

HS2 Phase Two Initial Preferred Scheme Sustainability Summary



HS2 Phase Two Initial Preferred Scheme

Sustainability Summary

A Report for HS2 Ltd

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Executive summary

The initial preferred scheme

This Sustainability Summary describes the potential impacts on people and the environment, both adverse and beneficial, of the Government's *initial preferred scheme* for Phase Two of High Speed Two (HS2), the proposed national high speed rail network. Appraisal work is ongoing, but the Summary reflects the findings of the appraisal undertaken to date. Further information on the proposals is set out in the DfT's *High Speed Rail: Investing in Britain's Future. Phase Two: The route to Leeds, Manchester and beyond*.

Phase Two will comprise northward extensions of the HS2 Phase One route along separate western and eastern legs via Manchester and Leeds respectively. The western leg of the initial preferred scheme would ultimately connect with the West Coast Main Line near Golborne; it would include a station in Manchester city centre, as well as a station at Manchester Airport. The eastern leg would connect with the East Coast Main Line south-west of York; as well as a station in Leeds, it would include intermediate stations at Toton near Nottingham (called the East Midlands Hub) and at Meadowhall, Sheffield.

The initial preferred scheme has been chosen by Government from a number of alternatives presented to it by HS2 Ltd in March 2012. Following discussions about the scheme with affected local councils and MPs, the Government is expected to announce a preferred scheme for public consultation later this year.

Sustainability and design

The initial preferred scheme has emerged from several hundred options as the one considered overall to best meet objectives for passenger demand, cost, ease-of-build, journey time and sustainability. Considerations of sustainability have been integral to scheme design since commencing work on Phase Two in autumn 2010. During this time, the sustainability team has worked closely with the engineers to develop route and station proposals that fit as far as possible with the environment and communities they pass. However, we are at an early stage in the development of the scheme: more work will be undertaken to refine the alignment and include mitigation such as landscaping and noise barriers, and a number of the impacts that are described in this report will reduce as the designs are progressed.

Therefore, the potential impacts described here reflect where we are in the design process. Assessment of the scheme's sustainability and general environmental impacts will continue to inform and guide the route choice and design proposals, as it has for the Phase One scheme, between London, Birmingham and the West Midlands. In particular, the advice received during later public consultation will be fundamental to the final scheme design.

The focus of scheme development was initially on route selection. From a long list, a great many options were rejected due to, amongst other things, their potential sustainability impacts. More recently, with a short list of favoured schemes in place, the emphasis has been on making refinements to the alignments and, where necessary, building up engineering detail to better understand how potential impacts could be avoided or reduced. This has helped to address possible impacts on settlements and properties, as well as on important environmental features, such as protected habitats, historic features, rivers, abstraction points and landfill sites. The scheme development has included discussions with Government's advisory bodies including Natural England, the Environment Agency and English Heritage.

Overview of the potential impacts of the initial preferred scheme

The operational scheme is expected to provide 1,400 permanent jobs, with up to 10,000 jobs created during the busiest part of construction. In addition, initial work on the potentially significant opportunities offered by HS2 indicates that the scheme would be expected to support some 49,700 jobs and 5,350 new houses through its enhancement of the development potential around high speed stations, particularly for the Manchester Piccadilly and Leeds termini. It may also initiate wholly new development schemes around the new stations, although this has not been considered in this report. HS2 would also displace an estimated 5,370 jobs through demolitions of business premises, although it is likely that these jobs would be re-established elsewhere in and around the areas affected.

More locally, the scheme would give rise to an estimated 227 residential demolitions. In addition, it would result in the demolition of five community facilities, 179 commercial properties and 42 industrial properties.

No assessment of construction impacts has been undertaken at this stage. However, as an indication of the number of people at greater risk of impacts from construction there would be approximately 3,300 dwellings within 100m of the surface route and the provisional station and depot construction boundaries.

A number of people are predicted to experience noise impacts from the operational railway. However, the potential impacts that have been determined at this stage would be expected to reduce substantially as mitigation is built into the scheme design. Current estimates are that, without mitigation, some 7,700 people would be expected to experience noise impacts from the operational railway, approximately 1,500 people on the western leg and approximately 6,200 people on the eastern leg. Noise insulation could be required at about 450 dwellings on the western leg and 1,400 dwellings on the eastern leg. However, with mitigation in place, these numbers would reduce. For the western leg, the number, based on the appraisal for HS2 Phase One, would be expected to approximately halve; and for the eastern leg, given the location of most of the impacts in urban areas where mitigation could be particularly effective, the reductions would be greater still.

The scheme would avoid any national parks or areas of outstanding natural beauty, although it would give rise to a number of local landscape and visual impacts. It would also avoid the most highly protected historic features, aside from one Scheduled Monument north of Ratcliffe on Soar. It would potentially affect the settings of four other Scheduled Monuments. It would avoid Grade I and II* Listed structures, but it would potentially demolish eight Grade II Listed structures: three on the western leg and five on the eastern leg, although some of these may be avoided or preserved. Seven conservation areas would be crossed. Registered Parks and Gardens and Historic Battlefields would all be avoided.

In terms of nature conservation, we have worked closely with Natural England and the Environment Agency in choosing options and preparing designs that would have no impacts on sites of internationally recognised importance. The route would avoid direct impacts on all but one SSSI, Bogs Farm Quarry, and the integrity of this site would be largely retained. A number of other SSSIs would be close to the route and designs will be progressed to avoid impacts on these, where possible. There are a number of small pockets of characteristic *Biodiversity Action Plan* habitat that would be directly affected. Thirty five of these recorded areas would be affected: 12 on the western leg and 23 on the eastern leg. Seventeen of these are also designated as Ancient Woodlands. These habitats would generally be retained, although they would be reduced in size. We will continue in seeking to further reduce these impacts, and at later stages, to explore opportunities for habitat creation and ecological enhancement as an integral part of mitigation.

The current scheme proposals would require the diversion of rivers in a number of locations. Seven rivers with larger catchments (termed major rivers) would need to be

diverted, all on the eastern leg. In addition, some 26 diversions of minor rivers would be required, although continuing design would seek to avoid the need for these. The route would cross six areas that are protected for public water supplies, which would need to be mitigated.

Much of the land crossed by the scheme would be farmland. Of this, about 1km is shown on mapping as the highest quality Grade 1 land; a further 50km is shown as Grade 2 land. Work would be undertaken to ensure that, as far as possible, proposals do not jeopardise continued use of agricultural holdings, and HS2 Ltd will work closely with farmers that are potentially affected in order to identify possible solutions. Nine active landfill sites would be directly affected to some degree, and further work will be undertaken to mitigate risks from these crossings.

Although large volumes of excavated materials are anticipated at this early stage, in practice much of this would be utilised for mitigation, within landscaping and noise bunds alongside the route. An estimated 0.8 million tonnes of steel and seven million tonnes of concrete would be required within the permanent infrastructure.

Key issues – western leg

The western leg would pass close by a number of internationally significant wildlife sites. However, the alignment has been selected, and elements of its design progressed in close liaison with Natural England and the Environment Agency, so that we can be certain that impacts to the qualifying interest of these sites would be avoided.

Between Lichfield and Crewe, the route would use significant lengths of cutting, as well as short tunnels, to fit with the landscape and avoid many of the villages in this part of Staffordshire. And use of a tunnel beneath Crewe would minimise impacts on the town. The variety and density of environmental features on the south side of Manchester has required particularly careful alignment of both the main route and of the spur into the city. The historic parkland landscape of Dunham Massey and most of the numerous landfill sites in the Glazebrook Valley have been avoided. However, the high viaduct carrying the railway across the Manchester Ship Canal would affect local landscape character, as well as views from local villages.

The train depot site near Golborne, south of Wigan, occupies an important strategic location. Within an area with a number of environmental designations, designs have already sought to reduce potential impacts on ecology, water, landscape and heritage; continued scheme design will seek to reduce them further.

The tunnel under Manchester would ensure that impacts on people and property are largely avoided, while the new station in Manchester would offer considerable opportunities for development and jobs.

Key issues – eastern leg

The eastern leg would bear north from Water Orton closely following the M42 and using cutting for much of its length. It would cross over the River Mease, which is an internationally protected habitat. However, the design, developed in liaison with Natural England and the Environment Agency, would ensure impacts to the river and the key species for which it is designated are avoided.

West of Nottingham the route would use a tunnel to pass beneath Strelley. Although this would help avoid impacts in the long term, the tunnel would cause some temporary disruption during construction. Further north, the route would follow the M1 for much of the next 40km. This would help to contain impacts within the transport corridor, although it is likely to require some modifications to the motorway and its junctions, causing temporary disruption for motorists. It would pass some notable historic sites north of Tibshelf, including Hardwick Hall, Sutton Scarsdale and Bolsover Castle, from which views of the scheme are expected, although potential impacts would be greatly offset by the route's alignment close to the motorway, as well as by the distance of the views.

North of Sheffield, the route would use extensive lengths of cutting to reduce impacts. There would be limited localised impacts on landscape, for example where the route passes the well-used reservoirs west of Ryhill and in crossing the valleys of the Aire and Calder rivers. The connection with the East Coast Main Line has been revised to avoid potential impacts on Towton Battlefield and the use of cutting though much of this area would help limit noise and visual impacts.

The stations would each provide considerable benefits through the interchange opportunities they provide with other transport networks, and through the secondary effects these would have on local development.

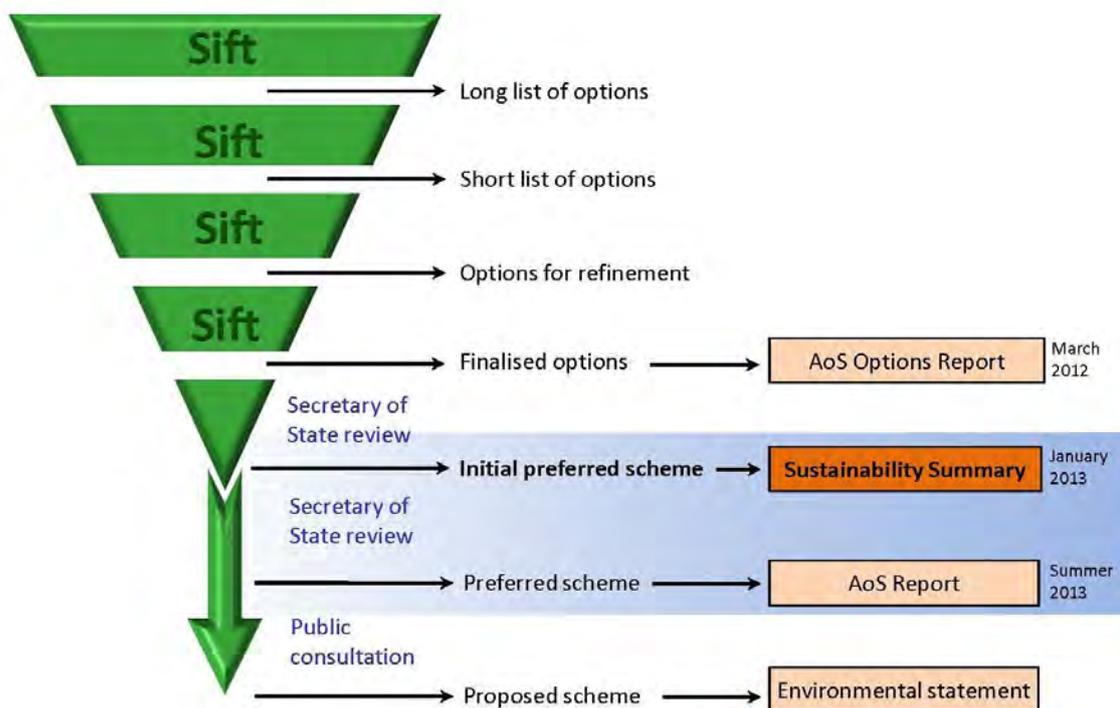
1. Context for the Sustainability Summary

- 1.1.1. This Sustainability Summary describes the potential impacts on people and the environment of the Government's initial preferred scheme proposals for Phase Two of High Speed Two (HS2). It has been prepared by Temple-ERM (sustainability consultants for HS2 Ltd) who are undertaking an Appraisal of Sustainability (AoS) of the proposals; the Summary reflects the findings of the appraisal work undertaken to date. The Summary provides supplementary information to the Government's Command Paper, *High Speed Rail: Investing in Britain's Future. Phase Two: The route to Leeds, Manchester and beyond*.
- 1.1.2. The Government's announcement of the initial preferred scheme initiates a period of informal engagement during which the Secretary of State for Transport and HS2 Ltd will discuss the proposals with affected local councils and MPs. Following this, the Secretary of State is expected to announce his preferred scheme for consultation later this year. A more detailed full AoS report on potential sustainability impacts will be published at that time, in advance of a period of formal public consultation.
- 1.1.3. Further modifications to the scheme design might be required as a result of this consultation and these will be included within the Secretary of State's decision on a preferred scheme and accommodated as part of the proposals submitted to Parliament in the form of a hybrid bill. The bill would include an Environmental Statement, documenting the findings of an Environmental Impact Assessment (EIA). It is currently assumed that operation of services on Phase Two will begin in 2032/33.
- 1.1.4. At this stage, people potentially affected by these Phase Two proposals or with an interest in them can seek further information through the HS2 Ltd enquiries line (020 7944 4908) or from the HS2 website at <http://www.hs2.org.uk/>.

2. HS2 and the initial preferred scheme

- 2.1.1. HS2 is the Government's proposed high speed rail network linking London with Birmingham, Manchester and Leeds. Proposals for Phase One of HS2, between London and Birmingham and the West Midlands, are well advanced. The Government plans to introduce a hybrid bill to Parliament by the end of 2013, through which it will seek the necessary powers to construct and operate Phase One.
- 2.1.2. Phase Two is at an earlier stage of development. Under instruction from the Government, HS2 Ltd has, since autumn 2010, been looking at options to extend the proposed Phase One network from the West Midlands along separate legs to Manchester and to Leeds, the latter via new stations in the East Midlands and South Yorkshire. During this time HS2 Ltd has designed, appraised and sifted several hundred options for routes, stations and depots. The AoS undertaken to date has systematically appraised the sustainability impacts of each of these, allowing their equitable comparison.
- 2.1.3. By early 2012, a small number of options remained that were considered to best meet the remit for HS2 in terms of passenger demand, cost, ease of build, journey time and sustainability. The sustainability impacts of these options were described in an *AoS Options Report*, which formed one of the documents provided to the Secretary of State at the end of March 2012 to help determine the Government's initial preferred scheme. The AoS Options Report can be read separately on the DfT's website (<https://www.gov.uk/government/policies/developing-a-new-high-speed-rail-network>).

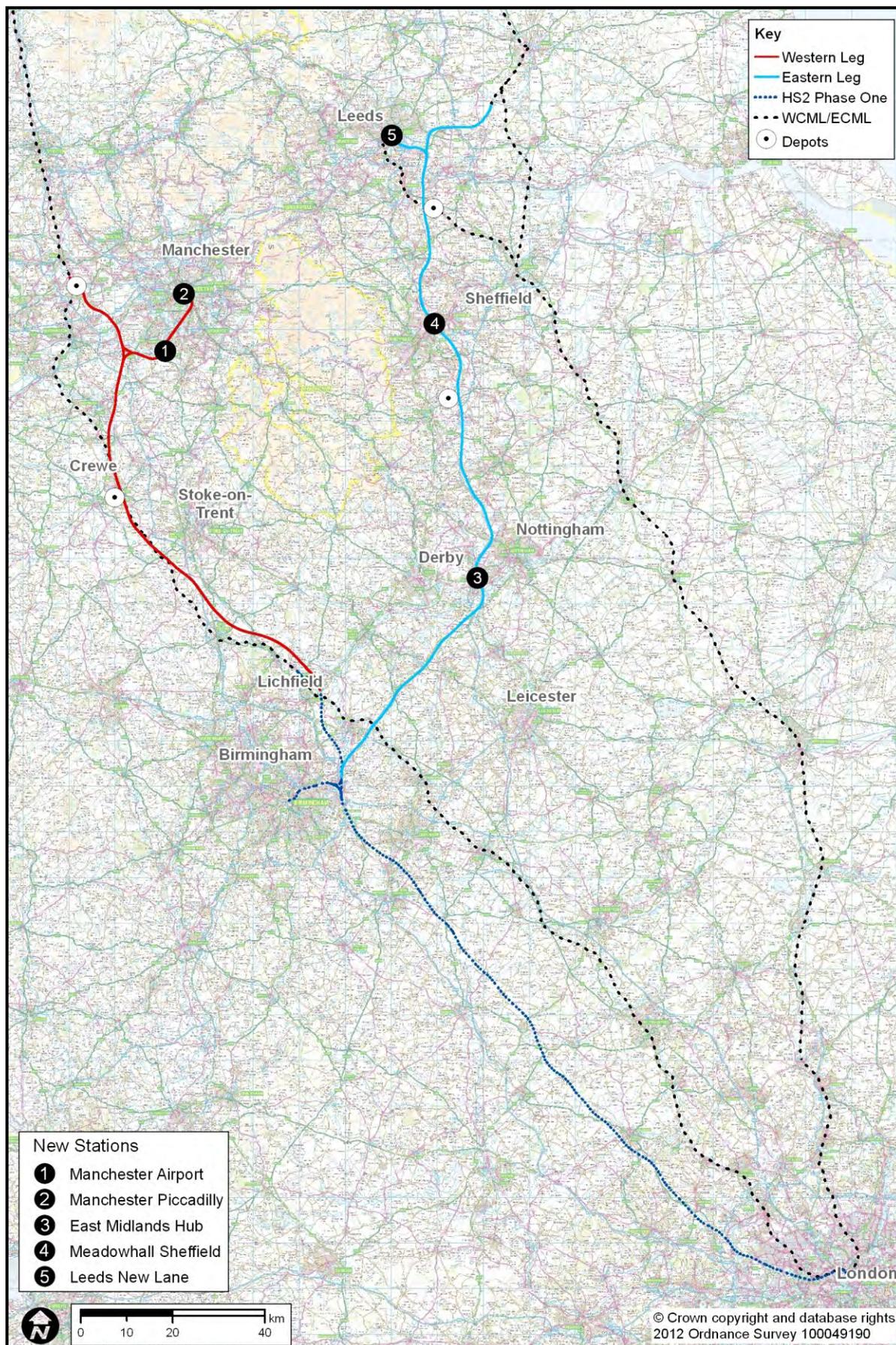
Work over two years has led to the initial preferred scheme



- 2.1.4. The *AoS Options Report* provides additional information about the AoS process and methodology, as well as describing the potential impacts of all of the options that have been considered by the Secretary of State. In particular, Appendix 3 of the *AoS Options Report* provides information on the alternatives considered at each sifting stage and summarises their main sustainability impacts.
- 2.1.5. During the spring and summer of 2012, the Secretary of State met with council leaders to discuss station options for the western and eastern legs, and separately visited areas potentially affected by the proposals. The initial preferred scheme that has now been announced and which forms the subject of this report reflects their deliberations. A separate update produced by HS2 Ltd¹ sets out the scheme refinements that have taken place between March and October 2012.
- 2.1.6. The scheme, which is described more fully later in this report, includes western and eastern legs including terminus stations in central Manchester and Leeds respectively. The eastern leg includes intermediate stations at Meadowhall in Sheffield and the East Midlands Hub at Toton near Nottingham. The western leg includes an interchange station that would serve Manchester Airport and surrounding areas.
- 2.1.7. The scheme also includes connections with the existing rail network allowing onward journeys, the western leg connecting with the West Coast Main Line south of Crewe and north of Golborne and the eastern leg connecting with the East Coast Main Line south-west of York. Each leg also includes two depots, one for servicing and parking trains and the second for maintaining the railway.
- 2.1.8. The AoS will continue to support design refinements to the initial preferred scheme, and will inform the reporting of impacts of the preferred scheme later this year. It will also inform inclusion of any revisions that are made in response to public consultation.

¹ *Selecting an initial preferred scheme for Phase Two: refinement work since March 2012*

The initial preferred scheme



3. The appraisal of sustainability process

3.1. Strategic approach

- 3.1.1. The AoS process follows and builds on the approach used for Phase One of HS2, which was developed in consultation with the statutory government advisory bodies - Natural England, the Environment Agency and English Heritage - as well as with Government departments. The AoS process reflects the preliminary level of design, as well as the need to compare large numbers of options.
- 3.1.2. The AoS serves several functions, including to:
- advise engineers and HS2 Ltd during scheme design of particular sustainability constraints and opportunities;
 - inform the engineers in making refinements to scheme proposals that would lessen potential adverse effects;
 - advise HS2 Ltd at key decision stages of the relative sustainability advantages and disadvantages of different options, and the consequence of potential impacts; and
 - formally report the sustainability impacts of the options at each stage.
- 3.1.3. The AoS addresses 18 topics, each under one of four key sustainability themes.

<p>Natural and cultural resource protection and environmental enhancement</p> <ul style="list-style-type: none"> • Landscape • Townscape and cultural heritage • Biodiversity and geodiversity • Water resources • Flood risk 	<p>Creating sustainable communities</p> <ul style="list-style-type: none"> • Air quality • Noise and vibration • Community integrity • Accessibility • Health and well-being • Security and safety • Economic prosperity • Economic welfare
<p>Reducing greenhouse gas emissions and combating climate change</p> <ul style="list-style-type: none"> • Climatic factors and adaptability • Greenhouse gases 	<p>Sustainable consumption and production</p> <ul style="list-style-type: none"> • Soil and land resources • Waste generation • Resource use

- 3.1.4. Most topics have been considered as part of option development; some (for example, air quality and greenhouse gases) will be considered at later stages on the basis of additional design detail. Chapter 5 describes how the topics considered to date have been appraised and how, in Chapters 6-8, their potential impacts are described in this report.

3.2. Support to option sifting

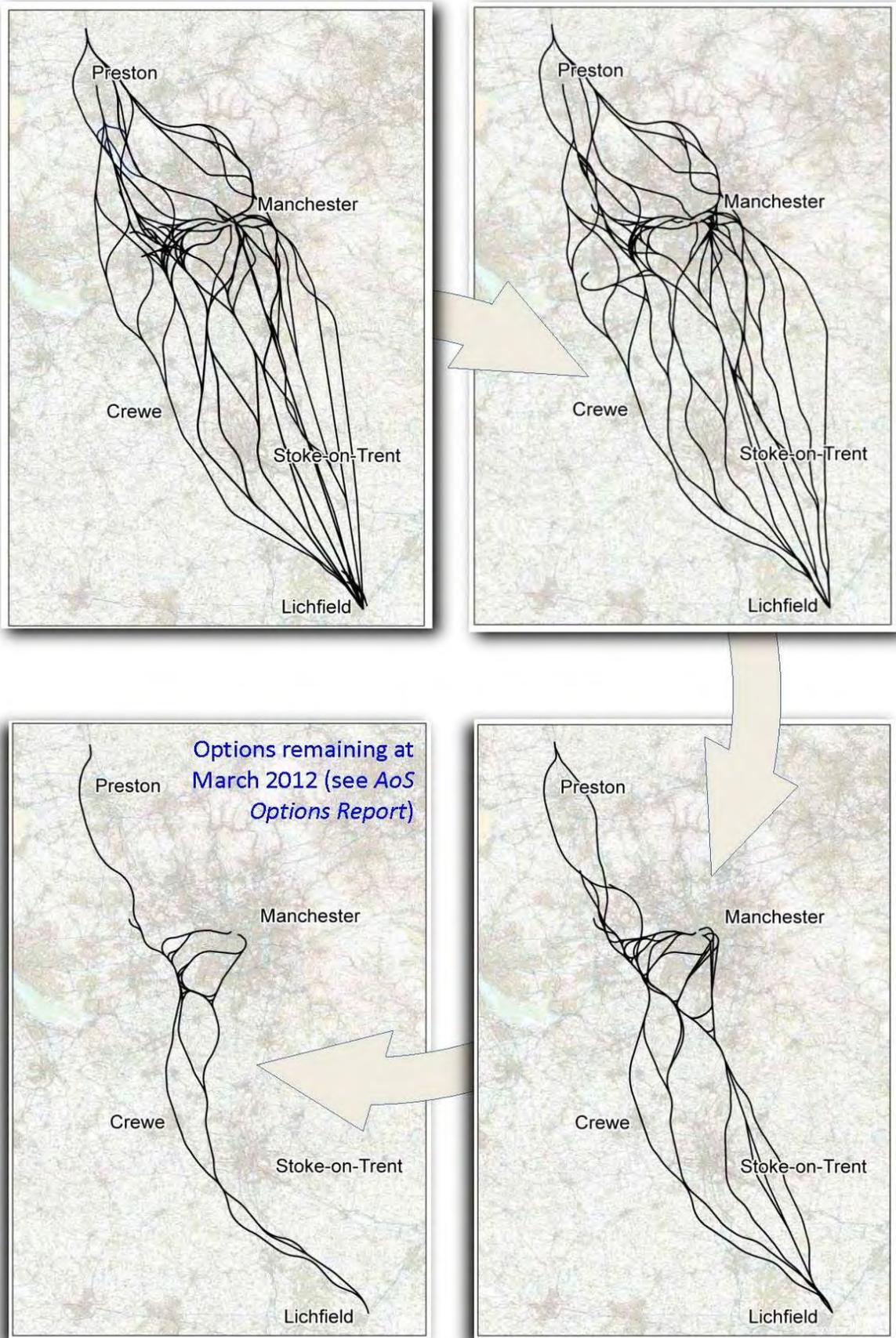
- 3.2.1. Option development used four sifting stages, with numbers of options reduced at each stage. The passage of the scheme proposals through this process saw a corresponding increase in both the detail of their design and the depth of their appraisal.

As options reduce, engineering and appraisal detail increases

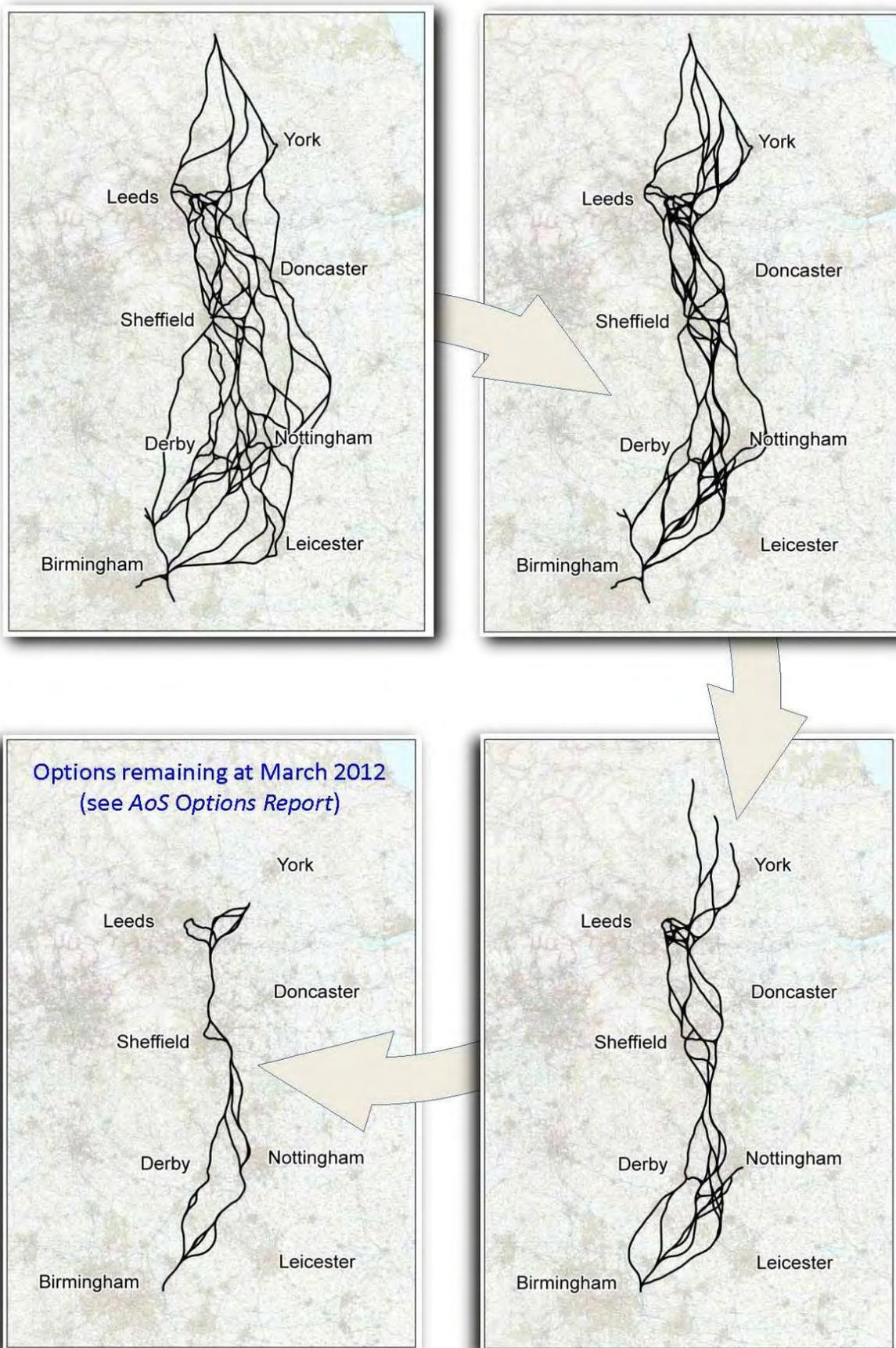


- 3.2.2. At the end of each sift, a series of internal meetings were held at which the HS2 Ltd Executive Team were briefed on the various advantages and disadvantages of the options. Sustainability and engineering considerations and cost information were presented at these meetings, along with journey time information for route options, and passenger demand and planning and development information for stations. The review of station options included relevant local councils, who provided context on wider transport and planning proposals. As a result, the Executive Team were able to decide which options to progress to the next stage.
- 3.2.3. By early 2012, the best performing scheme options had emerged from the sifting process, but there remained a number of key localised issues that needed to be resolved. Temple-ERM continued to work closely with HS2 Ltd and their engineers to make changes to the alignment, shifting it either vertically (up or down) and/or horizontally (sideways), to reduce local impacts where possible. These adjusted or mitigated options formed the subject of the March 2012 *AoS Options Report*, that was described earlier.
- 3.2.4. The diagrams on the following pages show how the options for the western and eastern legs were reduced through the four sifting stages.
- 3.2.5. Up to this stage, with the identification of the initial preferred scheme, the emphasis of the AoS had been on looking at those aspects most helpful in differentiating one option from another - those more concerned with the potential physical impacts of the proposals on, say, ecology or property. Once a decision on a preferred scheme for consultation is made later this year, the AoS will expand to cover the route wide issues; for example, its carbon footprint and some wider socio-economic effects. It will also consider further any potential cumulative effects, including those that may arise with Phase One of HS2. These will be reported in the final AoS Report to be published ahead of public consultation, although they are considered briefly in Chapter 8.

Since autumn 2010, hundreds of options have been considered through each of the four sifting phases, both for routes to Manchester ...



... and routes to Leeds



4. Scheme description summary

4.1. Initial preferred scheme: western leg route, stations and depots

Overview

- 4.1.1. The initial preferred scheme for the western leg would comprise about 153 kilometres (95 miles) of new railway, including the main route up to and past Manchester, the spur into Manchester station and the connection with the WCML. The scheme would comprise the following mix of alignments.

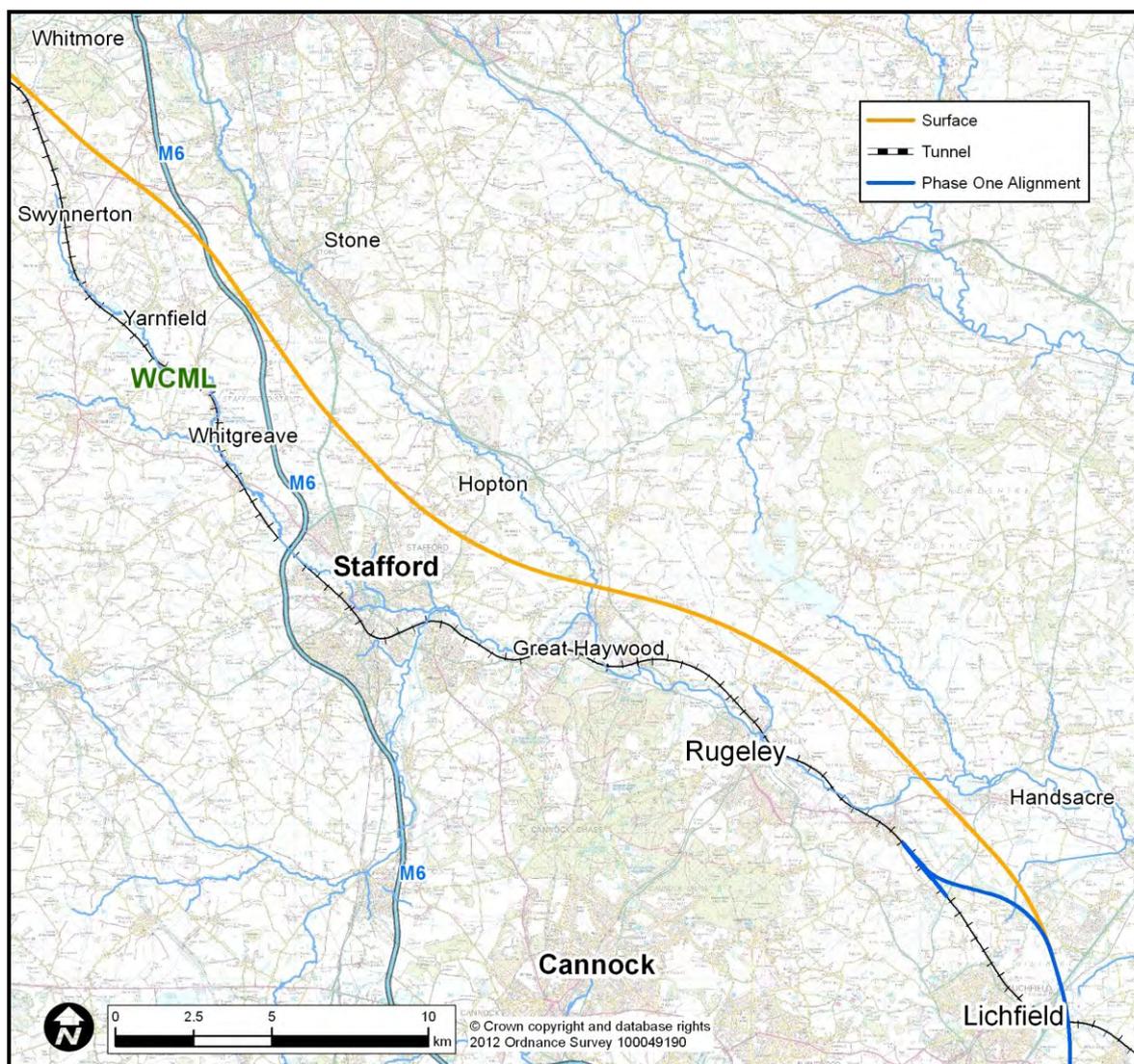
Alignment	Length (km)
At Grade	16.9 (11%)
Tunnel	17.6 (12%)
Cutting	55.8 (36%)
Embankment	48.5 (32%)
Viaduct	14.3 (9%)

- 4.1.2. Of this, an estimated 33km (just over 20% of the above ground route) would be within 150m of an existing major transport route (A-road, motorway or railway).
- 4.1.3. The main route would connect at its southern end with HS2 Phase One near Lichfield, and at its northern end with the WCML at Bamfurlong, to the north of Golborne. A spur to Manchester, off the main route, would include a new interchange station at Manchester Airport and a new terminus station adjacent to the existing Manchester Piccadilly station. Two depots would also be required, one south of Crewe for use in maintaining the railway infrastructure, and one near Golborne for stabling, preparing and maintaining the rolling stock.
- 4.1.4. More detailed drawings of the initial preferred scheme may be viewed on the HS2 website at <http://www.hs2.org.uk/>.

Description

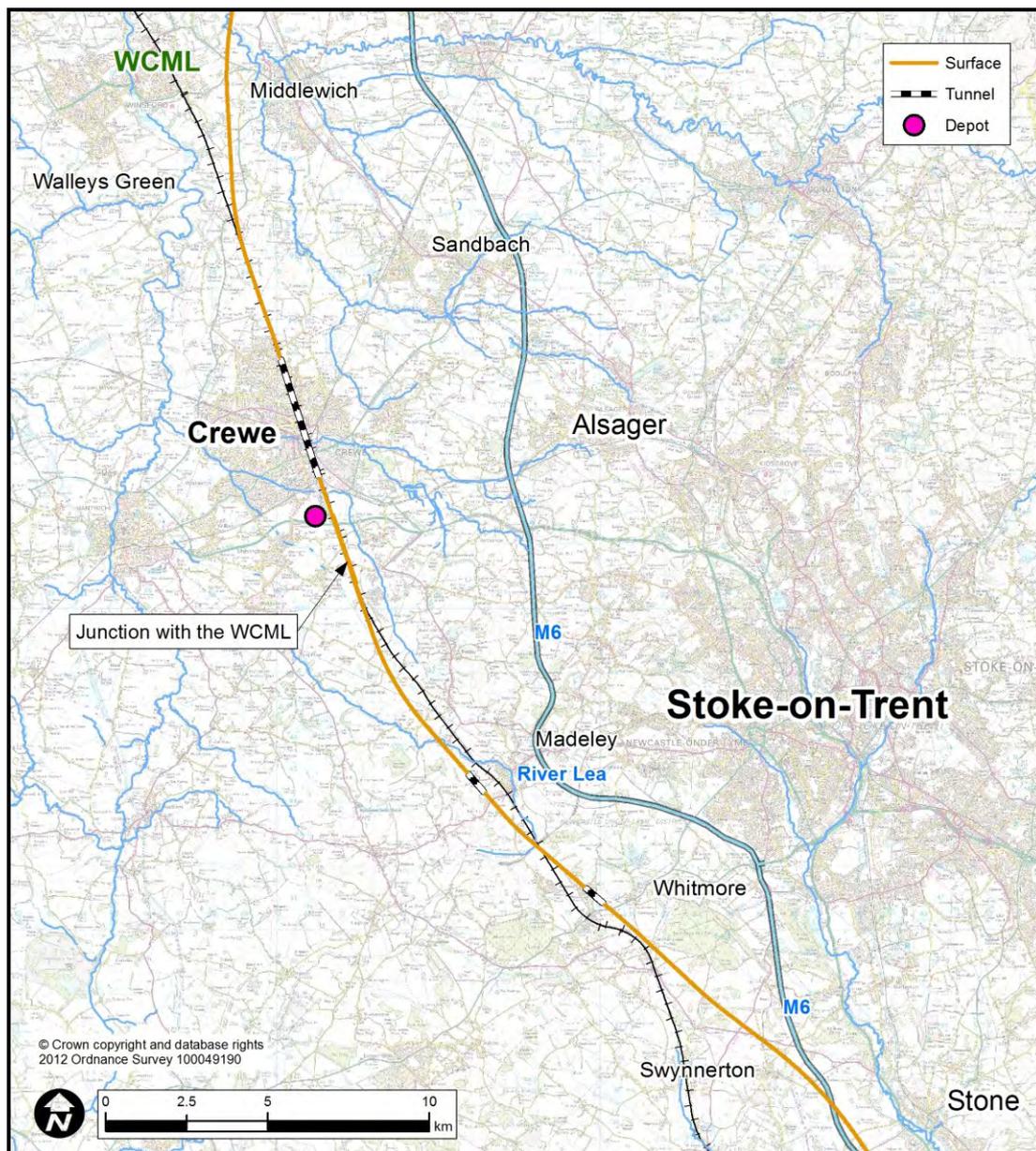
- 4.1.5. The route would commence about 1.5km to the north-east of Lichfield, continuing north-westwards from the Phase One alignment. It would enter the valley of the River Trent as it passes to the north-east of Handsacre on a long viaduct. It would pass north-west through the hills east of Colton that separate the Trent and Blithe valleys, before bearing westwards across the Trent Valley to the north of Great Haywood.
- 4.1.6. The route would continue through farmland past the northern edge of Stafford and just south of Hopton. Turning north-west, it would then run alongside the M6 for about 5km. The route would pass over the M6 to the north of Yarnfield and continue past the eastern side of Swynnerton. It would cross the Meece Brook Valley before cutting through the hills west of Whitmore and entering the valley of the River Lea.

Initial preferred scheme western leg: Lichfield to Swynnerton



- 4.1.7. The route would pass to the south and west of Madeley, aligning with the WCML and then remaining alongside and to the west of the WCML for several more kilometres. Passing to the west of Chorlton, on the far side of the WCML, it would approach the south of Crewe where a new junction with the WCML would be introduced to allow HS2 trains access to Crewe station and onward connections to serve Liverpool and intermediate stations, as well as Warrington and North Wales.
- 4.1.8. A depot for use in maintaining the railway infrastructure is proposed on the southern edge of Crewe. It would provide a central store and supply point for all engineering material and would provide facilities for rail plant maintenance and rescue and recovery locomotives.
- 4.1.9. The HS2 route would enter a tunnel beneath Crewe for just under 4km before re-emerging through the town's northern outskirts, once again alongside the WCML. The route would maintain this path as far as Walley's Green where the two railways would diverge, HS2 bearing north across the wide river crossed landscape of the Cheshire Plain. The route would pass between Winsford and Middlewich and continue north, requiring a series of embankments and bridges to carry it over the rivers and roads that criss-cross the area.

Initial preferred scheme western leg: Swynnerton to Middlewich



- 4.1.10. The route would pass villages on the eastern edge of Northwich, such as Lostock Green and Higher Wincham. It would pass over the M6 before splitting – the main route continuing north and a spur to the Manchester terminus station bearing east.
- 4.1.11. The main route would pass under the M56 and then use embankments and viaducts as the land dips into the Bollin Valley and the farmed former mosslands around the southern edge of Greater Manchester. The route would begin to bear north-west, with a high viaduct required over the Manchester Ship Canal to permit sufficient clearance for shipping.
- 4.1.12. The main route would continue on embankment for several kilometres as it passes close to Glazebrook and over the M62. The route would bear west as it passes the southern edge of Culcheth in cutting and in a disused rail corridor, before turning north once again to pass between Golborne and Leigh. It would connect with the WCML north of Golborne at Bamfurlong, the junction allowing onward connection with stations further north including Wigan, Preston, Lancaster, Glasgow and Edinburgh. A rolling stock depot is proposed immediately south of this junction. It would be used for stabling, inspection, repair, cleaning and light maintenance of trains.

Initial preferred scheme western leg: Middlewich to Golborne and spur to Manchester



- 4.1.13. The spur into Manchester would bear east at Hoo Green passing to the north of Rostherne Mere, largely in cutting, parallel and to the south of the M56. It would pass between Ashley and Tatton Park before bearing north beneath the M56. A new station, providing interchange at Manchester Airport and serving the surrounding area, is proposed at this location, located within a sub-surface box structure much like the current HS1 station at Stratford.
- 4.1.14. The route would continue north in cutting alongside the M56 before entering tunnel for some 12km beneath Manchester. The route would re-surface at West Gorton within an existing rail corridor, and follow this into Manchester Piccadilly, where a new terminus station would be constructed adjacent to the existing station.
- 4.1.15. There would also be a 6.5km section of connecting line south of Dunham Park and running beneath the M56 that would enable empty trains to move between the Manchester terminus and the rolling stock depot at Golborne.

4.2. Initial preferred scheme: eastern leg route, stations and depots

Overview

- 4.2.1. The initial preferred scheme for the eastern leg via Leeds would comprise about 187 kilometres (116 miles) of new railway, including the main route up to and past Leeds, the spur into Leeds station and the connection with the ECML. This would comprise the following mix of alignments.

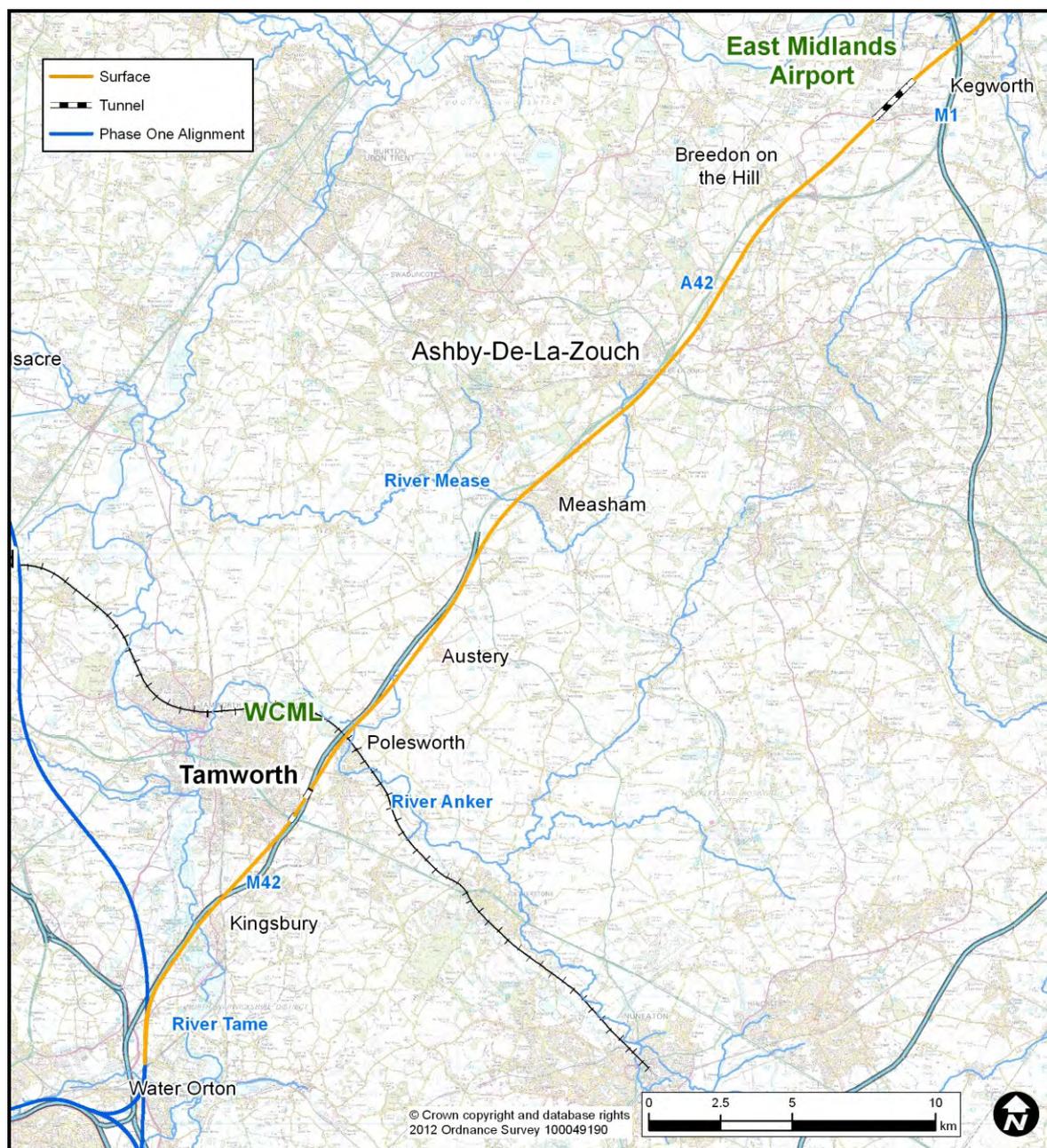
Alignment.	Length (km)
At Grade	6.1 (3%)
Tunnel	8.8 (5%)
Cutting	78.1 (42%)
Embankment	60.1 (32%)
Viaduct	33.9 (18%)

- 4.2.2. Of this, an estimated 74km (about 40% of the above ground route) would be within 150m of an existing major transport route (A-road, motorway or railway).
- 4.2.3. The main route would connect in with the ECML south of York. A separate spur would connect with a new terminus station in Leeds. Two further stations would be included on the main route: the East Midlands Hub at Toton, near Nottingham and a South Yorkshire station at Meadowhall, Sheffield. Two depots would also be required, one north of Staveley for use in maintaining the railway infrastructure, and one south of Crofton for stabling, preparing and maintaining the rolling stock.
- 4.2.4. More detailed drawings of the initial preferred scheme may be viewed on the HS2 website at <http://www.hs2.org.uk/>.

Description

- 4.2.5. The route would diverge north-eastwards from the Phase One alignment at Water Orton. It would pass close by or alongside the M42 and A42 for about the next 40km past Kingsbury, Tamworth, Austrey, Measham and Ashby-de-la-Zouch, and may require works affecting these roads and their junctions at several locations. Viaducts would carry the route over the valleys of the rivers Tame, Anker and Mease, but much of this section of the route would otherwise be within cutting.
- 4.2.6. At Breedon on the Hill the route would diverge from the A42, continuing north-eastwards still in cutting, before entering tunnel for a little under 2km to pass beneath East Midlands Airport.

Initial preferred scheme eastern leg: Water Orton to East Midlands Airport



- 4.2.7. Emerging from tunnel, it would rise over the M1 and then mostly use viaduct as it crosses the broad flood plains of the rivers Soar and Trent for some 5km. At this point, the route would bear north and then north-west as it enters the Erewash Valley through Long Eaton and the Toton suburb of Nottingham. The East Midlands Hub HS2 station, which incorporates national rail platforms, would be built at Toton alongside an existing rail freight yard. Integration of the national rail lines into the station would require works to the existing rail lines at Toton and at a few other locations, although these are still to be determined in detail.
- 4.2.8. The route would continue along this industrialised valley as far as Stapleford where it would then bear north-east alongside the M1. The route would run close to the motorway for much of the next 38km as it leaves Nottingham and passes the settlements of Strelley, Nuthall, Hucknall, Selston, Pinxton, Sutton-in-Ashfield, Tibshelf, Heath and Bolsover. Modification to the M1 and some of its junctions may be required at certain locations.

Initial preferred scheme eastern leg: East Midlands Airport to Tibshelf



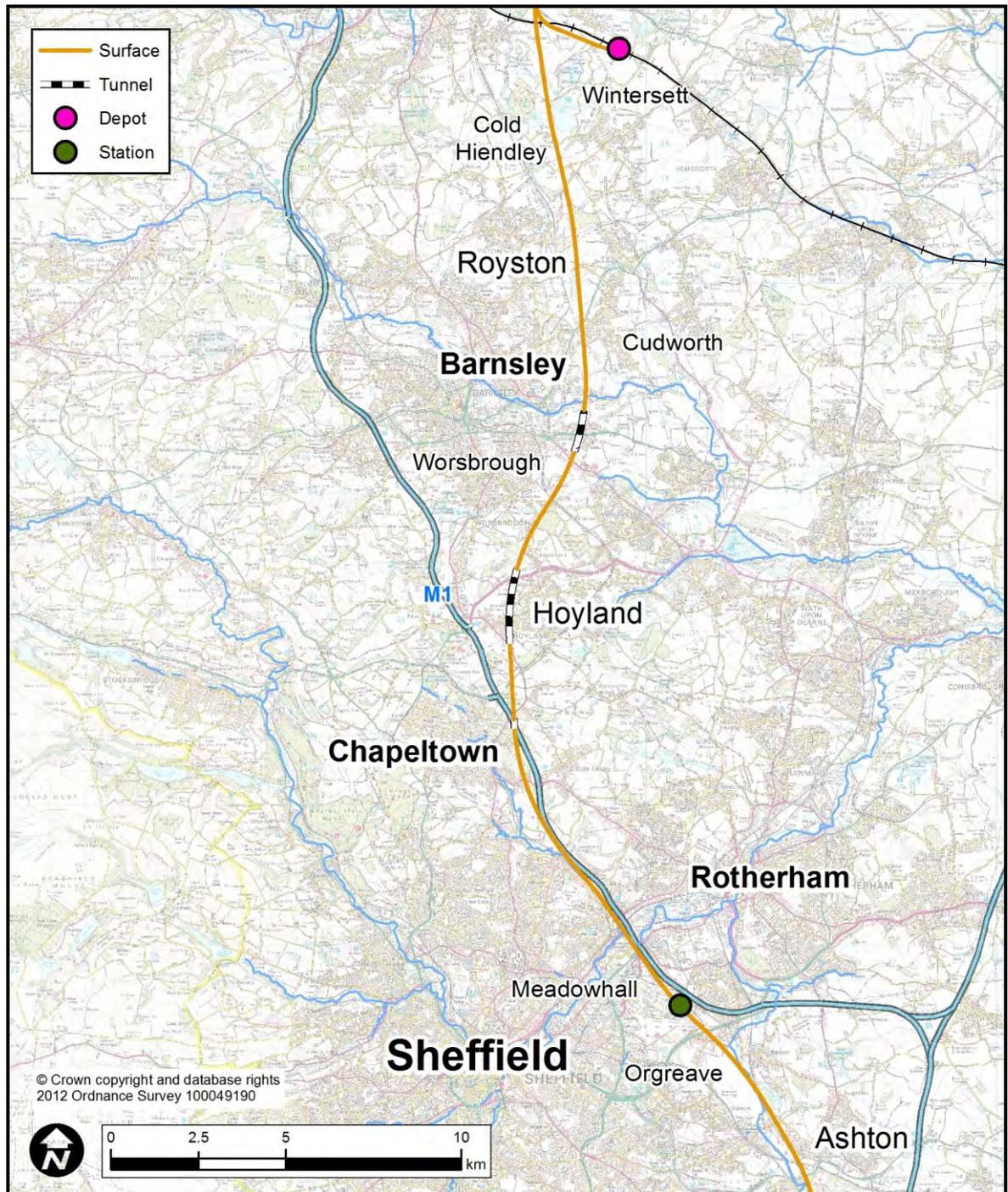
- 4.2.9. South of Staveley the M1 bears to the north-east, while the HS2 route would continue northwards along the Rother Valley. A depot for use in maintaining the railway infrastructure is proposed north of Staveley. Like the proposed Crewe depot on the western leg, it would provide a central store and supply point for all engineering material and would provide facilities for rail plant and maintenance rescue and recovery locomotives.
- 4.2.10. The route would continue along the Rother Valley for several kilometres past Renishaw, Killamarsh and the south-east suburbs of Sheffield. Where the Rother Valley widens around Orgreave, the route would rejoin the corridor of the M1, passing through the industrial corridor between Sheffield and Rotherham. An HS2 station would be built at Meadowhall, elevated alongside the M1.

Initial preferred scheme eastern leg: Tibshelf to Sheffield



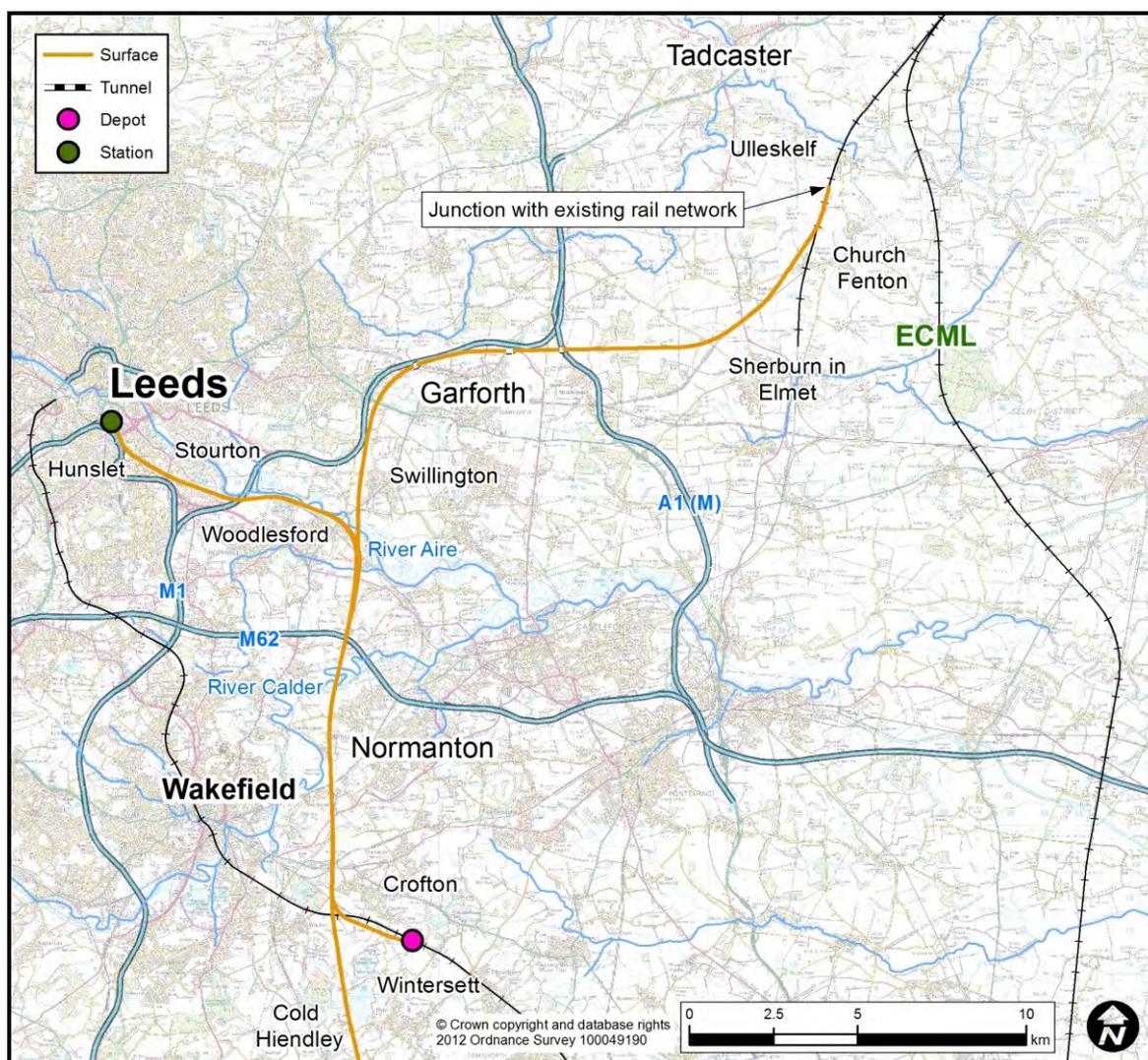
- 4.2.11. At Chapeltown the route would cut through the wooded slopes alongside the M1 before diverging from the motorway, bearing north-east past Hood Hill. The undulating terrain would require alternating cuttings and embankments for several kilometres, while tunnels would carry the route beneath Hoyland and then Ardsley on the eastern edge of Barnsley. Having passed west of Cudworth in an existing rail corridor, the route would enter the flatter terrain north of Royston up to and between Winterset and Cold Hiendley reservoirs.
- 4.2.12. A rolling stock depot is proposed south of Crofton. Like the proposed Golborne depot on the western leg, it would be used for stabling, inspection, repair, cleaning and light maintenance of trains.

Initial preferred scheme eastern leg: Sheffield to Winterset



- 4.2.13. North of Winterset the route would be elevated to cross a series of railway lines before passing scattered settlements amidst the farmland east of Wakefield, using cuttings and embankment to cross the undulating terrain. Viaducts would carry it over the rivers Calder and Aire and the Aire and Calder Navigation canals north of Normanton and Altofts. At this point the route would split - the main route continuing north and a spur to a new Leeds station bearing west.
- 4.2.14. The main route would pass Swillington before bearing east to join the corridor of the M1 north of Garforth. It would pass beneath the A1 just south of its junction with the M1, and then predominantly use cutting and embankment through undulating and wooded farmland before bearing northwards once again to the north of Sherburn in Elmet. It would then rise onto a long viaduct and connect into the section of existing railway between Church Fenton and Ulleskelf, which joins the ECML, allowing onward connection with stations further north including York, Newcastle and Edinburgh.
- 4.2.15. The spur into Leeds would diverge from the main route at Woodlesford and bear west on viaduct along the Aire Valley north of Woodlesford. It would drop into cutting to pass beneath the M1 and then continue alongside the Normanton to Leeds railway through the industrial areas of Stourton and Hunslet, just north of the M621. The spur would continue in cutting into Pottery Field before rising into the elevated new station at New Lane in Leeds.

Initial preferred scheme eastern leg: north of Winterset, including Leeds spur and ECML connection



5. Describing sustainability impacts and their mitigation

5.1. Introduction

- 5.1.1. The Sustainability Summary presents the findings of the AoS work undertaken to date to inform the design of the initial preferred scheme. This appraisal work will continue as the scheme design is refined, using more detailed information to inform the full AoS Report of the preferred Phase Two scheme, which will be consulted on in due course. The AoS uses a well-defined and rigorous approach that has been devised to enable an increasing depth of appraisal through successive phases of option development. As well as informing the design of the preferred Phase Two proposals that will be subject to public consultation, the AoS process will also inform the consideration of any proposed post-consultation changes.
- 5.1.2. Although akin to an EIA the AoS is a precursor to, not a substitute for, this process. An EIA will follow in due course, and a report of its findings will accompany a hybrid bill for the provision of powers to construct and operate Phase Two. The EIA will involve a more in-depth assessment, taking account of a wider range of environmental information derived from, amongst other things, baseline site surveys. Phase One of HS2 is currently the subject of an EIA.
- 5.1.3. The potential sustainability impacts of the scheme are described according to each of the 18 sustainability topics listed in Chapter 3. The elements addressed by the AoS up to this point in the process for each of these topics are summarised below. Not all of the AoS topics have yet been considered in detail, owing to the early stage of design and/or their inability to help with option sifting.

AoS topic	Coverage in this report
Reducing greenhouse gas emissions and combating climate change and its effects	
Climatic factors and adaptability	Addressed in terms of flood risk only at this stage (covered under water resources and flood risk)
Greenhouse gases	Embedded carbon estimates were developed for route options, although in the absence of wider carbon footprint information (to be addressed in the full AoS Report) they are not covered in this report. However, information on the weight of steel and concrete and the volume of excavated materials (both of which correlate with embedded carbon) is covered under waste and material use .
Natural and cultural resource protection and environmental enhancement	
Landscape	Covered under landscape
Townscape and cultural heritage	Covered under cultural heritage and landscape
Biodiversity and geodiversity	Covered under biodiversity and wildlife . No information on geodiversity, other than that reflected in geological SSSIs, is available at this stage
Water resources	Covered under water resources and flood risk
Flood risk	Covered under water resources and flood risk

AoS topic	Coverage in this report
Creating sustainable communities	
Air quality	Not addressed at this stage other than in terms of proximity of dwellings to route (covered under property and settlements) which serves as a proxy for risk of exposure to, amongst other things, construction dust. There would be implications for air quality from generated traffic at stations, as well as from modal shift, but these have not been determined at this stage.
Noise and vibration	Covered under noise . It is assumed that all significant effects from vibration could be mitigated.
Community integrity	Covered under property and settlements
Accessibility	Covered under access issues
Health and well-being	Not covered directly at this stage, although addressed indirectly through consideration of impacts on other components of community integrity, such as demolitions or noise (covered under property and settlements and noise)
Security and safety	Not addressed at this stage; would not vary significantly between options
Economic prosperity	Not addressed at this stage
Economic welfare	Covered under planning and development and employment and housing
Sustainable consumption and production	
Soil and land resources	Covered under land use resource
Waste generation	Covered under waste and material use
Resource use	Covered under waste and material use

- 5.1.4. The AoS has been principally concerned with permanent effects resulting from landtake and operation of the railway and its infrastructure. Details of construction are yet to be developed in detail, but would be addressed in due course by the EIA. Where reference is made to direct effects, these refer to impacts due to physical incursion on a feature by the initial preferred scheme. Indirect effects would occur away from the scheme but would be expected to result from the scheme's physical presence or operation.
- 5.1.5. The remainder of this chapter sets out the scope for the sustainability headings, along with an outline of the appraisal method. The potential effects of the western leg and eastern leg are described respectively in chapters 6 and 7.

5.2. Planning and development

- 5.2.1. HS2 may affect the development potential of land, either positively or negatively. For example, an interchange station could have beneficial effects by encouraging wider development through improved connectivity. A negative effect could arise where the scheme infringes on an area designated for another use or results in delays to consent decisions. In such circumstances, HS2 Ltd would seek to work with the relevant local authority and/or the affected parties to determine, where possible, how potential impacts might best be managed and how potential opportunities could be maximised.

- 5.2.2. HS2 Ltd has undertaken a review of proposed major development sites and projects from publicly available sources. In addition, consideration of strategic areas located around proposed station locations has been undertaken, in discussion with the local authorities, to determine where interactions, both positive and negative, may result with HS2. .

5.3. Employment and housing

- 5.3.1. The method used to estimate the likely number of jobs and houses potentially supported by HS2 around proposed stations is based on the approach used for the Crossrail project. The appraisal does not address the potential regional economic impacts of HS2. Nor do its conclusions have a bearing on the reported HS2 business case.
- 5.3.2. The amount of development that could be stimulated by HS2 with the introduction of any new station is based on the anticipated additional floorspace of commercial development and residential development within a 1km catchment of the proposed station over the next 25 years, determined for scenarios both with and without HS2 to determine the net difference. This reflects the potential for HS2 to “unlock” and bring forward development sites, support higher density and tall buildings and uplift the capacity of existing proposals. The appraisal cannot predict the extent to which a high speed rail station could itself effect transformation in an area, where no such major development proposals exist currently.
- 5.3.3. Information on the property market and potential future development has drawn on a variety of source material including published policy and guidance; relevant strategic planning documents; local planning information and assumptions; and existing property, retail and employment data and studies. In addition, the appraisal has included discussions with local planning authorities and uses the appraisal team’s local area knowledge. It relies to an extent on professional judgement and estimation.
- 5.3.4. Findings are described for each station in terms of HS2’s potential support for additional jobs and housing units. The occurrence of these in areas of relatively higher deprivation has also been identified. The numbers reported would represent new jobs and houses occurring within the catchment area of the HS2 stations, some of which might have occurred irrespective of HS2 but in other areas, and some of which would be entirely due to HS2; the proportion of each is not possible to quantify with any degree of certainty.
- 5.3.5. The Summary also includes estimates, provided by HS2 Ltd, for the numbers of permanent jobs from operation of the Phase Two facilities, including trains, stations and depots; and the number of temporary construction jobs at the peak of construction. The figures are based on the same assumptions used for Phase One at the equivalent stage. The number of operational jobs is based solely on those apportioned to the Phase Two scheme, accepting that in practice many people, such as drivers and maintenance staff, would work across the full HS2 network.
- 5.3.6. In addition, the appraisal estimates the likely number of jobs displaced due to potential demolition of commercial and industrial properties around stations and depots. However, these jobs would potentially be accommodated elsewhere in the region, and with occupiers having some 10-15 years advance notice of the potential impact, together with the necessary compensation to relocate, these jobs are considered as displaced as they are unlikely to be lost to the region.

5.4. Access issues

- 5.4.1. HS2 is fundamentally about improving access, in getting people to where they need to be more quickly, efficiently and in larger numbers. To do this most effectively it is important that the new railway provides an interchange hub with other transport infrastructure: roads, railways, airports, cycleways and footpaths.
- 5.4.2. The AoS also considers potential severance of ‘promoted recreational routes’, which are rights of way given additional status, albeit informally, by their designation as long distance

paths². These comprise continuous recreational walking trails which are actively publicised or promoted.

- 5.4.3. HS2 Ltd would aim to avoid stopping up existing rights of way (not just promoted recreational routes) where possible, and to maintain access across the railway through the on-going design of the scheme. This would involve working with local people, local authorities and relevant organisations to determine the best way of achieving this where feasible.
- 5.4.4. Potential impacts from the loss of recreational access are also reported, as measured by length of route crossing National Trust Land and open access land.

5.5. Property and settlements

- 5.5.1. Consideration of impacts on properties and settlements is largely addressed at this stage in terms of potential demolitions. Counts have been made of the number of residential properties, community facilities, industrial and commercial properties that would potentially be demolished by the route and station options, with further context provided by reference to such impacts within areas of relatively high deprivation.
- 5.5.2. In addition, the report addresses the potential for the route to result in severance or isolation of residential communities. Severance would occur when settlements are divided by the route; isolation would occur where areas become enclosed between the route and other, existing infrastructure, such as motorways or railways. HS2 Ltd would seek to mitigate any potential impacts as part of ongoing scheme design.
- 5.5.3. Other factors addressed by the AoS include impacts on country parks; the number of people at risk of construction disturbance (as measured by number of dwellings within 100m of above ground route); and impacts on areas of relatively high tranquillity³, although no such tranquillity areas would be affected by the initial preferred scheme.

5.6. Noise

- 5.6.1. Following a standard method, developed for HS2 and in accordance with WebTAG⁴, the noise impact results are based on the outputs of a noise model. They are represented as the change in population annoyed by noise from high speed trains and the number of properties potentially qualifying for noise insulation⁵. There is no consideration given at this stage to the potential impacts of noise from stations or depots.
- 5.6.2. The HS2 noise levels and the changes in noise levels are *not* calculated at individual dwellings: rather the appraisal focuses at a community level and identifies both the clusters of properties where comparable impacts may arise, and the numbers of people in these clusters that would potentially be affected. At later stages of the AoS process, a more refined model will be used. Further detail regarding likely noise effects would be determined at the EIA stage.
- 5.6.3. As well as helping to compare the impacts of different options, the main purpose of the noise appraisal at this stage is to help identify where the inclusion of noise mitigation, such as noise barriers or earth bunds, would be of most immediate benefit. Once a preferred scheme has been identified, and prior to public consultation, noise impacts will be assessed with indicative mitigation included, to provide a more representative impression of the scale of the impact and any residual effects.

² They also include national trails, although no such paths are affected by the initial preferred scheme.

³ Based on the Campaign to Protect Rural England (CPRE) regional tranquillity maps.

⁴ The DfT's web based guidance on appraising transport projects, which for noise is covered by *TAG Unit 3.3.2 – The Noise Sub-Objective Department for Transport August 2012*.

⁵ Based on the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 as amended.

- 5.6.4. In general terms, noise impacts would be expected where the route is at grade or elevated and is close to dwellings. Cuttings would provide various degrees of screening depending on their depth and gradient, while airborne noise impacts would be avoided where the route is in tunnel. Where the route passes through heavily built up areas, noise impacts could be generally limited to locations near the rail corridor, depending on the speed of trains and the orientation, configuration and density of buildings (and thus the screening that might be afforded by them).
- 5.6.5. HS2 Ltd is committed to ensuring that significant effects over tunnels as a result of vibration will be avoided, as experience from HS1 has shown that such potential effects can be mitigated. The assessment of potential vibration impacts and any necessary mitigation will be addressed by the EIA, once design details are sufficiently advanced.

5.7. Landscape

- 5.7.1. The area crossed by the initial preferred scheme encompasses a diverse range of landscape types, each one presenting to various degrees both constraints and opportunities to the development of a high speed railway. At this stage, the AoS has provided a general qualitative description of the landscape setting, visual sensitivities and potential visibility of the route, together with an indication of the principal landscape character and visual impacts that would occur. The appraisal is based on a study of maps and aerial photos. Site visits were made to all station sites to determine the degree of fit of new stations with respect to existing landscape or townscape character.
- 5.7.2. The AoS has used GIS appraisal of the more valued and protected areas of landscape, including Areas of Outstanding Natural Beauty (AONBs) and National Parks. However, the initial preferred scheme follows a route that avoids all direct impacts on these areas, and it is sufficiently distant from them to ensure that impacts on views on those potentially affected (namely, the Peak District National Park and Cannock Chase AONB) would be insignificant.
- 5.7.3. With continuing design, increasingly detailed proposals for mitigating impacts will be developed including variations in alignment, use of earthworks to help screen views and proposals for planting, particularly where this can be integrated with existing woods. These will explore any mutual opportunities for noise mitigation and ecological enhancement where appropriate.

5.8. Cultural heritage

- 5.8.1. England's principal heritage assets are protected through a series of statutory and non-statutory designations, including Scheduled Monuments, Historic Battlefields, Listed Buildings, Registered Parks and Gardens and Conservation Areas. The AoS has considered these assets, both in terms of direct impacts and effects on their settings. Impacts on setting were determined through inspection of maps and aerial photos. On-site inspections would be undertaken at a later stage, although some site visits have been undertaken to clarify impacts on certain features and areas, including terminus and intermediate stations. In addition, separate visits along the western and eastern legs were undertaken with English Heritage to discuss options potentially affecting certain key sites.
- 5.8.2. There is also a range of non-statutory designated heritage assets such as locally listed buildings, archaeological sites (including nationally important, but non-scheduled monuments) and historic landscapes. Information on these are held by a number of data sources and records, and will be considered in due course by the EIA.

5.9. Biodiversity and wildlife

- 5.9.1. Like cultural heritage, important ecological habitats are protected in the UK through a series of designations, each based on a range of qualifying criteria. The most important sites for biodiversity are those identified through international conventions and European Directives. A number of these sites occur within the study area and an extensive screening exercise has been undertaken to determine the likelihood of impacts. The route of the initial preferred scheme, together with some early design concepts, have been devised in discussion with Natural England and the Environment Agency in order to avoid these potential impacts.
- 5.9.2. Other key designations considered by the AoS include Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Biodiversity Action Plan (BAP) habitats and Ancient Woodlands. Local nature reserves will be reported in due course in the full AoS Report.
- 5.9.3. In addition, there are a number of non-statutory, locally listed designations, information on which is held by a number of sources, notably the Wildlife Trusts. The occurrence of particular species is not known at this stage, other than where they are mentioned within citations for protected sites. Surveys of protected species and consideration of locally designated sites would form part of the EIA.
- 5.9.4. On-going appraisal for the AoS will consider general opportunities for ecological enhancement. At later stages, as part of the EIA, detailed mitigation proposals will be developed that focus on the necessary measures for improving specific habitats.

5.10. Water resources and flood risk

- 5.10.1. The potential effect of the HS2 route on the rivers it crosses depends both on the extent of physical impact and the size of the rivers' catchments. The more significant potential impacts would be those where substantial works would be required to a river, such as in-channel works, channel widening and works within the floodplain. These are referred to collectively as river diversions. The engineering design teams have worked closely with our water specialists to avoid, where possible, the need for such diversions; and further solutions continue to be explored. The rivers potentially affected are described as being either major rivers or minor rivers, depending on whether their catchment areas are respectively greater than or less than 50km² at the point of the crossing. Diversions of these rivers will be carried out in accordance with the usual requirements for main river diversions, as specified by the Environment Agency. Opportunities for environmental enhancement will also be explored.
- 5.10.2. Sources of groundwater are categorised according to how vulnerable they are to pollution. Source Protection Zones (SPZs) define areas of greatest groundwater vulnerability, with the inner zone closest to the supply point, termed SPZ1. Potential impacts, where the route would cut across these SPZs, together with the licensed volumes of drinking water potentially affected are reported here. Where development is proposed within SPZs the impacts will need to be assessed in detail and supported by relevant detailed ground investigations. These will be scoped to establish both the baseline conditions and the magnitude of the likely impact. Appropriate mitigation will then be incorporated in the design and construction methodology in order to avoid any permanent impact on the groundwater abstraction. This mitigation might involve one or a combination of different solutions in order to ensure that the quality and quantity of groundwater available at the abstraction point are preserved, and the requirements of the Water Framework Directive are adhered to.
- 5.10.3. The report also addresses potential flood risk impacts. High flood probability zones comprise Zone 3b (the functional flood plain) and Zone 3a (where flooding is expected to occur at least once in every 100 years). Floodplain crossings would be designed in consultation with the Environment Agency as the scheme progresses.

5.11. Land use resource

- 5.11.1. The value of land in planning and economic terms, and the role it provides to farmers, developers or other 'land managers' is a consideration of the AoS. Potential effects on farmland would occur where agricultural land is lost or severed. The AoS has considered impacts of the scheme on the agricultural land shown on agricultural land classification maps as being of highest grade 1 and 2. The AoS also addresses impacts on green belt, as well as on land designated for waste disposal, and in particular, active landfill sites.
- 5.11.2. The way that HS2 may influence development potential is considered above under the **planning and development** section.

5.12. Waste and material use

- 5.12.1. Excavated material would be produced principally from tunnelling and cuttings. New embankments would require the addition of material. The balance between these is given as an estimated volume. However, the figures reported here are tentative and take no account of the potentially extensive re-use of much of this excavated material within landscaping proposals and noise bunds.
- 5.12.2. The report also records estimated tonnages of bulk building materials, namely steel and concrete, by way of indicating the principal material resource requirements of the project. These have taken into account the steel used for tracks, for tunnel reinforcement and for overhead wires, and the concrete used for permanent way, tunnels, viaducts and stations. The appraisal uses standard conversion factors for steel, but has used more specific conversion factors for concrete, agreed with the engineers, that accommodate the different characteristics of the scheme structures. The information was also the basis for embedded carbon figures which were used during sifting stages, although these figures are not included here, given the absence of wider operational carbon information.

6. Potential sustainability impacts: western leg

6.1. Introduction

- 6.1.1. This chapter describes the main potential sustainability impacts, both beneficial and adverse, that would result along the western leg of the Phase Two proposals. It should be read in conjunction with Chapter 5 which provides the AoS scope up to this point for each topic and gives an overview of the appraisal method.
- 6.1.2. The potential impacts that are recorded here are predicted to result from the initial preferred scheme in its current stage of design and on the basis of the current baseline environment. We could expect many of these impacts to change in detail as further refinements are made, and as mitigation is introduced. Other related works would also be required; for example for road re-alignments, utilities diversions and provision of access by high speed trains onto the existing rail network (the 'classic-compatible' services). Details for these are yet to be agreed. In addition, no construction planning has been undertaken at this stage. All of these additional works will be assessed by the EIA; the classic compatible works will also be considered in the full AoS Report.

6.2. Planning and development

- 6.2.1. Immediately north of Lichfield, the route would pass through the western edge of Fradley Park, which is identified in the Lichfield District Council Local Plan as offering sustainable, mixed use development providing up to 1,000 dwellings. The site is adjacent to an established business park and has planning approval for further business use development.
- 6.2.2. The Highways Agency intends to improve the A556 trunk road between junction 19 of the M6 near Knutsford and Junction 7 of the M56 near Bowdon. The proposals are, at the time of writing, in the pre-application stage and the Highways Agency intends to submit a Development Consent Order application in 2012/2013. The spur into Manchester would pass directly beneath these proposals at their northern end, where it turns alongside the M56.
- 6.2.3. There are a number of planning policy and development designations around the proposed interchange station for Manchester Airport. These include the "World Logistics Hub" and "Airport City" areas that are part of the Manchester Enterprise Zone. On the west side of the M56 there is also an area policy within Trafford Council's Core Strategy that references the future potential development of the Davenport Green site; the proposals would be on the far eastern boundary of this area. The HS2 proposals would take into consideration necessary highway modifications and future potential routes of the Manchester Metrolink.
- 6.2.4. At West Gorton, having emerged from tunnel, the route would pass through the western edge of a proposed mixed use development site which includes proposals for up to 565 dwellings and a community hub. An outline application was approved by Manchester City Council in November 2012 and forms part of the wider regeneration proposals as set out within the West Gorton Masterplan.
- 6.2.5. The terminus station in Manchester would support local policies in the Core Strategy (Public Consultation version, 2011), including the Mayfield development on the site of the former Mayfield Railway Station. It would also encourage the development of the eastern gateway to the city; and it could increase the density and quality of local development, thereby maximising the opportunities of Manchester Piccadilly Station in line with the Strategic Plan for Manchester City Centre (2009-2012).

6.3. Employment and housing

- 6.3.1. The new HS2 stations would enhance existing development potential in surrounding areas, which would in turn support jobs and houses. No assumptions are made in this document about the extent to which HS2 could initiate new development. The proposed terminus station at Manchester Piccadilly is predicted to support an estimated 29,700 jobs as a result of the development which might be expected to be generated as a result of HS2. This relatively high number of potential jobs is due to a number of factors including Piccadilly's position as the main transport hub within the regional centre; its proximity to the heart of the city centre, commercial core and the Southern Gateway / Oxford Road Corridor; an absence of major development constraints or accessibility problems on key sites within the immediate vicinity of the proposed stations; the availability of a large area of potential development sites to the north and east of the existing station, and around the Piccadilly Basin, which have the potential to be 'unlocked' and supported by the arrival of HS2; and the potential and precedent for high density and tall building city centre development, such as the Inacity Piccadilly Tower which has extant planning permission.
- 6.3.2. Of these jobs up to 2,970 jobs would be in areas of relatively higher deprivation. The station could support development of an estimated 3,100 housing units, of which up to 310 would be in areas of relatively higher deprivation.
- 6.3.3. The proposed interchange station at Manchester Airport would support an estimated 300 jobs. This relatively low number of jobs compared with Manchester Piccadilly reflects the fact that the envisaged development described above, under **planning and development**, for the Enterprise Zone, is likely to be built out regardless of HS2. In addition, the site is constrained by green belt and the new station would occupy existing development land.
- 6.3.4. Estimates of direct employment have been prepared for the scheme as a whole. The operational scheme is expected to provide 1,400 permanent jobs. Based on experience of previous large infrastructure projects, up to 10,000 jobs could be created at the peak of construction.
- 6.3.5. Due to its potential demolition of commercial properties, the terminus station could displace businesses providing an estimated 1,900 jobs. However, it is likely that these displaced jobs would be accommodated in the region.
- 6.3.6. The Golborne depot could result in the displacement of approximately 20 jobs, all associated with farm demolitions at Saddletree Fold Farm.

6.4. Access issues

- 6.4.1. The Manchester Piccadilly terminus would offer direct interchange with the national rail network and the Metrolink at Piccadilly, and is within walking distance of Oxford Road Station. It would create new opportunities for pedestrian routes through the undercroft, reducing severance, and would open up the northern end of the station with a new access road.
- 6.4.2. The provision of a new station at Manchester Airport would improve access to this airport, while also linking with existing transport systems, including the M56 and the proposed Metrolink.
- 6.4.3. The route would cross a large number of roads, cycleways and footpaths. A detailed appraisal of all access crossings will be undertaken as part of the EIA. However, as described in Chapter 5, the AoS has only considered potential impacts on promoted recreational routes, six of which would be crossed by the western leg.

6.5. Property and settlements

- 6.5.1. The western leg could result in the demolition of an estimated 122 dwellings. The majority of these would be associated with the spur into Manchester and the terminus station. An estimated 47 dwellings would be demolished at Manchester Piccadilly, north of the existing station. Where the tunnel under Manchester emerges in West Gorton, an estimated 22 dwellings would be demolished by the portal structure and tunnel approach. Three groups of properties, comprising an estimated 14 dwellings in total, would be demolished by the proposed interchange station and its approach, to the south and east of Warburton Green.
- 6.5.2. Other demolitions would be limited to single properties or small groups (less than five) at various locations along the route. Lowton St Mary's is the only exception to this, where an estimated five dwellings would be demolished as the route passes through a narrow corridor between Lowton Common and Golborne.
- 6.5.3. The route could result in isolation or severance of residential properties east of Swynnerton, west of Stone, south of Madeley, Wrinehill, Lostock Gralam, the northern edge of Crewe, east of Whatcroft, and north of Rostherne Mere.
- 6.5.4. The proposals would also require the demolition of two community facilities at Manchester Piccadilly Station. They would require the demolition of an estimated 63 commercial properties, almost all of which would be either at Piccadilly or south of Culcheth. An estimated 28 industrial properties would be demolished, all at Manchester Piccadilly.
- 6.5.5. No assessment of construction impacts has been undertaken at this stage. However, as an indication of the number of people at greater risk from construction impacts, there would be approximately 1,200 dwellings within 100m of the surface route and the provisional station and depot construction boundaries.

6.6. Noise

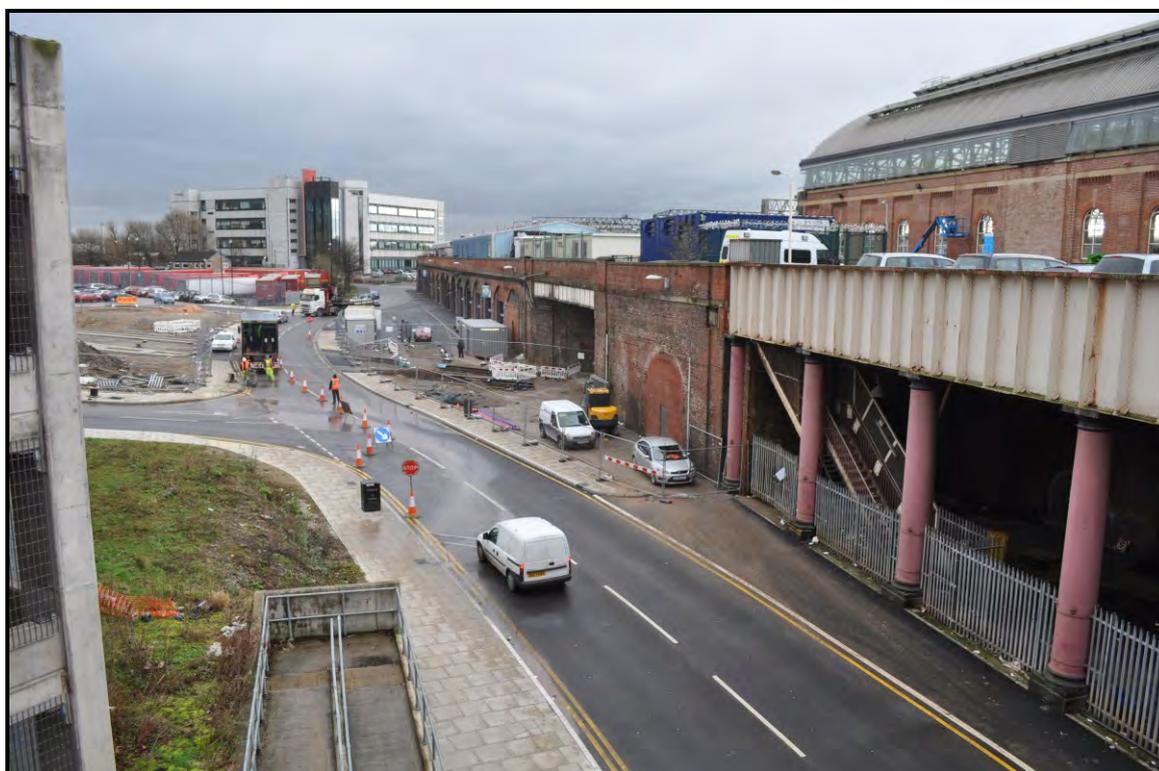
- 6.6.1. At this early stage the appraisal has sought only to identify areas at relatively greater risk of experiencing noise impact. This will help determine the potential need for, and approximate location of, noise mitigation. With this mitigation included in the design, the noise model will be re-run for the preferred scheme to obtain a more definitive view on where noise impacts are likely to be, and these will be reported in the full AoS Report.
- 6.6.2. As a preliminary estimate, without mitigation, there would be approximately 1,500 people along the western leg who could experience noise annoyance as a result of the operational high speed railway. Approximately 450 dwellings could qualify for noise insulation. However, with the application of mitigation in line with the approach being implemented on Phase One of HS2, these impacts could reduce by between 40% and 60%.
- 6.6.3. The settlements at which, or in the vicinity of which, a relatively higher risk of noise impacts has been identified are Great Haywood, Chorlton, Crewe (north), Lostock Green, Hollinfore, Lymm (east) and Warburton.
- 6.6.4. This early appraisal work will help inform the next phase of scheme refinement leading to the preferred scheme, where shifts in alignment may be possible to address particular impacts. It will also identify a list of locations where noise mitigation is likely to be required, so that this can be included in the next phase of design, prior to public consultation. For the noise appraisal, mitigation will be modelled with noise barriers. However, more tailored solutions, such as landscaped bunds, would be developed at later stages in consultation with affected communities as part of the EIA.

6.7. Landscape

- 6.7.1. North of Lichfield, the 2km long viaduct across the Trent Valley north of Handsacre would be prominent in the landscape, while the shorter crossing of the Trent and Mersey canal would cause localised visual impacts.
- 6.7.2. North of the Trent Valley the route would cross areas of rolling farmland, including some deep cuttings through hillsides as well as a number of short viaducts. This would affect landscape character and cause visual impacts across surrounding areas of open countryside near to Whitmore and Madeley. However, refinements to the alignment, taking it further west and using lower and shorter viaducts, as well as the introduction of a tunnel to the west of Madeley, have sought to reduce potential impacts on these settlements, from which the route would be viewed beyond the WCML.
- 6.7.3. Continuing north, the route would emerge into the extensive landscape of the Cheshire and Staffordshire Plain, with its lush and well-managed farmland. Approaching Crewe the route would be generally either in cutting or at grade, and would closely follow the western edge of the WCML. Landscape and visual impacts would therefore be quite limited, although a short section of low embankment and viaduct would result in some visual impact at the edges of Chorlton and Hough.
- 6.7.4. The proposed depot south of Crewe would occupy open, flat farmland close to existing Basford Hall railway sidings and industrial land. Landscape and visual impacts would be generally minor, seen principally by motorists and with limited views from parts of the village of Basford, which lies close to the site.
- 6.7.5. Emerging from tunnel north of Crewe, the route would cross several kilometres of very gently undulating landscape at grade, except for viaducts over the Trent and Mersey Canal and the River Dane. Visual impacts would affect Clive near Winsford, and Bostock Hall, the latter affected by the viaduct over the river.
- 6.7.6. Further north the route would run through farmland characterised by small fields, ponds, meres and mosses and tree-lined streams. The integrity of these historic landscape patterns could be affected to some degree, for example at Lostock Gralam where valley-side woodland would be affected. In addition, visual intrusion could result from high embankments and short viaducts at stream crossings; for example, at parts of Lostock Green. Embankments rising over the M6 could result in visual intrusion within the relatively flat and open landscape.
- 6.7.7. North of the M6 the route would enter the more populated landscape of the Mersey Valley, characterised by networks of roads, railways, canals and power lines. Up to the east of Lymm the route would closely follow two overhead power lines. It would cross the Bollin Valley and the Trans Pennine Trail on low viaduct resulting in localised landscape and visual impacts.
- 6.7.8. The route would require a high viaduct over the Manchester Ship Canal and then a continuing length of embankment. These would result in landscape impacts, as well as visual intrusion for residents in parts of Partington, Hollins Green, Cadishead and Glazebrook. The route would drop into cutting south of Culcheth, which would limit its visual impact on the town.
- 6.7.9. The main route and proposed depot near Golborne would fragment open countryside between Golborne and Abram. However, a number of revisions have sought to reduce potential impacts, including avoidance of crossings of the Leeds and Liverpool Canal and Abram Flashes SSSI. The elevated access road over the depot and structures within the depot, would affect views from the canal and parts of Dover and Crankwood. However, design revisions have avoided direct intrusion into the floodplain setting and reduced potential visual impacts on Pennington Flash Country Park.

- 6.7.10. The spur into Manchester running north of the M6 would be on embankment across open farmland. Residents in parts Winterbottom would have some visual impact, as would those at the edges of Hoo Green and Hulseheath. However, the close presence of power lines and the existing road network would limit the degree of landscape impact.
- 6.7.11. Running south of the M56, the route would pass largely in cutting through relatively unspoilt countryside, with a number of farmsteads and hamlets crossed by the route, notably Thorns Green and Halebank. Open southerly views from Ashley to Tatton Park would be interrupted by the embankment, although the setting of the park itself, which is more than 300m away at its closest point, would be largely unaffected. Impacts on small valley-side woods would have local landscape and visual effects.
- 6.7.12. The proposed interchange station at Manchester Airport would be located on greenfield land west of the M56. Views from the north and west would be contained to some degree by existing woodland along Timperley Brook, although the loss of some of this woodland would adversely affect local landscape character. Visual impacts would affect the northern edge of Hale Barns, but generally the close proximity of the motorway would limit potential impacts.
- 6.7.13. Cuttings and portal structures at each end of the long tunnel beneath Manchester could have some direct impacts on farmland in the south, and school grounds and a residential area at West Gorton in the north, resulting in local visual impacts.
- 6.7.14. The terminus station would be sited on land currently occupied by a mix of offices, light industrial and railway related uses. It would have a roof line at approximately the same height as the existing station. In general, the station development and approach would fit well with the existing townscape in terms of height and scale. Some views of the existing historic station would be obscured, including those of the northern façade by the new station building, and of the southern façade by the new train crew building. However, the overall impact on townscape is expected to be low.

The new Manchester station would sit alongside the existing one at Manchester Piccadilly



6.8. Cultural heritage

- 6.8.1. Given the rich heritage of the area crossed by the scheme, especially based on its more recent industrial history, the initial preferred scheme has to a large extent limited potential adverse impacts on the area's historic legacy. In total, three Grade II Listed structures would be directly affected, although Registered Parks and Gardens and Scheduled Monuments are avoided altogether. The impacts on the settings of designated historic features is expected to be limited, although more detailed assessment will follow at a later stage as part of the EIA. Further details on the potential effects of the western leg are given below.
- 6.8.2. North of Lichfield, the route would cross over the Trent and Mersey Canal Conservation Area. Further north, the approach to Madeley has been revised to avoid demolition of the Grade II Listed Hey House, although there would be some impact on its setting. The settings of a Grade II Listed bridge over the canal and the Grade II Listed Woodhouse Farmhouse would also be affected.
- 6.8.3. Continuing north of Crewe, there is the potential for impact on the setting of a Scheduled medieval moated site at Minshull Vernon. It is located in open farmland and would have clear views of the alignment along the line of a pre-existing railway.
- 6.8.4. Further north, the route would once again cross over the Trent and Mersey Canal Conservation Area, as well as the Shropshire Union Canal Conservation Area as it passes between Winsford and Middlewich. The Grade II Listed Hollow Wood farmhouse, just south of the M6, would have its setting affected to some degree, although it is partially screened by existing modern farm buildings.
- 6.8.5. Continuing north of the M6, the settings of the Grade II Listed Winterbottom Farmhouse at Winterbottom and the Grade II Ovenback Cottage near High Legh would be affected.
- 6.8.6. Passing the south side of Culcheth, the Grade II Listed Newchurch old 'refectory' would be demolished.
- 6.8.7. Although designed to avoid direct impacts on the Grade II* Listed Lightshaw Hall, the depot near Golborne would adversely affect the setting of this building, which would remain within the depot site. It would also affect the setting of the Grade II Listed Byrom Hall.
- 6.8.8. The spur into Manchester would pass some 300m north of the Grade II* Tatton Park at its closest point, although impacts on its setting would be minimal. The new interchange station at Manchester Airport would require the demolition of the Grade II Listed Buckhall (now part of a hotel).
- 6.8.9. The terminus station at Manchester Piccadilly is expected to require internal works to the fabric of the Grade II Listed train shed at Piccadilly Station, including breaking through of the undercroft. There would also be a major impact from the new train crew building. The new HS2 station would affect the setting of a Grade II Listed former goods office, the Whitworth Street Conservation Area to the west, and to some extent the Stevenson Square Conservation Area to the north.

6.9. Biodiversity and wildlife

- 6.9.1. The extraction of salt, by dissolving it and pumping it out of underground deposits within Mercia Mudstone has caused subsidence flashes which form important wetland areas. One of these areas north-west of Rugeley is Pasturefields Salt Marsh, which forms the only significant remaining example in the UK of a natural salt spring with inland saltmarsh vegetation. Consequently it is protected internationally as a Special Area of Conservation (SAC). HS2 Ltd has undertaken substantial work analysing the risks presented to this site, in conjunction with Natural England and the Environment Agency. As a result, the initial preferred scheme was selected on the basis of it having no adverse impact on the marsh's conservation status⁶.
- 6.9.2. Much of the ecological interest of the area potentially affected by the western leg is associated with the meres and mosses of the Cheshire and Staffordshire plains. A number of substantial water-bodies have been formed within depressions where glaciers have rounded off sandstone outcrops, creating meltwater channels and lake beds and depositing a variety of materials from boulder clay to marls, sands and gravels. These deposits have in places caused the formation of a number of shallow meres and mosses.
- 6.9.3. One group of meres and mosses within the Cheshire Plain is collectively designated the Midland Meres and Mosses Ramsar site⁷. The route would pass near two components of this – Betley Mere south of Crewe and the Mere, Mere west of Knutsford, both of which are also SSSIs. Betley Mere would lie east of the route. Although its international conservation status would not be affected, potential indirect impacts on the SSSI would need to be mitigated through use of best practice techniques. The Mere, Mere would be unaffected by the scheme, which passes to its west, given the design measures agreed with the Environment Agency and Natural England to ensure groundwaters feeding the mere are unaffected⁸.
- 6.9.4. Rostherne Mere immediately north of the Mere, Mere is separately designated a Ramsar site, as well as a NNR and SSSI. The scheme would pass to the west of this site, while the spur to Manchester would pass to the north. Neither section would affect Rostherne Mere's international status, again given the design measures agreed with the Environment Agency and Natural England to ensure groundwaters feeding the mere were not affected⁹. However, other potential indirect effects, for example on birds, would require mitigation.
- 6.9.5. As the route crosses the M62 to the east of Birchwood, it would pass near to Holcroft Moss SSSI, an area of raised bog. This, along with two other moss areas (neither of which would be affected by the initial preferred scheme) is designated as the Manchester Mosses SAC. Again, HS2 Ltd has undertaken detailed study of the risks to this European designated site, including discussions with Natural England and the Environment Agency. The route design has been developed such that impacts to this site would be avoided and its conservation status unaffected¹⁰.
- 6.9.6. Revisions to the design for the depot near Golborne have meant that direct impacts to Abram Flashes SSSI would be avoided, although there would remain risks of indirect impacts for which mitigation measures would need to be developed.
- 6.9.7. The route would also directly affect 12 BAP Habitats, six of which are also designated as Ancient Woodlands; these are indicated on the sustainability maps at the end of this document. In most cases, these direct impacts would affect only a proportion of the habitat and further design will seek to minimise or avoid these impacts as far as practicable.

⁶ HS2 Phase Two: HRA Screening Report for Pasturefields Salt Marsh SAC.

⁷ An international designation for wetlands, effectively equal in status to European designations.

⁸ HS2 Phase Two: HRA Screening Report for Midland Meres and Mosses Ramsar site.

⁹ HS2 Phase Two: HRA Screening Report for Rostherne Mere Ramsar site.

¹⁰ HS2 Phase Two: HRA Screening Report for Manchester Mosses SAC

Rostherne Mere



6.10. Water resources and flood risk

- 6.10.1. Close working between the scheme engineers and AoS water specialists has been successful in avoiding the need for river diversions along most of the route. However, diversions of minor rivers are still envisaged at eight locations.
- 6.10.2. Although aquifers would be crossed in a number of locations, potential impacts to groundwater supplies have been largely avoided. At Lowton, east of Golborne the route would cut through approximately 1.2km of SPZ2, potentially affecting groundwater flows to Pocket Nook 1 abstraction point (7,956m³/day). In addition, the depot at this location would intersect about 21ha of SPZ2 and may affect groundwater flow towards Slag Lane abstraction point (7,728m³/day). Whitmore borehole (12,420m³/day) and Swynnerton 1, 2 & 3 (10,227m³/day) would also potentially be affected. The way that these issues are resolved will be the subject of discussion between HS2 Ltd and their engineering teams, and the relevant water authorities, as set out in Section 5.10.
- 6.10.3. In total, the route would pass across 4.9km of highest risk Flood Zone 3, using designs that incorporate the general Environment Agency requirements to reduce risks to flood capacity and the passage of flood water. The most significant stretch includes the flood plain of the River Dane and its tributaries past Middlewich and Northwich. Other crossings include those of the River Bollin and its tributaries by the main route east and north-east of Lymm, and by the station spur south of Altrincham. The depot at Crewe would be within the flood plain of Gresty Brook.

6.11. Land use resources

- 6.11.1. Agricultural land classification maps show that Grade 1 agricultural land is limited to the rich peat of Chat Moss between Manchester and Liverpool. Some 900m of Grade 1 land would be crossed by the main route in the vicinity of Holcroft Moss. In addition, an estimated 19.8km of the route would be through Grade 2 agricultural land, notably along the Basford Brook south of Crewe and in the Mersey Valley around Lymm and Warrington. The depot south of Crewe is shown to occupy approximately 4.6ha of Grade 2 land, although it should be noted that much of the site comprises existing rail sidings.
- 6.11.2. The main areas of green belt crossed by the route would occur north of Lichfield, west of Stoke and on the approach to Manchester and connection to WCML. The interchange station would occupy some 6ha of green belt.
- 6.11.3. Two active landfill sites would be directly affected by the initial preferred scheme. Measures to mitigate potential effects from these crossings, reflecting best practice at that time, would need to be agreed with the Environment Agency. The sites are indicated on the sustainability maps at the end of this document.

6.12. Waste and material use

- 6.12.1. Our current estimate for excavated material on the western leg is 15.7 million cubic metres, although this does not take account of the materials likely to be re-used within the scheme for landscaping and bunding. As a result of the crossings of landfill sites, it is possible that some of the waste material arising would be hazardous.
- 6.12.2. The estimated quantities of bulk building material required for the scheme would comprise 334,400 tonnes of steel and 2,992,600 tonnes of concrete.

7. Potential sustainability impacts: eastern leg

7.1. Introduction

- 7.1.1. This chapter describes the main potential sustainability impacts, both beneficial and adverse, that would result along the eastern leg of the Phase Two proposals. It should be read in conjunction with Chapter 5 which provides the AoS scope up to this point for each topic and gives an overview of the appraisal method.
- 7.1.2. The potential impacts that are recorded here are predicted to result from the initial preferred scheme in its current stage of design and on the basis of the current baseline environment. We could expect many of these impacts to change in detail as further refinements are made, and as mitigation is introduced. Other related works would also be required; for example for road re-alignments, utilities diversions and provision of access by high speed trains onto the existing rail network (the 'classic-compatible' services). Details for these are yet to be agreed. In addition, no construction planning has been undertaken at this stage. All of these additional works will be assessed by the EIA; the classic compatible works will also be considered in the full AoS Report.

7.2. Planning and development

- 7.2.1. Emerging from the tunnel beneath East Midlands Airport, the route would pass through a proposed distribution centre and rail terminal, named the East Midlands Gateway Rail Freight Interchange. This is a Nationally Significant Infrastructure Project that would occupy a 100ha site with warehousing and a rail terminal suitable for freight trains up to 750m long. At the time of writing, the applicant had commenced the pre-application process by informing the Planning Inspectorate of their intention to submit a development consent order application. As stated in Chapter 5, HS2 Ltd would seek to work with the relevant local authority in order to minimise impacts and maximise opportunities, where possible.
- 7.2.2. Heading north past Pinxton and towards the A38, the route would pass through the centre of a large site named Castlewood Grange, which has permission for development of employment uses and local policy employment land allocations. Reserved matters have been granted for one part of this phased development. The site is located around the existing East Midlands retail outlet centre.
- 7.2.3. The depot site north-west of Staveley is designated for industrial and business use; Chesterfield Borough Council is currently preparing the Staveley Works Area Action Plan.
- 7.2.4. East of Sheffield, the route would pass through a number of planned growth sites at Orgreave that form part of the Sheffield Enterprise Zone. The sites include the Waverley New Community, the eastern part of which would be crossed by the route. This site would include some 4,000 residential units, commercial development, finance and professional services, leisure and community uses; work on these has commenced. The masterplan for the site also includes the Waverley Advanced Manufacturing site.
- 7.2.5. There are a number of policy allocations and planning consents on the approach to Meadowhall station: these include business and employment uses and the Meadowhall Quadrant masterplan. The station at Meadowhall would support the designation of the new Enterprise Zone, and the development of the area as a location for offices, with the potential to meet some longer term housing needs (Sheffield City Council Core Strategy 2009), the regeneration of the Lower Don Valley and growth of the wider city region.

- 7.2.6. The Welbeck landfill west of Normanton, which is currently the largest landfill facility within the Wakefield District area, would be crossed by the route. It has land allocated within the waste development plan document both for landfill and for the development of new commercial and industrial waste recovery facilities and modernised household waste recycling facilities.

Proposed station site at Meadowhall



- 7.2.7. The route would pass through the eastern edge of a proposed mixed used development site, which includes Wakefield Trinity Wildcat Stadium and business units. Following a public inquiry the scheme has been provisionally allowed, subject to legal agreement.
- 7.2.8. The approach to the Leeds terminus would pass through Character Area 8 of the Aire Valley Action Plan known as the Stourton Corridor. The proposed alignment would follow an existing rail corridor but would require widening through an area with a number of policy allocations, including mixed employment, general industry and warehousing.
- 7.2.9. The Leeds terminus would support the Enterprise Zone designated in the Aire Valley. The station would conflict with the South Bank Planning Statement. However, there is potential for the station to be integrated into the masterplan for the area south of the River Aire. The station would support the growth of the southern side of the city and the wider city region, as identified in the draft core strategy.

7.3. Employment and housing

- 7.3.1. The new HS2 stations would enhance existing development potential in surrounding areas, which would in turn support jobs and houses. No assumptions are made in this document about the extent to which HS2 could initiate new development. It is estimated that the New Lane station in Leeds could support an estimated 13,200 jobs, of which up to 3,250 would be in areas of relatively high deprivation. The station could support an estimated 1,700 housing units, of which 300 would be in areas of relatively higher deprivation.

- 7.3.2. The East Midlands Hub could support an estimated 1,500 jobs, while Meadowhall station could support an estimated 5,000 jobs, of which up to 3,750 would be in areas of relatively high deprivation. The East Midlands Hub could support an estimated 150 houses and Meadowhall could support an estimated 400 housing units, between 200 and 300 of which would be in areas of relatively high deprivation.
- 7.3.3. As stated previously, the operational scheme as a whole is expected to provide 1,400 permanent jobs, with up to 10,000 jobs created during the peak of construction.
- 7.3.4. Demolitions associated with the construction of the stations would potentially displace a number of businesses. Leeds station would displace an estimated 1,500 jobs; the East Midlands Hub could displace an estimated 600 jobs; and Meadowhall would displace an estimated 1,300 jobs. The Staveley depot could result in the displacement of approximately 50 jobs. However, it is likely that these displaced jobs would be accommodated in the region.

7.4. Access issues

- 7.4.1. The Leeds terminus would offer interchange with the national rail network. The East Midlands Hub would provide an opportunity for interchange with national rail services into Nottingham, Derby, Leicester and Loughborough which would be developed as part of the HS2 proposals. The new station would also accommodate an extension of the NET tramway. The Meadowhall intermediate station would offer interchange opportunities with national rail services and the Sheffield Supertram.
- 7.4.2. The route would cross a large number of roads, cycleways and footpaths. A detailed appraisal of all access crossings will be undertaken as part of the EIA. However, as described in Chapter 5, the AoS has only considered potential impacts on promoted recreational routes, some 35 of which would be crossed by the eastern leg.
- 7.4.3. In addition, the route would pass across 2.5km of National Trust Land associated with Hardwick Hall, although it would avoid the Registered Park and Garden, which lies to the east of the M1.

7.5. Property and settlements

- 7.5.1. The eastern leg could result in the demolition of an estimated 105 dwellings. These are almost all limited to single properties or small groups (less than five) at various locations along the route. The exception to this would be at Toton with an estimated nine residential demolitions and South Tinsley where there would be an estimated 22 residential demolitions.
- 7.5.2. Other locations where groups of residential demolitions are anticipated include: Whateley (six demolitions), Long Eaton (seven demolitions), Nuthall (five demolitions), Langton Hall (seven demolitions) and Renishaw (nine demolitions).
- 7.5.3. The route could result in severance or isolation of residential communities at Whateley, west of Polesworth, Willesley, Worthington, Long Eaton, Stanton Gate, Soleston, Trowell, Hucknall, Butterthwaite, Blackburn and New Crofton.
- 7.5.4. The route would also require the demolition of three community facilities. It would require the demolition of an estimated 116 commercial properties, largely at the station locations but also at Measham and Long Eaton. An estimated 14 industrial properties would be demolished, with five at Toton for the East Midlands Hub.
- 7.5.5. No assessment of construction impacts has been undertaken at this stage. However, as an indication of the number of people at greater risk from construction impacts, there would be approximately 2,100 dwellings within 100m of the surface route and the provisional station and depot construction boundaries.

7.6. Noise

- 7.6.1. At this early stage the appraisal has sought only to identify areas at relatively greater risk of experiencing noise impact. This will help determine the potential need for, and approximate location of, noise mitigation. With this mitigation included in the design, the noise model will be re-run for the preferred scheme to obtain a clearer early view on where noise impacts are likely to be, and these will be reported in the full AoS Report.
- 7.6.2. As a preliminary estimate, without mitigation, there would be approximately 6,200 people along the eastern leg who could experience noise annoyance as a result of the operational high speed railway. Approximately 1,400 dwellings could qualify for noise insulation. These relatively higher numbers when compared with the western leg reflect the denser areas of population that would be passed by the eastern leg. As a result, with the application of mitigation in line with the approach being implemented on Phase One of HS2, these impacts could reduce by 75% or more.
- 7.6.3. The settlements at which, or in the vicinity of which, a relatively higher risk of noise impacts has been identified are Kingsbury, Whateley, Tamworth (east), Polesworth, Measham, Packington, Ashby de la Zouch, Worthington, Long Eaton, Stapleford (north), Nuthall, Westville, Hucknall (west), Hilcote, Huthwaite, Staveley, Renishaw, Killamarsh, Beighton, Swallownest, Treeton, Catcliffe, Tinsley, Wincobank, Shiregreen, Thorpe Hesley, Chapelton, Blacker Hill, Worsbrough, Cudworth, Shafton, Royston, Crofton, Kirkthorpe, Normanton, Methley Lanes, Woodlesford and Hunslet.
- 7.6.4. This early appraisal work will help inform the next phase of scheme refinement leading to the preferred scheme, where shifts in alignment may be possible to address particular impacts. It will also identify a list of locations where noise mitigation is likely to be required, so that this can be included in the next phase of design, prior to public consultation. For the noise appraisal, mitigation will be modelled with noise barriers. However, more tailored solutions, such as landscaped bunds, would be developed at later stages in consultation with affected communities as part of the EIA.

7.7. Landscape

- 7.7.1. Passing north-east towards Tamworth, impacts would generally be limited by the route's alignment along the M42, with realignments of the motorway potentially required east of Tamworth. A viaduct over the Tame Valley and across Kingsbury Water Park would result in landscape impacts through loss of woodland, as well as visual impacts on the north and north-west edge of Kingsbury. Further north, use of cutting would limit visual impacts to Tamworth. Another viaduct north-west of Polesworth would result in visual impact for the village and for Pooley Country Park.
- 7.7.2. Continuing alongside the M42, elevated sections would result in visual impacts in parts of Austrey, Measham and Packington. Landscape impact would generally be limited, although local effects would result from the crossing of woodlands between Measham and Packington and from the viaduct over the River Mease.
- 7.7.3. Cuttings through the hills north-east of Ashby-de-la-Zouch would help to contain impacts, although the deep cut and embankment through the woodland at Rough Park would result in landscape impact. Further north, the route would pass the village of Worthington and then cross over the A42 on viaduct close to Breedon on the Hill and Tonge, resulting in visual impacts for parts of these villages.
- 7.7.4. Further north, impacts would be limited by the route's use of cutting and then tunnel beneath East Midlands Airport. Long viaducts across the Soar and Trent valleys would result in visual impacts for residents on the east side of Lockington and the west side of Ratcliffe on Soar, and for recreational users of the various waterways and footpaths in the area.

Existing sidings at Toton



- 7.7.5. Passing through Long Eaton along the line of the existing railway there would be some impact on the character of Long Eaton, and visual impact on its residents, located close to the line.
- 7.7.6. The East Midlands Hub would be sited on the east side of Toton Rail Yard, and would present fairly limited views due to topography and its location on a valley floor. Some visual impacts might be expected from the edge of Toton and Long Eaton and from the Erewash Canal.
- 7.7.7. The route would then follow the corridor of the M1 through a generally urban setting. Elevated sections would result in some impacts; for example on the townscape of Sandiacre, on residents at Stanton Gate and the west edge of Stapleford, and on the settings of the waterways. A cut and cover tunnel would take the route past Strelley; this would minimise impacts in the long term, but would result in temporary landscape and visual impacts during construction. North of Hucknall a cutting through the ridgeline would cross plantation woodland and affect landscape character. The high viaduct across the River Erewash would give rise to visual impact on the east side of Pinxton.
- 7.7.8. The route would continue through and past some sensitive historic landscapes. Past Hardwick Hall (see **cultural heritage**, below), the route, which would closely follow the M1, was selected in part for its lesser impacts to the setting of the hall and associated park and gardens, when compared with other options. However, the sensitivity of the landscape in this area is high, and adverse impacts on its landscape character would occur. There would also be some impact on views from Sutton Scarsdale, although the route would be seen in conjunction with the motorway.
- 7.7.9. On former industrial land, the depot near Staveley would have limited impacts, although the setting of Barrow Hill could be affected. The approach to the depot would cause visual impacts at Hartington and the approach viaducts over the River Rother would affect the character of the valley, the setting of Staveley, and the visual amenity of people in the

valley, including the Canal Marina. The new viaducts to the east would cause visual impacts for residents on the east side of Netherthorpe and the west side of Mastin Moor.

- 7.7.10. Continuing north from Mastin Moor along the Rother Valley, the route would affect woodland at the edge of Renishaw Park, as well as the setting of the valley landscape and the views of recreational users.
- 7.7.11. North of Killamarsh, the viaduct over the River Rother would have limited visual impacts on users of Rother Valley Country Park, and a second crossing of the river south of Treeton would affect the views of recreational users around Treeton Dyke. The route's viaduct crossing of the opencast workings would adversely affect the views of recreational users of Catcliffe Flash and the Trans Pennine Trail, as well as residents in parts of Catcliffe.
- 7.7.12. The new station at Meadowhall would be elevated alongside the M1 and would form a prominent new feature, although within a strongly urban setting, landscape and visual impacts would be limited. Direct impacts on canal side trees would affect the views of users of the Trans Pennine Trail.
- 7.7.13. As the route diverges from the M1 north of Ecclesfield it would result in the loss of woodland, causing both landscape and visual impacts in the Chapeltown area. The emergence of the route from the tunnel beneath Hoyland through hills and woodland, would cause visual impacts on the edges of Blacker Hill and Worsbrough. East of Barnsley, impacts would be limited, although viaducts and embankments in the vicinity of the River Dearne would cause local visual impact in parts of Lundwood and Cudworth.
- 7.7.14. The route would continue north crossing Rabbit Ings Country Park and Cold Hiendley Reservoir. Its high embankment and deep cutting would result in visual impacts for users of Anglers Country Park at Winterset and the two adjacent reservoirs.

Winterset Reservoir



- 7.7.15. The New Crofton depot would be widely visible within the open landscape, resulting in adverse landscape impacts, including the setting of Walton Country Park, and visual impacts for residents at Crofton, New Crofton and Walton. Users of Walton Hall Hotel and golf course would be similarly affected, the latter through loss of woodland on its eastern edge. Users of the country parks, as well as residents in parts of Crofton and Kirkthorpe, would also be affected by views of the route.
- 7.7.16. Across the open and undeveloped Calder Valley, the route would have an effect on landscape character around Normanton and further north near Oulton. It would be visually intrusive for recreational users and residents at Bottom Boat and Normanton. The character of the Aire Valley would be affected by the viaduct and embankments, and visual impacts would affect recreational users and residents at the edge of Woodlesford and Swillington.
- 7.7.17. As far as Garforth, the route would follow the M1 in cutting, with little impact as a result, except where the raised alignment and woodland loss would affect views from the western edge of Garforth. East of the A1(M) it would leave the motorway corridor to cross farmland, but would be in cutting for much of this. Rising on embankment over the Normanton to York railway, it would cause impacts on landscape character and visual impacts south of Barkston Ash and west of Church Fenton.
- 7.7.18. The spur into Leeds along the Aire Valley would have a fairly limited impact on landscape character and views, within the context of former mineral working. However, the viaduct would intrude into the views of residents in parts of Woodlesford and users of the Aire and Calder Navigation and the Trans Pennine Trail. The route would then remain in cutting parallel to an existing railway and through industrial areas. Local visual intrusion would occur as the route rises onto embankment and diverges from the rail corridor.

The Aire and Calder Navigation at Woodlesford



- 7.7.19. Based on preliminary designs, the station terminus at Leeds New Lane would be in scale with existing buildings. The diagonal route of the high level footbridge and pedestrian link would have adverse impacts on townscape character. Further south, the elevated platform and tracks would disrupt existing street patterns, although there could be opportunities for enhancement as part of future redevelopment in the longer term. The new station would affect views from and across the River Aire.

7.8. Cultural heritage

- 7.8.1. Direct impacts would be limited to one Scheduled Monument and five Grade II Listed structures; and of the latter, the two Listed bridges and listed chimney may be avoided through further refinement in design, while a Listed milepost could be preserved. The impacts on the settings of historic features will occur at a number of locations, although a clearer understanding of these would rely on a more detailed assessment at a later stage. Further details on the potential effects of the eastern leg are given below.
- 7.8.2. The route alongside the M42 and A42 would have few impacts on designated historic features. The Grade II Listed Meer Bridge at Measham could be directly affected, but with the route on viaduct, it is likely that physical impact can be avoided.
- 7.8.3. The proposed viaduct across the Trent Valley would directly affect a Scheduled Roman site on Red Hill at Ratcliffe on Soar, although impacts could be limited by careful placement of the viaduct piers and, with no known above ground remains, there would be no impact on its setting.
- 7.8.4. On the southern outskirts of Nottingham, the approach to the East Midlands Hub would affect the setting of the Long Eaton Conservation Area. The setting of a Grade II Listed Canal Bridge on Erewash Canal would be affected, although demolition of this would be avoided.
- 7.8.5. A cut and cover tunnel would take the route beneath the Strelley Conservation Area. This would minimise impacts on a number of Listed buildings, although there would be an adverse effect on the setting of a nearby Scheduled Moat and fishpond. The setting of a Scheduled group of fishponds south of Damstead Farm, near Annesley Woodhouse, would also be affected.
- 7.8.6. Within Derbyshire, the route would follow the M1 corridor through an area rich in historic buildings and settlements, and the choice of initial preferred scheme reflects considerable work developing the options in this location, including discussions with English Heritage. The Grade I Listed Hardwick Hall, sitting on a hilltop between Chesterfield and Mansfield, is one of the most significant Elizabethan country houses in England. Passing about 1km to its west beyond the M1, the route would be seen within some views from the house and its Grade I Registered Park and Garden, although clearly in the context of the motorway. However, the wider landscape, which provides the setting for the house and grounds, would be affected by the scheme.
- 7.8.7. The setting of the Scheduled Stainsby manorial complex north of Hardwick would be adversely affected as the route passes on embankment. The route would pass the edge of the Heath Conservation Area in cut and cover tunnel, but would directly affect the ruins of the Grade II Listed Heath Old Church. Further north, the route would affect views from Sutton Scarsdale Conservation Area, although seen in conjunction with the motorway. Elevated westward views from Bolsover Castle and its Conservation Area would be greatly attenuated by distance.
- 7.8.8. The depot at Staveley could affect the setting of Barrow Hill Conservation Area, and the approach viaducts over the River Rother are likely to adversely affect the character of the Staveley Conservation Area.

- 7.8.9. South of Sheffield, the route would pass through the Eckington and Renishaw Park Conservation Area, affecting the sensitive townscape at this location. However, impacts on the Grade II* Registered Park and Garden of Renishaw Hall would be negligible.

The route passes some 1km west of Hardwick Hall



- 7.8.10. In the Dove Valley, east of Worsbrough, a Scheduled Romano-British settlement is located in Wombwell Wood. The woodland would help to screen views and limit the impact on the setting of the monument. Immediately north of this, the route would adversely affect the settings of an isolated complex of three Grade II Listed buildings at Swaithe Hall Farm; impacts on the Grade II* Listed Swaithe House would be negligible, as other buildings and trees provide screening.
- 7.8.11. On the southern edge of Barnsley, the Scheduled Monk Bretton Priory and a Grade I Listed building would have eastward views of the route on viaduct over the Dearne Valley, but distance would greatly attenuate impact on the settings of these structures. A Grade II listed chimney at Bleachcroft Farm, Cudworth would potentially be directly affected, although further route refinement may avoid this feature.
- 7.8.12. With no above ground remains, the setting of the Scheduled Newland Preceptory at Normanton within the Calder Valley would be unaffected. However, the settings of two Grade II Listed farm buildings on the site would be affected. There may also be a direct impact on a Grade II Listed milepost although this could be preserved.
- 7.8.13. The spur into Leeds would directly affect the Grade II Listed Swillington Bridge over the Aire and Calder Navigation.
- 7.8.14. As already discussed, the station at New Lane would adversely affect the townscape through its impact on the local street pattern and through its intersection of the Canal Wharf Conservation Area. It would also adversely affect the setting of the Grade II Listed Victoria Bridge. The station development would be planned and designed to fit as far as possible within this townscape, and would also explore opportunities to enhance elements of it where appropriate.

View south from Victoria Bridge of proposed Leeds station site



7.9. Biodiversity and wildlife

- 7.9.1. Many of the sensitive ecological areas potentially affected by the route would be associated with rivers and their valley, including the river habitats themselves, as well as the fens, marshes and meadows alongside them and the Ancient Woodlands that have been preserved on the steeper valley sides.
- 7.9.2. The route's crossing of the River Anker near Polesworth would take the route past Alvecote Pools SSSI, presenting a risk of indirect impacts during construction and operation. Best practice techniques would be defined to establish how these risks would be minimised.
- 7.9.3. Near Measham, the route would cross over the River Mease, which is designated a SAC, as well as a SSSI, due to its aquatic plant communities and the presence of two species of fish: spined loach and European bullhead. HS2 Ltd have undertaken substantial work analysing the risks presented to this site and its wildlife, including discussions with Natural England and the Environment Agency. As a result the initial preferred scheme was selected, and detailed elements of its design were conceived, on the basis of it having no adverse impact on the river's conservation status¹¹.
- 7.9.4. North of Ashby-de-la-Zouch the route would pass near Lount Meadows SSSI, presenting risks of indirect impacts during construction, although these would be controlled through use of best practice techniques.
- 7.9.5. North of Nuthall, the route has been realigned to avoid a direct impact on Bulwell Wood – a SSSI, Ancient Woodland and BAP habitat, although the risk of indirect impacts cannot be ruled out at this stage.

¹¹ HS2 Phase Two: HRA Screening Report for River Mease SAC and HS2 Phase Two: HRA Appropriate Assessment Report for River Mease SAC.

River Mease



- 7.9.6. Use of a viaduct to cross Bogs Farm Quarry SSSI east of Selston would reduce potential landtake and disturbance. However, permanent impacts may arise from changes in hydrology and shading. Annesley Woodhouse Quarries SSSI is located immediately east of this and its grassland flora may be affected by hydrological impacts.
- 7.9.7. The route would also directly affect 23 BAP Habitats, 11 of which are also designated as Ancient Woodlands; these are shown on the sustainability maps at the end of this document. In most cases, these direct impacts would affect only a proportion of the habitat and further design will seek to minimise or avoid these impacts as far as practicable.

7.10. Water resources and flood risk

- 7.10.1. Close working between the scheme engineers and AoS water specialists has avoided the need for river diversions along much of the route. However, the possible need to divert major rivers at seven locations has been identified at this stage, namely:
- The River Erewash at Toton;
 - the River Doe Lea east of Staveley;
 - the River Rother north of Staveley; where it would be crossed by the approach lines to Staveley depot.
 - the River Rother north of Rensishaw;
 - the River Don at Meadowhall;
 - the Aire and Calder navigation north of Woodlesford; and
 - Farnley Beck a tributary of the River Aire on the outskirts of Leeds.
- 7.10.2. In addition, the possible need for diversion of minor rivers at 18 locations has been identified at this stage.

- 7.10.3. Aquifers of good yield and quality would be crossed in tunnel or cutting, notably in the area around Nottingham. No source protection zones or public water supplies would be directly affected by the eastern leg. Nevertheless, an appropriate construction methodology will be developed in accordance with the requirements of the Water Framework Directive, to ensure that the groundwater regime does not become polluted or reduced in quality.
- 7.10.4. In total, the route would pass across 20.9km of highest risk Flood Zone 3, using designs in accordance with general Environment Agency requirements to reduce risks to flood capacity and the passage of flood water. The most significant stretch includes the River Trent between Kegworth and Long Eaton which is crossed by the route as it passes towards Toton. Flood Zone 3 would be directly affected by the East Midlands Hub alongside the River Erewash, Meadowhall station alongside the River Don, and the depot at Staveley alongside the River Rother. The route and spur east of Leeds would cross the flood plains of the Aire and Calder rivers, while Leeds station at New Lane would also partly occupy Flood Zone 3.

7.11. Land use resources

- 7.11.1. Agricultural land classification maps show that no Grade 1 agricultural land would be directly affected by the eastern leg. An estimated 30km of the route would be through Grade 2 agricultural land, notably in the Tame Valley, in the low hills between the Anker and the Mease valleys, in the hills between Strelley and Greasley, and in the undulating plateau between Garforth and Church Fenton. The East Midlands Hub would also occupy over 16ha of Grade 2 land.
- 7.11.2. Green belt surrounds Nottingham and all of the main conurbations between Sheffield and Leeds, so the route would pass through it for much of its length. The East Midlands Hub would occupy an estimated 40ha of green belt. The New Crofton depot would occupy an estimated 31.4ha of green belt.
- 7.11.3. Seven active landfill sites would be directly affected by the initial preferred scheme. Measures to mitigate potential effects from these crossings, reflecting best practice at that time, would need to be agreed with the Environment Agency. The sites are indicated on the sustainability maps at the end of this document.

7.12. Waste and material use

- 7.12.1. Our current estimate for excavated material on the eastern leg is 12.6 million cubic metres, although this does not take account of the materials likely to be re-used within the scheme for landscaping and bunding. As a result of the crossings of landfill sites, it is possible that some of the waste material arising would be hazardous.
- 7.12.2. The estimated quantities of bulk building material required for the scheme would comprise 444,400 tonnes of steel and 4,115,500 tonnes of concrete.

8. HS2 potential combined impacts

- 8.1.1. HS2 will be built in two phases. Phase One will involve construction by 2026 of a new railway approximately 219km (136 miles) long between London and Birmingham, with a connection to the WCML near Lichfield. Phase One was subject to the same AoS process as Phase Two, and its findings in reference to a preferred scheme were published in February 2011. A period of public consultation led to further changes; these are included in an updated AoS Report¹². In order to provide an understanding of the sustainability performance of HS2 as a whole, this section summarises the potential combined impacts of HS2, emphasising those elements that can be quantified. The information is taken from this Sustainability Summary of Phase Two and the updated AoS Report for Phase One. Fuller consideration of these combined impacts will be provided in due course, within the full AoS Report.
- 8.1.2. In practice, the design of the Phase One scheme has evolved further since this time. In January 2012, the Secretary of State for Transport announced the Government's intention to proceed with HS2, and identified a preferred line of route from London to the West Midlands. An EIA of this scheme is underway and its findings will be published at the end of 2013 in an Environmental Statement (ES). The ES will reflect any changes to the scheme that have been made since January 2012 on the basis of more detailed design work, the recommendations of the EIA and the outcome of further public consultation.
- 8.1.3. Nonetheless, the combined impacts reported here reflect the findings of largely identical appraisals that have been undertaken to a comparable level of detail. The key differences in the derivation of the reported numbers for the Phase One and Phase Two schemes concern noise, where the Phase One appraisal excludes demolished properties (they are included for Phase Two at this stage), uses greater detail on earthwork profiles (including retained cuttings) and has better detail close to the route in terms of location of receptors. In addition, some minor changes to assumptions regarding screening in built up areas were put in place for the Phase Two appraisal to improve accuracy of the estimates.
- 8.1.4. The conversion factors used in calculating the quantities of concrete and steel have also been refined for the Phase Two proposals, resulting in more accurate estimates than were given for a similar stage on Phase One.
- 8.1.5. The sustainability performance of the Phase Two initial preferred scheme is expected to improve as further mitigation is incorporated with evolving design and in response to public consultation. This has been the case for the Phase One scheme with which the Phase Two scheme is now compared.

¹² High Speed 2 London to West Midlands Appraisal of Sustainability - Post Consultation Route Refinements

Table 8.1 Combined impacts of Phase One and Phase Two

	Phase One	Phase Two Manchester	Phase Two Leeds	(Phase Two total)	Total
Route characteristics (km)¹³					
<i>Total</i>	219.1	153.1	187.0	340.1	559
<i>At grade</i>	27.6	16.9	6.1	23	50
<i>Bored or cut and cover tunnel</i>	28.1	17.1	8.8	25.9	54
<i>Green tunnel</i>	8.1	0.5	0.0	0.5	9
<i>Cutting</i>	91.2	55.8	78.1	133.9	225
<i>Viaduct</i>	25.6	14.3	33.9	48.2	74
<i>Embankment</i>	38.5	48.5	60.1	108.6	147
Property and settlements					
Residential demolitions	338	122	105	227	565
Total demolitions (including residential)	528	215	238	453	981
Isolation and severance (number of dwellings)	51	15	69	84	135
Employment and housing					
Permanent jobs created	1,500	-	-	1,400	2,900
Construction jobs created	9,000	-	-	10,000	19,000
Jobs supported	30,000	30,000	19,700	49,700	79,700
Houses supported	Not reported	3,100	2,250	5,350	-
Jobs displaced	800	1,920	3,450	5,370	6,170

¹³ Alignment dimensions for the Phase One scheme were as at January 2012, but may have changed since this time

	Phase One	Phase Two Manchester	Phase Two Leeds	(Phase Two total)	Total
Noise					
Unmitigated noise	People annoyed by noise: ~3,200	People annoyed by noise: ~1,500	People annoyed by noise: ~6,200	~7,700	NA ¹⁴
Unmitigated noise/km of route (indicative and rounded to whole number)	People annoyed by noise: ~15	People annoyed by noise: ~10	People annoyed by noise: ~33	People annoyed by noise: ~23	NA
WebTAG monetary cost	£158,000,000	£78,000,000	£320,000,000	£398,000,000	£556,000,000
Landscape					
AONB crossed at surface (km)	8.9	0	0	0	8.9
Cultural heritage					
Scheduled Monuments directly affected	1	0	1	1	2
Grade I & II* structures directly affected	0	0	0	0	0
Grade II structures directly affected	14	3	5	8	22
Registered Parks and Gardens directly affected	2	0	0	0	2
Biodiversity and wildlife					
European sites affected	0	0	0	0	0
SSSIs directly affected	4	0	1	1	5
Ancient Woodlands directly affected	16	6	11	17	33

¹⁴ Total noise impacts not determined at this stage, as previously reported Phase One impacts would be affected by increased train frequency for the Phase Two service

	Phase One	Phase Two Manchester	Phase Two Leeds	(Phase Two total)	Total
BAP habitats directly affected	31	12	23	35	66
Water resources and flood risk					
Route through SPZ1 and SPZ2 (km)	11.2	3.2	0	3.2	14.4
Route through Flood Zone 3 (km)	4.4	4.9	20.9	25.8	30.2
Major rivers diverted	5	0	7	7	12
Land use resource					
Active landfills crossed	3	2	7	9	12
Grade 1 and 2 agricultural land (km)	21.1	20.7	30.1	50.8	71.9
Waste and material use					
Excavated material (Mm ³)	4.19 (tunnelling waste only)	15.7	12.6	28.3	32.5
Concrete (tonnes)	6,575,500 ¹⁵	2,992,600	4,115,500	7,108,100	13.7M
Steel (tonnes)	671,900	334,400	444,400	778,800	1.5M

¹⁵ Phase One figures for concrete and steel exclude the HS1 link

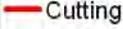
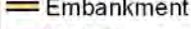
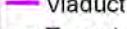
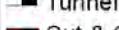
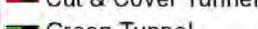
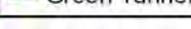


HS2 Phase Two Initial Preferred Scheme

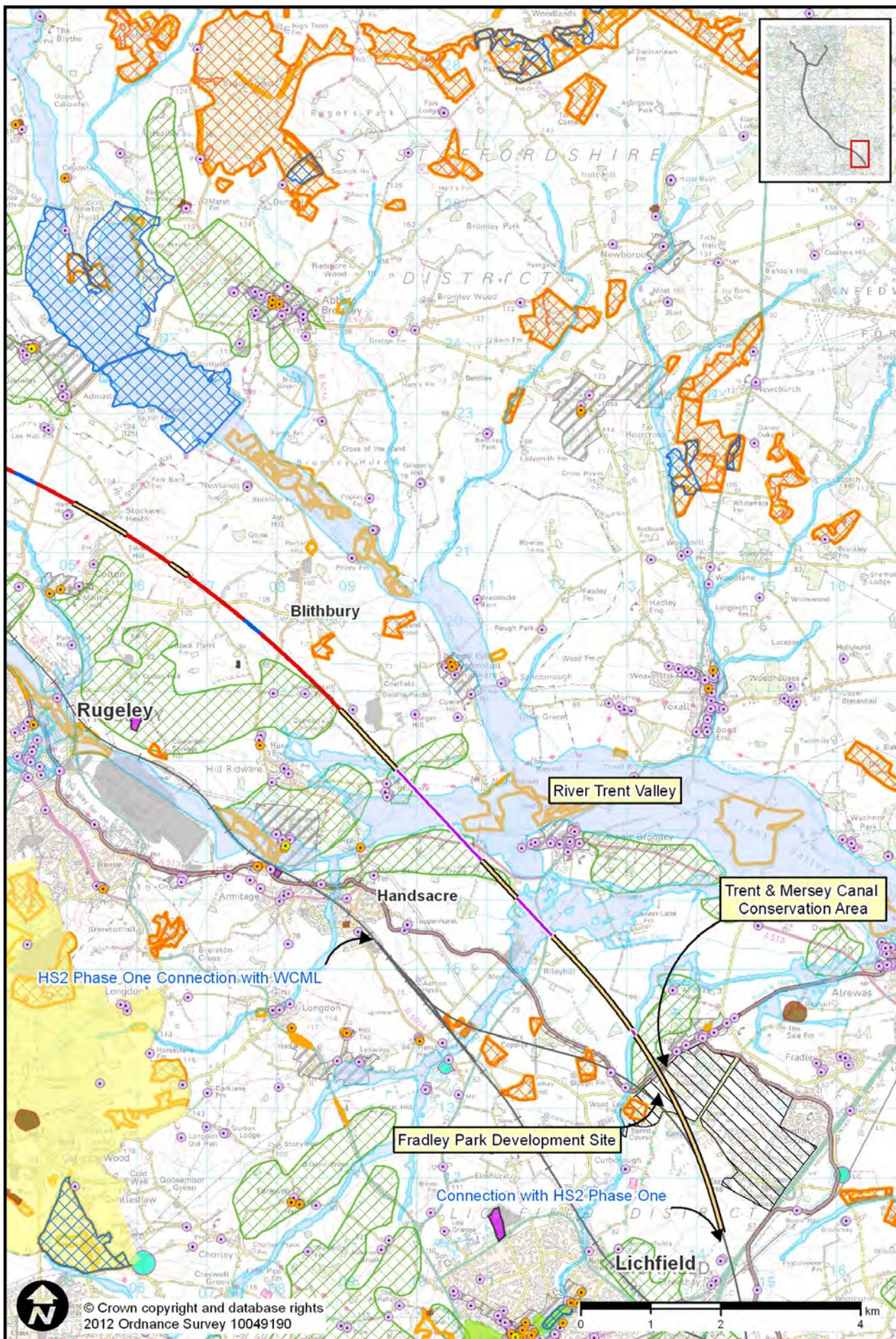
Maps showing key sustainability features

Key

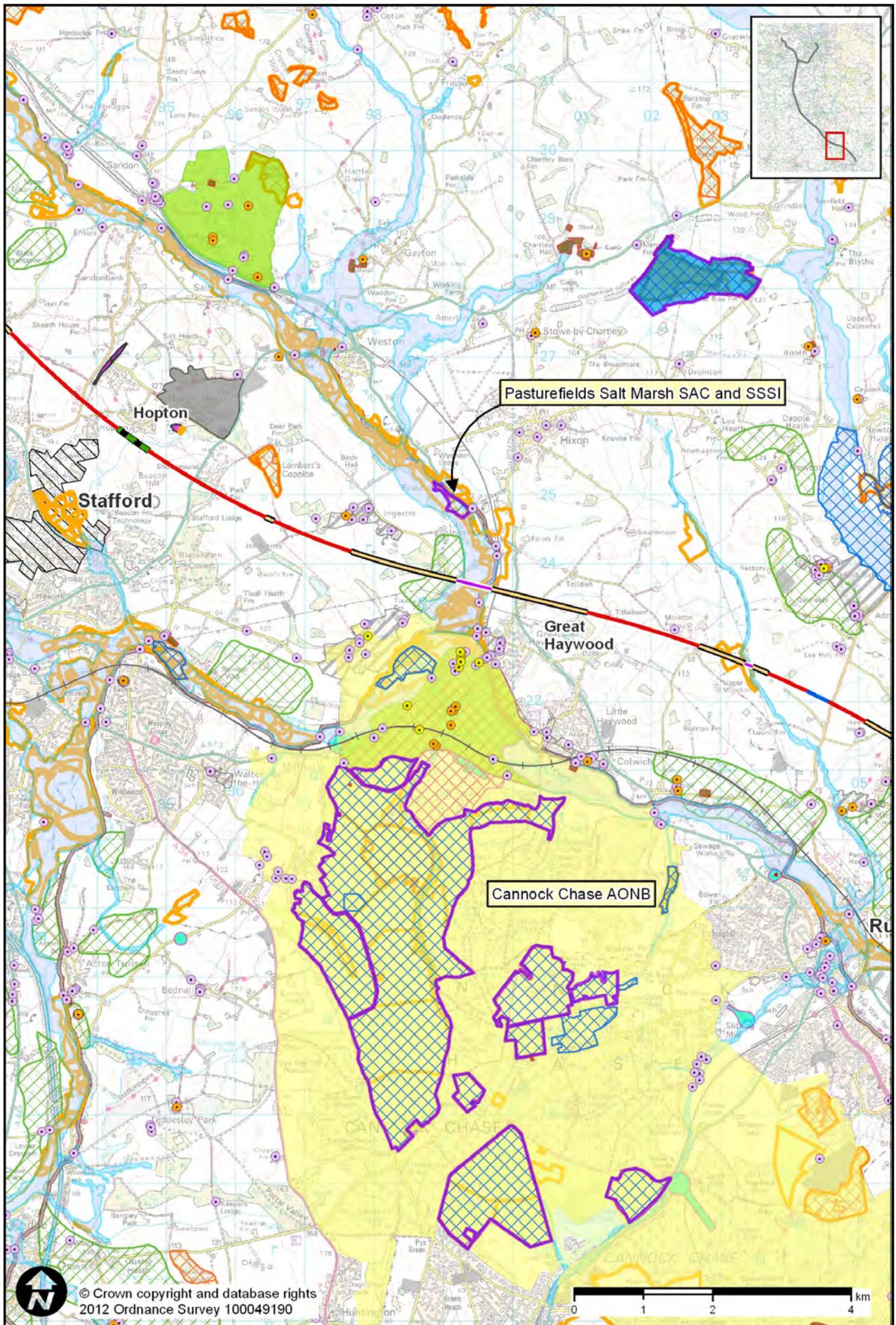
Key Sustainability Features	
	World Heritage Site
	Ramsar
	Special Areas of Conservation
	Special Protection Areas
	SSSI
	National Nature Reserves
	Area of Outstanding Natural Beauty
	Scheduled Monuments
	Registered Parks and Gardens
	Historical Battlefields
	Listed Building Grade I
	Listed Building Grade I
	Listed Building Grade II*
	Listed Building Grade II*
	Listed Building Grade II
	Listed Building Grade II
	Flood Zone 3
	Ancient Woodland
	BAP Habitats
	National Trust Ownership
	Country Parks
	Conservation Areas - Canals
	Conservation Areas
	Major Development Sites
	Active Landfill Sites
	Historic Landfill Sites
	Source Protection Zone 1
	Agricultural Land Grade 1
	Agricultural Land Grade 2

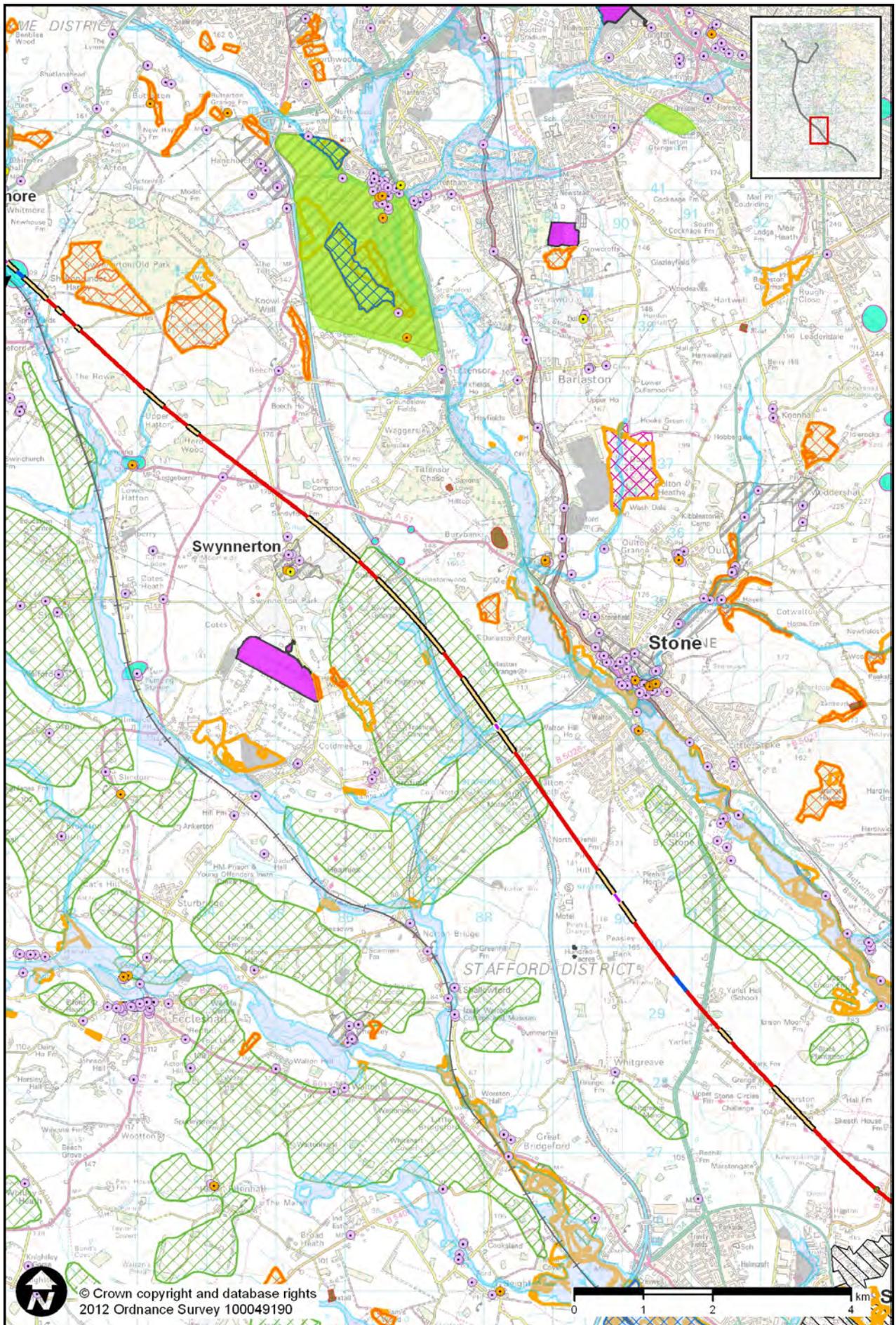
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	Tunnel
	Cut & Cover Tunnel
	Green Tunnel

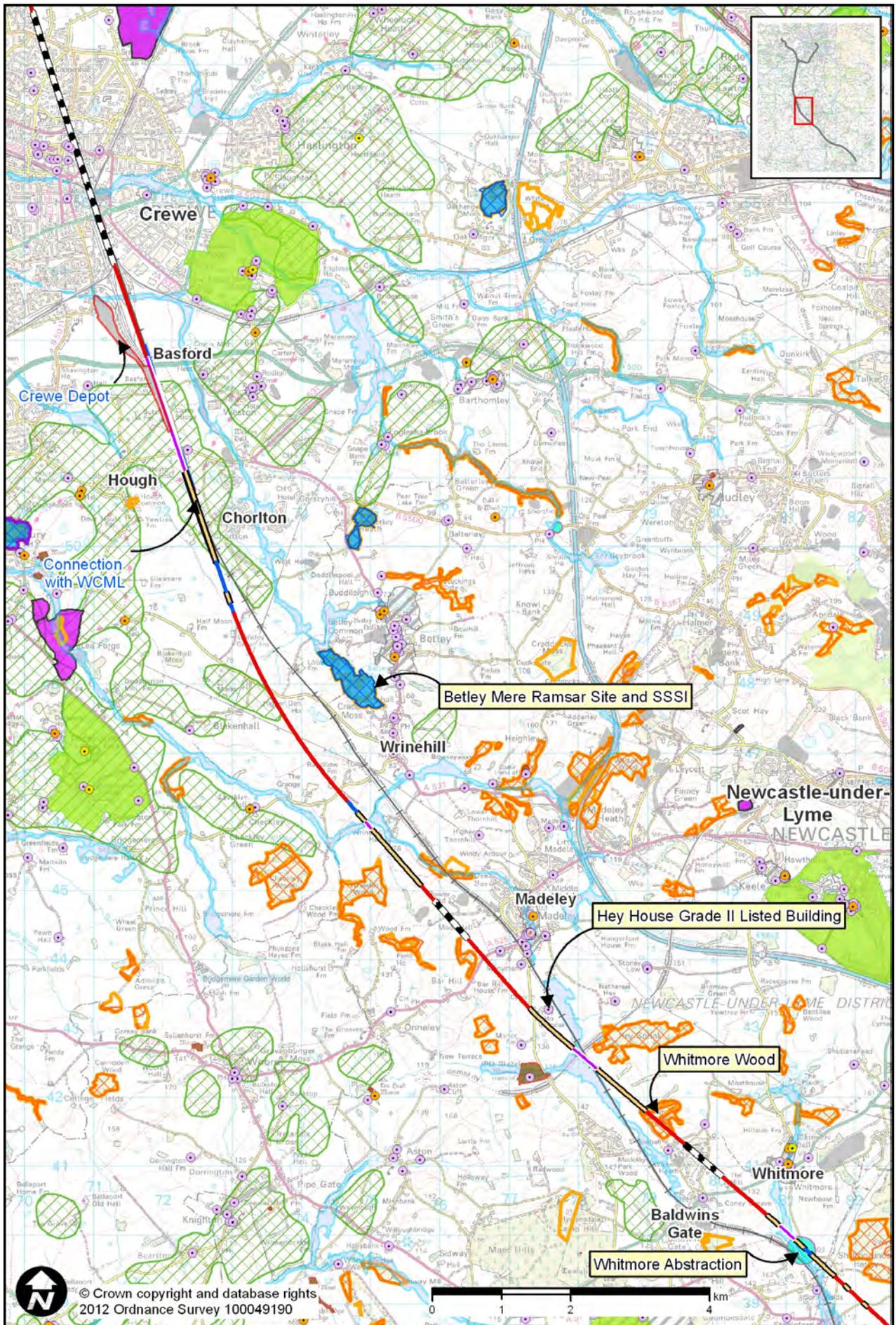
Western leg

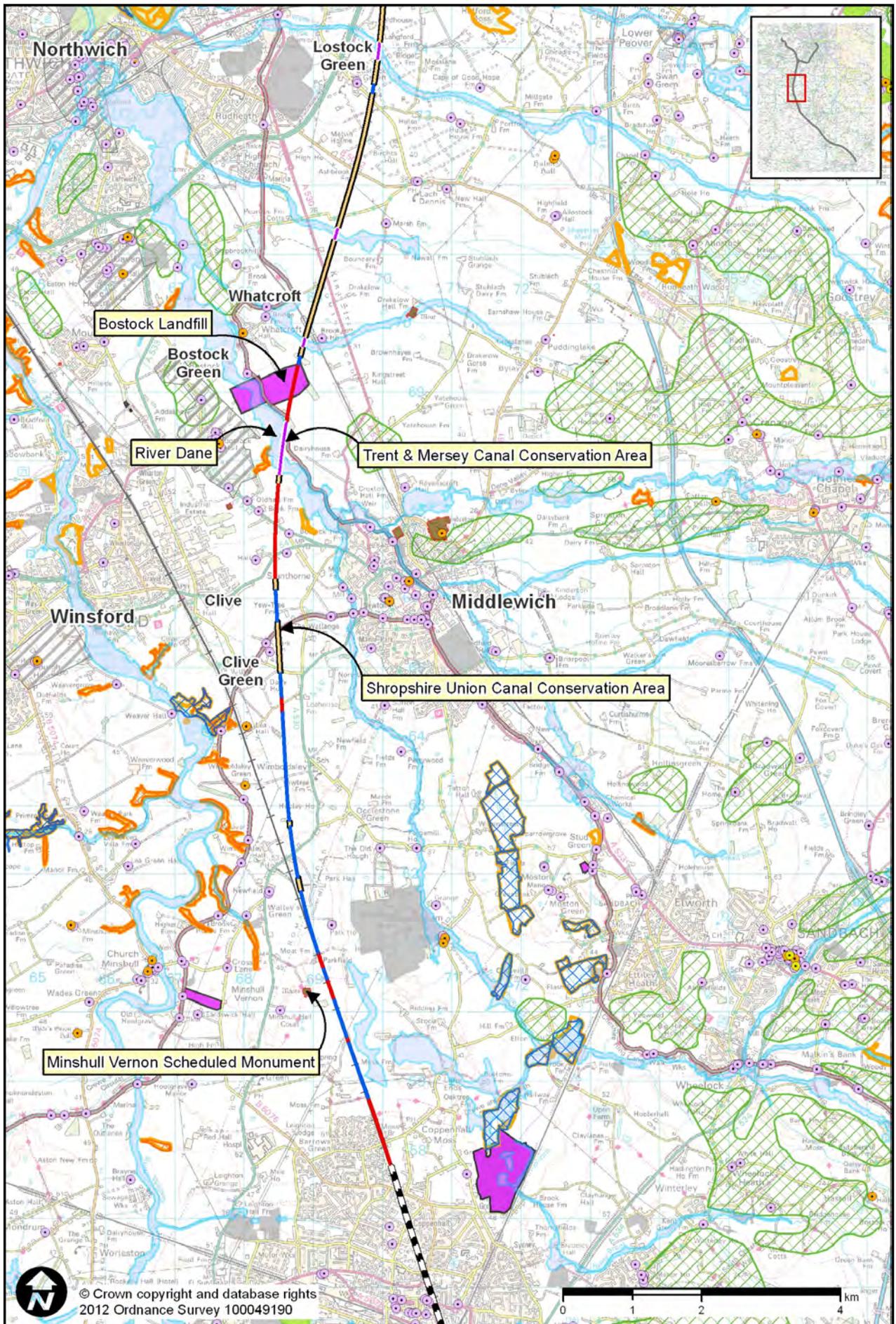


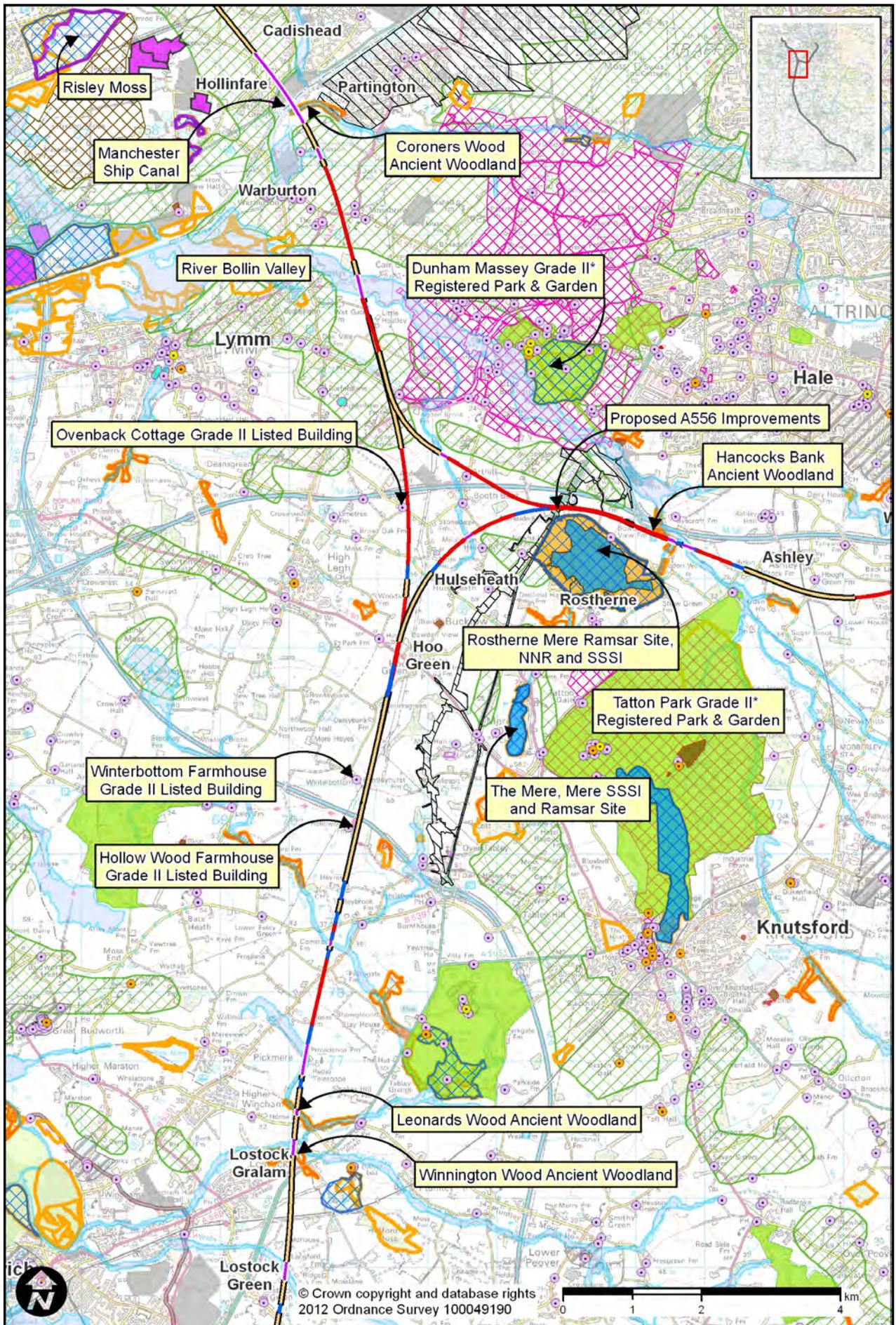
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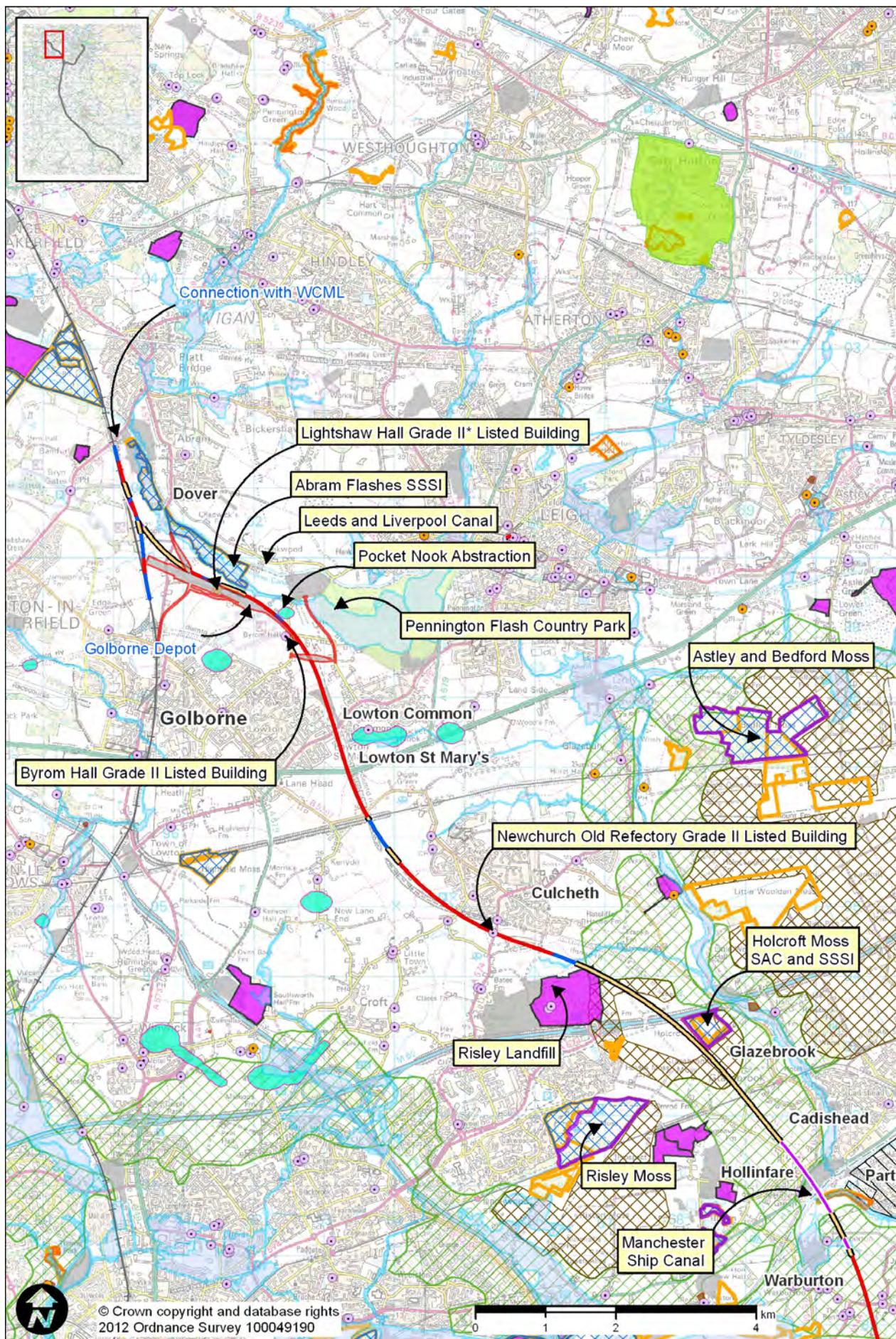


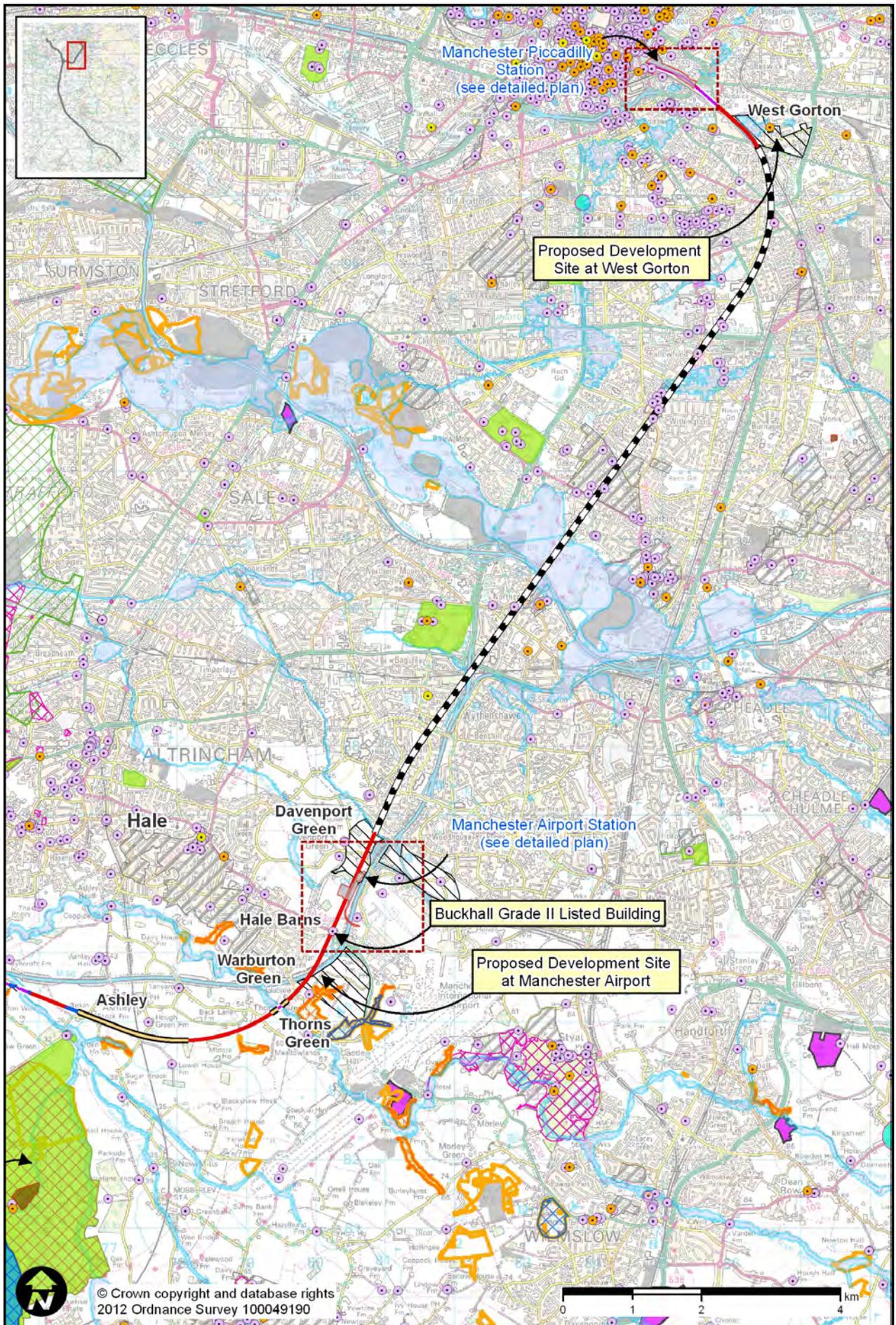


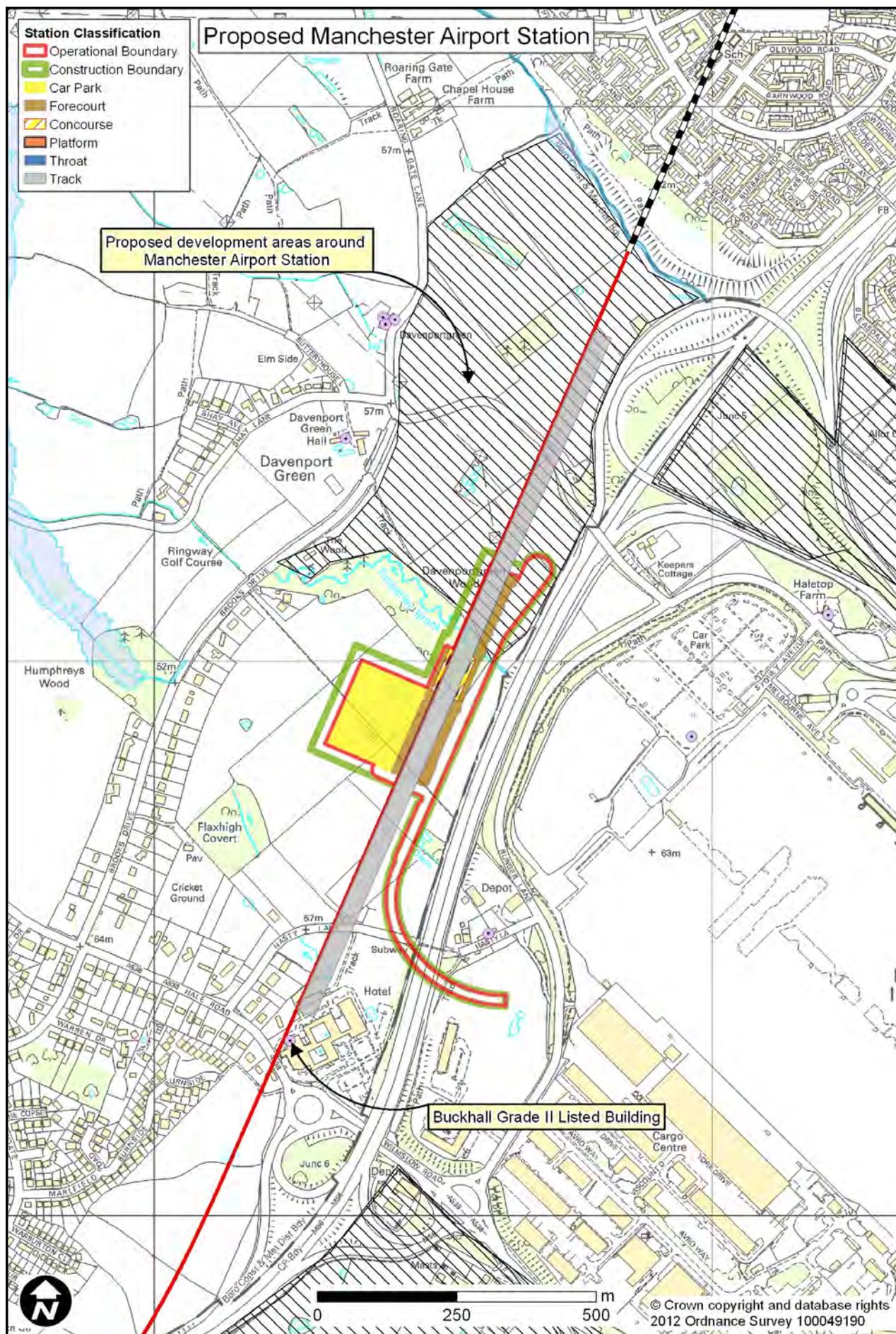


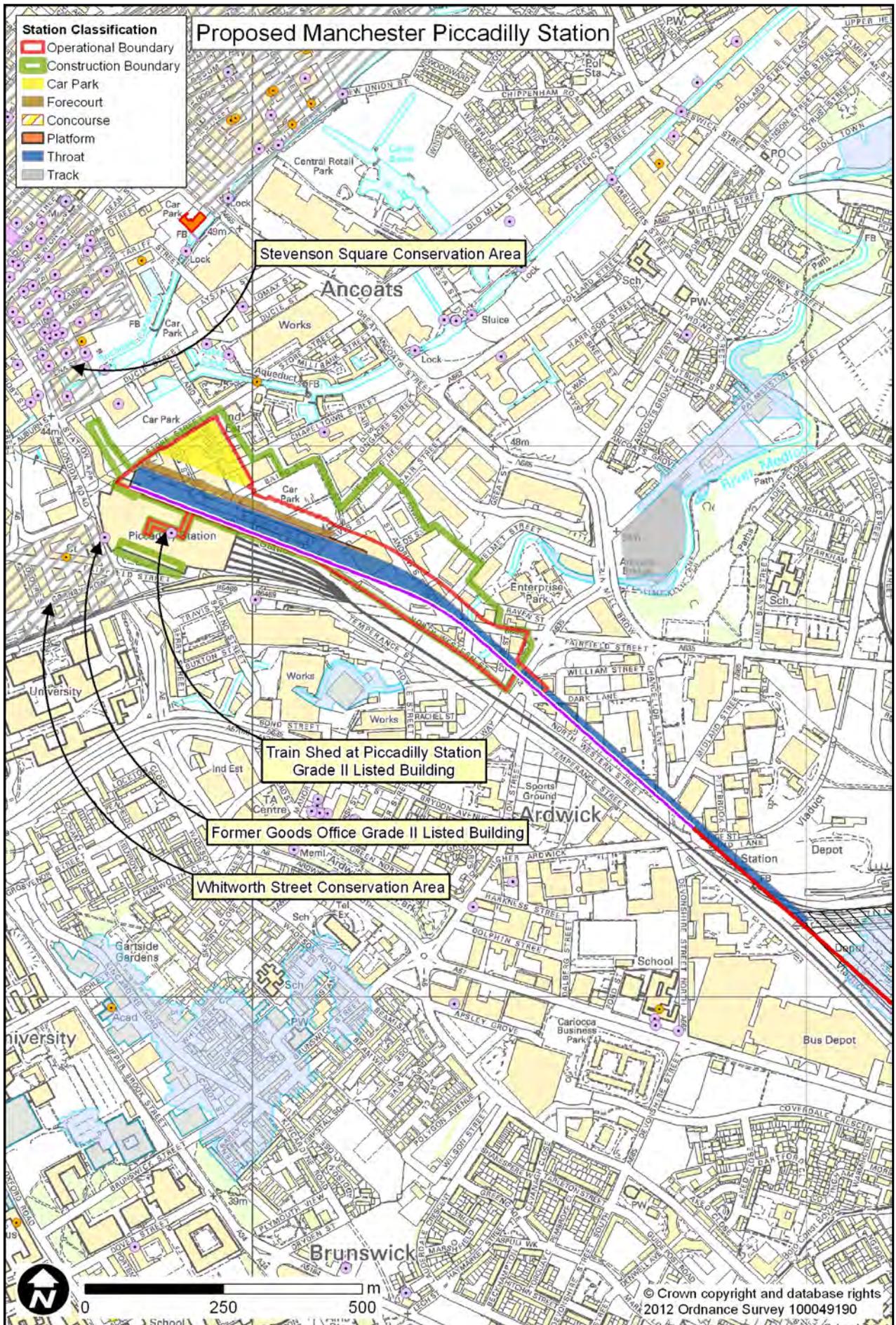




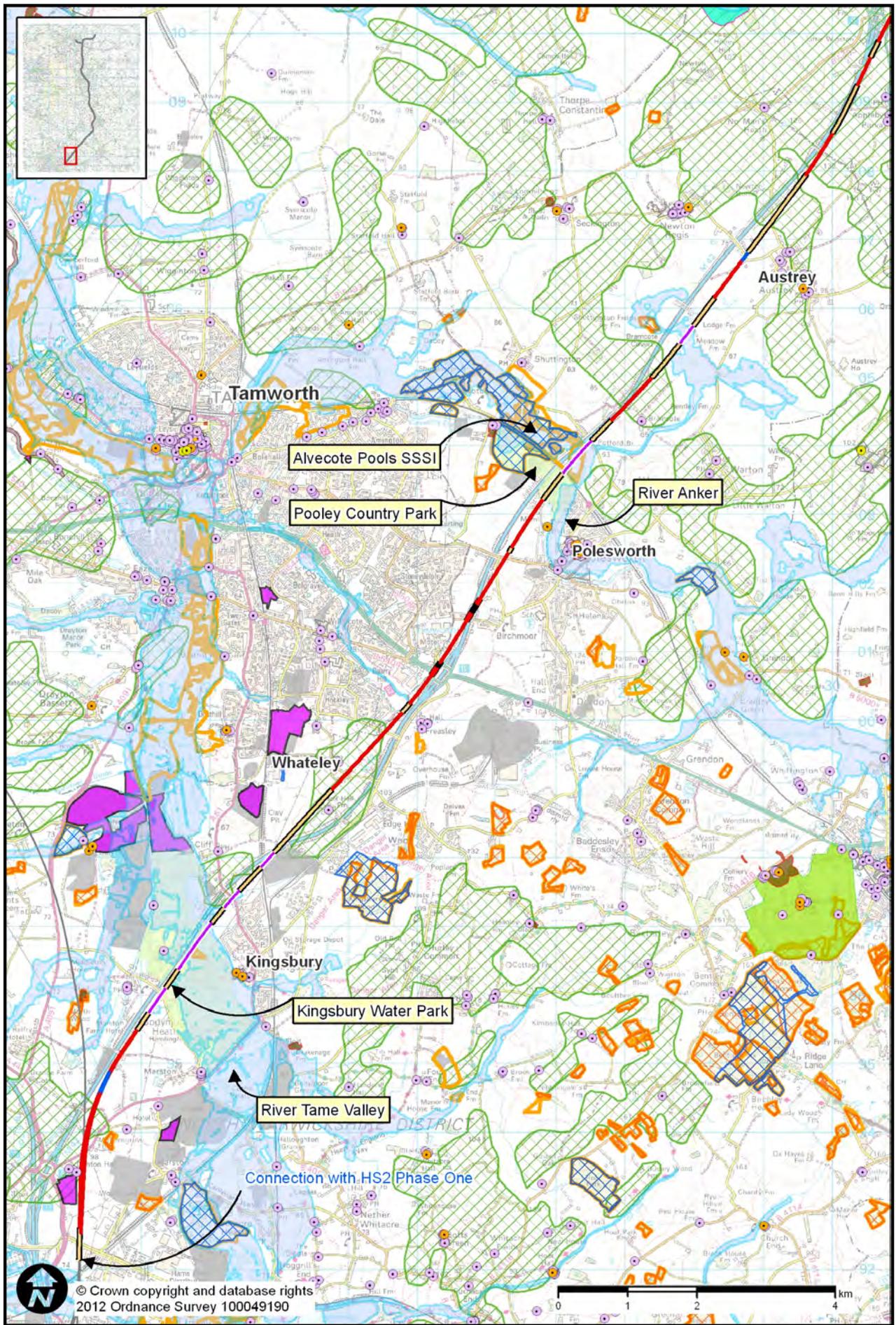


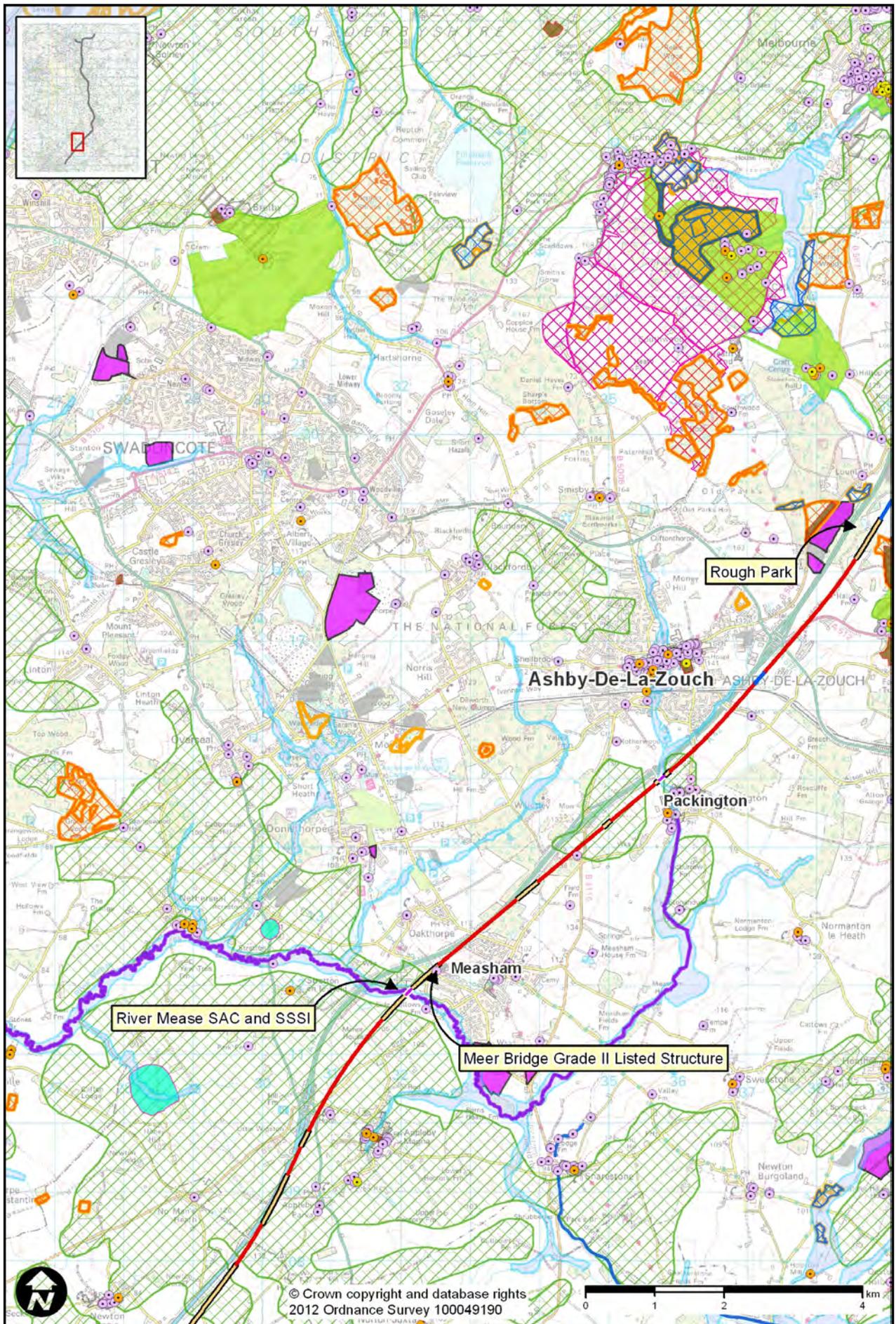


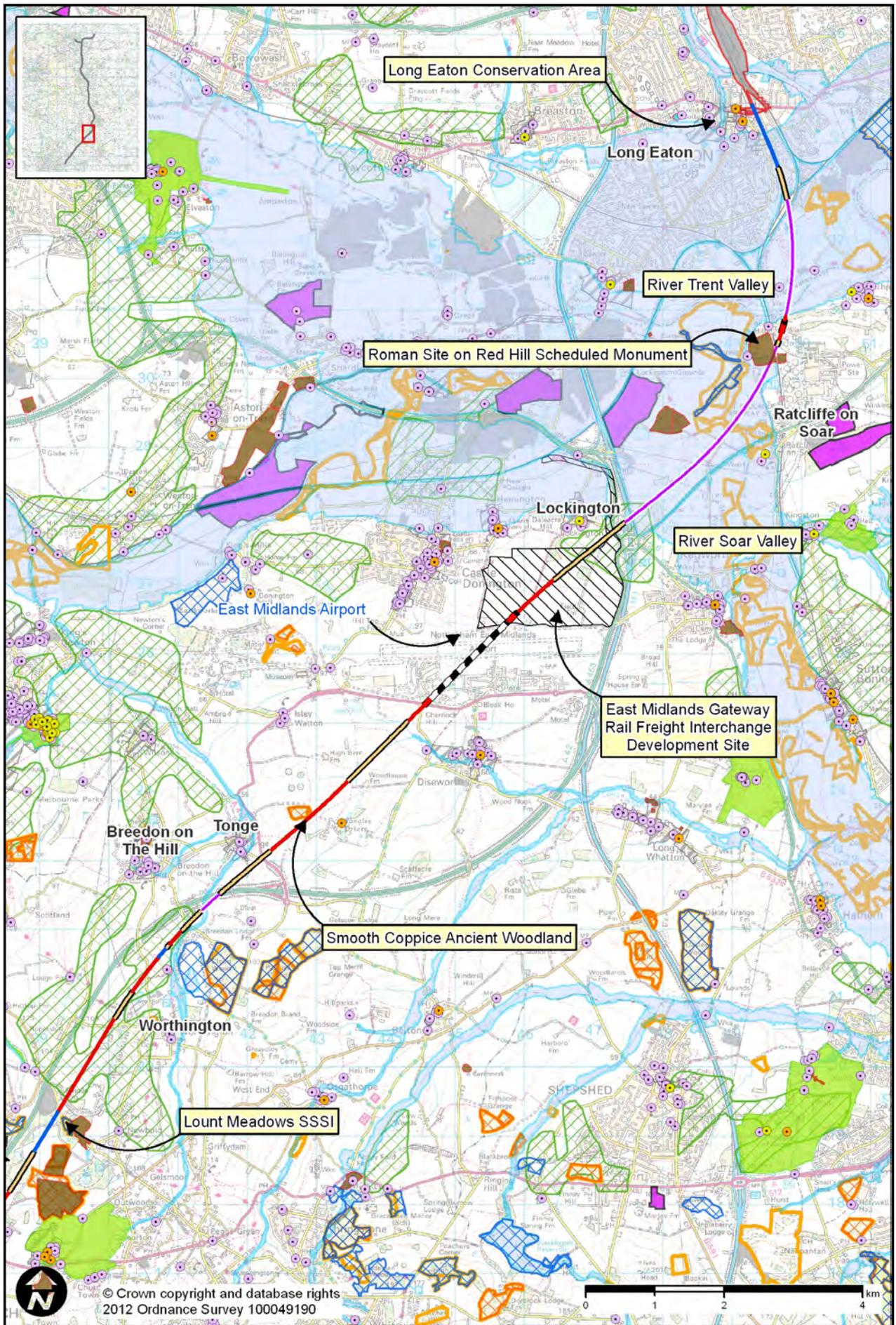


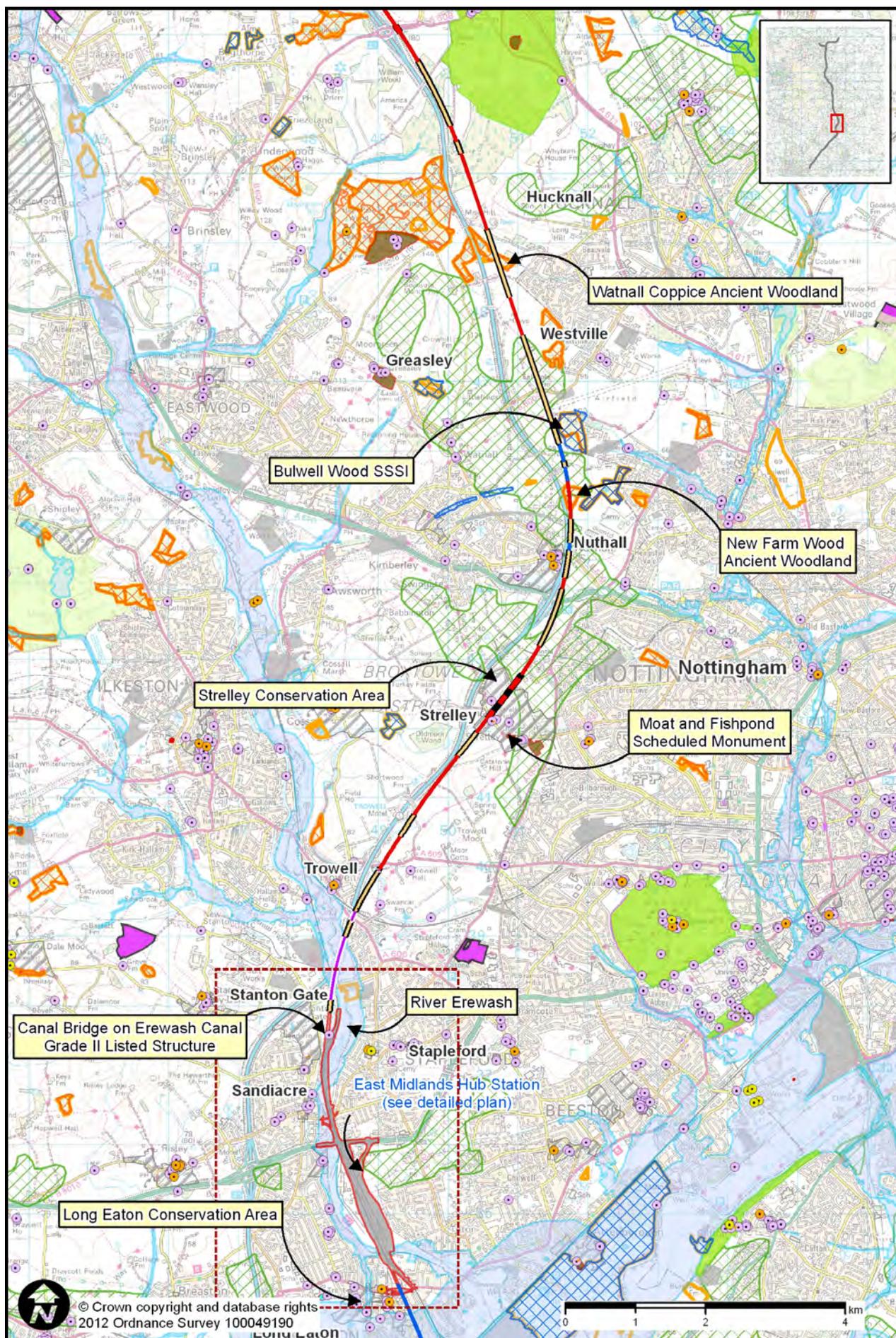


Eastern leg

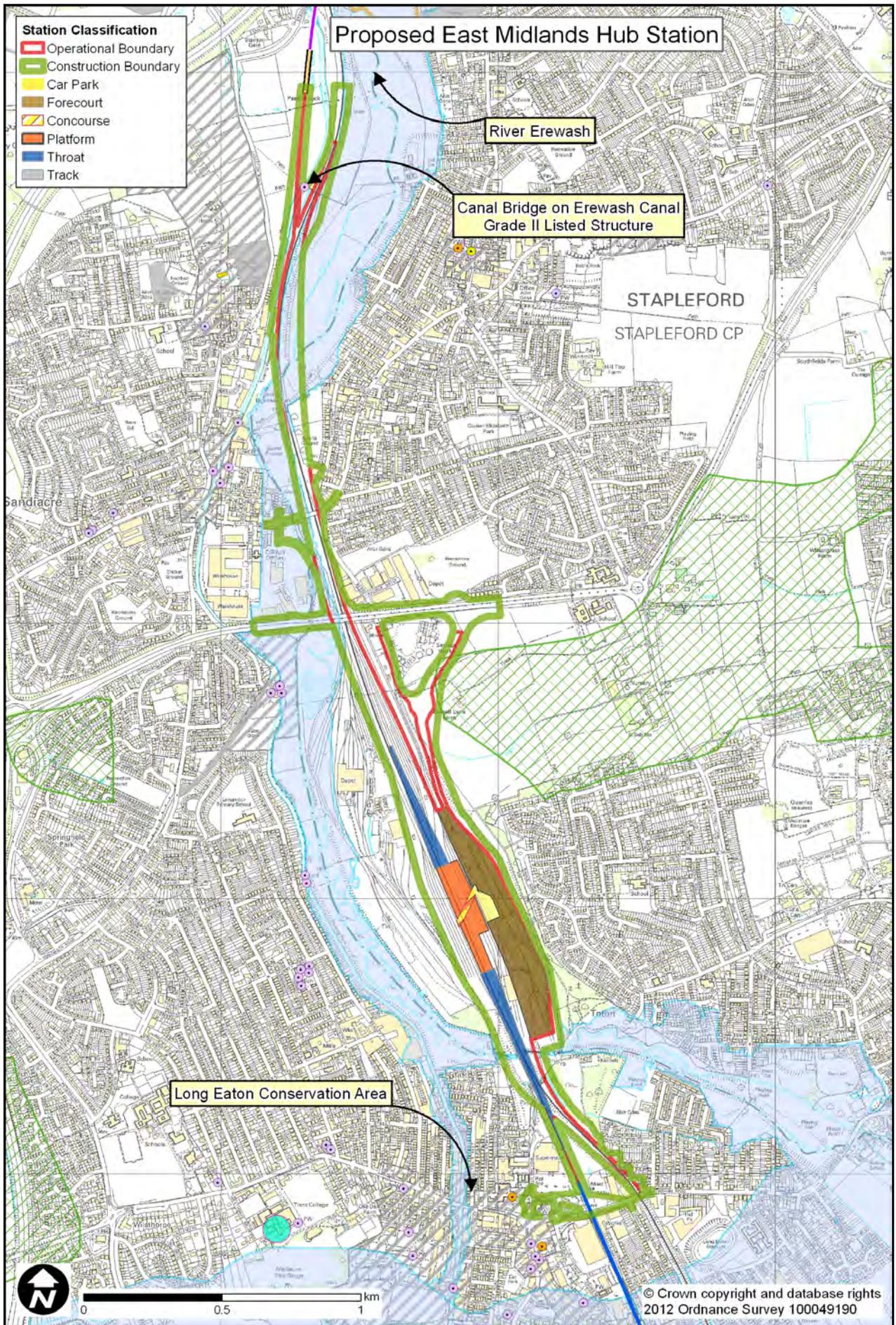


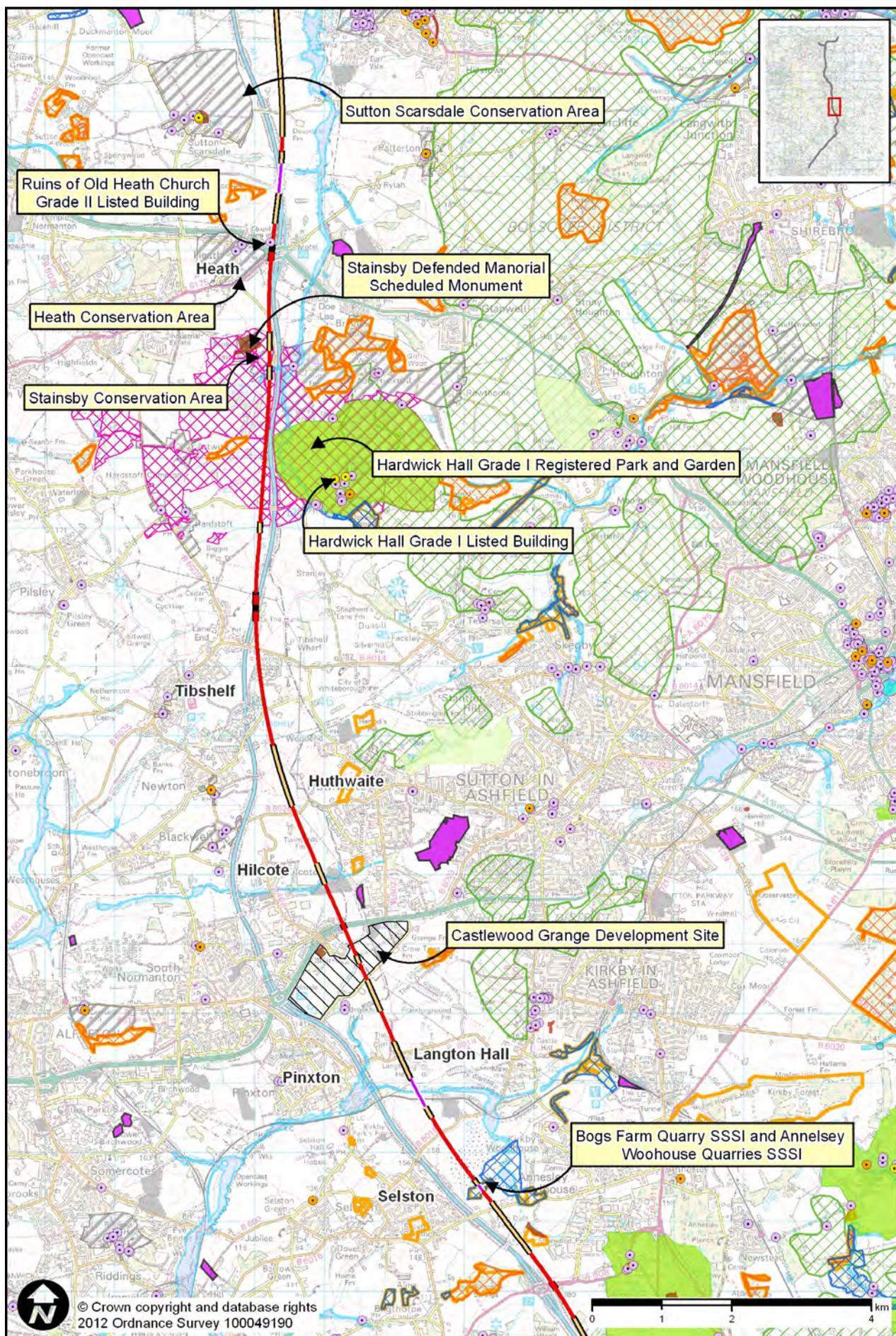


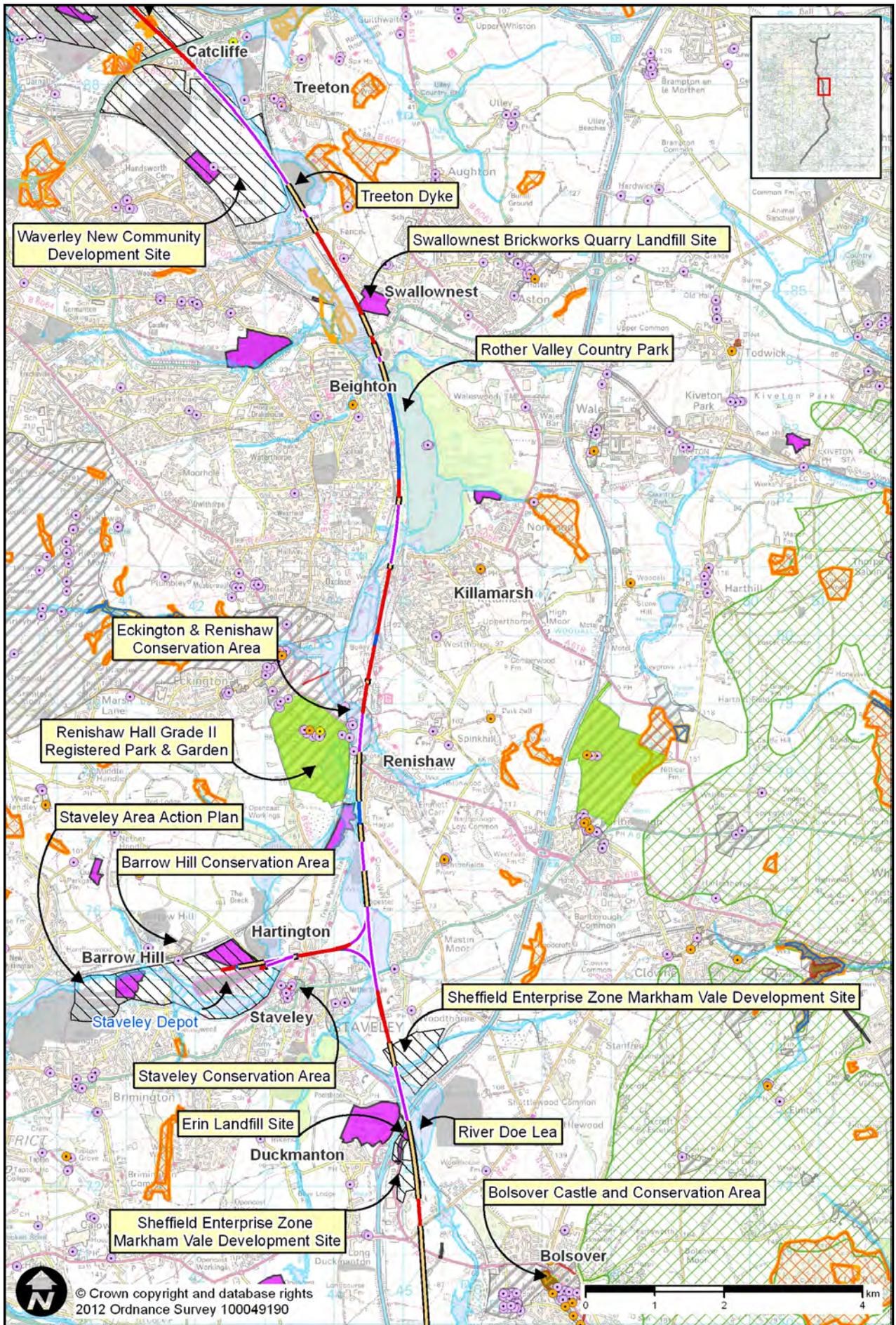


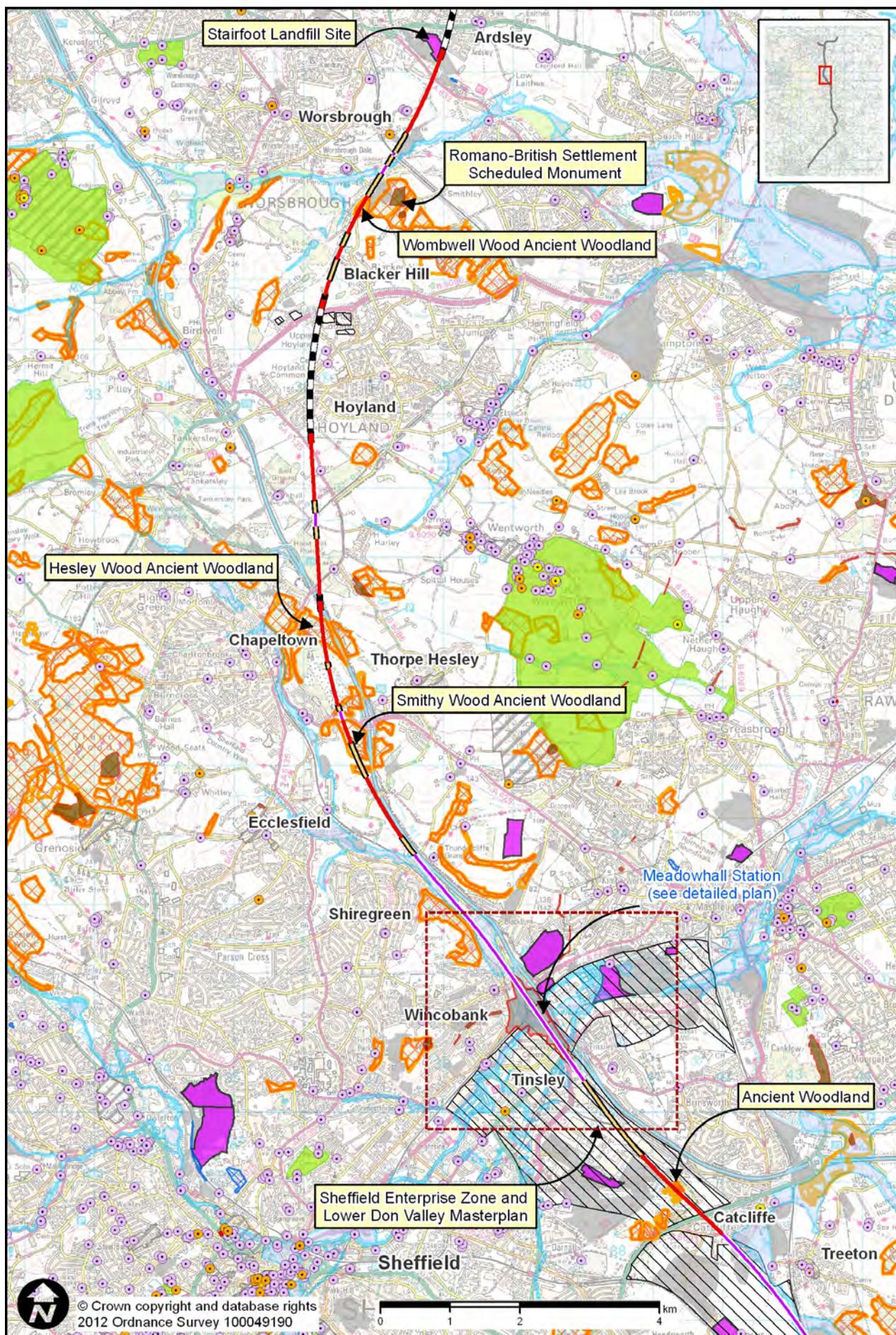


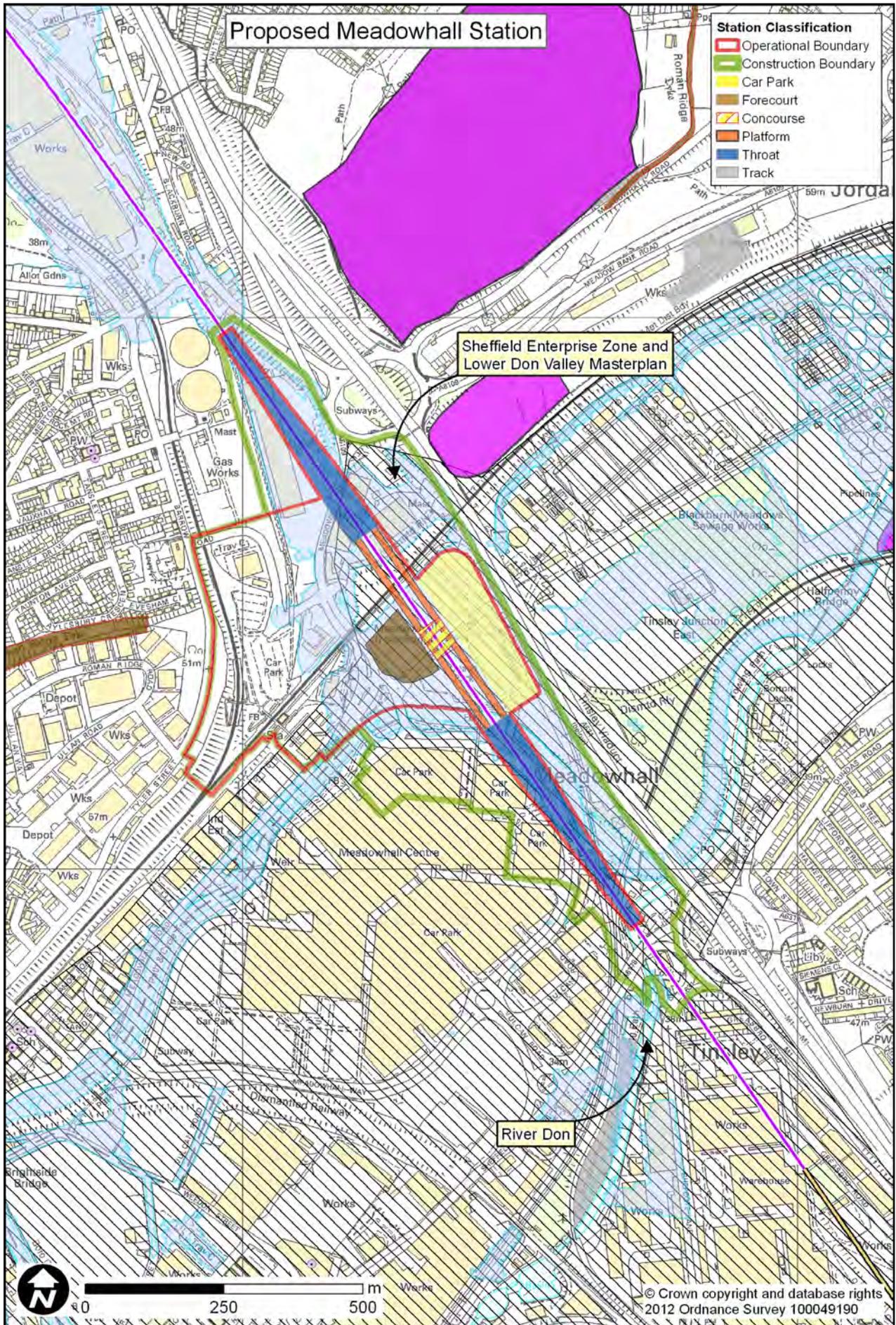
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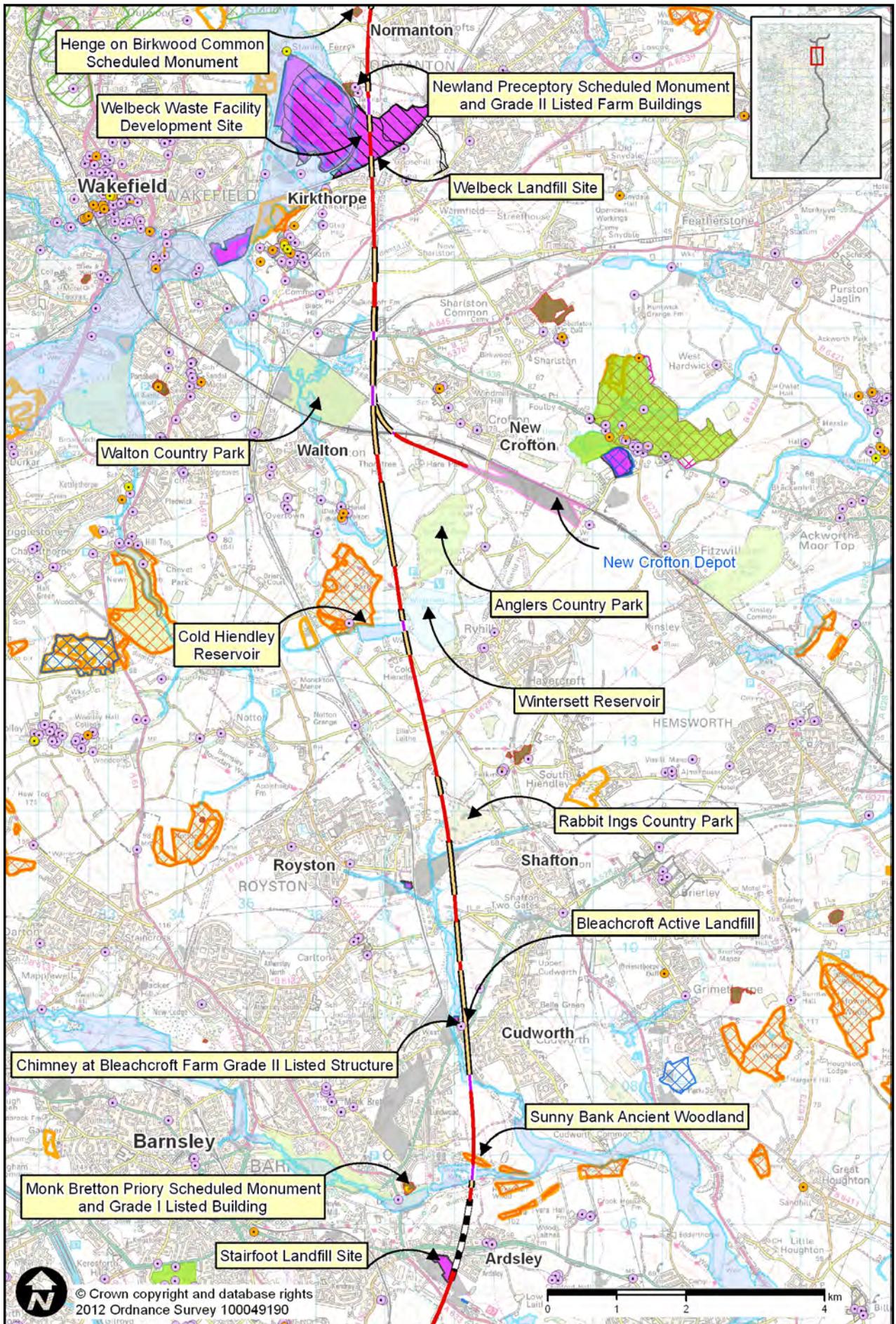












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