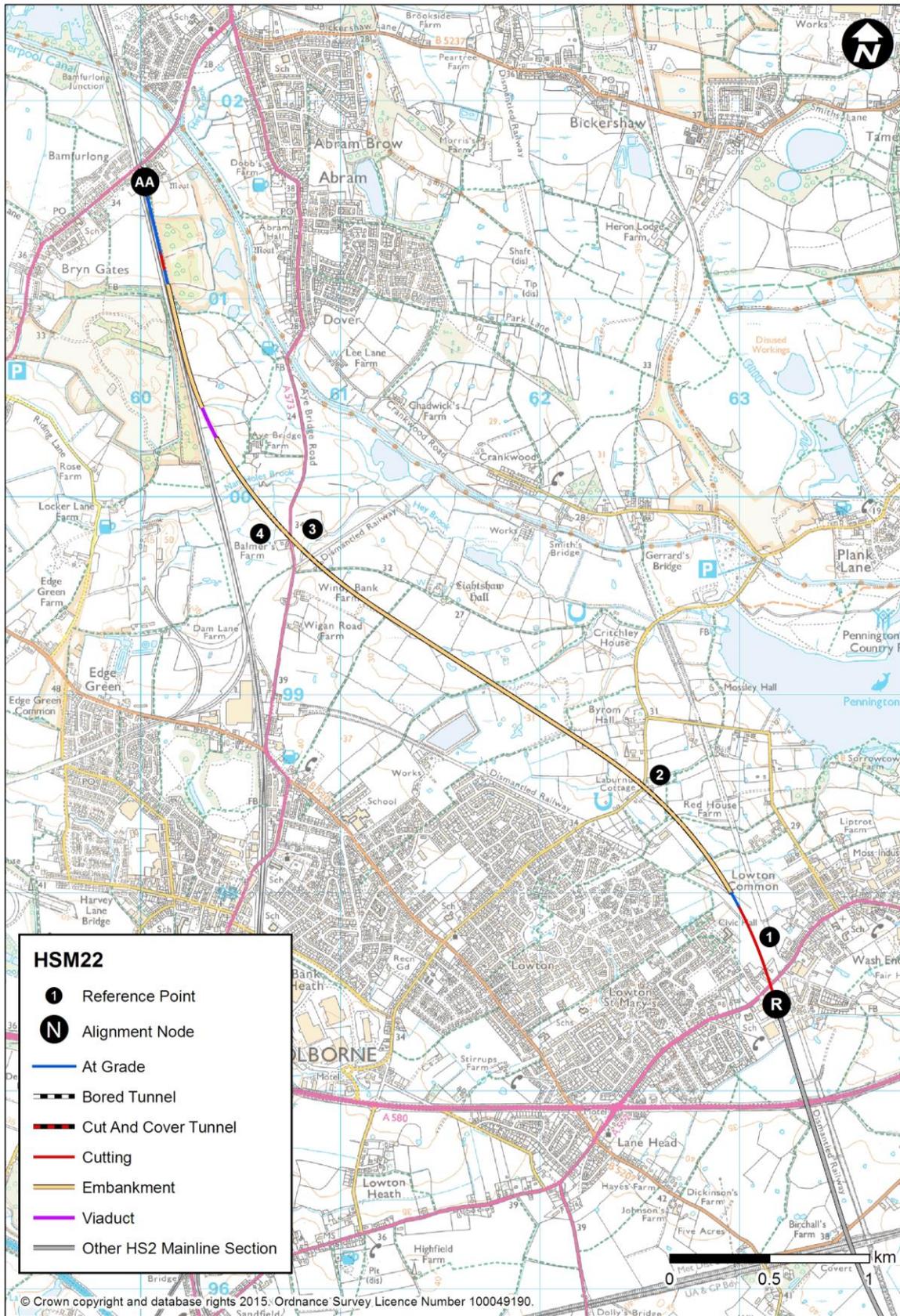
M62 to Lowton

- 3.4.6 The route would pass through the north-east corner of the Risley landfill site **(1)** on an 8m high embankment. The route then passes approximately at ground level to the south of Taylor Industrial Estate **(2)**. New Hall Lane **(3)** would be realigned and the A574 **(4)** realigned onto a bridge over the route. Glaziers Lane and Wigshaw Lane **(5)** would be realigned to connect into the A574 to the east and west of HS2. The route would pass west of Culcheth on an embankment (up to 6.5m high).
- 3.4.7 The route would cross over the Liverpool to Manchester railway **(6)**. Wilton Lane **(7)** would be realigned onto a bridge over the route. The A580 **(8)** would cross over the route on a bridge.
- 3.4.8 At Lowton the route would continue along section HSM22 to Bamfurlong (section 3.5).



3.5 HSM22: Lowton (R) to Bamfurlong (AA)

- 3.5.1 The route section between Lowton and Bamfurlong would be 3.4 miles (5.5km) long. The design speed is 230km/h reducing to 200km/h. This section of route provides a connection to the West Coast Main Line.
- 3.5.2 At Lowton Common the A572 **(1)** would be realigned onto a bridge over the route at the location of the dismantled railway.
- 3.5.3 The route would be in a cutting, passing through a historical coal mining area and landfill site, which would extend for 550m at a maximum depth of 12m. Following this the route would rise onto embankment of 4m height for 1.7 miles (2.75km). Slag Lane **(2)** would be realigned to cross the railway. The A573 **(3)** would be realigned onto a bridge over the route.
- 3.5.4 The route would then rise on embankment to pass over and connect into the WCML.
- 3.5.5 The existing most easterly of the four WCML lines **(4)** would be realigned east by up to 60m over a length of approximately 1.2 miles (2km). This allows HS2 to pass over it (at a height of 12m) and descend to connect to the WCML at a junction 300m south of A58 at Bamfurlong in a historical coal mining area.



3.6 HSM28A: Winterbottom (H) to Rostherne (Z)

- 3.6.1 The route between Winterbottom and Ardwick (continuing to Manchester Piccadilly) would be 17.3 miles (27.9km) long. The section of route connecting to Winterbottom from the south is HSM10B from Chorlton (section 3.2). The design speed is 400km/h south of the grade separated junction and 230km/h through the junction and on the spur towards Ardwick.
- 3.6.2 The route would be on an embankment with a maximum height of 12m for 0.6 miles (1km) before the junction. A junction **(1)** would be provided on the through route (HSM12) with the two lines splitting to four lines 50m south of Hoo Green Lane **(2)**. The outer two lines would form the diverging spur towards Manchester Piccadilly. The most westerly line would grade separate over the mainline approximately 350m north of the A50, with both the mainline and the spur line in deep cutting. Hoo Green Lane would be realigned. The A50 **(3)** would be realigned onto a bridge over all four lines. The western diverging line would rise to cross over the through route joining the eastern line on an embankment with a maximum height of 5m. Peacock Lane **(4)** would be realigned onto a bridge over the route.
- 3.6.3 The route would then pass into cutting with a maximum depth of 3m, cross the Agden Brook **(5)** floodplain on a 60m long viaduct (height 11m) and enter a further length of cutting up to 9m deep, passing under Millington Lane **(6)**.



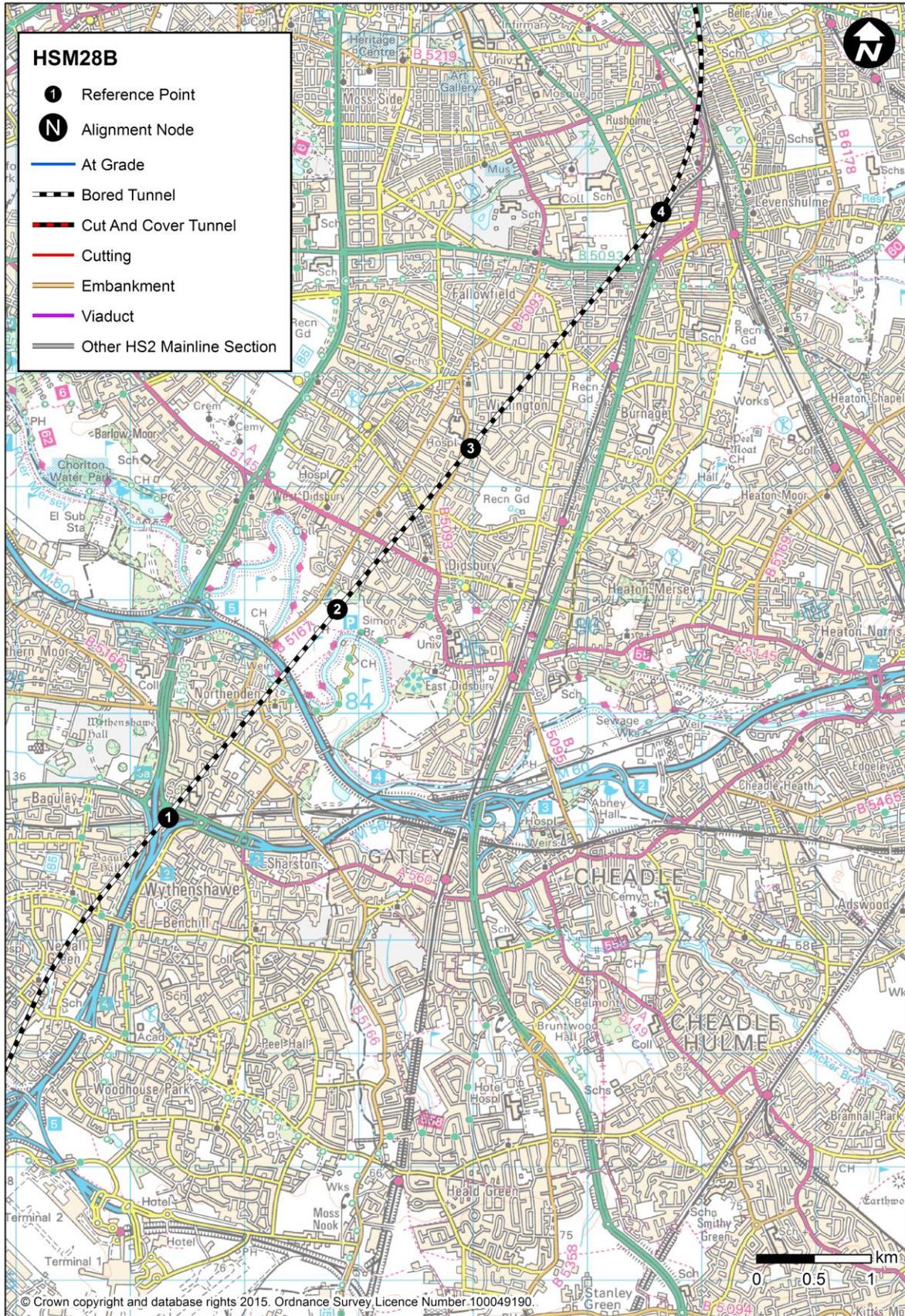
3.7 HSM28B: Rostherne (Z) to Ardwick (Y)

Rostherne to Davenport Green

- 3.7.1 The route would pass under the A556 **(1)** and run between Rostherne Mere and the M56 in a cutting up to 11m deep. It will be necessary to prevent groundwater flow into the cutting and maintain an alternative path for groundwater flow. Tom Lane **(2)** would cross over the route on a bridge.
- 3.7.2 The Blackburn's and Birkin Brooks **(3)** would be crossed on a 390m long viaduct at a height of up to 6m. A short length of shallow cutting (maximum depth 2m) would follow with the route then continuing generally at ground level for 0.7 miles (1.2km). Ashley Road **(4)** would be realigned with Lamb Lane **(5)** to avoid the route, and connected into Mobberley Road to pass over HS2 further north.
- 3.7.3 The route would cross over Mobberley Road and the Altrincham to Chester railway **(6)**. The road would be realigned to cross over the existing railway and the route. The route would then pass into a cutting with a depth of up to 9m with Brickhill Lane **(7)** realigned along HS2 into Castle Mill Lane, and Castle Mill Lane **(8)** realigned onto a bridge over the route. The River Bollin floodplain **(9)** would be crossed on a 125m long viaduct at a height of up to 13m.
- 3.7.4 The route would then continue in a cutting with a depth of up to 20m for 1.7 miles (2.7km) to the portal of a tunnel. Sunbank Lane **(10)** would be realigned onto a bridge over the route. A box structure would be used to carry the railway under the M56 **(11)** before the route passes under the A538 (Hale Road) **(12)**, Hasty Lane **(13)** and Timperley Brook **(14)**. The latter of which would require a large inverted siphon to allow the brook to pass under HS2.
- 3.7.5 At Hale Road a junction would be provided to increase the two lines to four. The two outside lines would be the through route to Manchester Piccadilly and the two inside lines would be the platform lines for the Manchester Airport High Speed Station (see section 4.2), which would be located north of Hasty Lane.
- 3.7.6 After Timperley Brook the route would pass beneath Thorley Lane **(15)**, which would cross over the route on a bridge. The two stopping lines would re-join the through lines at a junction north of the station. The through lines would remain apart to pass into twin tunnels just after Thorley Lane.

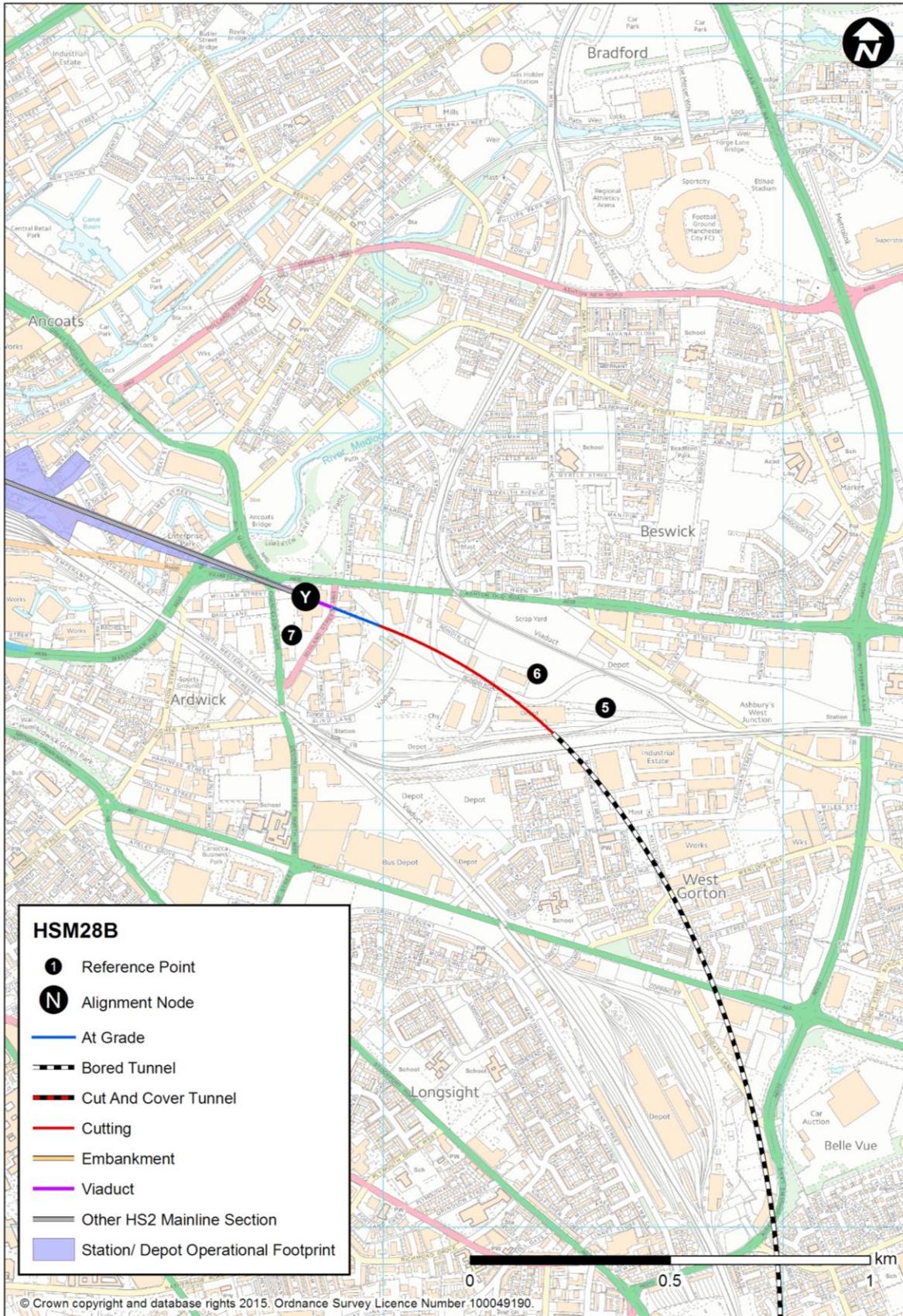
Davenport Green to Rusholme

- 3.7.7 The twin tunnels would be 7.9 miles (12.8km) long and would pass under the built up area between the Airport and Ardwick, through historical limestone workings. Four intervention / ventilation shafts would be required at roughly equal spacing along the tunnel length. A potential option for the first of these vent shafts would be at the commercial development at the junction of Altrincham Road (A560) and the M56 **(1)**. The indicative location of the second shaft would be in an area to the north of the Withington golf course off the Palatine Road **(2)**. The indicative location of the third shaft would be on the site of a demolished public house, currently used as a car park, on Wilmslow Road between Ferndene Road and Rathen Road **(3)**. The fourth shaft would be located off Lytham Road in an area presently occupied by playing fields **(4)**.
- 3.7.8 The design speed profile would reduce from 230km/h to 100km/h over the last 0.9 miles (1.4km) of this section for the approach to the Manchester terminus station (see section 4.1).



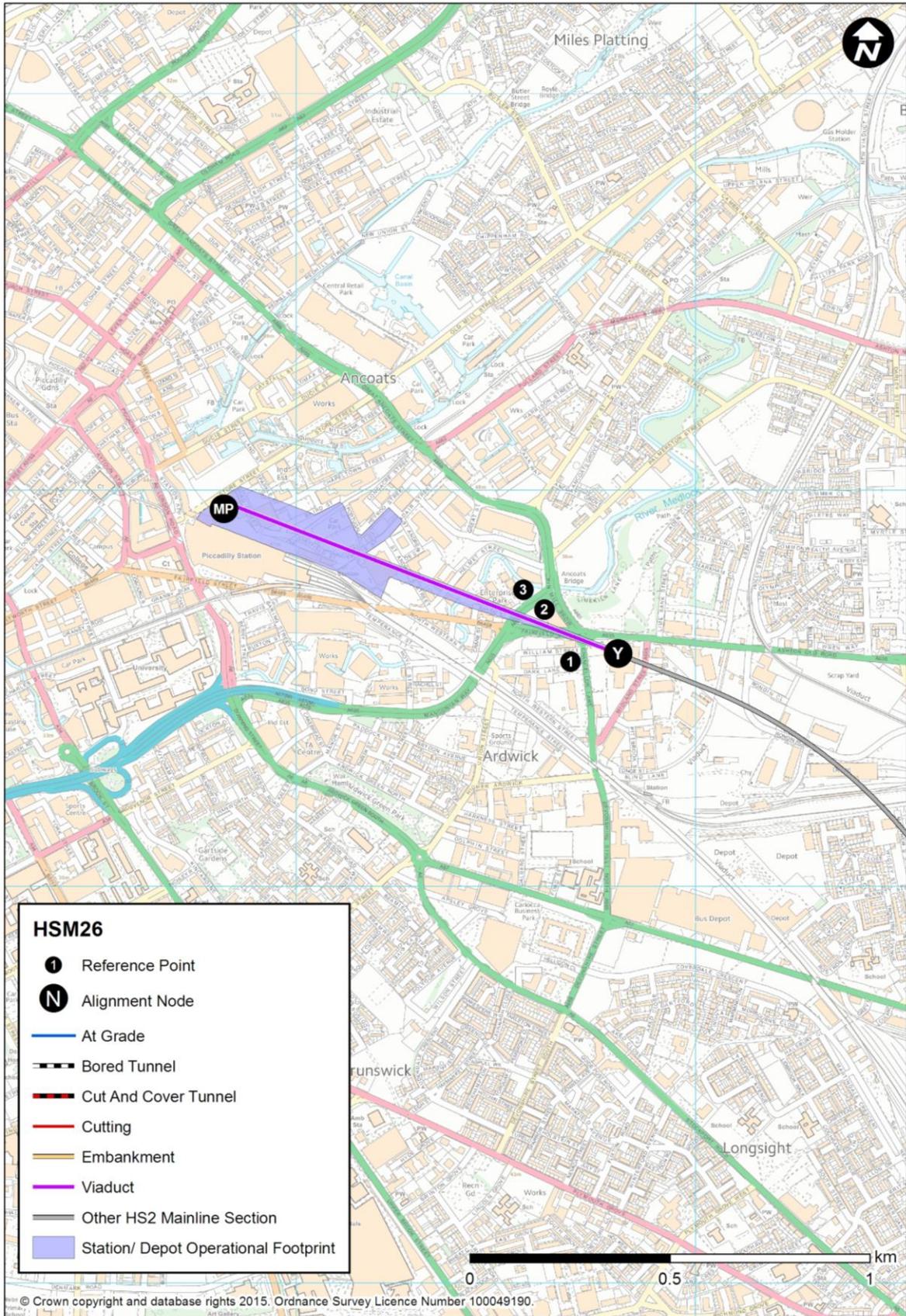
Rusholme to Ardwick

- 3.7.9 The route would emerge from the tunnels immediately north of the Trans-Pennine railway **(5)**. The route would rise at a gradient of 2.5% in a fully retained cutting approaching Manchester Piccadilly Station. Rondin Road **(6)** would be realigned to pass over the route. Midland Street **(7)** would be realigned to pass over HS2 approximately 250m further east.
- 3.7.10 At Ardwick the route would continue along section HSM26 to Manchester Piccadilly (section 3.8).



3.8 HSM26: Ardwick (Y) to Manchester Piccadilly (MP)

- 3.8.1 The route section between Ardwick and Manchester Piccadilly would be 0.6 miles (1.0km) long. The design speed of the section is 100km/h for the approach to the Manchester Piccadilly terminus station.
- 3.8.2 Over this section of route the two running tracks would split into four, ultimately forming the platform tracks at Piccadilly station. The splitting of these tracks and the provision of switches and crossings (points) on the approaches to the platforms would require the widening of the viaducts from 15m to 35m.
- 3.8.3 The route would then pass onto a viaduct on the approach to Manchester Piccadilly station. In this area significant alterations to the local highway network would be required. The A665 (Chancellor Way) **(1)** would be diverted via Midland Street to pass over the route approximately 400m further east with associated alterations to connecting highways. Fairfield Street **(2)** would be realigned, and the route would pass over the A635 (Mancunian Way) **(3)** with Helmet Street, Raven Street and St Andrews Street realigned to avoid the route. Travis Street, Sheffield Street, Baird Street and Boad Street would also be affected by the route.



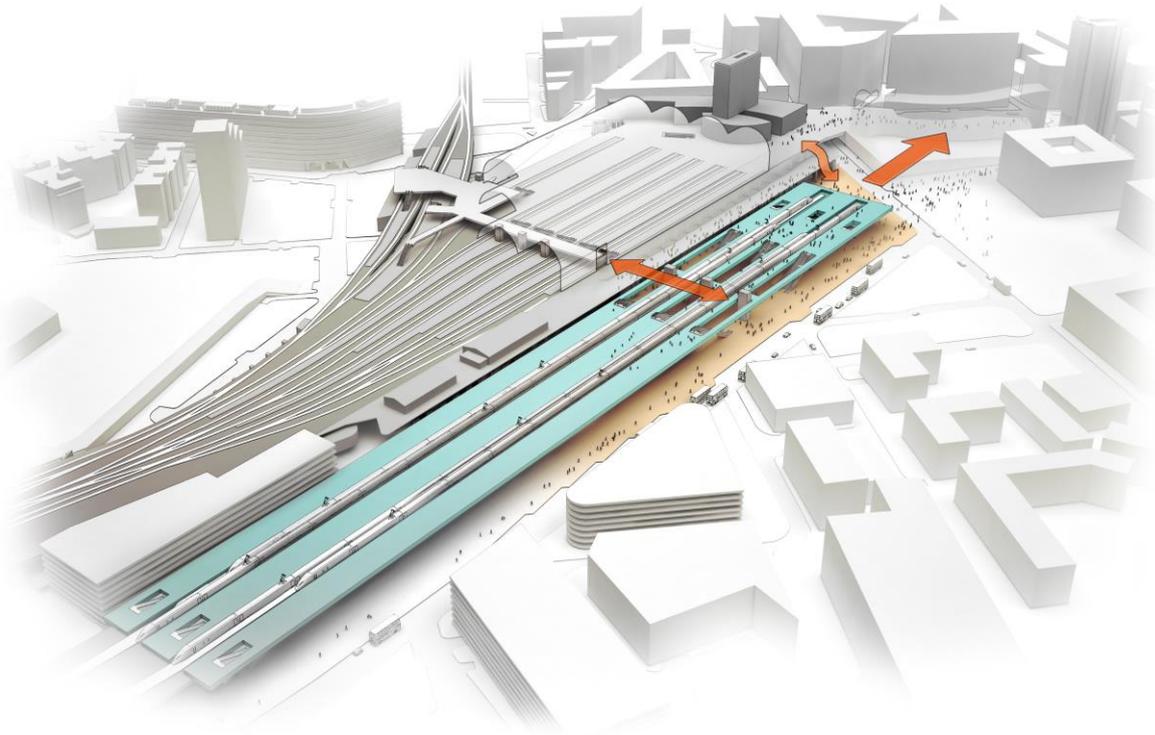
4 Stations

This section describes the stations at the current stage of design development. Further work will be carried out at the next stage of the design. HS2 will continue to work closely with local stakeholders to ensure that future station design will complement local development aspirations.

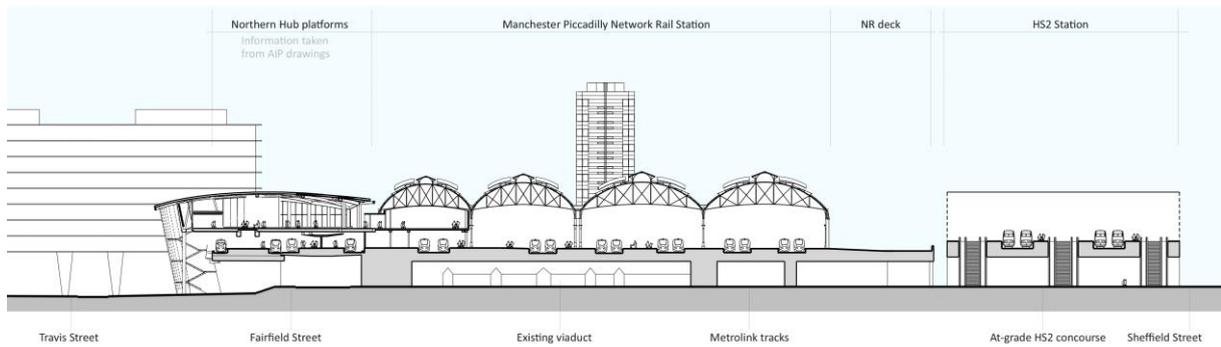
4.1 Manchester Piccadilly Station

Route Overview

- 4.1.1 The existing Piccadilly station in relation to the proposed station option is illustrated opposite. The HS2 lines and platforms would be located to the immediate north of the existing station. Approaching from the east, the spur route from the south would be in a twin tunnel and would emerge at a tunnel portal immediately north of the Ardwick branch railway line, at the existing Ardwick depot. The route would rise at a gradient of 2.5%, continuing in a retained cutting followed by viaduct on its approach to Piccadilly station. A junction would be located just north of Midland Street where the route would increase from two lines to four, and points provided to allow the running tracks to efficiently access all of the platforms.
- 4.1.2 Beyond the crossing of the Ardwick branch railway, the lines would continue to rise. Rondin Road would be realigned to pass over the railway, and Midland Street and Chancellor Lane realigned further south to pass over the railway. Fairfield Street would also be realigned.
- 4.1.3 The lines would rise to a level slightly above that of the existing adjacent railway tracks and would be at a sufficient height to cross over the A635 Mancunian Way. The tracks would then remain level, entering the HS2 platforms. See also Section 3.8, HSM26 for further route details.



Plan



Section

Station Location and Existing Site

4.1.4 The existing station is located directly south-east of Manchester city centre on a site bounded by London Road to the west, Fairfield Street to the south and Sheffield Street to the north. The train shed is a grade II listed structure; the station opened in 1842 as London Road station and has undergone major rebuilding and renovation works at several stages since then. The most recent major improvement programme was carried out in time for the 2002 Commonwealth Games.

4.1.5 Manchester Piccadilly station handles over 83,000 passengers and 1,000 train movements every day. The station is served by six train operating companies serving intercity routes to London Euston, Birmingham New Street, South Wales, the south coast of England, Edinburgh and Glasgow Central, as well as routes throughout northern England. The station consists of 14 rail platforms elevated to approximately 9m above the adjacent ground level. 12 of these platforms terminate within the main train shed. Two through platforms, platforms 13 and 14, are on a viaduct to the south of the station. The longest platforms are 360m which, together with the concourse, result in an overall station length of 435m.

4.1.6 Future expansion of the station as part of the proposed Northern Hub works would result in two new through platforms, 15 and 16, also to the south of the station, and a direct link to Victoria station via a new curve at Ordsall. These works are expected to be in place well in advance of the construction of HS2.

Piccadilly station serves as a terminus and through station for Manchester Metrolink. The current, unperturbed service pattern (i.e. normal service pattern) is as follows.

Eccles - Ashton-under-Lyne (through service)

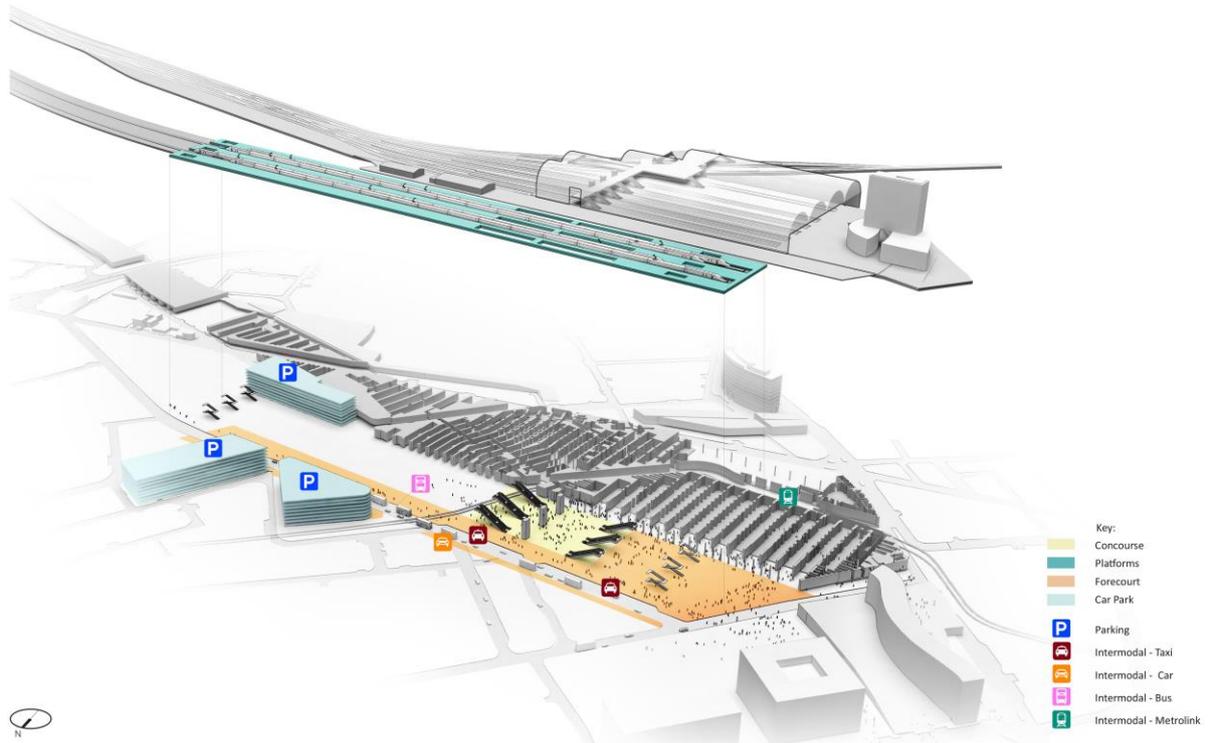
MediaCityUK - Piccadilly (terminus)

Altrincham - Piccadilly (terminus)

Bury - Etihad Campus (through service)

4.1.7 Passenger parking is provided at various locations around the existing station as follows:

- Piccadilly station multi-storey car park to the north of the station;
- Piccadilly station surface car park to the north of the station;
- Sheffield Street surface car park to the north east of the station;
- Store Street Arches to the west of the station;
- Store Street surface car park to the north west of the station.



Station Description

Platforms

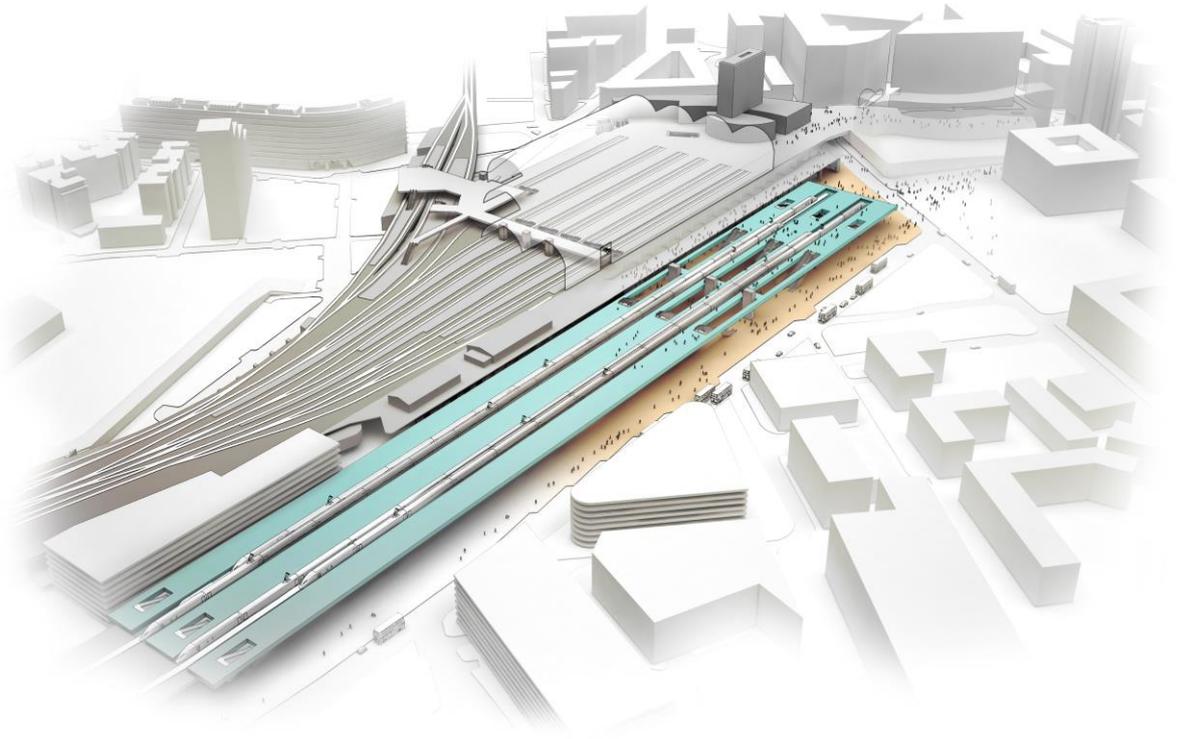
- 4.1.8 The brief for the HS2 station requires 4x440m long platforms including an “over-run” length. These platforms would service six arriving and six departing trains per hour. Three of these trains would be carrying up to 1100 passengers each, and three up to 550 passengers each. The overall length of the station would be approximately 458m, which accommodates a structural zone to the end of the platforms. The overall width of the station would be approximately 54m. Accommodating the new station requires the demolition of a number of buildings to the north of the existing station.
- 4.1.9 The proposed station consists of two side platforms and one island station platform parallel with platform 1 of Manchester Piccadilly Station. The platforms would be elevated to the same level as the existing platforms at Piccadilly station. The two side platforms would be 10m wide and the central island platform 14m wide. This would allow for access (i.e. stairs, escalators and lifts) and the necessary clearance to the platform edge. Platforms would be straight along their whole length. Escalators and stairs to platforms would be located as central as possible, within the given site constraints, to aid efficient dispersal of passengers and encourage intuitive wayfinding by means of filtering passengers through one concourse area.
- 4.1.10 The station roof would cover the full length of the HS2 platforms and be approximately the same height as that of the existing train shed of Manchester Piccadilly Station.

Concourse and Forecourt

- 4.1.11 HS2 concourse facilities would be located at ground level, beneath the elevated platforms and to the west side of the Metrolink. The route between concourse and platforms would be via stairs, escalators and lifts through the platforms.
- 4.1.12 The forecourt comprises of a pedestrian “square” to the west of the concourse and the linear intermodal concourse laid out along Sheffield Street.
- 4.1.13 Areas directly adjacent to the east side of the concourse have been identified as zones for servicing and operational support to platforms and the concourse areas. Locating the servicing to the east end of the station would avoid conflict with passenger movements towards the concourse.

Car parks

- 4.1.14 Three new car parks are proposed all of which would be seven storeys high. In total these car parks would provide in excess of 2100 car parking spaces.



Accessibility

- 4.1.15 The primary pedestrian entrance to the HS2 concourse would be from the realigned Sheffield Street parallel with, and to the north of, the HS2 station. Onward pedestrian travel from the concourse to the city centre would be either via Store Street and London Road, or via the pedestrian link between Store Street and Ducie Street which is proposed as part of the adjacent Inacity Tower development.
- 4.1.16 The existing entrances to Piccadilly station from the Station Approach Road and Fairfield Street would be retained. Passengers would transfer directly between the existing rail and HS2 concourses via a new vertical circulation core adjacent to the western end of the HS2 platforms.
- 4.1.17 Vehicular access to the site from the inner ring road would be via a new spur off the Fairfield Street junction with Mancunian Way. Traffic accessing the station would travel from this junction along a realigned Sheffield Street running in a one way system parallel to the HS2 station. Traffic connecting back onto the inner ring road would either turn right at the top of Sheffield Street onto Store Street and onto Great Ancoats Street or turn left at the top of Sheffield Street and left onto London Road which connects with Mancunian Way.

Intermodal Interchange

- 4.1.18 The site benefits from good connections to major highways, existing Metrolink and bus services which would aid good onward dispersal of passengers. A newly combined existing rail and HS2 forecourt and car park is proposed for the northern edge of the site.
- 4.1.19 The close proximity of the HS2 and existing rail stations presents a variety of options for how interchange could take place between the two rail services. Passengers transferring from the existing rail concourse would descend one level via a new circulation core adjacent to the western end of the HS2 platforms and continue a short distance to the HS2 concourse.
- 4.1.20 The undercroft of Manchester Piccadilly Station presents opportunities for direct at-grade links between the Metrolink platforms and the HS2 concourse. Rail passengers connecting to Metrolink services would continue to use the existing links between the Piccadilly station and Metrolink concourses.
- 4.1.21 A new forecourt running parallel with the station and a realigned Sheffield Street would combine drop off/pick up and taxi facilities for both HS2 and Piccadilly station passengers. Car parking would be located in the three new car parks.

Site Specific Constraints

- 4.1.22 There are three primary constraints on the site which have dictated how the scheme could be developed for construction:
- The East Manchester Metrolink extension.
 - The proposed Inacity Tower development.
 - Gateway House.
- 4.1.23 Metrolink dictates the concourse location and prevents the concourse being centrally located with the platforms above. The proposed Inacity Tower development prevents the HS2 station from being located closer to the city. In its current configuration Gateway House is somewhat of a barrier to intuitive wayfinding towards the city centre. While the HS2 station proposal works within these three constraints, further opportunity exists at detailed planning stages for improved integration of the HS2 station around these constraints.

Constructability

- 4.1.24 Initial preliminary strategic work suggests that the work would be carried out in three main stages. Initial studies were carried out to identify methods of constructing the station with the following primary objectives:
1. Identifying any major risks associated with the site.
 2. Minimising the number of demolitions and extent of disruption to existing infrastructure.
 3. Minimising the land take associated with the station development.
- 4.1.25 Stage 1 (18 months)
- Demolish and clear site east of Metrolink.
 - Construct multi storey car parks and relocate necessary services.
 - Construct temporary accommodation for the train drivers behind the Station Approach buildings.
 - Construct a temporary unloading bay off Store Street, north of the railway bridge to be used for servicing the existing station facilities.
 - Construct new foundations and station structure to platform level east of the Metrolink.
 - Strengthen arch structures to north of existing station.
- 4.1.26 Stage 2 (24 months)
- Divert train drivers accommodation, station car parking, undercroft car-parking and service unloading.
 - Demolish the remaining buildings including the old multi storey car park and the column and beam deck to the north of the existing station.

- Construct the remainder of new foundations and station structure to platform level.
- Construct a new ground level concourse.

4.1.27 Stage 3 (36 months)

- Construct the station roof.
- Install escalators.
- Construct new station facilities below, above and at platform level.
- Construct a new loading bay and access for servicing station facilities and any amendments to existing servicing infrastructure.
- Construct new drop-off, taxi and bus ranks including the final road layout and carry out any amendments to the Metrolink station.

4.1.28 As there would be considerable overlap between the stages it is expected that the overall programme would continue for four and a half to five years.

4.2 Manchester Airport High Speed Station

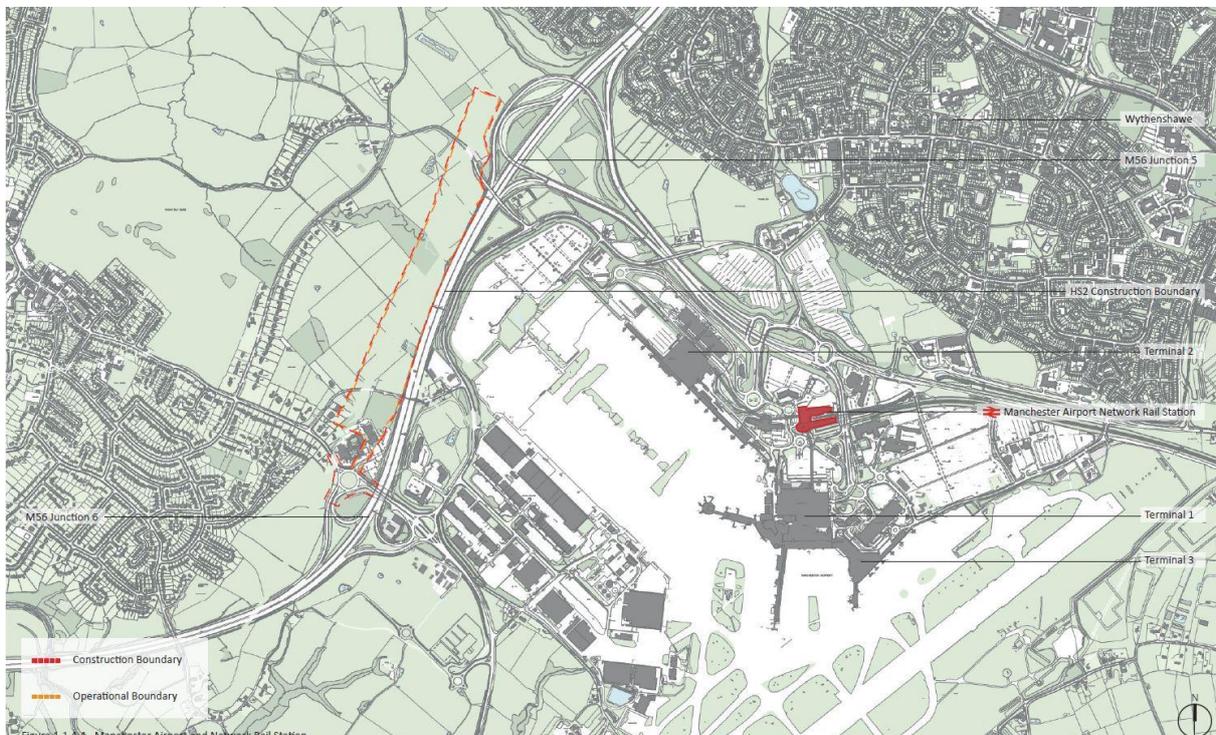
- 4.2.1 Subject to funding being secured from third party stakeholders, an intermediate station is proposed adjacent to Manchester Airport.

Route overview

- 4.2.2 The platforms for the proposed Phase 2b Preferred Route Manchester Airport High Speed Station would be located west of the M56 between junctions 5 and 6. The stopping lines which serve the platforms would diverge from the route to Manchester Piccadilly at a junction approximately 600m south of the centre of the station, and re-join at a junction approximately 600m north immediately prior to the route descending into tunnel. The through lines at the station location would diverge from each other to provide sufficient separation for the twin tunnels immediately to the north; the stopping lines would diverge into the centre rather than the outside to utilise this additional width. See also Section 3.7, HSM28B for further line of route details.

Station Location and Existing Site

- 4.2.3 This station would be located less than 1km west of Manchester Airport. The site lies immediately west of the M56. The distance by road to junction 6 would be 0.4 miles (0.7km).



Station Description

Platforms

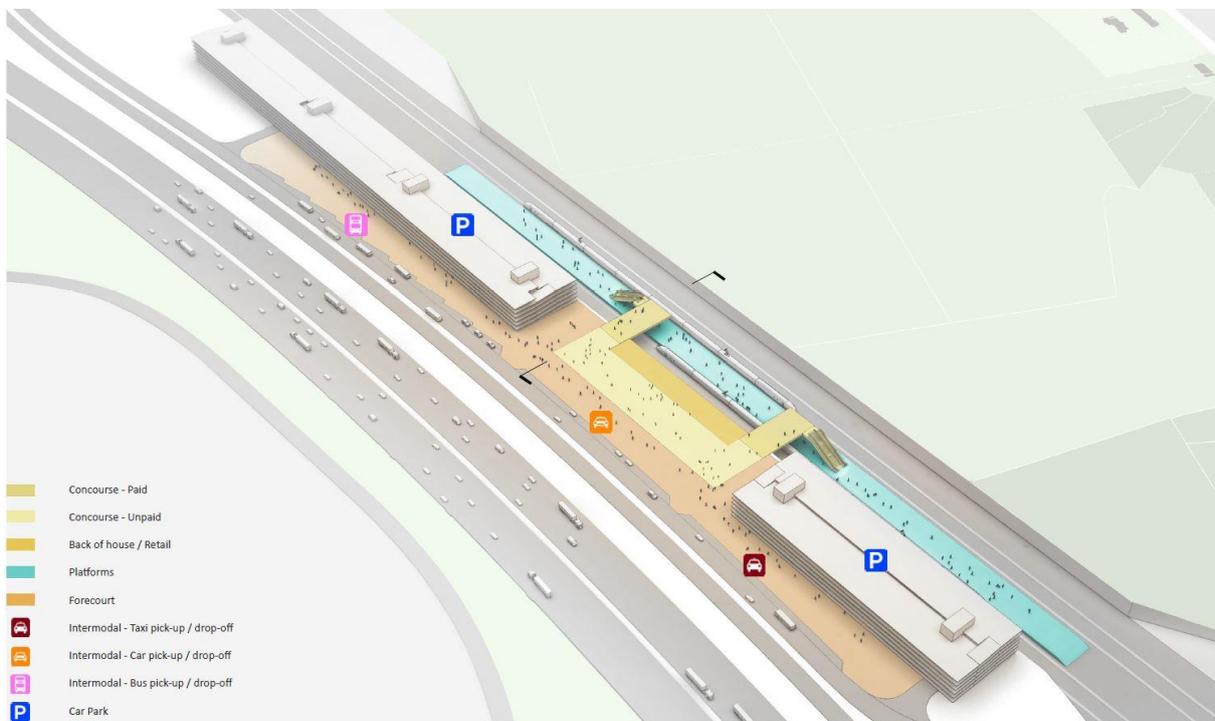
- 4.2.4 The two outer through lines on the spur to Manchester Piccadilly would enable HS2 trains to run at maximum speed whilst the two inner stopping lines would enable trains to stop and serve the Manchester Airport High Speed station via an island platform. The platform would be 415m long by 14m wide, in a cutting approximately 8.5m below existing ground level.

Concourse

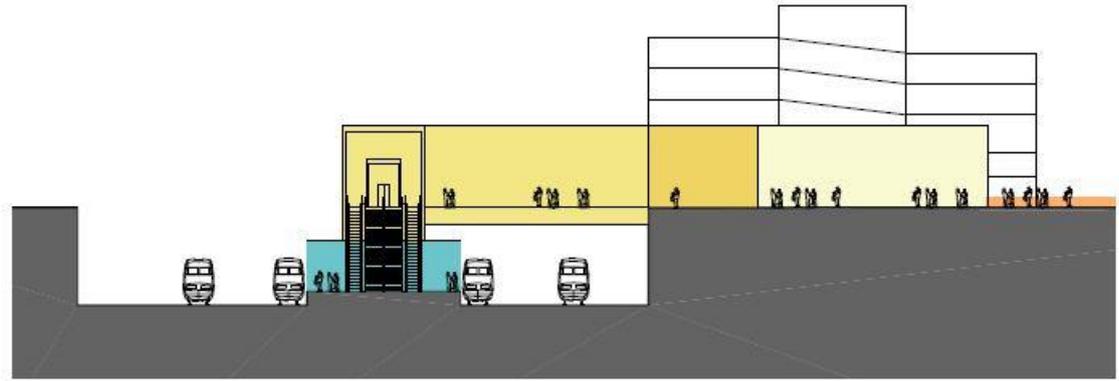
- 4.2.5 HS2 concourse facilities would be located at grade above the platforms. The main entrance to the concourse would be located on the eastern, airport facing, side of the station. The route between concourse and platforms would be via stairs, escalators and lifts through the concourse.

Forecourt and Car parks

- 4.2.6 A linear forecourt arrangement would run along the full length of the eastern side of the station. Multi-storey car parks would be provided to the east of the route, to the north and south of the station forecourt. These car parks would accommodate a total of 3,000 cars.
- 4.2.7 Areas directly adjacent to the concourse have been identified as zones for servicing and operational support to platforms and concourse areas.



Plan



Section

Accessibility

- 4.2.8 Vehicular access to the site is proposed via a connection off the local highways network at junction 6 of the M56.
- 4.2.9 It is understood that works are currently planned as part of existing planning agreements for growth at Manchester Airport to help ease congestion on the M56 between Junctions 5 and 6.
- 4.2.10 Revised proposals will emerge from ongoing work with the local stakeholders and communities. Their performance will be validated by combining the various traffic components such as those associated with the Airport, the Airport City Enterprise Zone, HS2 Station and wider traffic growth in the M56 corridor.

Intermodal Interchange

- 4.2.11 The fact that this site is currently undeveloped would facilitate an efficient planning of the station arrangement. A resultant short interchange from the platform to concourse to forecourt facilities would be included. Taxi and private vehicle drop off and pick up facilities would be located next to the station entrance.
- 4.2.12 There are two bus routes along the A538 Hale Road/Wilmslow Road; Route 18 services connect the airport with Hale and Altrincham via the A538 to the Cargo Centre, main terminal complex and Trafford Centre, and services along Route 19 during the early morning, connect the cargo centre with the main airport complex, Wythenshawe and Altrincham. A slight modification to these routes would enable them to serve the HS2 station.
- 4.2.13 Current work is being developed in parallel with other stakeholders.

Constructability

- 4.2.14 The constructability of the station has been assessed with the following objectives:
- Identifying any major risks associated with the site.
 - Minimising the number of demolitions and extent of disruption to existing infrastructure.
- 4.2.15 Initial preliminary strategic work suggests that the works would be carried out in 3 main stages. The overall schedule would be approximately 3 years as there would be opportunity to overlap the stages.
- 4.2.16 Stage 1 (26 months)
- Clear the construction area and set-up site compound using temporary access from Hasty Lane.
 - Provide access to, and areas for, the southern tunnelling construction site for the Manchester tunnel.
 - Construct inverted siphon for Timperley Brook.
 - Construct new roundabout and road connection to airport M56 link.
 - Excavate and build concrete box.
- 4.2.17 Stage 2 (12 months)
- Construct platforms.
 - Construct ground level concourse.
 - Level area for car park.
- 4.2.18 Stage 3 (17 months)
- Construct station roof.
 - Complete platform fit-out and install HS2 escalators to concourse.
 - Construct new station facilities including commercial.
 - Construct new car parks.
 - Construct access roads, taxi and bus ranks and car drop-off points.
 - Completion works including constructing footpaths, landscaping, etc.

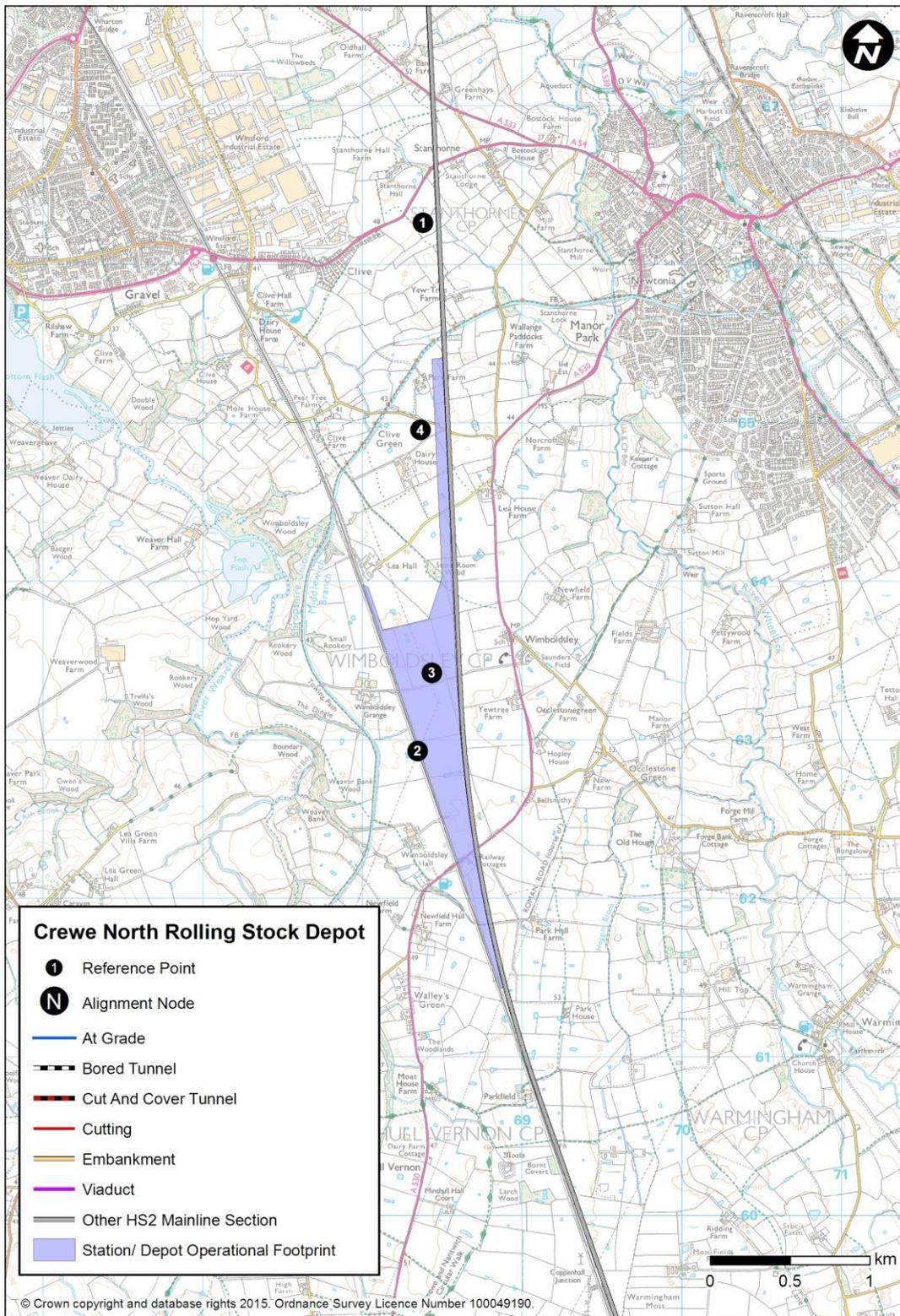
5 Depots

5.1 Introduction

- 5.1.1 Two depots would be required for the operation of the West Midlands to Manchester leg (Phase 2a and 2b). One would be an infrastructure maintenance base-rail (IMB-R) as a base from which to carry out engineering activities to inspect, maintain and renew the infrastructure. The second would be a rolling stock depot (RSD) at which the trains would be stabled overnight, for cleaning and maintenance.
- 5.1.2 There is no IMB-R on this section of the route. The IMB-R for Phase Two (Manchester Leg) will be located in Phase 2a, near Stone.

5.2 Rolling Stock Depot

- 5.2.1 The proposed RSD **(3)** would be situated on relatively level farmland between the WCML north of Crewe and the HS2 Mainline (HSM10B). The site would be strategically located to serve Manchester, and allow access to the WCML, for trains terminating at Liverpool and Preston.
- 5.2.2 Access from HS2 would be provided from the north using a grade separated junction from the adjacent route (HSM10B). This would allow trains to run north to Manchester. One line on each side of the adjacent route would be provided from a junction **(1)** to the north of the Shropshire Union Canal. The eastern line, which would be 1.4 miles (2.3km) long, would cross over the connecting route to run into the depot. Connections into the WCML would be provided where the WCML is adjacent to the western side of the depot **(2)**. This junction would enable classic compatible trains from the depot to access Liverpool and Preston via the WCML. Access to the site during operations would be from the A530 and Clive Green Lane **(4)** which would be diverted to cross the route and enter the depot from the north.
- 5.2.3 Construction of the depot in this location would use standard methods.



6 Ancillary Design Works

6.1 Tunnel Portals

- 6.1.1 Tunnel portals will be required on all tunnels, both bored and cut and cover, and fulfil a number of purposes. These include:
- A structure to retain the surrounding ground at the entrance of the tunnel;
 - emergency intervention access to the tunnels from the surface;
 - emergency passenger evacuation where evacuation through the portal is part of the emergency strategy; and
 - to reduce noise and air pressure effects as trains enter or exit the tunnel.
- 6.1.2 Tunnel portals would incorporate some or all of the following features:
- Porous portals (see 6.1.3);
 - buildings housing services such as power, telecommunications, water supply, fire safety, drainage and ventilation equipment to service the tunnel;
 - parking for service vehicles; and
 - access and parking for emergency services.
- 6.1.3 Work has been carried out on Phase One of HS2 to assess the requirements for porous tunnel portals. Porous portals would be provided at the ends of tunnels to mitigate the effects of pressure waves created by trains entering or exiting tunnels at high speed. For speeds in excess of 230km/h porous portals should be provided. The length of these porous portals is dependent on a number of factors, however the overall length of the portals is dependent principally on the line speed, the diameter and the length of the tunnel. Using the findings of work done on Phase One, the length of these portals is currently estimated to be 150m for the Crewe tunnel and 50m for the Manchester tunnel.
- 6.1.4 Tunnel portals would take different forms, depending on ground conditions, local terrain and train speeds. In rural locations, portals would typically be constructed in open excavation, with soil and rock slopes benched (i.e. cut in steps) and reinforced as necessary, and reinforced concrete headwalls and wing walls around the tunnel entrances. In urban locations, and where space is restricted, portals would utilise earth retaining structures.
- 6.1.5 Where excavation is relatively shallow, tunnel portals would be constructed by open cut. For deeper excavations, diaphragm wall or contiguous bored pile techniques would be utilised, requiring support by propping beams or a cover slab for the deepest excavations.
- 6.1.6 A minimum “rescue” area of 550m² for emergency services would be provided at both portals.

6.2 Tunnel shafts

- 6.2.1 Tunnel shafts are vertical openings connecting underground tunnels to the surface and open air. The purpose of tunnel shafts are to:
- Enable the smoke produced in the event of a fire to be extracted in a controlled manner, and to provide fresh air in order to create smoke free evacuation routes;
 - Provide access for routine maintenance;
 - Provide access for the emergency services; and
 - Meet the comfort requirements of passengers and staff in tunnels by keeping the air quality and temperature within prescribed limits.
- 6.2.2 Tunnel shafts would be constructed by various techniques depending on the location and ground/groundwater conditions.
- 6.2.3 Ideally, a site of 2500m² would be required to facilitate the overall construction of the shaft.
- 6.2.4 The indicative vent shaft locations can be found on the plan and profile drawings.
- 6.2.5 On the Phase 2b Crewe to Manchester route there are two tunnels, the Crewe tunnel and the Manchester tunnel. HS2 Ltd.'s design standards dictate that a ventilation/intervention shaft is required every 2-3km, for a tunnel of length greater than 3km. Based on these requirements, the shafts will be provided at roughly equal spacing. Each shaft would service both tunnel bores. HS2 Ltd. will continue to review the ventilation shaft requirements for both Crewe tunnel and Manchester tunnel through the Phase 2b hybrid Bill development. This is summarised in the table below

Tunnel	Length
Manchester	12765m
Crewe	6110m

6.3 Further Works

- 6.3.1 The scheme design is still at a preliminary stage and further work will be required to incorporate other aspects of railway infrastructure. This will be done at a later stage of the design process and will include:
- Power supply and overhead line electrification;
 - Signalling and other railway systems;
 - Drainage and drainage attenuation; and
 - Accesses to the railway for maintenance.

7 Glossary of terms

- 7.1.1 **At-grade** – at ground level.
- 7.1.2 **Classic compatible trains** – a European high speed standard train which can also run on existing UK rail lines, also known as the “classic network”.
- 7.1.3 **Floodplain** – area of land surrounding a watercourse which will be subject to flooding.
- 7.1.4 **GC Gauge** – gauge is the shape beyond which a vehicle is not to be built, or within which a structure is not to intrude. GC Gauge is the European “Loading” gauge, to which the HS2 new infrastructure will be constructed.
- 7.1.5 **Grade separated junction** – a junction where one or more routes cross other routes at a different level by being raised above or below them. This could apply to either to railways or highways.
- 7.1.6 **Green tunnel** – where earth is built-up around and over a section of the rail line to reduce its environmental impacts.
- 7.1.7 **High Speed Two Limited (HS2 Ltd)** – a company wholly owned by the Department for Transport responsible for developing and promoting HS2 London to West Midlands and preparing proposals for HS2 to Leeds and Manchester.
- 7.1.8 **Intermodal interchange** – interchange between different forms of transport, for example between rail and tram or bus.
- 7.1.9 **Infrastructure maintenance depot** – Base for maintenance of infrastructure associated with the proposed high speed rail line, including track, signalling equipment, cuttings and embankments.
- 7.1.10 **Network Rail** – owner and operator who runs, maintains and develop’s Britain’s rail tracks, signalling, bridges, tunnels, level crossings, viaducts and selected rail stations. Network Rail owns and manages Birmingham New Street station, Liverpool Lime Street station and Manchester Piccadilly station.
- 7.1.11 **OHLE** - Overhead Line Equipment, the conductor cables above the trains which carry the electricity supply for the trains.
- 7.1.12 **Rolling stock depot** – Depot used to service and maintain trains operating on the proposed route.
- 7.1.13 **Sprayed Concrete Lining (SCL)** – A method for the construction of tunnels, by spraying concrete immediately on the exposed ground to retain it.
- 7.1.14 **Spur** – a railway line which branches off the main through route.

- 7.1.15 **TBM** – Tunnel Boring Machine, used to construct tunnels.
- 7.1.16 **Tunnel portal** – the entrance to a tunnel
- 7.1.17 **Twin tunnel** – two tunnels constructed side by side spaced slightly apart, one of which will take the northbound track and one the southbound track
- 7.1.18 **West Coast Main Line (WCML)** – Intercity railway route in the UK connecting London, Birmingham, Manchester, Liverpool and Glasgow.

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