E16

High Speed Rail (West Midlands - Crewe)

Environmental Statement

Volume 2: Community Area report

CA4: Whitmore Heath to Madeley

July 2017

ES3 .2.1.4

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Department for Transport

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Preface

The Environmental Statement

This document forms part of Volume 2 of the Environmental Statement (ES) that accompanies the deposit of the hybrid Bill for Phase 2a of High Speed Two (HS2). Phase 2a comprises the second section of the proposed HS2 rail network, between the West Midlands and Crewe, and is referred to in this ES as the 'Proposed Scheme'. The ES sets out the Proposed Scheme, its likely significant environmental effects and the measures proposed to mitigate those effects.

Phase 2b comprises the remainder of Phase Two, between Crewe and Manchester and between the West Midlands and Leeds, completing what is known as the 'Y network'. Phase 2b will be the subject of a separate hybrid Bill and therefore is not the subject of this ES.

The hybrid Bill for Phase One of the HS2 network, between London and the West Midlands, was the subject of an ES submitted in November 2013, followed by subsequent ESs deposited with Additional Provisions to that Bill in 2014 and 2015. The Bill received Royal Assent in February 2017 and initial works on Phase One have commenced.

Consultation on the Environmental Statement

The public has an opportunity to comment on this ES as part of the hybrid Bill submission. The period of public consultation on the ES extends for at least 56 days (eight weeks) following the first newspaper notices that follow deposit of Bill documents in Parliament.

Structure of the Environmental Statement

This report is part of the suite of documents that make up the Environmental Statement (ES) for Phase 2a of the proposed High Speed Two (HS2) rail network between the West Midlands and Crewe (the Proposed Scheme). The structure of the ES is shown in Figure 1.

The ES documentation comprises the following:

Non-technical summary

This provides:

- a summary in non-technical language of the Proposed Scheme and the reasonable alternatives studied;
- the likely significant effects of the Proposed Scheme;
- the means to avoid, prevent or reduce likely significant environmental effects; and
- an outline of the monitoring measures to manage the effects of construction and the effectiveness of mitigation post construction, as well as appropriate monitoring during operation.

Glossary of terms and list of abbreviations

This contains terms and abbreviations, including units of measurement used throughout the ES documentation.

Volume 1: Introduction and methodology

This provides:

- a description of HS2, the environmental impact assessment (EIA) process and the approach to consultation and engagement;
- details of the permanent features of the Proposed Scheme and general construction techniques;
- a summary of the scope and methodology for the environmental topics;
- an outline of the general approach to mitigation;
- an outline of the approach to monitoring, including measures to manage the effects of construction, the effectiveness of mitigation post construction, as well as the approach to monitoring during the operational phase; and
- a summary of the reasonable alternatives studied (including local alternatives studied prior to the November 2015 route announcement). Local alternatives studied post November 2015 are discussed in the relevant Volume 2 community area reports.

Volume 2: Community area reports and map books

These cover the following community areas: 1 Fradley to Colton; 2 Colwich to Yarlet; 3 Stone and Swynnerton; 4 Whitmore Heath to Madeley; and 5 South Cheshire. The reports provide the following for each area:

- an overview of the area;
- a description of the construction and operation of the Proposed Scheme within the area;
- a summary of the local alternatives studied since November 2015;
- a description of the environmental baseline;
- a description of the likely significant environmental effects of the Proposed Scheme;
- the proposed means to avoid, prevent or reduce the likely significant adverse environmental effects; and
- the proposals for monitoring, including measures during and post construction, and during the operational phase.

The maps relevant to each community area are provided in separate Volume 2 map books. These maps should be read in conjunction with the relevant community area report. These maps include the location of the key environmental features (Map Series CT-10), key construction features (Map Series CT-05) and key operational features (Map Series CT-06) of the Proposed Scheme. There are also specific maps showing viewpoint and photomontage locations (Map Series LV, to be read in conjunction with Section 11, Landscape and visual of the Volume 2: community area reports) and noise contours (Map Series SV, to be read in conjunction with Section 13, Sound, noise and vibration of the Volume 2: community area reports).

Volume 3: Route-wide effects

This describes the significant environmental effects that are likely to occur at a geographical scale greater than the community areas described in Volume 2.

Volume 4: Off-route effects

This provides an assessment of the likely significant environmental effects of the Proposed Scheme at locations beyond the Phase 2a route corridor and its associated local environment. The maps relevant to the assessment of off-route effects are provided in a separate map book.

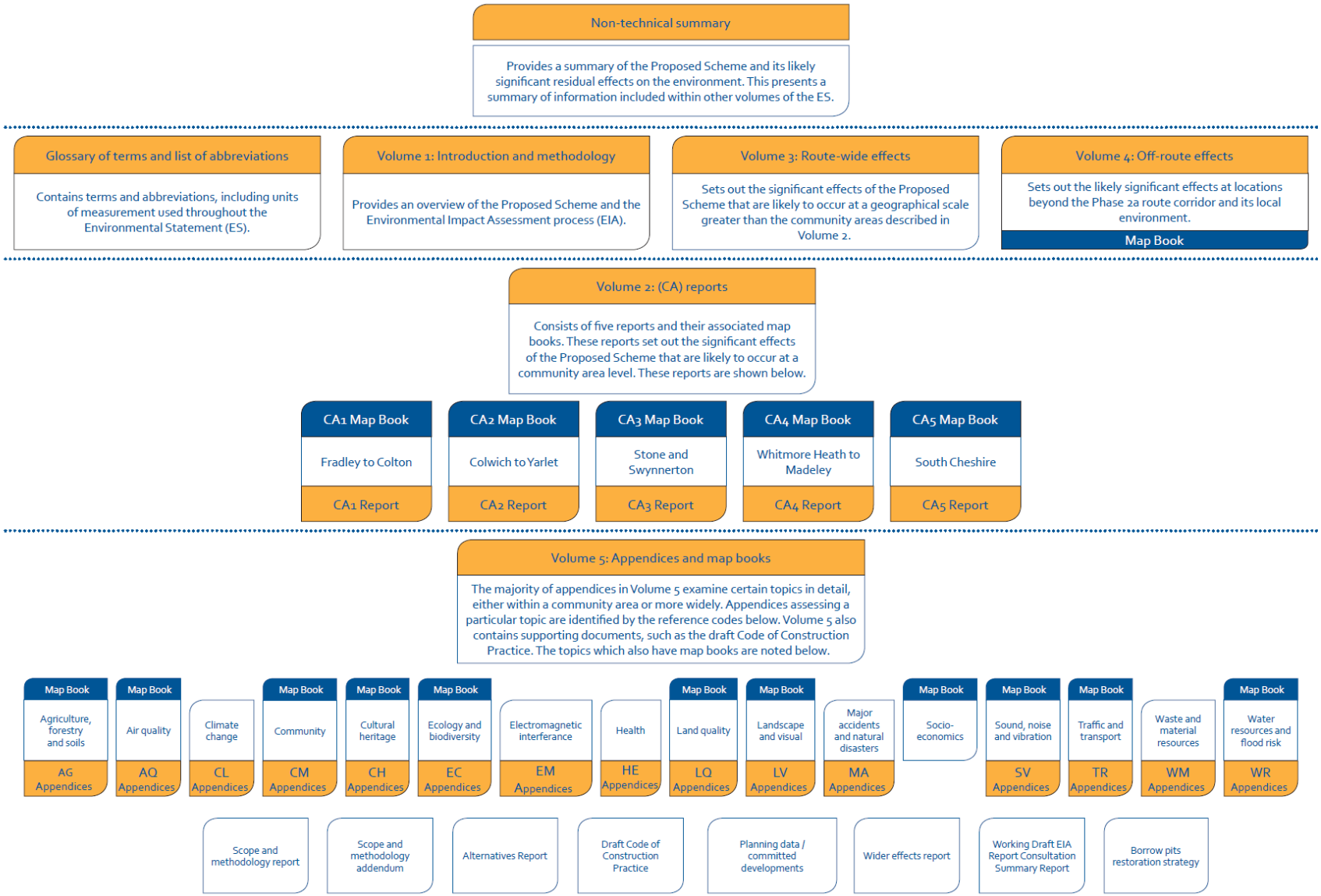
Volume 5: Appendices and map books

This contains supporting technical information and associated map books to be read in conjunction with the other volumes of the ES.

Background information and data (BID)

Certain reports and maps containing background information and data (BID) have been produced, which do not form part of the ES. These documents are available on the HS2 website. The BID reports and maps present relevant survey information, collated from published and unpublished sources, and other relevant background material.

Figure 1: Structure of the Environment Statement



1 Introduction

1.1 Introduction to HS2

1.1.1 High Speed Two (HS2) is a new high speed railway proposed by the Government to connect major cities in Britain. Stations in London, Birmingham, Leeds, Manchester and East Midlands will be served by high speed trains running at speeds of up to 225mph (360kph). Trains will also run beyond the HS2 network to serve destinations including South Yorkshire, Liverpool, Glasgow, Edinburgh, Newcastle and York.

1.1.2 HS2 will be built in phases. Phase One comprises the first section of the HS2 rail network of approximately 143 miles (230km) between London and the West Midlands and is planned to become operational in 2026. It was the subject of an Environmental Statement (ES) deposited with the High Speed Rail (London – West Midlands) Bill in 2013. Subsequent ESs were deposited with Additional Provisions to that Bill in 2014 and 2015. The High Speed Rail (London – West Midlands) Bill received Royal Assent in February 2017 and initial works on Phase One have commenced.

1.1.3 Phase Two of HS2 will extend the line to the north-west and north-east: to Manchester with connections to the West Coast Main Line (WCML) at Crewe and Golborne, and to Leeds with a connection to the East Coast Main Line approaching York, completing what is known as the 'Y network'.

1.1.4 Phase Two will be constructed in two phases:

- Phase 2a (the Proposed Scheme): the western section of Phase Two between the West Midlands and Crewe, comprising approximately 36 miles (58km) of HS2 main line (including the section which would connect with and form the first part of Phase 2b) and two spurs (approximately 4 miles (6km)) south of Crewe that will allow trains to transfer between the HS2 main line and the existing WCML. Construction of the Proposed Scheme will commence in 2020, ahead of the rest of Phase Two, with operation planned to start in 2027, six years earlier than originally planned bringing more of the benefits of HS2 to the North sooner; and

- Phase 2b: comprising the remainder of Phase Two, between Crewe (where it would connect with the Proposed Scheme) and Manchester and between the West Midlands and Leeds. Phase 2b will be the subject of a separate hybrid Bill with construction expected to commence in 2023 and operation planned to start around 2033.

1.1.5 The Proposed Scheme will connect with Phase One at Fradley, to the north-east of Lichfield, and to the WCML south of Crewe, providing onward services beyond the HS2 network and between the north-west of England and Scotland.

1.1.6 The Proposed Scheme has been the subject of an environmental impact assessment (EIA). During the development of the Phase 2a proposals, a working draft EIA Report was consulted on to help inform the design and assessment of the Proposed Scheme.

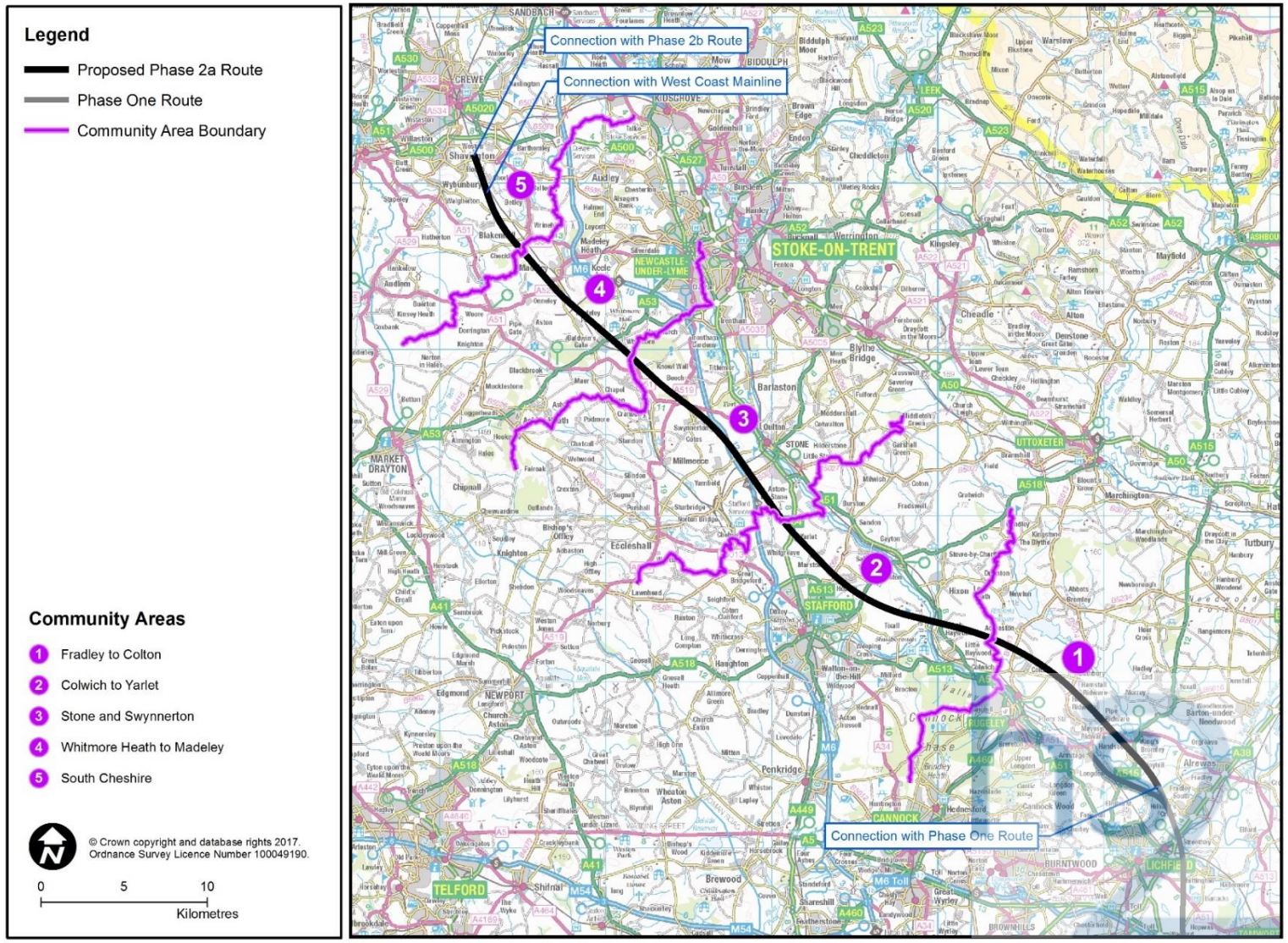
1.1.7 The findings of the assessment of the Proposed Scheme are reported in an Environmental Statement (the ES), of which this Volume 2 report forms a part. The ES

has been deposited alongside a hybrid Bill for Phase 2a, in accordance with the requirements of Parliamentary Standing Order 27A (SO27A)[1],[2].

1.1.8 For the purposes of environmental assessment and community engagement, the Proposed Scheme has been divided into five community areas. These are shown in Figure 2.

[1] Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment) - 2015, House of Commons.
[2] Standing Orders of the House of Lords - Private Business – 2015, House of Lords.

Figure 2: The HS2 Phase 2a route and community areas



1.2 Purpose of this report

1.2.1 This report presents the likely significant effects of the construction and operation of the Proposed Scheme on the environment within the Whitmore Heath to Madeley area. The report also describes the means to avoid, prevent or reduce the likely significant effects of the Proposed Scheme on the environment within the area, along with any proposed monitoring measures.

1.3 Structure of this report

1.3.1 This report is divided into the following sections:

- Section 1 – an introduction to HS2 and the purpose and structure of this report;
- Section 2 – overview of the community area, description of the Proposed Scheme within the community area and its construction and operation, and a description of the local alternatives studied;
- Section 3 – consultation and stakeholder engagement; and
- Sections 4 to 15 – an assessment of the following environmental topics:
  - agriculture, forestry and soils (Section 4);
  - air quality (Section 5);
  - community (Section 6);
  - cultural heritage (Section 7);
  - ecology and biodiversity (Section 8);
  - health (Section 9);
  - land quality (Section 10);
  - landscape and visual (Section 11);
  - socio-economics (Section 12);
  - sound, noise and vibration (Section 13);
  - traffic and transport (Section 14); and
  - water resources and flood risk (Section 15).

1.3.2 Each environmental topic section comprises:

- an introduction to the topic;
- a description of the existing and future environmental baseline within the community area;
- a description of the impacts and likely significant environmental effects arising during construction and operation of the Proposed Scheme, including cumulative effects; and

- a description of proposed mitigation and any monitoring measures that have been identified.

1.3.3 Environmental effects have been assessed in accordance with the methodology set out in Volume 1 (Section 8), the EIA Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001-001) and the EIA SMR Addendum (Volume 5: Appendix CT-001-002). The purpose of the SMR Addendum is to set out where the assessment methodology presented within the SMR has been amended or developed, for example, as a result of changes in legislation or industry best practice guidance or where methodologies have undergone refinement in the course of preparation of the ES.

1.3.4 The Proposed Scheme in the Whitmore Heath to Madeley area is shown in Volume 2: CA4 Map Book on the Map Series CT-05 (construction) and CT-06 (operation), and should be read in conjunction with this report. There is some flexibility during detailed design to alter the horizontal and vertical alignments and other details within the limits shown on the plans and sections submitted to Parliament and as set out in the Bill. This flexibility is included within the scope of the environmental assessment. Further explanation is provided in Volume 1, Section 1.

1.3.5 In addition to the environmental topics covered in Sections 4 to 15 of this report, electromagnetic interference is addressed in Volume 1 and climate change, major accidents and natural disasters, and waste and material resources are addressed in Volume 3 on a route-wide basis. An assessment of potential environmental effects beyond the Phase 2a route corridor and its associated local environment has also been undertaken and this 'off-route' assessment is reported in Volume 4.

1.3.6 Supporting technical information, including technical appendices and map books, relating to the assessment in this Volume 2 report is provided in Volume 5 of the ES.

1.3.7 In addition to the technical appendices and map books in Volume 5, certain reports and maps containing background information and data (BID) have been produced, which do not form part of the ES. These documents are available on the HS2 Ltd website. The BID reports and maps present survey information, collated from published and unpublished sources, and other background analysis, and are referenced at various places within the ES.

2 Overview of the area and description of the Proposed Scheme

2.1 Overview of the area

General

2.1.1 The Whitmore Heath to Madeley area covers an approximately 9.1km section of the Proposed Scheme passing through the parishes of Whitmore, Baldwin's Gate and Madeley, within the Newcastle-under-Lyme Borough Council (NBC) and Staffordshire County Council (SCC) areas. The boundary between Swynnerton parish and Whitmore parish forms the southern boundary of this area. The boundary between Madeley parish and Checkley cum Wrinehill parish forms the northern boundary of this section.

2.1.2 As shown in Figure 3, the Stone and Swynnerton community area (CA3) lies to the south and South Cheshire community area (CA5) lies to the north.

Settlement, land use and topography

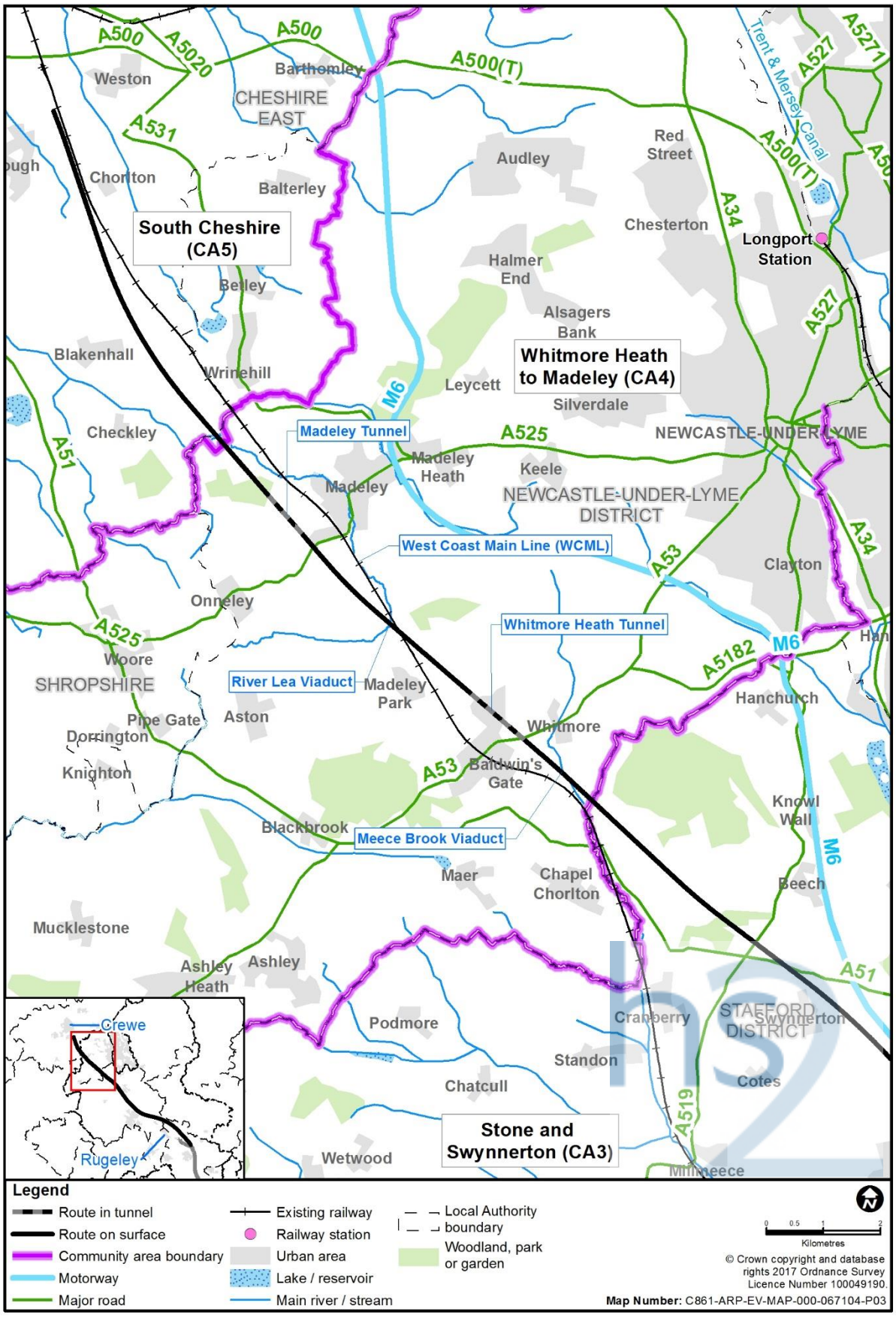
2.1.3 The area is predominantly rural in character, with agriculture being the main land use. This is interspersed with woodland, including ancient woodland, small villages and a scattering of isolated dwellings and farmsteads. Much of the area encompasses gently undulating lowland and settled river valley landscapes, with occasional lowland bog and floodplain pasture at lower levels.

2.1.4 At the southern end of this section, the route of the Proposed Scheme will pass within 1km of the settlements of Baldwin's Gate and Madeley Park Wood, which lie to the west of the Proposed Scheme, and Whitmore and Madeley, which lie to the east. The route will pass under Whitmore Heath in tunnel and through Whitmore Wood. It will then enter the valley of the River Lea, through which the WCML, the Madeley Chord and the Stoke to Market Drayton Railway (also known as the Silverdale line of the Stoke to Market Drayton Railway) pass. There are a number of designated heritage assets including the Grade II listed building Hey House and the scheduled monument of Old Madeley Manor in the area. The floor of the River Lea valley is around 120m above Ordnance Datum (AOD) in the south of the area, falling to 80m AOD, in the north at Wrinehill.

2.1.5 The route will continue towards the village of Madeley, passing Bar Hill, the Lea Head moated site scheduled monument, and a number of listed buildings, including the farmstead of Aston Cliff and Lea Head Manor. It will also pass through part of Barhill Wood. The sandstone plateau at Bar Hill is at a height of around 165m to 170m AOD with steep valley sides to the River Lea, the Meece Brook and the Checkley Brook.

2.1.6 To the east and north of Whitmore village there are several detached rural properties along the A53 Newcastle Road. To the east of Madeley village there are several large isolated farmsteads set back from the A53 Newcastle Road, including Moor Hall Farm, Bower End Farm, Beechfields and Bar Hill House Farm.

Figure 3: Area context map



Key transport infrastructure

2.1.7 The M6 runs in a north-west to south-east alignment to the east of the Proposed Scheme in the Whitmore Heath to Madeley area. Junction 15 of the M6 is located on the south-east boundary of the Whitmore Heath to Madeley area. The A53 Newcastle Road runs east to west across the area, crossing the route of the Proposed Scheme to the south of Whitmore Heath. The A525 Bar Hill Road runs north-east to south-west crossing the route at Bar Hill. The main local roads crossing the Proposed Scheme are Bent Lane, which connects the settlements of Whitmore and Stableford; Heath Road, Snape Hall Road, and Manor Road, which all serve the village of Baldwin's Gate; and Bower End Lane, which connects a number of rural properties to the settlement of Madeley.

2.1.8 The route will cross several public rights of way (PRoW), including local access roads, bridleways and public footpaths, which provide important links between the scattered dwellings and surrounding villages. These PRoW include the Newcastle Way long distance walking route.

2.1.9 The WCML traverses the area in a broadly north-west / south-east alignment and is crossed by the route of the Proposed Scheme at the River Lea. There are no stations within the area. WCML services stop at Stoke-on-Trent with onward connections to major national destinations, including London, Birmingham and Manchester. Rail users can interchange at Stoke-on-Trent for regional and local destinations.

Socio-economic profile

2.1.10 Within the NBC area there is a wide spread of business types reflecting a diverse range of commercial activities. Retail accounts for the largest proportion of businesses (12%) alongside professional, scientific and technical (12%) followed by construction (11%)[3].

2.1.11 According to the Annual Population Survey (2016)[4], the employment rate within the NBC area was 79%[5] (63,200 people) and the unemployment rate was 4%, which is lower than the West Midlands and England.

2.1.12 According to the Annual Population Survey (2015)[6], 28% of NBC's residents aged 16-64 were qualified to National Vocational Qualification Level 4 and above, while 9% of residents had no qualifications.

Notable community facilities

2.1.13 The Whitmore Heath to Madeley area is predominantly agricultural land with three main villages: Baldwin's Gate, Whitmore and Madeley. These small settlements have limited community facilities, which generally lie within the village centres. These facilities include the Moss Lane Surgery and Baldwin's Gate Surgery, the Saint Mary and All Saints Church, Baldwin's Gate Church of England (VC) Primary School,

[3] Office for National Statistics; UK Business Counts – Local Units 2015. Available online at: http://www.nomisweb.co.uk
[4] Annual Population Survey (2016) Unemployed refers to people without a job who were available to start work in the two weeks following their interview and who had either looked for work in the four weeks prior to interview or were waiting to start a job they had already obtained. As the unemployed form a small percentage of the population, the APS unemployed estimates within local authorities are based on very small samples so for many areas would be unreliable. To overcome this ONS has developed a statistical model that provides better estimates of total unemployed for unitary authorities and local authority districts (unemployment estimates for counties are direct survey estimates), NOMIS.
[5] The proportion of working age (16-64 year olds) residents that is in employment.
[6] Annual Population Survey, (2016), NOMIS. Available online at: http://www.nomisweb.co.uk

Madeley High School, Sir John Offley Church of England (VC) Primary School, Meadows Primary School, Madeley Manor Care Home, several community meeting places including Whitmore Village Hall, and Madeley Cemetery.

Recreation, leisure and open space

2.1.14 Whitmore Heath to Madeley is an area of gently undulating lowland with a combination of dairy pasture, arable and horse grazing. Areas of heath occur on higher ground in combination with mixed species woodland and ancient woodland. The route of the Proposed Scheme will cross several PRoW including the Newcastle Way, a long-distance walking route, where it runs along Manor Road to the south of Madeley.

2.1.15 There is a woodland site used for paintballing off Manor Road. Farm holdings in the area provide fishing ponds, shooting facilities and a swimming pool. Whitmore Hall, Whitmore Cricket Club and Cudmore Fisheries are local and regional visitor attractions.

2.1.16 Hey Sprink is an accessible natural green space located approximately 1.5km south of Madeley.

Policy and planning context

Planning framework

2.1.17 HS2 is not included or referred to in many local plans, given that it is being developed on a national basis to meet a national need. Relevant local plan documents and policies have nevertheless been considered in relation to environmental topics, as part of considering the Proposed Scheme in the local context.

2.1.18 The following local policies have been considered and are referred to where appropriate to the assessment:

- Staffordshire and Stoke-on-Trent Joint Waste Core Strategy 2010 - 2026 (Adopted 2013)[7];
- The Minerals Local Plan for Staffordshire 2015 to 2030 (Adopted February 2017)[8];
- Newcastle-under-Lyme Local Plan 2011 (Adopted 2003 – saved policies 2007)[9];
- Newcastle-under-Lyme and Stoke-on-Trent Core Spatial Strategy (Adopted 2009[10];

[7] Staffordshire and Stoke-on-Trent Joint Waste Core Strategy 2010 - 2026 (Adopted 2013). Available online at: https://www.staffordshire.gov.uk/environment/planning/policy/thedevelopmentplan/wastelocalplan/Adopted-Staffordshire-and-Stoke-on-Trent-Joint-Waste-Local-Plan-(2010-to-2026)-(adopted-March-2013).pdf

[8] The Minerals Local Plan for Staffordshire 2015 to 2030 (Adopted February 2017). Available online at: https://www.staffordshire.gov.uk/environment/planning/policy/thedevelopmentplan/mineralslocalplan/mineralsLocalPlan.aspx

[9] Newcastle-under-Lyme Local Plan 2011 (Adopted 2003 – saved policies 2007). Available online at: https://www.newcastle-staffs.gov.uk/sites/default/files/IMCE/Planning/Planning_Policy/Saved%20Policies%20of%20the%20Newcastle-under-Lyme%20Local%20Plan%20154KB.pdf

[10] Newcastle-under-Lyme and Stoke-on-Trent Core Spatial Strategy (Adopted 2009). Available online at: https://www.newcastle-staffs.gov.uk/sites/default/files/IMCE/Planning/Planning_Policy/SpatialStrategy/Core%20Strategy%20Final%20Version%20-%2028th%20October.pdf

- Shropshire Local Development Framework: Adopted Core Strategy (Adopted 2011)[11]; and
- Shropshire Site Allocations and Management (SAMDev) Plan (Adopted 2015)[12].

2.1.19 Emerging policies are not considered as part of the assessment.

2.1.20 There are a number of key planning designations in the area. These include conservation areas, listed buildings, important archaeological assets listed on the National Heritage List for England (NHLE), ancient woodland and mineral safeguarding areas (MSA).

Committed development

2.1.21 Committed developments are defined as developments with planning permission and sites allocated for development or safeguarded for minerals in adopted development plans, on or close to the land required for the Proposed Scheme. Allocations and MSA in the submission drafts of the Minerals Local Plan for Staffordshire (2015) and the Plan for Stafford Borough: Part 2 (2015) have also been included as committed developments. These are listed in Volume 5: Appendix CT-004-000 and are shown in Volume 5: Maps CT-13-113b to CT-13-115a-R1.

2.1.22 Where it is likely that committed developments will have been completed by 2020, these have been identified as 'future baseline' schemes and have been taken into account for the purpose of assessing the likely significant environmental effects of the Proposed Scheme, for example, as new receptors as appropriate. Where these developments have a particular relevance to an assessment topic, this is noted in Volume 5: Appendix CT-004-000.

2.1.23 Where there are committed developments that are considered likely to be constructed between 2020 and 2027, i.e. at the same time as the Proposed Scheme, they are considered to be receptors for the operation of HS2, but also potentially to give rise to cumulative impacts with the Proposed Scheme during construction. These 'potential cumulative' developments are noted in Volume 5: Appendix CT-004-000.

2.1.24 There are no potential cumulative developments identified that are relevant to the topic assessments in the Whitmore Heath to Madeley area.

2.1.25 Where a committed development lies wholly or partly within the land required for the Proposed Scheme, consideration has been given as to whether it will be commenced or completed in its proposed form. These developments are noted in Volume 5: Appendix CT-004-000.

2.1.26 Planning applications yet to be determined and sites that are proposed allocations in development plans that have yet to be adopted, on or close to the Proposed Scheme, are termed 'proposed developments'. These are listed in Volume 5: Appendix CT-004-000, but are not included in the assessment.

[11]Shropshire Local Development Framework: Adopted Core Strategy (Adopted 2011). Available online at: http://shropshire.gov.uk/media/830904/shropshire-core-strategy-2011-reduced.pdf

[12] Shropshire Site Allocations and Management (SAMDev) Plan (Adopted 2015). Available online at: http://shropshire.gov.uk/media/1900363/SAMDev-Adopted-Plan.pdf

Changes to the design since the working draft EIA Report

2.1.27 Since the working draft EIA Report was published, a number of changes have been introduced to the Proposed Scheme. These have resulted from design development and in response to consultation feedback. The key changes include (all dimensions below are approximate unless stated otherwise):

- the River Lea viaduct has increased in length from 485m to 785m (see Volume 2: Map CT-06-231, C6 to A5 and CT-06-232, J5 to G6);
- the proposed portal building and rescue area to the north of Whitmore Heath tunnel have moved from the northern to the southern side of the route of the Proposed Scheme. This has reduced the requirement for rail infrastructure to the north of the route of the Proposed Scheme, close to the woodland planting near Whitmore Wood (see Volume 2: Map CT-06-230, C6 to B6);
- Bitterns Lane auto-transformer station has been removed and the following two auto-transformer stations added in alternative locations:
  - Whitmore North auto-transformer station, to the south of the route of the Proposed Scheme, 500m south-east of the River Lea viaduct (see Volume 2: Map CT-06-231, F6 to E6); and
  - Madeley North auto-transformer station, to the north of the route of the Proposed Scheme, at the north portal of Madeley tunnel (see Volume 2: Map CT-06-234, H5);
- Madeley Bridleway 1 (Red Lane) will be realigned to cross the route of the Proposed Scheme on Madeley Bridleway 1 accommodation green overbridge, 25m north-west of its current alignment (see Volume 2: Map CT-06-233, H6 to G2);
- the introduction of a retaining wall at the southern porous portal of Madeley tunnel and associated modification to Madeley cutting has reduced the area of land required within Barhill Wood from 0.5ha to 0.2ha (see Volume 2: Map CT-06-233, E6 to D5);
- the introduction of a borrow pit to the west of Netherset Hey Farm for the extraction of sand and gravel for construction (see Volume 2: Map CT-05-232, H5 to D1 and Map CT-05-232 R1, H10 to D9);
- the introduction of tunnelling facilities and logistics areas at Whitmore Heath tunnel and Madeley tunnel. These will be located at each end of the tunnels and will provide areas for the storage of bulk materials for construction and for transfer of materials associated with the tunnelling works (see Volume 2: Map CT-05-230, H5, GS and C5 and Map CT-05-233, E5 to D5 and Map CT-05-234, I5 to H5);
- the introduction of a viaduct launching yard and viaduct pre-casting yard located south of where the route of the Proposed Scheme will cross the WCML to facilitate construction of the River Lea viaduct (see Volume 2: Map CT-05-231, D6 to C5 and B5);

- transfer nodes for the storage, loading and unloading of bulk earthworks materials will be located at the Whitmore Heath tunnel satellite compound, Madeley cutting satellite compound and Madeley tunnel (south) satellite compound.

2.1.28 The location and configuration of construction compounds, stockpiles and site haul routes have been considered as part of the design development. In addition, mitigation such as noise barriers and landscape earthworks, green bridges, compensatory planting and replacement ponds and wetlands have been included throughout the Whitmore Heath to Madeley area to reduce effects.

2.2 Description of the Proposed Scheme

General

2.2.1 The following section describes the main features of the Proposed Scheme in the Whitmore Heath to Madeley area, including the proposed environmental mitigation measures that have been identified. Further information on typical permanent features is provided in Volume 1, Section 5. Similarly, a general description of the approach to mitigation is provided in Volume 1, Section 9. Some of the ecological mitigation described in this section has been provided on a precautionary basis. This is set out in Section 8, Ecology and biodiversity.

2.2.2 Land required for operation of the Proposed Scheme is described in this section and is shown on Map Series CT-06 in the Volume 2: CA4 Map Book. Land also required for construction is described in Section 2.3 and shown on Map Series CT-05 in the Volume 2: CA4 Map Book.

Overview

2.2.3 The route of the Proposed Scheme through this area is approximately 9.1km long and will continue from the Stone and Swynnerton area (CA3), 100m west of Shelton under Harley.

2.2.4 In the Whitmore Heath to Madeley area the route will run in a general south-east to north-west orientation towards the boundary with the South Cheshire area (CA5).

2.2.5 The route will travel in a north-west direction between Baldwin's Gate and Whitmore and pass under Whitmore Heath in a tunnel. The route will then emerge onto a series of cuttings, embankments and viaducts, which will cross the WCML, the Stoke to Market Drayton Railway, the River Lea, and the Madeley Chord Railway before entering a section of tunnel to the south of Madeley.

2.2.6 The route will exit the tunnel north of Madeley and will continue on an embankment to the boundary with the South Cheshire area (CA5), 140m south of Checkley Brook.

2.2.7 All dimensions in the sections below are approximate.

2.2.8 In the Whitmore Heath to Madeley area, the route of the Proposed Scheme will be carried on the following features:

- viaducts for a total length of 1km (Meece Brook and River Lea viaducts);

- cuttings for a total length of 2.4km (Whitmore South, Whitmore North and Madeley cuttings);
- embankments for a total length of 3.5km (Stableford North, Meece, Lea South, Lea North and Checkley South embankments); and
- tunnels for a total length of 2.2km (Whitmore Heath and Madeley tunnels).

2.2.9 Embankments and cuttings have been labelled according to their predominant physical characteristics. It is important to note that a number of embankments and cuttings vary as to their depth of cutting or height or embankment as a result of the topography through which the railway passes. Moreover, there are some sections of cutting over which the railway passes at grade or above ground and some sections of embankment which are at grade or below ground level. In the Whitmore Heath to Madeley area, this applies to the following embankments and cuttings:

- Stableford North embankment has some sections where the railway passes up to 1m below existing ground level; and
- Checkley South embankment has some sections where the railway passes up to 4m below existing ground level.

2.2.10 The Proposed Scheme is described in three separate sections below.

2.2.11 In general, features are described along the route of the Proposed Scheme from south-east to north-west and to the southern and northern sides of the route as they cross the Proposed Scheme, as shown on Map Series CT-06 in the Volume 2: CA4 Map Book.

Shelton under Harley Farm to Whitmore Heath tunnel northern porous portal

2.2.12 The route of the Proposed Scheme will pass from the Stone and Swynnerton area (CA3) into the Whitmore Heath to Madeley area (CA4) west of Shelton under Harley Farm near to Chorlton Mill and continue on Stableford North embankment into the Meece Brook Valley. The route of the Proposed Scheme will pass onto the Meece Brook viaduct, followed by the Meece embankment. It will then continue into the Whitmore South cutting before passing under the A53 Newcastle Road and into a tunnel under Whitmore Heath.

2.2.13 This section of route is illustrated on Maps CT-06-229 and CT-06-230.

2.2.14 Key features of this 2.8km section will include:

- Stableford North embankment, 565m in length and up to 11m in height, with landscape earthworks on both sides of the Proposed Scheme. The earthworks will help integrate the route of the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-229, I6 to G5);
- an area of wetland habitat creation to the south of the route of the Proposed Scheme extending north under Meece Brook viaduct and to the north of the Meece Brook. There will also be an area of wetland habitat creation to the south of the A53 Newcastle Road and 340m to the north-east of the Whitmore South cutting (see Volume 2: Map CT-06-229, I7 to C3 and C2);

- realignment and closure of Bent Lane to the southern side of the route of the Proposed Scheme. The realignment will be 350m in length and 100m south-west of its existing alignment, continuing from the Stone and Swynnerton area (CA3) and passing along the southern side of the route of the Proposed Scheme to create Bent Lane (South), continuing along the southern side of the route of the Proposed Scheme for 600m, where the road will be closed (see Volume 2: Map CT-06-228b, D7 to A6 and Map CT-06-229, I6 to H6);
- diversion of Bent Lane, to the northern side of the route of the Proposed Scheme, by 700m, 150m north-east of its existing alignment, continuing from the Stone and Swynnerton area (CA3) along the northern side of the route of the Proposed Scheme to create Bent Lane (North) (see Volume 2: Map CT-06-229, I5 to F4);
- two balancing ponds for highway drainage, within an area of woodland habitat creation, to the north of the route of the Proposed Scheme, one adjacent to the start of the Stableford North embankment and one adjacent to the Meece Brook viaduct (see Volume 2: Map CT-06-229, I5 and F5). Access to both will be from the diverted Bent Lane (North);
- the Meece Brook viaduct, 240m in length and up to 12m in height over Meece Brook (see Volume 2: Map CT-06-229, G5 to E5);
- realignment of Meece Brook for 60m in a north/south direction around the piers of the Meece Brook viaduct (see Volume 2: Map CT-06-229, F6 to F5);
- a replacement floodplain storage area to the south-west of the route of the Proposed Scheme, in the Meece Valley adjacent to the Meece Brook viaduct. Following excavation, the area will be re-graded back to tie into existing ground level (see Volume 2: Map CT-06-229, G6 to E7);
- Meece embankment, 260m in length and up to 10m in height, with landscape earthworks on both sides. The embankment will have slopes graded out to integrate the Proposed Scheme into the surrounding landscape, with woodland planting on both sides to provide visual screening for properties in Baldwin's Gate and Whitmore (see Volume 2: Map CT-06-229, E6 to D5);
- a balancing pond for railway drainage, with an area of grassland habitat creation, to the south of the route of the Proposed Scheme, adjacent to the Meece embankment. Access will be provided via an access road 800m in length running north-west to join the A53 Newcastle Road (see Volume 2: Map CT-06-229, E7 to D6);
- two landscape bunds[13], with landscape mitigation planting, 200m north-west of the Meece Brook viaduct, one on the north of the route of the Proposed Scheme 200m in length and up to 2m in height, and one to the south 150m in length and up to 2m in height. The landscape bunds will provide visual screening for the residents of properties in Whitmore and along the A53

[13] A bund is an earthworks structure designed to provide either visual screening or noise attenuation to receptors in proximity.

Newcastle Road to the north and Hill Chorlton to the south of the route of the Proposed Scheme (see Volume 2: Map CT-06-229, D5 to C5);

- an ecological mitigation pond, to provide replacement habitat for reptiles and amphibians, 50m north-west of the Meece embankment (see Volume 2: Map CT-06-229, D5);
- Whitmore South cutting, 530m in length, up to 13m in depth and 99m in width (see Volume 2: Map CT-06-229, D6 to A5);
- a balancing pond for highway drainage, to the north of the route of the Proposed Scheme, 300m east of the A53 Newcastle Road overbridge. Access will be provided from the A53 Newcastle Road (see Volume 2: Map CT-06-229, B3);
- a tunnel portal building[14] and rescue area at the southern end of the Whitmore Heath tunnel, to the south of the route of the Proposed Scheme. Access will be provided from the A53 Newcastle Road to the north (see Volume 2: Map CT-06-230, I6);
- a porous portal 150m in length at the southern end of Whitmore Heath tunnel, with a headwall[15] 69m long and 10m in height at the northern end of the portal cutting. There will be landscape mitigation planting to the north, east and west to provide visual screening for the residents of Whitmore village and from the A53 Newcastle Road (see Volume 2: Map CT-06-230, I6 to H5);
- the A53 Newcastle Road overbridge, 100m in length, 4m above existing ground level and 13m above track level, to carry the A53 Newcastle Road on its existing alignment over the Whitmore Heath tunnel southern porous portal. The road will be realigned up to 7m above its existing level on embankments on both sides of the overbridge (see Volume 2: Map CT-06-230, J3 to H7);
- five ecological mitigation ponds, to provide replacement habitat for reptiles and amphibians, four within an area of grassland habitat creation and one within an area of woodland habitat creation 200m to the west of the southern porous portal of the Whitmore Heath tunnel (see Volume 2: Map CT-06-230, H9 to G7);
- a balancing pond for highway drainage, within an area of woodland habitat creation, to the south of the route of the Proposed Scheme, 20m to the north of the A53 Newcastle Road. Access will be provided from the A53 Newcastle Road (see Volume 2: Map CT-06-230, H7 to G7);
- a cut and cover section of Whitmore Heath tunnel, 240m in length and up to 17m in depth, continuing into Whitmore Heath twin bore tunnel (see Volume 2: Map CT-06-230, H6 to G5);

[14] A tunnel portal building houses equipment, such as control equipment for the tunnel and ventilation fans for rail tunnel operations.
[15] A tunnel headwall retains the level difference between the porous portal and the material over the tunnel opening.

- a twin bore section of Whitmore Heath tunnel, 690m in length and up to 50m in depth, passing under Whitmore Heath. The top of the bored tunnel will be up to 40m below existing ground level and track level will be up to 50m below ground level. Both excavated bores will be 10.2m in diameter with a lined internal diameter of 8.8m. There will be cross passages providing access between the two bores (see Volume 2: Map CT-06-230, G6 to C5);
- a porous portal 150m in length at the northern end of Whitmore Heath tunnel, with a headwall 94m in length and up to 15m in height at the end of the porous portal cutting (see Volume 2: Map CT-06-230, C5 to C6);
- a noise fence barrier, up to 3m in height, at the top of the porous portal cutting along the headwall to the north of the Whitmore Heath tunnel. The barrier will provide acoustic screening for properties in Whitmore Heath to the south of the porous portal (see Volume 2: Map CT-06-230, D6 to D5);
- a surface water pumping station for railway drainage, to the south of the route of the Proposed Scheme, 100m north of Whitmore Heath tunnel. Access will be provided from an access road to join Snape Hall Road (see Volume 2: Map CT-06-230, C6);
- Snape Hall Road drop inlet culvert, 120m north of Whitmore Heath tunnel, to convey an unnamed watercourse under the route of the Proposed Scheme (see Volume 2: Map CT-06-230, C6 to C5);
- widening of Common Lane and Snape Hall Road over a length of 1.1km to the south of Whitmore Heath. The road will be widened to 5.5m on the opposite side to the existing properties, to enable maintenance and emergency vehicle access to the tunnel portal building and rescue area to the west of Whitmore Heath tunnel (see Volume 2: Map CT-06-230, G8 to C6); and
- Snape Hall Road will be closed where it crosses the route of the Proposed Scheme at the Whitmore Heath tunnel northern porous portal. Two turning heads will be provided to facilitate vehicle access on the retained sections of Snape Hall Road, one to the south of the route of the Proposed Scheme and one to the north (see Volume 2: Map CT-06-230, D6 to C4).

2.2.15 This section of the route of the Proposed Scheme will include one emergency access point, located 10m to the west of the Stableford North embankment, and four maintenance access points allowing vehicle access to the route. There will also be maintenance access routes and hedgerow planting throughout this section. There will also be minor utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.16 Construction of this section will be managed from the Stableford North embankment satellite compound, Whitmore Heath tunnel south portal satellite compound, Whitmore Heath tunnel north portal satellite compound and the Whitmore Heath tunnel satellite compound, which are described in Section 2.3, and as shown on Maps CT-05-229 and CT-05-230.

Whitmore Heath tunnel northern porous portal to Manor Road overbridge

2.2.17 The route of the Proposed Scheme in this section will emerge from the Whitmore Heath tunnel northern porous portal and continue through a section of Whitmore Wood in Whitmore North cutting. The route will then enter the valley of the River Lea on Lea South embankment and continue onto the River Lea viaduct, passing over the River Lea, the WCML, Stoke to Market Drayton Railway and the Madeley Chord. The route will then continue on Lea North embankment until passing under Manor Road overbridge.

2.2.18 This section of route is illustrated on Maps CT-06-230 to CT-06-232.

2.2.19 Key features of this 3.1km section will include:

- a tunnel portal building and rescue area at the northern end of Whitmore Heath tunnel to the southern side of the route of the Proposed Scheme. Access will be provided by an access road from Snape Hall Road, 150m to the west (see Volume 2: Map CT-06-230, C6 to B6);
- Whitmore North cutting, 600m in length, up to 13m in depth, measured from track level to the existing ground level and 45m in width (see Volume 2: Map CT-06-230, B6 to A6 and Map CT-06-231, J6 to G6);
- Whitmore Wood retaining wall, 577m in length and up to 20m in depth below existing ground level with an additional 1.8m parapet extending above existing ground level, running from the north of Snape Hall Road and continuing north-west along the northern side of the route of the Proposed Scheme (see Volume 2: Map CT-06-230, C5 to A5 and Map CT-06-231, J5 to G5);
- a noise fence barrier, up to 3m in height, extending across the width of the cutting above the northern porous portal of Whitmore Heath tunnel and extending along the southern side of Whitmore North cutting. The noise barrier will provide acoustic screening for properties on Snape Hall Road, Whitmore Heath and Madeley Park Wood (see Volume 2: Map CT-06-230, C6 to A6 and Map CT-06-231, J6 to G5);
- areas of woodland habitat creation to connect fragmented areas of existing woodland, to the north of the route of the Proposed Scheme, extending from Whitmore Heath tunnel northern porous portal for 2km to the River Lea and extending out to 1.5km north-east of the route of the Proposed Scheme (see Volume 2: Map CT-06-230, C5 to A2, Map CT-06-231, J5 to A4, Map CT-06-231-R1, J10 to C4 and Map CT-06-232, J5 to H4);
- an area of woodland restoration, including the restoration of an area of plantation within the boundary of Whitmore Wood to the north and south of Whitmore North cutting (see Volume 2: Map CT-06-231, J6 to G4);
- four ecological mitigation ponds to provide replacement habitat for reptiles and amphibians, with an area of grassland habitat creation, to the north of the route of the Proposed Scheme, 250m to the north-east of Whitmore Heath tunnel northern porous portal (see Volume 2: Map CT-06-231, J4 to I3);

- a balancing pond for railway drainage, within an area of landscape mitigation planting, to the south of the route of the Proposed Scheme, adjacent to Whitmore Heath tunnel northern tunnel portal building and rescue area. Access will be provided from an access road 100m in length running south to Snape Hall Road (see Volume 2: Map CT-06-231, J6);
- Dab Green drop inlet culvert, 350m north of Snape Hall Road as the route passes through Whitmore Wood, for surface water drainage under the route of the Proposed Scheme (see Volume 2: Map CT-06-231, H5 to H6);
- Whitmore Footpath 6 will be realigned in two places and diverted in another along the south of the route of the Proposed Scheme. A section of Whitmore Footpath 6 to the south-west of Whitmore Wood overbridge will be realigned by 30m west of its current alignment to create Whitmore Footpath 6 (South), increasing the length of journey by 30m along this section. A second part will be realigned by 20m north-west of its current alignment, around the Whitmore North auto-transformer station, to create Whitmore Footpath 6 (North) and increasing the length of journey by 20m along this section. A further section, where Whitmore Footpath 6 meets Madeley Footpath 14, will be diverted for 600m to the west of its current alignment, along the base of the Lea South embankment and under the River Lea viaduct, increasing the length of journey by 150m along this section (see Volume 2: Map CT-06-231, H7 to C5);
- Whitmore Wood overbridge, 6.8m above existing ground level and 10m above track level, will provide access to Snape Hall Farm and areas of woodland habitat creation and enhancement, 120m north-west of Dab Green drop inlet culvert (see Volume 2: Map CT-06-231, H5 to H6);
- Whitmore Wood culvert, 500m north of Snape Hall Farm, to convey an unnamed watercourse under the route of the Proposed Scheme (see Volume 2: Map CT-06-231, G5 to G6);
- a balancing pond for railway drainage, within an area of grassland habitat creation, to the south of the route of the Proposed Scheme, adjacent to Whitmore Wood culvert. Access will be provided via an access road 600m in length running south-east to Snape Hall Road (see Volume 2: Map CT-06-231, G6 to G7);
- Lea South embankment, 845m in length and up to 21m in height. There will be landscape earthworks and landscape mitigation planting to both sides of the embankment, with slopes graded out to help integrate the Proposed Scheme into the surrounding landscape. A noise fence barrier, up to 4m in height, on the southern side of the route of the Proposed Scheme will extend along the top of the Lea South embankment to the start of the River Lea viaduct. The barrier will provide acoustic screening for properties at Madeley Park Wood (see Volume 2: Map CT-06-231, G6 to C5);
- Whitmore North auto-transformer station, 58m by 25m to the south of the route of the Proposed Scheme, adjacent to the Lea South embankment. Access will be via an access road from Snape Hall Road, 900m to the south-east (see Volume 2: Map CT-06-231, F6 to E6);

- Madeley Park culvert, for surface water drainage, 30m north of Whitmore North auto-transformer station (see Volume 2: Map CT-06-231, E5 to E6);
- two ecological mitigation ponds, to provide replacement habitat for reptiles and amphibians, within an area of grassland habitat creation, to the north of the route of the Proposed Scheme, 300m to the south-east of the River Lea viaduct (see Volume 2: Map CT-06-231, D3 to D5);
- River Lea viaduct, 785m in length and up to 21m in height. A noise fence barrier, up to 3m in height, will extend along part of the southern side of the River Lea viaduct and provide acoustic screening for properties at Madeley Park Wood (see Volume 2: Map CT-06-231, C6 to A5 and Map CT-06-232, J6 to I5);
- access for maintenance and accommodation access to farmland associated with Snape Hall Farm, on the northern side of the route of the Proposed Scheme, will be provided by the diverted Madeley Footpath 14 (see Volume 2: Map CT-06-231, C5 to C6);
- an area of grassland habitat creation under the River Lea viaduct and to the north of the WCML to provide replacement grassland habitat. An additional area of grassland habitat creation will be located 680m to the north-east of the River Lea viaduct to provide replacement terrestrial habitat for great crested newt (see Volume 2: Map CT-06-231, D7 to B5 and Map CT-06-232 R1, G8 to G9);
- an area of wetland habitat creation under the River Lea viaduct and to the west of the WCML (see Volume 2: Map CT-06-231, C6 to A6);
- diversion of an unnamed watercourse for 220m, in a south-east to north-west direction from the route of the Proposed Scheme, between the WCML and the Stoke to Market Drayton Railway (see Volume 2: Map CT-06-231, B6 to A6 and Map CT-06-232, J6 to I6);
- a replacement floodplain storage area on the south side of the route of the Proposed Scheme in the Lea Valley, adjacent to the River Lea viaduct. Following excavation, the area will be re-graded back to tie into existing ground level (see Volume 2: Map CT-06-232, H9 to G7);
- the Lea North embankment, 860m in length and up to 16m in height, extending from the River Lea viaduct to Manor Road. The embankment will have landscape mitigation planting and landscape earthworks on both sides, with slopes graded out to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-232, G6 to C5);
- River Lea flood culvert, 230m north-west of the River Lea viaduct, to provide flood relief. There will be associated flood relief channels[16] which will extend

[16] Flood relief channels consist of grass depressions which transmit flows from the surrounding floodplain through a culvert.

for 260m along the northern side and 500m along southern side of the route of the Proposed Scheme, (see Volume 2: Map CT-06-232, H6 to E5);

- modifications to the WCML to accommodate the connection of the Proposed Scheme with the conventional rail network. This includes a provision for relocating signalling equipment and extension of an existing access road for 250m alongside the WCML, east of Hey House (see Volume 2: Map CT-06-233, F4 to B2);
- realignment of Manor Road, 100m to the north-west of its existing alignment on an embankment 1km long and up to 13m in height. The realigned Manor Road will cross over the route of the Proposed Scheme on Manor Road overbridge, up to 14m above existing ground level and 10m above track level. A separate accommodation access for Manor Farm over the Manor Road overbridge will be provided, to the north of the road, connecting the fields to the north and south of the route of the Proposed Scheme. The existing Manor Road will be closed where it crosses the route of the Proposed Scheme and retained as public highway to both sides of the route for fields associated with Manor Farm to the south and for Madeley Cemetery and Hey House to the north (see Volume 2: Map CT-06-233, E8 to B3);
- a balancing pond for highway drainage, within an area of grassland habitat creation, to the south of the route of the Proposed Scheme, 50m west of the Lea North embankment. Access will be provided via an access road from Manor Road (see Volume 2: Map CT-06-233, D6);
- an access road from Manor Road to provide accommodation access for Hey House to the north of the route of the Proposed Scheme (see Volume 2: Map CT-06-233, D5 to B3); and
- a balancing pond for railway drainage, within an area of grassland habitat creation, to the north of the route of the Proposed Scheme, adjacent to Manor Road overbridge. Access will be provided via an access road Manor Road to the north (see Volume 2: Map CT-06-233, D5 to C5).

2.2.20 This section of the route of the Proposed Scheme will include one emergency access point, located 20m west of the route of the Proposed Scheme and 100m north of the Manor Road overbridge, and six maintenance access points allowing vehicle access to the route. There will also be maintenance access routes and hedgerow planting throughout this section. There will also be minor utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.21 Construction of this section will be managed from the Whitmore North cutting satellite compound, Whitmore Heath tunnel north portal compound, Whitmore North auto-transformer station compound and the River Lea viaduct satellite compound, which are described in Section 2.3 and shown on Maps CT-05-230, CT-05-231 and CT-05-232. Modifications to the WCML will be managed from the Stone railhead main compound in the Stone and Swynnerton area (CA3), as shown on Map CT-05-223 in the Volume 2: CA3 Map Book.

Manor Road overbridge to Checkley Brook

2.2.22 The route will continue into Madeley cutting, passing under the A525 Bar Hill overbridge before entering a porous portal and Madeley tunnel, to the west of Madeley, through part of Barhill Wood. From Madeley tunnel the route will emerge into a porous portal and then into a cutting before transferring to Checkley South embankment, and will continue into the South Cheshire area (CA5) south-west of Wrinehill Mill.

2.2.23 This section of route is illustrated on Maps CT-06-232 to CT-06-234.

2.2.24 Key features of this 3.3km section will include:

- Madeley cutting, 1.02km in length, up to 17m in depth and 133m in width (see Volume 2: Map CT-06-233, B6 to A5 and Map CT-06-234, J6 to E5). Noise fence barriers up to 3m in height will be located on the northern side of the cutting, extending from the Madeley Bridleway 1 accommodation green overbridge across the A525 Bar Hill Road to the southern porous portal of Madeley tunnel portal buildings and rescue area. There will be landscape mitigation planting along both sides of the cutting to provide visual screening. The noise barriers and planting will provide acoustic and visual screening for residents of properties to the north of the Proposed Scheme on the A525 Bar Hill Road and in Madeley (see Volume 2: Map CT-06-233, H5 to E5);
- a landscape bund with woodland planting, 300m in length and 2m in height, to the north of the route of the Proposed Scheme, extending from the start of Madeley cutting to the Madeley Bridleway 1 accommodation green overbridge. The bund will provide visual screening for residents on the A525 Bar Hill Road (see Volume 2: Map CT-06-233, I5 to H5);
- three ecological mitigation ponds, two to the north and one to the south of the route of the Proposed Scheme, to provide replacement habitat for reptiles and amphibians, within two separate areas of grassland habitat creation, to the south of Madeley Bridleway 1 (Red Lane) (see Volume 2: Map CT-06-233, H6 to H4);
- realignment of Madeley Bridleway 1 (Red Lane), 25m north-west of its current alignment for 600m, to cross over the route of the Proposed Scheme on the Madeley Bridleway 1 accommodation green overbridge. The overbridge will be 7m in height above existing ground level and 10m above track level. This overbridge will contain planting to facilitate ecological connectivity across the route of the Proposed Scheme. Further detail about this overbridge is presented in Section 8, Ecology and biodiversity (see Volume 2: Map CT-06-233, H7 to G2);
- areas of woodland habitat creation to the north of Madeley Bridleway 1 (Red Lane) and the A525 Bar Hill Road, 500m to the south-west of Madeley cutting, to provide replacement habitat creation and connect fragmented areas of existing woodland (see Volume 2: Map CT-06-233, H7 to G10);
- a landscape bund, 250m in length and 2m in height, on the northern side of the route of the Proposed Scheme from the start of Madeley Bridleway 1

accommodation green overbridge to the A525 Bar Hill overbridge. The bund will provide visual screening for the residents of properties on A525 Bar Hill Road (see Volume 2: Map CT-06-233, H5 to G5);

- Drummer Stile inverted siphon, 175m south-east of the A525 Bar Hill Road, for surface water flow under the route of the Proposed Scheme (see Volume 2: Map CT-06-233, G6);
- realignment of the A525 Bar Hill Road, 20m to the south-east of its existing alignment, to cross over the route of the Proposed Scheme on the A525 Bar Hill overbridge, 4m above existing ground level and 10m above track level. The existing A525 Bar Hill Road will be closed to both sides of the Proposed Scheme and retained as private means of access for properties to the north (see Volume 2: Map CT-06-233, G7 to F4);
- widening of the existing Moor Hall Farm access road and Madeley Footpath 24 to 5.5m over a 400m section and extension of the road by 200m north-east of Moor Hall Farm, to connect to Bower End Lane (see Volume 2: Map CT-06-233, F5 to C3);
- a tunnel portal building, rescue area and surface water pumping station, to the north of the route of the Proposed Scheme at the southern end of Madeley tunnel. Access will be provided from a shared farm accommodation access to join the A525 Bar Hill Road to the south-east (see Volume 2: Map CT-06-233, E5);
- a porous portal extending 150m to the south of Madeley tunnel with landscape mitigation planting to the north, east and west to help integrate the Proposed Scheme into the existing landscape (see Volume 2: Map CT-06-233, E5 to D6);
- Bar Hill aqueduct, 100m in length, for surface water flow over Madeley tunnel southern porous portal (see Volume 2: Map CT-06-233, D5 to D6);
- porous portal retaining wall to retain the cut around the Madeley tunnel southern porous portal, with an element on either side of the route to provide support to a headwall above the tunnel portal, 40m in width, 100m in length (to both sides of the porous portal) and up to 24m in height. The wall will limit the area required for the Proposed Scheme within Barhill Wood (see Volume 2: Map CT-06-233, D5 to D6);
- an area of woodland habitat creation, along with woodland enhancement around the Madeley tunnel southern porous portal, connecting to Barhill Wood (see Volume 2: Map CT-06-233, E7 to D6);
- an area of grassland habitat creation, 75m to the north of the Madeley tunnel southern porous portal, to provide replacement habitat (see Volume 2: Map CT-06-233, E5 to D3);
- diversion of Madeley Footpath 24, for 70m, 20m north of its current alignment, to join the new access road between the A525 Bar Hill Road and Bower Lane where it is connected with the realigned Madeley Footpath 26. This diversion will not increase the journey length (see Volume 2: Map CT-06-233, D4 to D3);

- realignment of Madeley Footpath 26, 15m north-east of its current alignment, along the new access road between A525 Bar Hill Road and Bower Lane, reducing the length of journey by 30m (see Volume 2: Map CT-06-233, B4);
- a balancing pond for railway drainage, within an area of grassland habitat creation, 100m north of the Madeley tunnel southern porous portal. Access will be provided from Bower End Lane via farm accommodation access from the A525 Bar Hill Road (see Volume 2: Map CT-06-233, D5 to C4);
- realignment of Madeley Bridleway 5, 10m south of its current location for 100m along the access road between Bower End Lane and the Madeley tunnel northern porous portal, to the east of Madeley Tunnel. This diversion will not increase the journey length (see Volume 2: Map CT-06-233, B4 to A4);
- Madeley tunnel, a twin bore tunnel 673m in length and up to 38m in depth, extending under Bar Hill. The top of the bored tunnel will be 28m below existing ground level and track level will be 38m below ground level. Each excavated bore will be 10.2m in diameter with a lined diameter of 8.8m. Cross passages will provide access between the bores (see Volume 2: Map CT-06-233, D5 to A6 and Map CT-06-234, J5 to I6);
- a porous portal extending 150m to the north of Madeley tunnel, with a tunnel headwall, 71m in length and 12m in height at the end of the portal cutting. There will be an area of woodland habitat creation to the north and south-west of the route of the Proposed Scheme which will facilitate ecological connectivity between fragmented habitats (see Volume 2: Map CT-06-234, I5 to I6);
- four ecological mitigation ponds, to provide replacement habitat for reptiles and amphibians, within areas of grassland habitat creation, two to the north-east and two to the south-west of the Madeley tunnel northern porous portal (see Volume 2: Map CT-06-234, H4 and G7);
- a tunnel portal building and rescue area, to the north of the route of the Proposed Scheme at the northern end of Madeley tunnel. There will also be a telecommunications mast 15m in height adjacent to the tunnel portal. Access will be provided from a track running south to Bower End Lane (see Volume 2: Map CT-06-234, H5);
- Madeley North auto-transformer station, 46m by 24m, to the north of the route of the Proposed Scheme. Access will be provided from a track joining Bower End Lane to the south-east (see Volume 2: Map CT-06-234, H5);
- areas of woodland habitat creation, to the north and south-west of the route of the Proposed Scheme, with areas of woodland extending 400m from the northern end of Madeley tunnel to provide connectivity between fragmented habitats and Wrinehill Wood (see Volume 2: Map CT-06-234, I7 to E6 and G8 to F9);
- Checkley South embankment, 1.2km in length and up to 15.7m in height. The embankment will have slopes graded out to help integrate the Proposed

Scheme into the surrounding landscape and landscape mitigation planting on both sides of the embankment (see Volume 2: Map CT-06-234, G6 to B5);

- closure of Madeley Bridleway 5 with users diverted along the route of Madeley Footpath 28, which will be upgraded to a bridleway, decreasing the length of journey by 220m if travelling from Madeley Bridleway 5 and increasing the length of journey by 75m if travelling north from Madeley Bridleway 2 (see Volume 2: Map CT-06-234, G3 to D6);
- Wrinehill Wood culvert, 500m north-west of the northern porous portal of Madeley tunnel, for diversion of an unnamed watercourse (see Volume 2: Map CT-06-234, F5 to F6);
- realignment of Madeley Bridleway 2 for 200m to cross under the route of the Proposed Scheme via Madeley Bridleway 2 accommodation underbridge. To the north of the route of the Proposed Scheme it will be realigned 20m to the east of its current alignment and to the south of the route, 15m to the west. The Madeley Bridleway 2 accommodation underbridge will also provide passage for diversion of two unnamed watercourses under the route of the Proposed Scheme (see Volume 2: Map CT-06-234, D5 to D6); and
- a balancing pond for railway drainage, to the south-west of the route of the Proposed Scheme, 100m west of Madeley Bridleway 2 accommodation underbridge. Access will be provided via Madeley Bridleway 2 accommodation underbridge and an access road connecting to Bower End Lane to the south-east of the route of the Proposed Scheme. This access road continues north for 130m to provide maintenance access for the South Cheshire area (CA5) (see Volume 2: Map CT-06-234, D6 to B6).

2.2.25 This section of the route of the Proposed Scheme will include eight maintenance access points allowing vehicle access to the route. There will also be maintenance access routes and hedgerow planting throughout this section. There will also be minor utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.26 Construction of this section will be managed from the Madeley cutting satellite compound, Madeley tunnel (south) satellite compound, Madeley tunnel (north) satellite compound, Madeley tunnel north portal compound and Checkley South embankment satellite compound, which are described in Section 2.3 and shown on Maps CT-05-233 and CT-05-234.

Demolitions

2.2.27 Demolition of three residential properties, one commercial/business property (including farm outbuildings) and five other buildings will be required to construct the permanent features in the Whitmore Heath to Madeley area. Demolitions will be managed from the same construction compounds as the permanent features with which they are associated. The identified demolitions of the Proposed Scheme are listed in Section 2.3 under the relevant construction compounds.

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the key construction activities that it is envisaged will be required to build the Proposed Scheme in the Whitmore Heath to Madeley area. It includes:

- an overview of the construction process;
- a description of the advance works;
- a description of the engineering works to build the Proposed Scheme;
- information on construction waste and material resources;
- a description of how the Proposed Scheme will be commissioned;
- an indicative construction programme; and
- monitoring arrangements during the construction period.

2.3.2 The construction arrangements described in this section provide the basis for the assessment presented in this ES.

2.3.3 Land used only for construction purposes will be restored as agreed with the owner of the land and the relevant planning authority once the construction works in that area are complete.

2.3.4 Land will be required permanently for the key features of the Proposed Scheme described in Section 2.2.

2.3.5 During the construction phase, public roads and PRoW routes will remain open for public use wherever reasonably practicable. Where such routes cross the Proposed Scheme and require diversion, the alternative road or PRoW crossing the Proposed Scheme will be constructed prior to any closure of existing roads or PRoW wherever reasonably practicable. Where they cross the Proposed Scheme in proximity to their existing alignment, a temporary alternative alignment may be required. In some instances, diverted or realigned roads or PRoW may need to pass through areas required for construction of the Proposed Scheme. Routes through these areas will be provided where it is safe and reasonably practicable to do so.

2.3.6 Volume 1, Section 5 and Section 6 provide details of the typical construction techniques. For the purposes of the environmental assessment, standard construction techniques as provided in Volume 1, Section 6 have been assumed.

Code of Construction Practice

2.3.7 All contractors will be required to comply with a Code of Construction Practice (CoCP). In addition, Local Environmental Management Plans (LEMP) will be produced for each local authority area. The CoCP and the LEMP will be the means of controlling the construction works associated with the Proposed Scheme, and set out monitoring requirements, with the objective of ensuring that the effects of the works on people and the natural environment are reduced insofar as reasonably practicable. The CoCP will contain general control measures and standards to be implemented throughout the construction process.

2.3.8 A draft CoCP has been prepared and is published as part of this ES, in Volume 5: Appendix CT-003-000. It will remain a draft document through the parliamentary process and will be finalised at Royal Assent. The draft CoCP sets out measures to be implemented by the nominated undertaker.

Overview of the construction process

2.3.9 Building and preparing the Proposed Scheme for operation will comprise the following general stages:

- advance works including: site investigations further to those already undertaken and preliminary mitigation works;
- civil engineering works including: extraction of sand and gravel from borrow pits; establishment of construction compounds; site haul routes, site preparation and enabling works; main earthworks and structure works; site restoration; removal of construction compounds and site restoration where the compound is not required for railway installation works; and associated utility diversions;
- railway installation works including: establishment of construction compounds; infrastructure installation; connections to utilities; changes to the existing rail network; and removal of construction compounds and site restoration;
- site finalisation works; and
- systems testing and commissioning.

2.3.10 General information about the construction process is set out in more detail in Volume 1, Section 6, and the following sections of the draft CoCP (see Volume 5: Appendix CT-003-000) including:

- the approach to environmental management during construction and the role of the CoCP (Section 2);
- working hours (Section 5);
- management of construction traffic (Section 14); and
- handling of construction materials (Section 15).

Advance works

2.3.11 General information about advance works can be found in Volume 1, Section 6. Advance works will be required before the main construction works commence and typically include:

- further detailed site investigations and surveys;
- further detailed environmental surveys;
- advance mitigation works including, where appropriate, contamination remediation, habitat creation and translocation, landscape planting and built heritage survey and investigation;

- advance site access works; and
- site establishment with temporary fence construction; along with soil stripping and vegetation removal.

Engineering works

Introduction

2.3.12 Construction of the Proposed Scheme will require the following broad types of engineering works along the entire length of the route, and within land adjacent to the route:

- civil engineering works, including earthworks such as embankments and cuttings, erection of bridges and viaducts and works to public roads; and
- works to install, test and commission railway systems, including track, overhead line equipment, communications and signalling equipment and traction power supply.

2.3.13 The construction of track and railway systems works in open areas will include the installation of track form, rails, infill material, minor drainage works, and installation of electrification, signalling and communication equipment.

2.3.14 The construction of the Proposed Scheme will be divided into sections, each of which will be managed from compounds. The compounds will act as the main interface between the construction work sites and the public highway, as well as performing other functions as described below. Compounds will either be main compounds or satellite compounds. Satellite compounds are generally smaller. Compounds will either be used for civil engineering works, for railway installation works, or for both.

2.3.15 Eight civil engineering satellite compounds will be located within the Whitmore Heath to Madeley area, one of which will continue to be used as a satellite compound for railway systems works following the completion of civil engineering works at that compound. Four additional satellite compounds for railway systems works will also be located in the Whitmore Heath to Madeley area.

2.3.16 Satellite compounds for civil engineering works will be managed from the Swynnerton North cutting main compound and the satellite compounds for railway systems works will be managed from the Stone railhead main compound, both in the Stone and Swynnerton area (CA3) (see Volume 2: Community area 3, Stone and Swynnerton).

2.3.17 Figure 4 shows the management relationship for civil engineering works compounds and Figure 5 for the railway installation works. Details about the works associated with individual compounds are provided in subsequent sections of this report.

2.3.18 Figure 6 provides a programme of works which will be managed from each construction compound. All dates and durations of activities set out in this section are indicative.

General overview of construction compounds

2.3.19 Main compounds will be used by core project management staff (i.e. engineering, planning and construction delivery) and commercial and administrative staff. These

teams will directly manage some works and coordinate the works at the satellite compounds. In general, a main compound will include:

- space for the storage of bulk materials;
- space for the receipt, storage and loading and unloading of excavated material;
- an area for the fabrication of temporary works equipment and finished goods;
- fuel storage;
- plant and equipment storage including plant maintenance facilities; and
- office space for management staff, limited car parking for staff and site operatives, and welfare facilities.

2.3.20 In the Whitmore Heath to Madeley area there will be no worker accommodation for the construction workforce.

2.3.21 Satellite compounds will be used as the base to manage specific works along a section of the route. Depending on the nature and extent of the works to be managed, these satellite compounds could include office accommodation for staff, local storage for plant and materials, car parking for staff and site operatives, and welfare facilities.

2.3.22 The storage of soil, stripped as part of the works prior to it being re-used when the land is reinstated, requires land for the duration of construction. The location of soil storage areas will generally be within and adjacent to compounds and areas of construction activity. These areas are referred to as material stockpiles and those adjacent to compounds are shown on maps CT-05-228b to CT-05-234 in the Volume 2: CA4 Map Book.

2.3.23 Further information on the function of compounds is provided in Section 6 of Volume 1 and Section 5 of the draft CoCP. This includes general provisions for the operation of compounds, such as security fencing, lighting, utilities supply, site drainage and codes of worker behaviour.

Construction traffic routes, site haul routes and transfer nodes

2.3.24 The movement of construction vehicles, whether to carry materials, plant, other equipment and workforce, or moving empty, will take place within the construction compounds, on public roads and between the compounds and working areas. Where reasonably practicable, movements between the construction compounds and the work sites will be on designated site haul routes within the site, often along the line of the route of the Proposed Scheme or running parallel to it.

2.3.25 The proposed railhead near Stone (in the Stone and Swynnerton area (CA3)) will connect with the existing railway network for the delivery of large materials required for the construction of the railway systems and the movement of excavated materials. This will reduce the volume of construction vehicles using the public road network.

2.3.26 The construction compounds will provide the interface between the construction works and the public road or railway network. The likely road routes to access

compounds in the Whitmore Heath to Madeley area are described in the subsequent sections of this report.

2.3.27 It may be necessary to undertake minor works including a number of minor highways and junction improvements along public roads that will be used as construction traffic routes but are at a distance from the route of Proposed Scheme. These minor works are reported in Volume 4: Off-route effects.

2.3.28 Areas of land are also required for the storage, loading and unloading of bulk earthworks materials that are moved to and from the site on public roads. These will allow transfer of material between road vehicles and site vehicles during construction to balance traffic movements on the road network. These areas are referred to as transfer nodes and are shown on maps CT-05-228b to CT-05-234 in the Volume 2: CA4 Map Book.

2.3.29 There will also be areas for the storage of bulk materials, such as aggregates, structural steel, and steel reinforcement, and for transfer of materials associated with the tunnelling works. These are called tunnelling facility and logistics areas, of which there will be four in the Whitmore Heath to Madeley area. These areas will be used to drive and recover the tunnel boring machine (TBM) for the construction of Whitmore Heath and Madeley tunnels.

Use of borrow pits

2.3.30 The Proposed Scheme will require high quality aggregate for construction. This will be provided, in part, through excavation of cuttings and other earthworks. However, it is unlikely that excavation across the Proposed Scheme will generate sufficient volume of suitable quality materials. As a result, it would be necessary to import material, either from further distances across the Proposed Scheme or from other sources. In some locations, this would be likely to result in significant adverse transport effects during construction on minor roads used by local communities. Therefore, six borrow pits in proximity to the route of the Proposed Scheme are proposed along the length of the route, of which one will be located in the Whitmore Heath to Madeley area.

2.3.31 A borrow pit is an area where material, usually sand and gravel, is excavated for use in the construction of nearby infrastructure projects. In most cases the sand and gravel is used for road or rail earthworks. The use of borrow pits is intended to reduce the need for longer distance transport and import of materials, therefore reducing the volume and impact of road traffic on local roads and communities.

2.3.32 For the purpose of this assessment, it has been assumed that borrow pit sites will be restored to existing ground level and land use once excavation has been completed. It is anticipated that borrow pits will be restored with materials generated from construction of the Proposed Scheme, typically clay, which does not have suitable characteristics for use as construction or engineering fill. Further information on the need, use and restoration strategy for borrow pits is provided in Volume 1, Section 6.

2.3.33 In the Whitmore Heath to Madeley area, one borrow pit located to the west of Netherset Hey Farm will be used to extract sand and gravel for construction, shown on Maps CT-05-232, H5 to C1 and CT-05-232-R1, H10 to C9 in the Volume 2: CA4 Map Book, which will (all dimensions are approximate):

- be excavated to an assumed average depth of 4.5m, comprising 1m of topsoil and subsoils and 3.5m of sand and gravel extraction, across an area of up to 28ha (based on this assumed average mineral depth). Topsoils and subsoils will be stored and used in restoration of the borrow pit; and
- be accessed initially during site set up from Netherset Hey Lane and the A525 Bar Hill Road. The main access will then be via site haul routes, along the route of the Proposed Scheme.

2.3.34 A maximum mineral depth of up to 17m, derived from geotechnical desk study of mineral resources, has also been assessed for relevant topics. Excavation of sand and gravels to this maximum depth, to avoid sterilisation of mineral resources for example, would mean excavation across the full 28ha area would not be required.

2.3.35 This borrow pit will be excavated over a period of four years, commencing in 2021, and will be progressively backfilled during this period. During the period of operation of the borrow pit, processes such as dewatering, crushing and materials blending may be carried out on the site. The borrow pit sites will be restored to a condition suitable for a return to its existing land use.

2.3.36 The majority of material being excavated from the borrow pit will be used within the Whitmore Heath to Madeley area and transported along the route of the Proposed Scheme via site haul routes. It may also be transported to construct parts of the Proposed Scheme in the Stone and Swynnerton area (CA3) and South Cheshire area (CA5). The material to infill the borrow pit for restoration (which will be material excavated from cuttings and other earthworks to construct the Proposed Scheme) will be provided from more distant locations across the route; as such, it may be necessary to transport some material along the public roads.

Figure 4: Construction compounds showing key civil engineering works within the Whitmore Heath to Madeley area

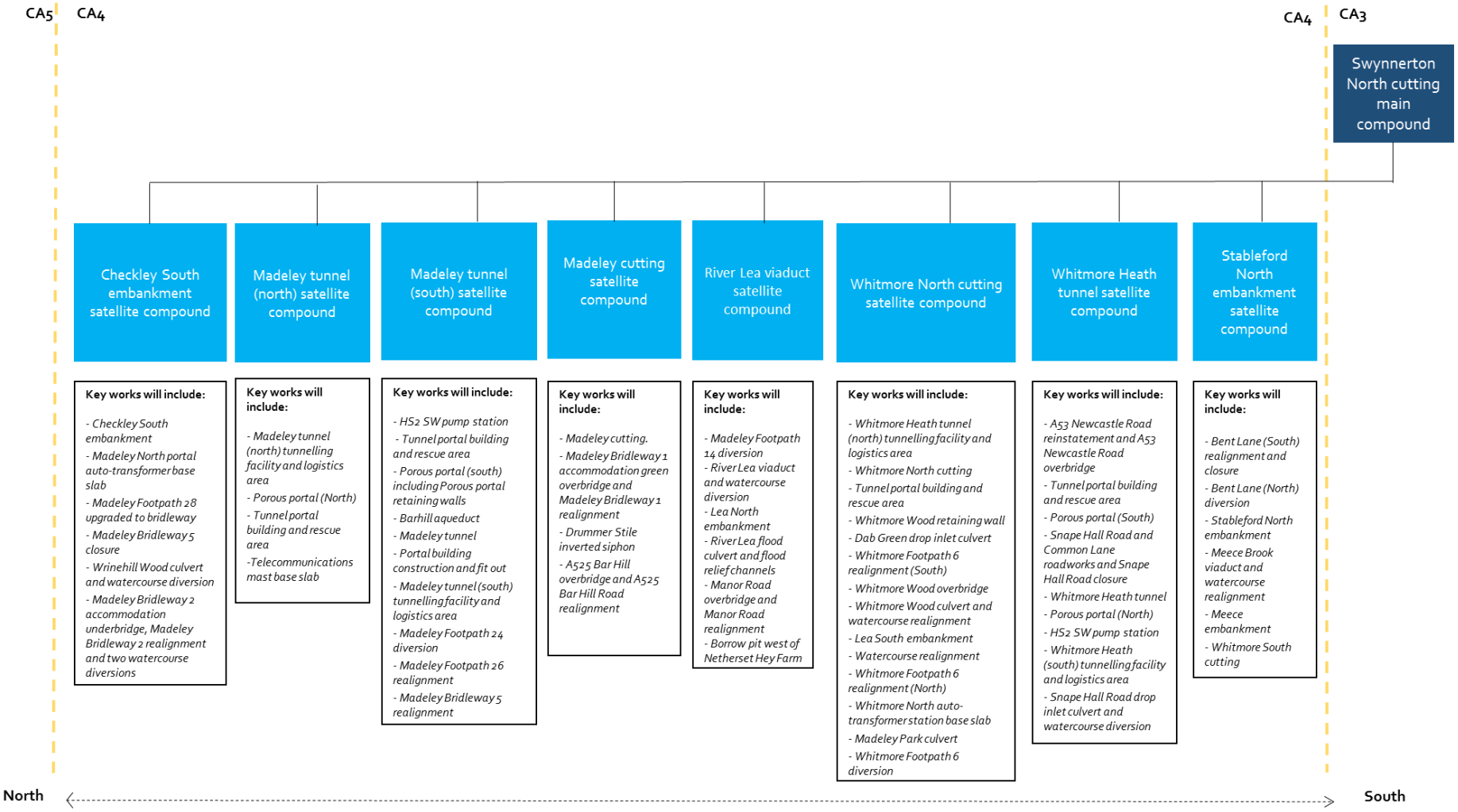
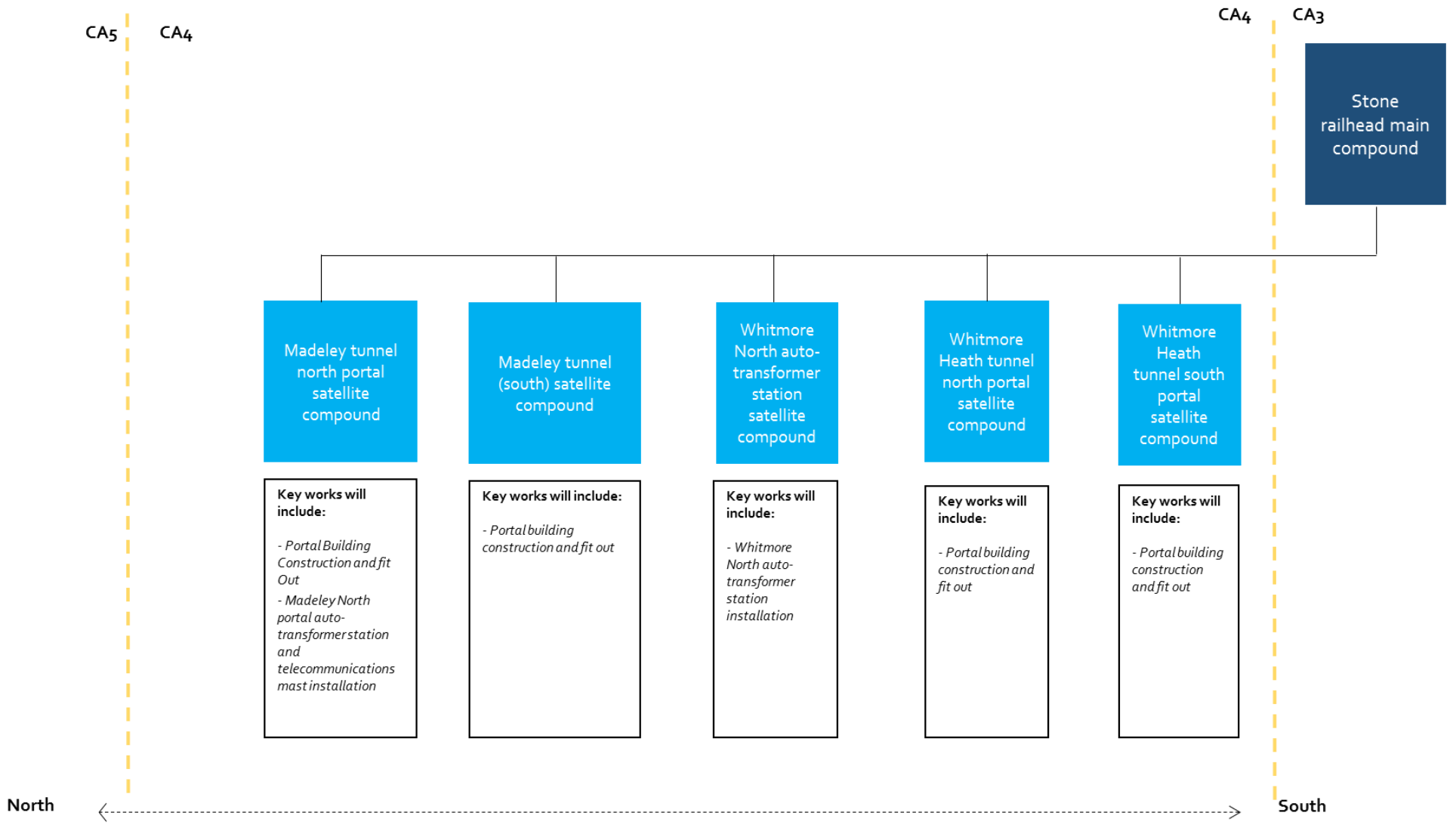


Figure 5: Construction compounds for railway installation works showing key works within the Whitmore Heath to Madeley area



2.3.37 This section provides details of the works to be managed from the construction compounds in the Whitmore Heath to Madeley area, including duration of works, number of workers and a summary of the works to be undertaken. All dates and durations of activities and number of workers are indicative.

Stableford North embankment satellite compound

2.3.38 This compound will provide for civil engineering works (see Volume 2: Map CT-05-229) and will:

- be operational for four years and six months, commencing during 2020;
- support 30 civil engineering workers per day (45 workers at peak times);
- be accessed for initial site set up via Bent Lane, which will remain as a secondary access during the construction period. The main access will be via site haul route along the route of the Proposed Scheme connecting to the A53 Newcastle Road; and
- provide one temporary material stockpile area (see Volume 2: Map CT-05- 229, G4to E3).

2.3.39 There will be no worker accommodation associated with this compound.

2.3.40 The works to be managed from this compound will not require demolition of any buildings.

2.3.41 The compound will be used to manage the construction of the Meece Brook viaduct, which will take three years to complete.

2.3.42 The compound will additionally be used to manage construction of the following earthworks:

- Stableford North embankment, which will take three years to complete;
- Meece embankment, which will take two years to complete; and
- Whitmore South cutting, which will take two years and three months to complete.

2.3.43 Material for the Stableford North embankment and Meece embankment will be received from Whitmore South cutting, from cuttings elsewhere along the Proposed Scheme and/or from borrow pits.

2.3.44 The works to be managed from this compound will require the following works to public roads:

- permanent realignment of an 350m section of Bent Lane, from the Stone and Swynnerton area along the south-west side its existing alignment to create Bent Lane (South), continuing for 600m along the southern side of the route of the Proposed Scheme, where the road will be permanently closed. This will

take nine months to complete and will be built offline[17]. On completion of construction, a temporary diversion via a temporary access track, 100m in length, will be required for three months to enable the connection of the new diversion to the existing Bent Lane. To enable safe access to this compound during construction, temporary passing bays along the existing Bent Lane, between the A51 Stone Road (in the Stone and Swynnerton area (CA3)) and the route of the Proposed Scheme will be provided; and

- permanent diversion of a 700m section of Bent Lane, from the Stone and Swynnerton area (CA3), 150m north-east of its existing alignment to create Bent Lane (North), which will take nine months to complete. The diversion will be built offline and access will be maintained throughout construction.

2.3.45 The works to be managed from this compound will require the realignment of Meece Brook. The realignment will be 10m east of its existing alignment in a north to south direction for 60m to pass around a viaduct pier of the Meece Brook viaduct.

2.3.46 Finalisation works will include site reinstatement, landscaping and planting.

Whitmore Heath tunnel satellite compound

2.3.47 This compound will provide for civil engineering works (see Volume 2: Map CT-05-230) and will:

- be operational for four years and six months, commencing during 2020;
- support 100 civil engineering workers per day (140 workers at peak times);
- be accessed from a site haul route along the east of the route of the Proposed Scheme connecting to the A53 Newcastle Road;
- provide one transfer node, accessed from the A53 Newcastle Road (Volume 2: Map CT-05-229, C5 to B4), for the storage and loading and unloading of bulk earthworks materials, which will be moved to and from the site on public highways; and
- provide four temporary material stockpile areas (see Volume 2: Maps CT-05-229, D6 to C6, D5 to C4 and B5 to B3 and CT-05-230, I7).

2.3.48 There will be no worker accommodation associated with this compound.

2.3.49 No demolitions will be required as a result of the works to be managed from this compound.

2.3.50 The compound will be used to manage the construction of the A53 Newcastle Road overbridge, which will take one year and nine months to complete.

2.3.51 The compound will be used to manage the following tunnelling works and associated infrastructure:

[17] Offline works are works which are generally constructed along or nearby the existing routes, which will remain open during construction.

- the porous portal at the southern end of Whitmore Heath tunnel, which will take one year and three months to complete;
- tunnel portal building and rescue area at the southern end of the Whitmore Heath tunnel, which will take nine months to complete;
- a surface water pumping station for drainage of the Whitmore Heath tunnel, which will take nine months to complete;
- the cut and cover section of Whitmore Heath tunnel, which will take one year and three months to complete;
- the twin bore section of Whitmore Heath tunnel, which will take two years to complete; and
- the northern porous portal at the northern end of Whitmore Heath tunnel, which will take one year and three months to complete.

2.3.52 Construction activities for the Whitmore Heath tunnel will be managed from this compound. The TBM will be driven from the Whitmore Heath (South) tunnelling facility and logistics area and the tunnel excavated materials will be removed from that site. The TBM will break through at the north portal where it will be dismantled and returned to the southern end to drive the second bore.

2.3.53 The works to be managed from this compound will require the following works to public roads:

- Snape Hall Road and Common Lane will be permanently widened to 5.5m to the south, away from the existing residential dwellings for 1.1km to the south of Whitmore Heath, which will take nine months to complete. A temporary road adjacent to Snape Hall Road and Common Lane will be constructed to provide temporary access which will take nine months to construct and be in operation for a period of nine months, during the Snape Hall Road and Common Lane works. Temporary measures will include traffic management and intermittent passing places for a period of six months. On completion of construction, a section of Snape Hall Road will be permanently closed where it would cross the route of the Proposed Scheme, with access maintained to the properties along Snape Hall Road; and
- the A53 Newcastle Road will be temporarily diverted for 900m in length, 150m to the south of its existing alignment for a period of one year and nine months during the construction of the cut and cover section and southern porous portal of Whitmore Heath tunnel and A53 Newcastle Road overbridge. A temporary roundabout for construction access will be provided and in place for four years during the construction period. There will be temporary measures for a period of three months consisting of intermittent lane restrictions on the A53 Newcastle Road to allow for the formation of this construction access. On completion of construction, the A53 Newcastle Road will be reinstated passing over the route of the Proposed Scheme via the A53 Newcastle Road overbridge.

2.3.54 Whitmore Footpath 4 will be temporarily diverted for four years during the construction period. Initially users will be diverted 230m to the north of its existing alignment around the extent of the area required to construct the Whitmore Heath cut and cover tunnel. On completion of the A53 Newcastle Road overbridge users would then be diverted 250m to the south and along the A53 Newcastle Road. On completion of construction, Whitmore Footpath 4 will be reinstated on its existing alignment.

2.3.55 This compound will be used to manage the construction of Snape Hall Road drop inlet culvert, for the realignment of an unnamed watercourse 50m north of Snape Hall Road, which will take nine months to complete.

2.3.56 Finalisation works will include site reinstatement, landscaping and planting.

Whitmore Heath (south) tunnelling facility and logistics area

2.3.57 The tunnelling facility and logistics area will occupy land to the west of the Whitmore Heath tunnel satellite compound and be operational for four years and six months (see Volume 2: Map CT-05-230, H5-G5). This will provide an area for the storage of bulk materials (aggregates, structural steel, and steel reinforcement) and for transfer of materials associated with the tunnelling works. The TBM for construction of Whitmore Heath twin bore tunnel will be driven from this facility. This area will be managed from the Whitmore Heath tunnel satellite compound and accessed from the A53 Newcastle Road and site haul route.

Whitmore Heath tunnel south portal satellite compound

2.3.58 This compound will provide for the construction and fit out works for the tunnel portal building to the south of Whitmore Heath tunnel and track installation (see Volume 2: Map CT-05-230, I6).

2.3.59 This compound will:

- be operational for one year, commencing during 2025;
- support 10 railway installation workers per day (15 workers at peak times); and
- be accessed via the A53 Newcastle Road to the west of the Proposed Scheme.

2.3.60 There will be no worker accommodation associated with this compound.

2.3.61 No demolitions will be required as a result of the works to be managed from this compound.

2.3.62 Other works that will be managed from this compound include site clearance, enabling works, and finalisation works including site reinstatement, fencing, planting, and landscaping.

Whitmore Heath tunnel (north) tunnelling facility and logistics area

2.3.63 The tunnelling facility and logistics area will occupy land between Whitmore Heath and Snape Hall Road and be operational for four years and six months (see Volume 2: Map CT-05-230, C5). This will provide an area for the storage of bulk materials (aggregates, structural steel, and steel reinforcement) and for transfer of materials associated with the tunnelling works. The TBM for construction of Whitmore Heath

twin bore tunnel will be recovered from this facility. This area will be managed from the Whitmore North cutting satellite compound and accessed from Snape Hall Road.

Whitmore Heath tunnel north portal satellite compound

2.3.64 This compound will provide for the construction and fit out works for the portal building to the north of Whitmore Heath tunnel and track installation (see Volume 2: Map CT-05-230, C7).

2.3.65 This compound will:

- be operational for one year and six months, commencing during 2025;
- support 30 railway installation workers per day (45 workers at peak times); and
- be accessed from Snape Hall Road to the east for site set up. After that, HGVs accessing the compound will be via site haul routes along the line of route of the Proposed Scheme.

2.3.66 There will be no worker accommodation associated with this compound.

2.3.67 Finalisation works will include site reinstatement, landscaping and planting.

Whitmore North cutting satellite compound

2.3.68 This compound will provide for civil engineering works (see Volume 2: Map CT-05-230, C5 to B5) and will:

- be operational for a total of four years and six months, commencing during 2020;
- support 35 civil engineering workers per day (50 workers at peak times);
- be accessed for initial site set up via Snape Hall Road, and will provide secondary access during the construction period for on-going surveys and servicing, worker access and for the widening works required to Snape Hall Road and Common Lane. Main access will be via a site haul route connecting to the A53 Newcastle Road; and
- provide six temporary material stockpile areas (see Volume 2: Map CT-05- 231, G7 to D6 and G5 to C5).

2.3.69 There will be no worker accommodation associated with this compound.

2.3.70 The works to be managed from this compound will require the demolition of one commercial property as set out in Table 1.

Table 1: Demolitions to be managed from the Whitmore North cutting satellite compound

Description	Location	Feature resulting in the demolition
Commercial		
An outbuilding (barn)	Snape Hall Farm, Whitmore	Access road and turning head and infrastructure associated with tunnel portal building

2.3.71 The compound will be used to manage the construction of the Whitmore Wood overbridge, which will take one year and three months to complete.

2.3.72 The compound will be used to manage construction of the following earthworks:

- Whitmore North cutting, which will take one year and six months to complete; and
- Lea South embankment, which will take three years and six months to complete.

2.3.73 Material for the Lea South embankment will be received from Whitmore North cutting, from cuttings elsewhere along the Proposed Scheme and/or from borrow pits.

2.3.74 In addition, the compound will be used to manage construction of the Whitmore Wood retaining wall, which will run along the Whitmore North cutting and will take two years and three months to complete.

2.3.75 The compound will also be used to manage construction of a tunnel portal building and rescue area at the northern end of Whitmore Heath tunnel, which will take one year to complete.

2.3.76 The following works to PRoW will be required as a result of the works to be managed from this compound:

- temporary diversion of Whitmore Footpath 5 for one year during the construction period. For six months users will be diverted for 250m, 90m to the south-west around Snape Hall Farm. After this, users will be diverted along Whitmore Footpath 18 and onto the A53 Newcastle Road for a period of six months. On completion of construction, the Whitmore Footpath 5 will be returned to its existing alignment; and
- temporary diversion of Whitmore Footpath 6, by 1.5km, for three years during the construction period. Users will be diverted to the north-west, from Whitmore Footpath 5 to the north of Snape Hall Farm, and along the north-east side of the area required for construction, 200m to the north of the existing footpath alignment. The temporary diversion will cross a site haul route, where traffic management measures will be implemented. On completion of construction, Whitmore Footpath 6 will be permanently realigned in two places along the south of the route of the Proposed Scheme. A section south-west of Whitmore Wood overbridge will be realigned by 30m west of its current alignment to create Whitmore Footpath 6 (South). A second section will be realigned by 20m north-west of its current alignment, around the Whitmore North auto-transformer station, to create Whitmore Footpath 6 (North). Whitmore Footpath 6 will also be diverted to meet Madeley Footpath 14, and be diverted for 600m to the west of its current alignment, along the base of the Lea South embankment and under the River Lea viaduct.

2.3.77 The following drainage works and watercourse diversions will be required as a result of the works to be managed from this compound:

- construction of Dab Green drop inlet culvert for surface water drainage, which will take six months to complete;

- construction of Whitmore Wood culvert for the realignment of Whitmore Wood Stream, which will take nine months to complete; and
- construction of Madeley Park culvert for surface water drainage, which will take nine months to complete.

2.3.78 The compound will manage the construction of the Whitmore North auto-transformer station foundations and building and will include provision of a site haul route from the A53 Newcastle Road. These works will take six months to complete.

2.3.79 Finalisation works will include site reinstatement, landscaping and planting.

Whitmore North auto-transformer station satellite compound

2.3.80 This compound will provide for the installation of railway systems equipment at Whitmore North auto-transformer station (see Volume 2: Map CT-05-231, F6) and will:

- be operational for one year and three months, commencing during 2024;
- support 30 railway installation workers per day (45 workers at peak times); and
- be accessed via a site haul route from Snape Hall Road to the east for site set up. After that, HGVs will access the compound via the site haul route along the line of route of the Proposed Scheme.

2.3.81 There will be no worker accommodation associated with this compound.

2.3.82 No demolitions will be required as a result of the works to be managed from this compound.

2.3.83 Finalisation works will include site reinstatement, landscaping and planting.

River Lea viaduct satellite compound

2.3.84 This compound will provide for civil engineering works (see Volume 2: Map CT-05-232, H7 to G7) and will:

- be operational for four years and six months, commencing during 2020;
- support 50 civil engineering workers per day (70 workers at peak times);
- be accessed during initial site set up via Manor Road, which will be retained for secondary access. Main access will be from the A53 Newcastle Road to the east and via site haul route using a temporary crossing of the WCML; and
- provide two temporary material stockpile areas (see Volume 2: Map CT-05-232, G10 to E6).

2.3.85 There will be no worker accommodation associated with this compound.

2.3.86 Demolition of one residential property will be required as a result of the works to be managed from this compound, as described in Table 2.

Table 2: Demolitions to be managed from the River Lea viaduct satellite compound

Description	Location	Feature resulting in the demolition
Residential		
Farmhouse	Hey House Lodge, Manor Road	Lea North embankment
Other		
Outbuilding	Hey House Lodge, Manor Road	Lea North embankment

2.3.87 The compound will be used to manage the construction of the following bridges and viaducts:

- River Lea viaduct, which will take three years to complete; and
- Manor Road overbridge, which will take one year and nine months to complete.

2.3.88 The compound will be used to manage construction of the Lea North embankment, which will take two years and six months to complete.

2.3.89 Material for the Lea North embankment will be received from cuttings elsewhere along the Proposed Scheme and/or from borrow pits.

2.3.90 This compound will be used to manage the works associated with the excavation, material extraction and restoration of the borrow pit to the west of Netherset Farm, which will take four years to complete. Access to the borrow pit will be via Netherset Hey Lane and the A525 Bar Hill Road during site set-up and then via site haul routes, with temporary crossings of the WCML and the Stoke to Market Drayton Railway.

2.3.91 A pre-cast yard to manufacture concrete elements, such as viaduct beams, and a viaduct launching yard, from which pre-cast elements for the River Lea viaduct will be installed, will be located to the north-east of the River Lea viaduct and at the northern end of the Lea South embankment for a period of four years and six months.

2.3.92 Manor Road will be permanently realigned via Manor Road overbridge. The realignment will be built offline and on completion of construction, temporary local lane closures and traffic management measures will be implemented for six months to enable connection of the realigned road to the existing road. Access to Madeley Cemetery and Hey House will be maintained during the construction period with a permanent access road.

2.3.93 There will be a temporary diversion of Madeley Footpath 14 for 400m along the north-eastern extent of the area required for construction, for three years during the construction. The temporary diversion will connect into Whitmore Footpath 6 temporary diversion route, 50m north-east of the existing Madeley Footpath 14 alignment. On completion of construction, Madeley Footpath 14 will be permanently diverted to run along the route of the Proposed Scheme and under the River Lea viaduct to join the diverted Whitmore Footpath 6.

2.3.94 The following drainage works and watercourse diversions will be required as a result of the works to be managed from this compound:

- the permanent diversion of a watercourse, for 220m in a south-east to north-west direction, 50m south-west of its existing alignment; and

- construction of the River Lea flood culvert, to provide flood relief channels, which will take nine months to complete.

2.3.95 Finalisation works will include site reinstatement, landscaping and planting.

Madeley cutting satellite compound

2.3.96 This compound will provide for civil engineering works (see Volume 2: Map CT-05-233, H7 to G6) and will:

- be operational for four years and six months, commencing during October 2020;
- support 15 civil engineering workers per day (25 workers at peak times);
- be accessed from the A525 Bar Hill Road to the west. After that, HGVs will access the compound via the site haul route along the line of route of the Proposed Scheme;
- provide a transfer node, accessed from the A525 Bar Hill Road and via site haul route (Volume 2: Map CT-05-233, G7 to G6), for the storage and loading and unloading of bulk earthworks materials which will be moved to and from the site on public roads; and
- provide four temporary material stockpile areas (see Volume 2: Map CT-05-234, J6 to I6, J5 to I5 and G5 to G4).

2.3.97 There will be no worker accommodation associated with this compound.

2.3.98 Demolition of buildings associated with two properties will be required as a result of the works to be managed from this compound, as described in Table 3.

Table 3: Demolitions to be managed from the Madeley cutting satellite compound

Description	Location	Feature resulting in the demolition
Residential		
Farmhouse	82 Barhill Cottages, Bower End Lane	Madeley cutting
Farmhouse	84 Barhill Cottages, Bower End Lane	Madeley cutting
Other		
Two outbuildings	82 Barhill Cottages, Bower End Lane	Madeley cutting
Two outbuildings	84 Barhill Cottages, Bower End Lane	Madeley cutting

2.3.99 The compound will be used to manage the construction of the following bridges:

- Madeley Bridleway 1 accommodation green overbridge, which will take one year and three months to complete; and
- A525 Bar Hill overbridge, which will take one year and nine months to complete.

2.3.100 The compound will be used to manage construction of the Madeley cutting, which will take two years and three months to complete.

2.3.101 Material from the Madeley cutting will be used for construction locally within the Whitmore Heath to Madeley area, insofar as is reasonably practicable.

2.3.102 The A525 Bar Hill Road will be permanently realigned over the A525 Bar Hill overbridge. The A525 Bar Hill Road realignment and overbridge will be built offline and will take one year and nine months to complete. A temporary roundabout for construction access will be provided and in place for four years during the construction period. On completion of construction, temporary traffic management measures will be implemented for three months to enable connection the existing road with the new alignment over the A525 Bar Hill overbridge.

2.3.103 To enable access during the construction period, temporary modifications to widen the A525 Bar Hill Road, where it joins the A53 Newcastle Road, will be required, which will take three months to complete. There will be other works to the A525 Bar Hill Road/Newcastle Road. These are described and assessed in Volume 4: Off-route effects.

2.3.104 Temporary diversion of Madeley Bridleway 1 will be required for one year and six months during the construction. This will divert users for 600m, south-east of its existing alignment. For limited periods users would be diverted 350m to the north-west and along the realigned A53 Newcastle Road. On completion of construction, Madeley Bridleway 1 will be permanently realigned 25m north-west of its current alignment for 600m to cross over the route of the Proposed Scheme via the Madeley Bridleway 1 accommodation green overbridge.

2.3.105 This compound will be used to manage construction of the Drummer Stile inverted siphon, which will take nine months to complete.

2.3.106 Finalisation works will include site reinstatement, landscaping and planting.

Madeley tunnel (south) satellite compound

2.3.107 This compound will be used for civil engineering and railway installation works. Civil engineering works will be managed from this compound for the first four years and three months. After the civil engineering works are complete, this compound will reduce in size and be used to manage railway systems works for a period of nine months. The compound (Volume 2: Map CT-05-233, F5 to D4) will:

- be operational for five years, commencing during 2020;
- support 45 civil engineering workers per day (150 workers at peak times);
- support 10 railway installation workers per day (15 workers at peak times);
- be accessed from the A525 Bar Hill Road to the east and via site haul route along the route of the Proposed Scheme;
- provide management for the Madeley tunnel (south) tunnelling facility and logistics area and the Madeley tunnel (north) tunnelling facility and logistics area;
- provide two transfer nodes, accessed from the A525 Bar Hill Road (Volume 2: Map CT-05-233, F5 and E6 to D5) for the storage and loading and unloading of

bulk earthworks materials, which will be moved to and from the site on public roads; and

- provide one temporary material stockpile area (see Volume 2: Map CT-05-233, F4 to E4).

2.3.108 There will be no worker accommodation associated with this compound.

2.3.109 No demolitions will be required as a result of the works to be managed from this compound.

2.3.110 The compound will be used to manage the construction of the Bar Hill aqueduct, which will take one year and nine months to complete.

2.3.111 The compound will be used to manage the construction of the following tunnelling works:

- the southern porous portal of Madeley tunnel, porous portal retaining wall and tunnel headwall, which will take one year and three months to complete;
- an HS2 surface water pumping station for tunnel drainage, which will take nine months to complete; and
- Madeley tunnel including tunnel earthworks, which will take two years and three months to complete.

2.3.112 Construction activities for the Madeley tunnel will be managed between this compound and the Madeley tunnel north satellite compound. The TBM will be driven from the Madeley tunnel (south) tunnelling facility and logistics area and the tunnel excavated materials will be removed from that site. The TBM will break through at the north portal where it will be dismantled and returned to the southern end to drive the second bore.

2.3.113 The compound will also be used to manage construction of a tunnel portal building and rescue area at the southern end of Madeley tunnel, which will take nine months to complete.

2.3.114 No works to public roads will be required as a result of the works to be managed from this compound.

2.3.115 Works to the following PRoW will be required as a result of the works to be managed from this compound:

- temporary diversion of Madeley Footpath 24, for 1.5km east to the Madeley Footpath 26 diversion route and onto the WCML overbridge to Moss Lane for a period of three years. On completion of construction, Madeley Footpath 24 will be permanently diverted, 20m north of existing alignment 200m, to join the access road between A525 Bar Hill Road and Bower Lane, to the east of the porous portal retaining wall and connect with the realigned Madeley Footpath 26;
- temporary diversion of Madeley Footpath 26, 50m to the south east of its existing alignment, for one year and six months during the construction period. On completion of construction, the Madeley Footpath 26 will be

permanently realigned 15m north-east of existing alignment increasing the length of the journey by 30m; and

- temporary diversion of a section of Madeley Bridleway 5, 70m to the east of its existing alignment and via Bower End Lane for three years during the construction period. On completion of construction, the Madeley Bridleway 5 will be permanently realigned along the access road between Bower End Lane and the Madeley tunnel northern porous portal for 100m in length, 10m south of the existing alignment.

2.3.116 Key railway systems installation works to be managed from this compound include the installation of railway systems equipment at the porous portal to the south of the Madeley tunnel and track installation, which will take nine months to complete.

2.3.117 Finalisation works will include site reinstatement, landscaping and planting.

Madeley tunnel (south) tunnelling facility and logistics area

2.3.118 The tunnelling facility and logistics area will occupy land to the west of the Madeley tunnel (south) satellite compound (see Volume 2: Map CT-05-233, E5 to D5) for four years and three months. This will provide an area for the storage of bulk materials (aggregates, structural steel, and steel reinforcement) and for transfer of materials associated with the tunnelling works. The TBM for construction of Madeley tunnel will be driven from this facility. This area will be managed from the Madeley tunnel (south) satellite compound and accessed from the A525 Bar Hill Road and site haul route.

Madeley tunnel (north) satellite compound

2.3.119 This compound will provide for civil engineering works (see Volume 2: Map CT-05-234, I4) and will:

- be operational for three years and six months, commencing during January 2021;
- support five civil engineering workers per day (10 workers at peak times); and
- be accessed via the site haul route along the line of route of the Proposed Scheme from the A525 Bar Hill Road to the east.

2.3.120 There will be no worker accommodation associated with this compound.

2.3.121 No demolitions will be required as a result of the works to be managed from this compound.

2.3.122 The compound will be used to manage construction of a tunnel portal building and rescue area at the northern end of Madeley tunnel, which will take nine months to complete, and the northern porous portal of Madeley tunnel, which will take three years to complete.

2.3.123 The compound will be used to manage the construction of the telecommunications mast base slab, which will take nine months to complete. An access road from the A525 Bar Hill Road will provide access during the construction period.

2.3.124 Finalisation works will include site reinstatement, landscaping and planting.

Madeley tunnel (north) tunnelling facility and logistics area

2.3.125 The tunnelling facility and logistics area will occupy land to the west of the Madeley tunnel (north) satellite compound (see Volume 2: Map CT-05-234, I5 to H5) for three years and six months. This will provide an area for the storage of bulk materials (aggregates, structural steel, and steel reinforcement) and for transfer of materials associated with the tunnelling works. The TBM for construction of Madeley tunnel will be recovered from this facility. This area will be managed from the Madeley tunnel (south) satellite compound and accessed from the A53 Newcastle Road.

Madeley tunnel north portal satellite compound

2.3.126 This compound will provide for railway systems works (see Volume 2: Map CT-05-234, H5) and will:

- be operational for two years and three months, commencing during 2024;
- support 45 railway installation workers per day (85 workers at peak times); and
- be accessed via site haul route along the line of route of the Proposed Scheme from the A525 Bar Hill Road to the east.

2.3.127 There will be no worker accommodation associated with this compound.

2.3.128 No demolitions will be required as a result of the works to be managed from this compound.

2.3.129 The compound will be used to manage the following railway systems works:

- construction and fit out works for the portal building to the north of Madeley tunnel, which will take one year and nine months to complete;
- installation of railways systems equipment at the Madeley North auto-transformer station and the installation of the telecommunications mast, which will take one year and three months to complete; and
- track installation, which will take six months to complete.

2.3.130 Finalisation works will include site reinstatement, landscaping and planting.

Checkley South embankment satellite compound

2.3.131 This compound will provide for civil engineering works (see Volume 2: Map CT-05-234, C7 to B6) and will:

- be operational for four years and six months, commencing during 2020;
- support 35 civil engineering workers per day (50 workers at peak times);
- be accessed during initial site set-up works via the Madeley Bridleway 2 and farm access tracks. Main access will be from the A525 Bar Hill Road to the east and via site haul route along the route of the Proposed Scheme; and
- provide three temporary material stockpile areas (see Volume 2: Map CT-05-234, G7 to E7, G5 to D5 and E6 to D6).

2.3.132 There will be no worker accommodation associated with this compound.

2.3.133 No demolitions will be required as a result of the works to be managed from this compound.

2.3.134 The compound will be used to manage the construction of the Madeley Bridleway 2 accommodation underbridge, which will take nine months to complete.

2.3.135 The compound will be used to manage construction of Checkley South embankment, which will take two years and three months to complete.

2.3.136 Material for the Checkley South embankment will be received from cuttings elsewhere along the Proposed Scheme and/or from borrow pits.

2.3.137 The following works to PRoW will be required as a result of the works to be managed from this compound:

- Madeley Bridleway 5 will be permanently closed where it crosses the route of the Proposed Scheme, with users diverted to Madeley Footpath 28 (which will be upgraded to a bridleway);
- permanent upgrade of Madeley Footpath 28 to a bridleway prior to the closure of Madeley Bridleway 5;
- temporary diversion of Madeley Bridleway 2 for one year and six months during the construction period. This will divert users 80m west of its existing alignment and across a site haul route. On completion of construction, Madeley Bridleway 2 will be permanently realigned, for 200m, crossing under the route of the Proposed Scheme on its current alignment via Madeley Bridleway 2 accommodation underbridge. To the north of the route of the Proposed Scheme it will be realigned to the east of its current alignment; and
- temporary diversion of Madeley Footpath 7 for one year and six months, with users diverted on the northern side of the route of the Proposed Scheme, from the River Lea to join the Madeley Bridleway 2 temporary diversion route. On completion of construction, the Madeley Footpath 7 will be returned to its existing alignment.

2.3.138 The following drainage works and watercourse diversions will be required as a result of the works to be managed from this compound:

- construction of Wrinehill Wood culvert, for the diversion of an unnamed watercourse, which will take nine months to complete; and
- diversion of two unnamed watercourses beneath the Madeley Bridleway 2 accommodation underbridge, which will take nine months to complete.

2.3.139 The compound will be used to manage the construction of the Madeley North Portal auto-transformer station foundations and building, which will take nine months to complete. An access road from the A525 Bar Hill Road will provide access during the construction period.

2.3.140 Finalisation works will include site reinstatement, landscaping and planting.

Construction waste and material resources

2.3.141 Excavated material generated across the Proposed Scheme will be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, where reasonably practicable.

2.3.142 Forecasts of the amount of construction, demolition and excavation waste that will be produced during construction of the Proposed Scheme are reported in Volume 3: Route-wide effects.

2.3.143 Local excess or shortfall of excavated material within the Whitmore Heath to Madeley area will be managed through the mitigation earthworks design approach adopted for the Proposed Scheme, as well as the use of borrow pits, with the aim of contributing to an overall balance of excavated material on a route-wide basis and help reduce the amount of material transported on public roads. The overall balance of excavated material is presented in Volume 3, Section 14.

Commissioning of the railway

2.3.144 Commissioning is the process of testing the infrastructure to ensure that it operates as expected. It will be carried out in the period prior to opening. Further details are provided in Volume 1, Section 6.

Construction programme

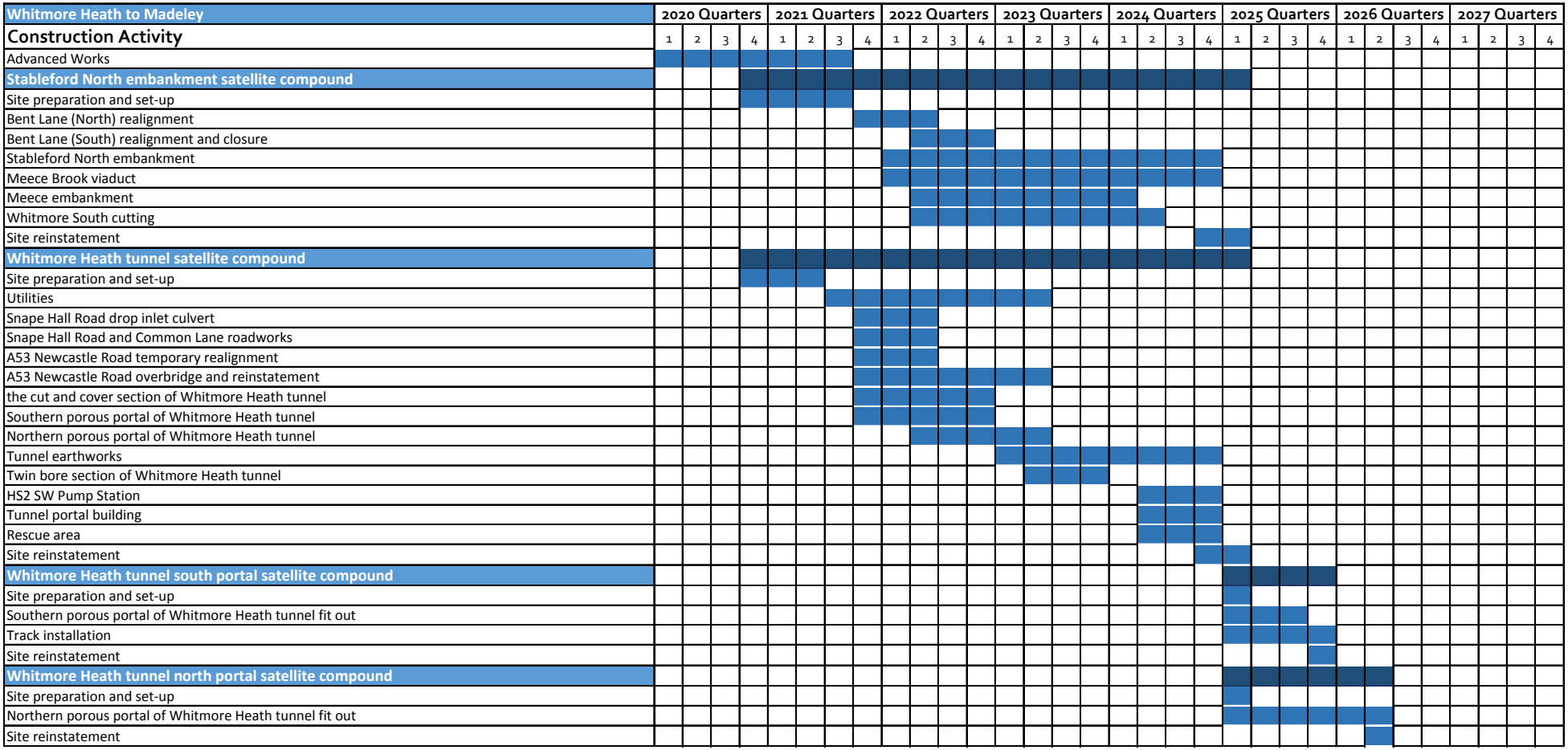
2.3.145 A construction programme illustrating indicative periods for each of the core construction activities described above is provided in Figure 5.

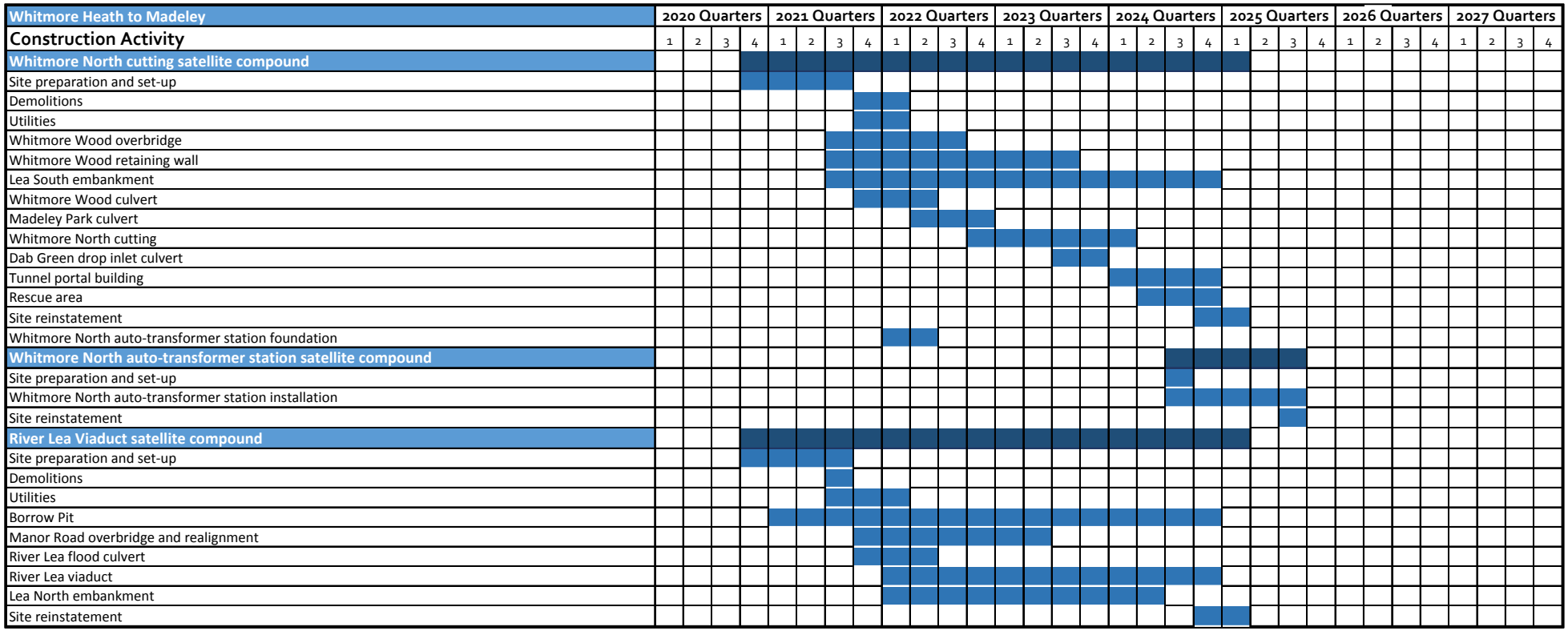
Monitoring during construction

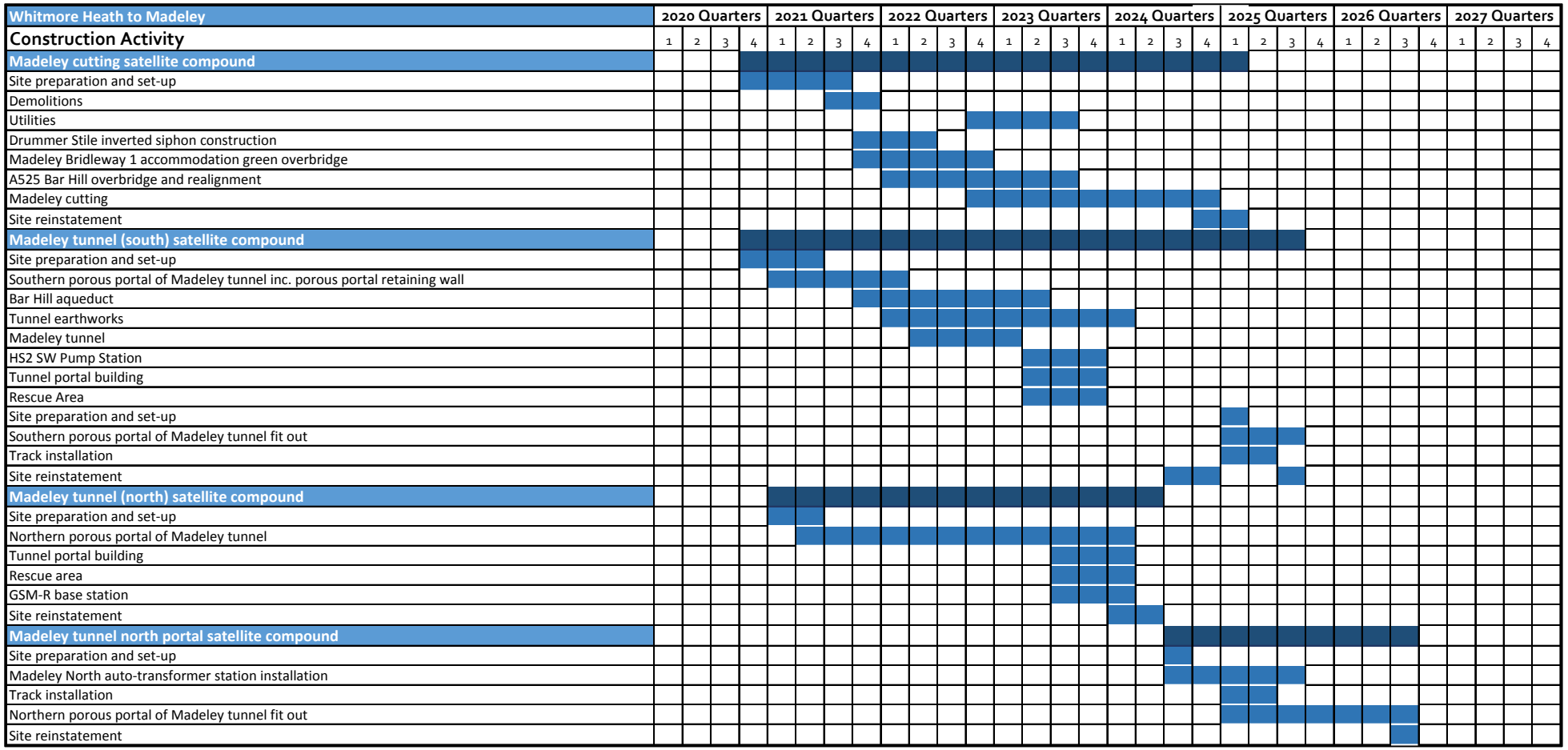
2.3.146 The appointed contractor will be required to undertake the necessary monitoring for each environmental topic to comply with the requirements of the CoCP and any additional consent requirements. Any actions that may be necessary for compliance will be reported to the nominated undertaker and remedial action identified.

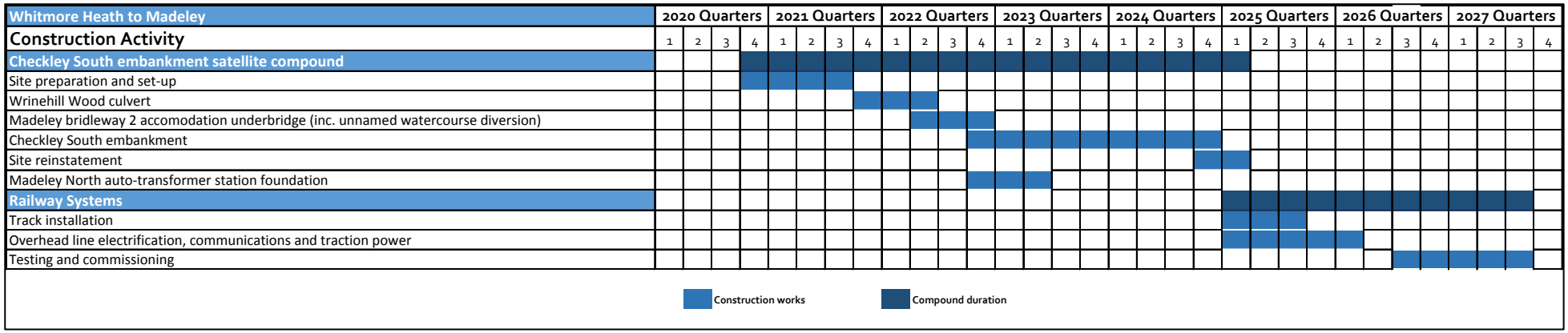
2.3.147 The CoCP will set out inspection and monitoring procedures to assess the effectiveness of measures to prevent or reduce environmental effects during construction. Relevant local authorities and consenting authorities, such as the Environment Agency, will be consulted on the monitoring procedures to be implemented prior to construction commencement, as appropriate.

Figure 6: Indicative construction programme 2020 - 2027




Whitmore Heath to Madeley
2020 Quarters
2021 Quarters
2022 Quarters
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
Construction Activity
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
Whitmore North cutting satellite compound
Site preparation and set-up
Demolitions
Utilities
Whitmore Wood overbridge
Whitmore Wood retaining wall
Lea South embankment
Whitmore Wood culvert
Madeley Park culvert
Whitmore North cutting
Dab Green drop inlet culvert
Tunnel portal building
Rescue area
Site reinstatement
Whitmore North auto-transformer station foundation
Whitmore North auto-transformer station satellite compound
Site preparation and set-up
Whitmore North auto-transformer station installation
Site reinstatement
River Lea Viaduct satellite compound
Site preparation and set-up
Demolitions
Utilities
Borrow Pit
Manor Road overbridge and realignment
River Lea flood culvert
River Lea viaduct
Lea North embankment
Site reinstatement


Whitmore Heath to Madeley
2020 Quarters
2021 Quarters
2022 Quarters
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
Construction Activity
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
Madeley cutting satellite compound
Site preparation and set-up
Demolitions
Utilities
Drummer Stile inverted siphon construction
Madeley Bridleway 1 accommodation green overbridge
A525 Bar Hill overbridge and realignment
Madeley cutting
Site reinstatement
Madeley tunnel (south) satellite compound
Site preparation and set-up
Southern porous portal of Madeley tunnel inc. porous portal retaining wall
Bar Hill aqueduct
Tunnel earthworks
Madeley tunnel
HS2 SW Pump Station
Tunnel portal building
Rescue Area
Site preparation and set-up
Southern porous portal of Madeley tunnel fit out
Track installation
Site reinstatement
Madeley tunnel (north) satellite compound
Site preparation and set-up
Northern porous portal of Madeley tunnel
Tunnel portal building
Rescue area
GSM-R base station
Site reinstatement
Madeley tunnel north portal satellite compound
Site preparation and set-up
Madeley North auto-transformer station installation
Track installation
Northern porous portal of Madeley tunnel fit out
Site reinstatement


Whitmore Heath to Madeley
2020 Quarters
2021 Quarters
2022 Quarters
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
Construction Activity
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
Checkley South embankment satellite compound
Site preparation and set-up
Wrinehill Wood culvert
Madeley bridleway 2 accomodation underbridge (inc. unnamed watercourse diversion)
Checkley South embankment
Site reinstatement
Madeley North auto-transformer station foundation
Railway Systems
Track installation
Overhead line electrification, communications and traction power
Testing and commissioning
Construction works
Compound duration

2.4 Operation of the Proposed Scheme

Introduction

2.4.1 Volume 1, Section 4 describes the envisaged operational characteristics of the Proposed Scheme and how they may change when Phase Two, as a whole, is operational.

HS2 services

2.4.2 It is anticipated that there will be up to six trains per hour in each direction upon opening in 2027, increasing to up to 12 trains per hour each way passing through the Whitmore Heath to Madeley area when from 2033 the full Phase Two route is operational. Services are expected to operate between 05:00 and 24:00 from Monday to Saturday and 08:00 and 24:00 on Sunday.

2.4.3 In this area, trains will run at speeds of up to 225mph (360kph). The trains will be either single 200m trains or two 200m trains coupled together (i.e. 400m), depending on demand and time of day.

Maintenance

2.4.4 Volume 1, Section 4 describes the maintenance regime for the Proposed Scheme.

2.4.5 Asset performance and condition monitoring will be undertaken using asset condition monitoring and unattended measurement systems fitted to the HS2 passenger rolling stock. Intrusive inspections will be carried out during the maintenance period. The maintenance approach will be a combination of risk based, preventative and reactive maintenance.

2.4.6 Provision for railway maintenance vehicles will be made at the HS2 Infrastructure Maintenance Base - Rail (IMB-R) near Stone in the Stone and Swynnerton area (CA3). Further information on the Stone IMB-R can be found in Volume 2: Community area 3, Stone and Swynnerton.

Operational waste and material resources

2.4.7 The assessment of the likely significant environmental effects associated with the disposal of operational waste has been undertaken for the Proposed Scheme as a whole in Volume 3, Section 15.

2.4.8 Forecasts of the amount of waste arising from track maintenance and ancillary infrastructure and the associated likely significant environmental effects are provided in Volume 5: Appendix WM-001-000.

Monitoring during operation

2.4.9 The nominated undertaker will be responsible for monitoring during operation of the Proposed Scheme. General monitoring measures during operation are set out in Volume 1, Section 9. Monitoring requirements and proposed monitoring measures relevant to the Whitmore Heath to Madeley area are presented in Sections 4 to 15 of this report.

2.5 Route section alternatives

Introduction

2.5.1 Since November 2015, as part of the design development process, a series of potentially feasible amendments to the Proposed Scheme have been identified and reviewed within workshops attended by engineering, construction, planning and environmental specialists. During the workshops, a comparison was conducted of each design option, which included consideration of:

- engineering requirements: the degree of design complexity of the alternatives and the impact this would have on construction durations and construction and operational costs;
- cost: whether the alternatives would be more cost effective or incur additional costs; and
- potential environmental impact: whether the alternatives would have more or less environmental impact (e.g. sound, noise and vibration and landscape and visual).

2.5.2 The comparison also considered, as appropriate, feedback provided through stakeholder engagement and responses to the consultation between September and November 2016 on the working draft EIA Report and the Design Refinement Consultation.

2.5.3 The following sections detail the reasonable local alternatives studied and the main reasons for selecting the option to be taken forward into the Proposed Scheme. The environmental impacts of the option selected (the Proposed Scheme) are then presented, followed by the environmental impacts of the alternative options compared to those of the Proposed Scheme. Other considerations are also noted including engineering requirements and cost. In some cases a preliminary appraisal of options has been undertaken, whereby options have been considered in terms of whether they are reasonable against environmental, technical and design criteria, and should, therefore, be progressed for further consideration.

2.5.4 In considering the environmental impacts, all EIA topics have been taken into account, however, only those topics where there is a potential impact are reported. During the preparation of the EIA, alternatives were appraised against the baseline scheme; however, in accordance with the new Environmental Impact Assessment (EIA) Directive (2014/52/EU) that was implemented by the Town and Country Planning (Environmental Impact Assessment) Regulations that came into force on 16 May 2017, the comparison is presented below against the Proposed Scheme.

Route alignment between Whitmore Heath and Madeley

2.5.5 During the design development process since the announcement of the preferred route to Crewe in November 2015, further consideration has been given to the route of the Proposed Scheme between Whitmore Heath and Madeley. The sensitivity of this location, particularly the residential communities in and around Whitmore Heath, Baldwin's Gate and Madeley, potential for traffic and transportation disruptions, landscape character, presence of ancient woodland, and impacts on agricultural land

and farm holdings, have been key considerations in the development of these alternatives.

2.5.6 A detailed appraisal of engineering and construction feasibility, cost and environmental impacts were considered for the following four options:

- Option D9-11.0a: as the route passes beneath Whitmore Heath it would be in a cut and cover tunnel for approximately 240m in length, which would continue into a twin bore tunnel, for approximately 690m in length and a depth of up to 50m. The southern portal would be located where the route crosses the A53 Newcastle Road requiring realignment over an overbridge. The northern portal would be located where the route crosses Snape Hall Road, which would be permanently closed at either side of the route of the Proposed Scheme. On leaving the tunnel, the route would continue through a section of Whitmore Wood, an area of ancient woodland, in a cutting up to 13m in depth with a retaining wall on the north-east side. The route would then continue on embankment and pass over the River Lea, the WCML, the Stoke to Market Drayton Railway and the Madeley Chord on a viaduct approximately 785m in length and up to 17m in height. The route would pass underneath Manor Road and the A525 Bar Hill Road which would both be realigned and cross the route on overbridges. The route would then continue in a twin bore tunnel for approximately 670m and a depth of up to 38m as it passes under Bar Hill;

- Option D9-11.0b: as the route passes beneath Whitmore Heath it would be in a twin bore tunnel, for approximately 1.4km in length and a depth of up to 60m. The southern portal would be located approximately 265m south-east of the A53 Newcastle Road and the northern portal would be located immediately north of Snape Hall Road. On leaving the tunnel the route would continue through a section of Whitmore Wood in a cutting up to 20m in depth with a retaining wall on the north-east side. The route would then continue on embankment and pass over the River Lea, the WCML, the Stoke to Market Drayton Railway and the Madeley Chord on a viaduct approximately 570m in length and up to 21m in height. The route would pass underneath Manor Road which would be realigned and cross the route on an overbridge. The route would then continue in a twin bore tunnel for approximately 1.2km and a depth of up to 51m as it passes under Bar Hill. The southern portal of Madeley tunnel would be located immediately south of the A525 Bar Hill Road;

- Option D9-11.1: the route would pass beneath Whitmore Heath and the WCML in a twin bore tunnel, approximately 1.9km in length and a depth of up to approximately 43m. The southern portal would be located immediately south of the A53 Newcastle Road and the northern portal would be located north of where the route would cross the WCML. On leaving the tunnel the route would continue in a cutting up to 16m in depth prior to passing over the River Lea on a viaduct approximately 100m in length and up to 7m in height. The route would pass underneath Manor Road which would be realigned and cross the route on an overbridge. The route would then continue in a twin bore tunnel for approximately 1.3km and a depth of up to 30m as it passes under Bar Hill. The southern portal of Madeley tunnel would be located immediately south of

the A525 Bar Hill Road; and

- Option D9-11.3: the route would pass beneath Whitmore Heath, Whitmore Wood, the WCML, the River Lea and Bar Hill in a twin bore tunnel, approximately 6.4km in length and a depth of up to approximately 75m. The southern tunnel portal would be located approximately 265m south-east of the A53 Newcastle Road and the northern portal would be located approximately 150m south-west of Bower End Farm. Due to the length of tunnel, two vent shafts would be required to provide ventilation and emergency access. One vent shaft would be located between Whitmore Heath and Whitmore Wood and the other would be located south-east of Manor Road.

2.5.7 The preferred option taken forward into the Proposed Scheme was Option D9-11.0a. Although each of the alternative options provide some environmental benefits in comparison to Option D9-11.0a, the benefits were not considered sufficient to justify the significant additional cost associated with each of them.

2.5.8 The analysis of engineering, cost and potential environmental impacts associated with all four options is set out below, with the impacts of the option selected presented first.

Option D9-11.0a

2.5.9 Option D9-11.0a would result in the need to demolish properties and would introduce visual, noise and visual amenity impacts in Whitmore Heath and Bar Hill. This option would result in the loss of agricultural land and holdings and the loss and fragmentation of ecological habitat, including approximately 6.0ha (34%) of ancient woodland at Whitmore Wood and 0.2ha (4%) of ancient woodland at Barhill Wood. There would be an impact on the local landscape character in the area, most notably around the A53 Newcastle Road, Whitmore Wood and Barhill Wood.

2.5.10 There would be impacts on cultural heritage including visual intrusion on the scheduled monument of Old Madeley Manor, an impact on the setting of the Grade II listed Hey House and visual intrusion on other Grade II listed buildings, including a cluster within Madeley Conservation Area. The route would cross a number of historic landfills and therefore presents a risk of contamination.

2.5.11 Additionally there would be impacts on a number of watercourses and tributaries and the tunnels have the potential to impact upon groundwater abstractions and springs. The route is in immediate vicinity to the Severn Trent Water Whitmore groundwater boreholes and encroaches into the Source Protection Zone (SPZ). Most of the route through this section is within a MSA.

2.5.12 Option D9-11.0a involves complex construction activities associated with the two twin bore tunnels, tunnel fit out, pumping stations and construction of tunnel porous portals. There would be high maintenance requirements during operation associated with tunnel drainage and mechanical, electrical and plumbing systems. Three highway realignments would be required (A53 Newcastle Road, Manor Road and A525 Bar Hill Road) and Snape Hall Road would be permanently closed on either side of the northern porous portal of Whitmore Heath tunnel. There would also be a number of temporary and permanent PRoW diversions. The construction of the River Lea viaduct

over the WCML would also require railway possessions and would result in disruption to rail services.

Option D9-11.0b

2.5.13 In comparison to Option D9-11.0a (the Proposed Scheme), Option D9-11.0b would present a reduction in landscape effects at Whitmore. There would however be increased land required for construction and operation of the Proposed Scheme at Whitmore Wood. This would result in increased effects on biodiversity and landscape character. Sound, noise and vibration impacts would be reduced due to a shifting works away from Whitmore Heath. However, tunnelling works would encroach further into the SPZ. There would be no demolition of properties in Whitmore Heath and no likely amenity effects on residents along the A53 Newcastle Road.

2.5.14 Impacts on landscape character would be reduced at Bar Hill, although the removal of a pond would still be necessary. The loss of 0.2ha (4%) of Barhill Wood would be avoided, sound and vibration effects to properties along Bar Hill road would be reduced, less agricultural land would be impacted and there would be hydrological benefits including removing the need for an aqueduct at Barhill Wood. This option would avoid demolition of properties on the A525 Bar Hill Road and there would be no realignment of the A525 Bar Hill Road and associated isolation effects. This option would also avoid the disruption of a commercial shoot at Bar Hill Farm during construction.

2.5.15 This option would generate less construction traffic as there would be no highway works to the A53 Newcastle Road, Heath Road, the A525 Bar Hill Road and Red Lane and would result in fewer diversions of PRoW and Snape Hall Road would no longer be closed during operation.

2.5.16 Construction of Option D9-11.0b would be less complex than the Proposed Scheme due to the reduced highway and drainage works. However, due to the longer tunnels, this option would be significantly more expensive to construct and the costs of maintenance during operation would be higher. Railway possessions at the WCML and potential disruptions to rail services would be same as for Option D9-11.0a.

Option D9-11.1

2.5.17 In comparison to Option D9-11.0a (the Proposed Scheme), Option D9-11.1 presents environmental benefits such as avoidance of Whitmore Wood and demolitions at Whitmore Heath. There would be a reduction in sound, noise and vibration impacts to properties in Whitmore Heath and along the A525 Bar Hill Road. Properties in Whitmore Heath would have reduced amenity effects and impacts associated with Barhill Wood would also be minimised

2.5.18 Visual amenity impacts to Madeley Park properties and landscape character would be increased. Whitmore Wood would be unaffected with no loss of trees, and therefore landscape character impacts here would be removed. There would be reduced landscape impacts on Barhill Wood, the A525 Bar Hill Road, and nearby residential properties. However, landscape impacts would instead be generated to Manor Farm, Manor Cottages and Bar Hill House. Reduced amenity impacts would be experienced by Moor Hall Farm and Bower End Farm. This option would require two demolitions.

2.5.19 There would be an increased effect on cultural heritage receptors with this option. Although the route is moved away from the Grade II listed Hey House it would pass in close proximity to Grade II listed Manor Farmhouse and to the Old Madeley Manor scheduled monument.

2.5.20 This option would generate less construction traffic than Option D9-11.0a and there would be a significant reduction in highway works. This option would be less complex to construct when compared to Option D9-11.0a due to significantly reduced highways works and by avoiding any operational disruption to the WCML. However there would be insufficient clearance for the Stoke to Market Drayton Railway to remain viable, and this option would be significantly more expensive to construct than Option D9-11.0a.

Option D9-11.3

2.5.21 In comparison to Option D9-11.0a (the Proposed Scheme), Option D9-11.3 would avoid the need to demolish properties along this section, reduce loss of agricultural land and reduce community isolation effects and transport impacts. There would be a reduction in noise, visual and amenity impacts to residents at Whitmore Heath and Bar Hill during construction. Visual impacts on the local landscape character during construction and operation between Whitmore Heath and Bar Hill would also be significantly reduced. Direct impacts on watercourses, including unnamed watercourses at Snape Hall Road and Whitmore Wood and a tributary of the River Lea, would be avoided.

2.5.22 Whitmore Wood and Barhill Wood would be avoided and therefore there would be no loss or fragmentation of ancient woodland and no operational disturbance upon these habitats. Similarly, effects on all cultural heritage assets within this area would be reduced, however, given the proximity of a tunnel vent shaft to Hey House it is likely that there would still be effects on the setting of this Grade II listed building.

2.5.23 With this option there would be an increase in excavated material associated with the longer tunnel which would correspond with an increase in construction traffic. The risk to groundwater resources and intrusion into the groundwater SPZ at Whitmore would be increased due to longer tunnelling works.

2.5.24 Construction of Option D9-11.3 would be significantly less complex than Option D9-11.0a. Highways works would be significantly reduced and operational disruption to the WCML would be avoided. However, due to the increase in length of the bored tunnel, this option would be significantly more expensive to construct and the costs of maintenance during operation would be higher.

Route alignment from the A525 Bar Hill Road to Wrinehill Wood

2.5.25 During the design development process since the announcement of the preferred route to Crewe in November 2015, further consideration has been given to the route of the Proposed Scheme between north of the A525 Bar Hill Road and Wrinehill Wood. The option to replace the twin bore tunnel beneath Bar Hill with a cutting has been considered. The sensitivity of this location, particularly the proximity of the route to residential properties at Bar Hill, landscape character, ecological receptors, including Barhill Wood, and the effects of construction activities, including traffic, have been key considerations in the development of these alternatives.

2.5.26 A preliminary appraisal of three variations of the depth of cutting was undertaken. It was concluded that the environmental impacts associated with all three depths (up to 36m, 32m and 28m) were broadly similar with the cutting depth of up to 32m being marginally better overall, therefore, this option was taken forward for further consideration.

2.5.27 The following two options were taken forward to a more detailed appraisal where engineering and construction feasibility, cost and environmental impacts were considered:

- Option 0: the route would pass beneath the A525 Bar Hill road overbridge within Madeley cutting before entering the southern porous portal of Madeley tunnel. Madeley tunnel would be a twin bore tunnel approximately 670m in length with a depth of up to 38m. The route would then emerge from the northern porous portal of Madeley tunnel before continuing onto the Checkley South embankment; and
- Option 2: a cutting, approximately 180m in width and a depth of up to 32m, would extend approximately 1.4km from north of the A525 Bar Hill Road towards Wrinehill Wood culvert. Bower End Lane would cross over the cutting on an overbridge. As a consequence of changing the vertical alignment of the route, the A525 Bar Hill Road would become an underbridge rather than an overbridge and there would be changes to the drainage infrastructure. The track spacing would be reduced by up to 13m (from 18m to 5m) in the vicinity of the River Lea to north of Checkley Brook.

2.5.28 Option 0 was taken forward into the Proposed Scheme as on balance it presented the most favourable environmental outcome. Option 2 in comparison had significant cost savings and engineering benefits, however, on balance these were not considered sufficient to justify the additional environmental impacts during construction and operation most notably visual impacts, ecological impacts, impacts to agricultural land holdings and heritage assets.

2.5.29 The analysis of engineering, cost and potential environmental impacts associated with both options is set out below, with the impacts of the option selected presented first.

Option 0

2.5.30 Option 0 would result in the demolition of properties, generate noise impacts in Bar Hill, introduce construction activities associated with 24-hour tunnelling works, and generate amenity impacts at Madeley. This option would result in the loss of agricultural land and holdings and of ecological habitat, including 0.15ha (3%) of Barhill Wood. A number of surface water flows would be intercepted and channelled into Bar Hill aqueduct. The tunnel would also run through a Principal aquifer and have the potential to impact upon groundwater abstractions and springs.

2.5.31 Construction of the tunnel would generate a large number of construction vehicles. The presence of the tunnel porous portals and associated infrastructure would impact on the landscape character in the area, most notably around Bar Hill and Wrinehill, and would introduce visual impacts on a number of residential properties and users of the PRoW network. The route would cross historic landfills located at Beechfields and

Bower End Farm and therefore presents a risk of contamination. The route would also cross an MSA.

2.5.32 Option 0 would involve complex construction activities associated with bored tunnels, tunnel fit out, pumping stations and construction of tunnel porous portals. There would be high maintenance requirements during operation associated with tunnel drainage and mechanical, electrical and plumbing systems.

Option 2

2.5.33 In comparison to Option 0 (the Proposed Scheme), with Option 2, whilst some residential properties would experience a reduced visual impact, there would generally be an increase in visual impact on receptors close to the route and across a wider area such as in elevated locations to the south-east and properties south of Madeley. There would be an impact on landscape character between Bar Hill and Wrinehill, however the impact on landscape character around the A525 Bar Hill Road and at Wrinehill would be reduced.

2.5.34 Barhill Wood would be avoided by this option, however, there would be an increase in impacts on ecological receptors due to the presence of the cutting. Impacts on agricultural land and holdings would be increased due to additional land required for the cutting which would also increase impacts on heritage assets. This option would increase the impacts on surface and groundwater as the cutting presents a greater barrier to surface and groundwater flow.

2.5.35 Option 2 would marginally reduce the number of properties to be demolished when compared to Option 0 and there would be no requirement for 24-hour tunnelling works during construction which would therefore reduce construction noise impacts on residential properties in Bar Hill. There would also be a reduction in the number of construction vehicles associated with this option.

2.5.36 The construction of the cutting in Option 2 would be significantly less complex than the construction of bored tunnel in Option 0 and would reduce the risk of safety hazards. This option would also potentially reduce the construction programme as construction of the cutting could take place from a number of work sites. Some material from this cutting would be suitable for use within the Proposed Scheme and as such would reduce the requirement to obtain fill materials from other sources.

Madeley Bridleway 1 (Red Lane)

2.5.37 During the design development process since the announcement of the preferred route to Crewe in November 2015, further consideration has been given to the design of Madeley Bridleway 1 (Red Lane) where the lane crosses the route of the Proposed Scheme. The historic sensitivity of this route, which connects Madeley to Aston, two settlements of probable medieval origin, the safety of users being diverted onto the A525 Bar Hill Road and the landscape and ecological connectivity of the surrounding area, have been the key considerations in the development of these alternatives.

2.5.38 The following two options were taken forward to a more detailed appraisal where engineering and construction feasibility, cost and environmental impacts were considered:

- Option 1: maintaining Madeley Bridleway 1 (Red Lane) on its existing

alignment on an accommodation green overbridge where it crosses the route of the Proposed Scheme. The bridge would provide ecological connectivity across the route; and

- Option 2 (the scheme as assessed in the working draft EIA Report): a permanent diversion of Madeley Bridleway 1 (Red Lane) for approximately 500m along the south-west of the route of the Proposed Scheme, crossing the route on the A525 Bar Hill overbridge to join the realigned A525 Bar Hill Road.

2.5.39 Option 1 has been taken forward into the Proposed Scheme as on balance it presented the most favourable environmental outcome. Option 2 in comparison would present cost savings and engineering benefits, however, on balance these were not considered sufficient to justify the additional environmental impacts during construction and operation.

2.5.40 The analysis of engineering, cost and potential environmental impacts associated with both options is set out below, with the impacts of the option selected presented first.

Option 1

2.5.41 Option 1 would maintain the historic alignment of the lane and avoid users being diverted onto the A525 Bar Hill Road to the north-west. The green overbridge would provide ecological connectivity across the route and the continuous hedgerow would retain some of the character of the existing route. This option would additionally maintain use of the bridleway for access to agricultural land.

Option 2

2.5.42 In comparison to Option 1 (the Proposed Scheme), Option 2 would not provide any ecological connectivity. The permanent diversion of Madeley Bridleway 1 (Red Lane) would alter the historic route and divert users to the A525 Bar Hill Road, a distance increase of 500m on the original route. Severance effects on agricultural land would also be worsened.

2.5.43 The construction of this option would be less complex and have a reduced cost as the overbridge would be replaced by an at-grade diversion of Madeley Bridleway 1 (Red Lane) over the A525 Bar Hill Road.

Borrow pit within Whitmore Heath to Madeley area

2.5.44 During the design development process since the announcement of the preferred route to Crewe in November 2015, further consideration has been given to the way in which the Proposed Scheme will acquire high quality aggregate (usually comprising sand and gravel) to construct embankments. This material will be provided, in part, through excavation of cuttings and other earthworks along the route of the Proposed Scheme, where the quality is appropriate. However, at some locations along the route there is insufficient high quality material for use in railway embankment construction. The use of borrow pits close to the route of the Proposed Scheme would enable aggregate to be extracted and processed and backfilled locally and transported largely on site haul routes lowering HGV movements and reducing impacts on the local road network and communities. Section 6.10 of Volume 1 of this ES presents an overview of the alternatives to using borrow pits.

2.5.45 During the design development process a requirement was identified for a borrow pit in the section of the route covering the Whitmore Heath to Madeley or South Cheshire area (CA5). Two options were proposed for a potential borrow pit in the area, a combination of three borrow pit locations (two located in the South Cheshire area (CA5) and one located in the Whitmore Heath to Madeley area) and one borrow pit located in the Whitmore Heath to Madeley area. The option taken forward into the Proposed Scheme was a refined option located in the South Cheshire area (CA5) as it would be less complex to construct and reduce the requirement to transport materials over longer distances. Details of the options considered is provided within the Volume 2: Community area 5, South Cheshire.

2.5.46 Subsequent to further analysis of construction traffic data, it was determined that a borrow pit would also be required to support construction within the Whitmore Heath to Madeley area. The borrow pit in the Whitmore Heath to Madeley area which has been taken forward into the Proposed Scheme is located north of the proposed River Lea viaduct and occupies a 40ha area of agricultural land associated with Netherset Hey Farm. The area is bordered by the River Lea and WCML to the west, Netherset Hey Lane to the east, the Stoke to Market Drayton Railway to the south and Netherset Industrial Estate to the north.

2.5.47 This location was identified using plans showing suitable geology combined with requirements for excavated material where the largest shortfalls of material occurred along the route of the Proposed Scheme. Selection criteria also included areas of mineral resource identified by Staffordshire County Council (SCC) and avoidance, where reasonably practicable, of residential properties, environmentally sensitive receptors, major services and diversions.

2.5.48 The presence of the borrow pit would increase the landscape and visual effects during construction. It would result in the temporary loss of agricultural land associated with Netherset Hey Farm holding.

2.5.49 The proximity of the borrow pit to the River Lea means that there would be the potential for baseflow to be impacted during excavation and dewatering activities. A minor tributary running through the site would also have to be temporarily diverted.

2.5.50 There are engineering benefits associated with this borrow pit as it sits within a larger area that has previously been promoted by the landowner for mineral extraction but was not included in the Minerals Local Plan for Staffordshire 2015 to 2030. Despite offering a significant resource, the area was not identified as a preferred site within this plan due to the absence of satisfactory road access, impacts to soil and impacts upon the local landscape. The intention by HS2 Ltd to predominantly use the on-site haul routes and to restore this area to the former ground levels and agricultural land-use would reduce the potential adverse impacts previously identified by SCC. The use of this area also avoids the need to deplete other preferred mineral resources within the SCC area.

3 Stakeholder engagement and consultation

3.1 Introduction

3.1.1 HS2 Ltd's approach to stakeholder engagement and consultation on the Proposed Scheme is set out in Volume 1, Section 3.

3.1.2 Since the route announcement in November 2015, HS2 Ltd has carried out a programme of stakeholder engagement and formal consultation with a broad range of stakeholders.

3.1.3 A variety of mechanisms have been used to ensure an open and inclusive approach to engagement and consultation, reflecting the differing requirements and expectations of stakeholders.

3.2 Key stages of Phase 2a engagement and consultation

Summary of engagement

3.2.1 A summary of engagement undertaken or underway since the route announcement in November 2015 is provided in Table 4.

Table 4: Mechanisms and timeline of stakeholder engagement and consultation since the route announcement in November 2015

Date	Engagement and consultation activity and mechanisms	Stakeholders engaged/consulted
November 2015	Local authority briefings.	Local authority officers along the line of route.
November 2015 – February 2016	Consultation on schemes to assist property owners from 30 November 2015 to 25 February 2016.	National consultation with information published on the HS2 Ltd website. Direct engagement with communities and their representatives through public events and documents being made available at a range of community locations along the route.
December 2015 – September 2016	Direct engagement to develop the Proposed Scheme, the Environmental Impact Assessment (EIA) and Equality Impact Assessment (EQIA).	Local authorities, parish councils and technical and specialist stakeholders.
January 2016 - ongoing	Site visits and meetings to observe and discuss possible impacts and understand people's concerns.	Residents, landowners, businesses, community interest groups and other directly affected stakeholders and their representatives along the route.
March 2016 - May 2016	Consultations on the draft EIA and EQIA Scope and Methodology Reports (SMR) from 8 March to 13 May 2016.	National consultation with information published on the HS2 website. Technical and specialist stakeholders, local authorities and parish councils on the line of route directly invited to participate.
September – November 2016	Consultations on the working draft EIA Report; working draft EQIA Report; and Design Refinements from 13 September to 7 November 2016.	National consultation with information published on the HS2 Ltd website. Direct engagement with communities and their representatives through public events and documents being made available at a range of community locations along the route.

Date	Engagement and consultation activity and mechanisms	Stakeholders engaged/consulted
November 2016 - ongoing	Ongoing discussions, meetings and site visits in response to issues raised during consultation and through broader stakeholder engagement.	Residents, landowners, businesses, community interest groups and other directly affected stakeholders and their representatives along the route.

Property consultation

3.2.2 Property consultation focused on those individuals and landowners potentially directly affected by the Proposed Scheme. Consultation took place between 30 November 2015 and 25 February 2016. Its purpose was to inform the Government's decision on whether to implement the same compensation and assistance schemes as for Phase One, taking into consideration the views of those individuals and organisations who expressed their opinions on the proposals.

3.2.3 Within the Whitmore Heath to Madeley area, property consultation events were held at Whitmore and District Village Hall on 23 January 2016 and The Madeley Centre on 29 January 2016.

3.2.4 Consultation responses were analysed, and reported on 26 May 2016 in the Government's report entitled "HS2 Phase Two: West Midlands to Crewe Property Consultation 2015"[18] and the Government's response was issued in the Decision Document HS2 Phase Two: West Midlands to Crewe Property Consultation 2015[19]".

EIA SMR consultation

3.2.5 The draft EIA Scope and Methodology Report (SMR) was formally consulted on from 8 March to 13 May 2016 and was issued to statutory bodies, non-government organisations and local authorities. It was also available on the Government's website, allowing comment by local interest groups and the public. Twenty six responses to the draft EIA SMR were received, as a result of which changes were made to the EIA SMR, which was published in September 2016. The changes between the draft EIA SMR and publication of the EIA SMR were set out in the EIA SMR Consultation Summary Report[20], also published in September 2016.

3.2.6 The assessment set out in this ES follows the scope and methodology in the EIA SMR and SMR Addendum (Volume 5: CT-001-001 and CT-001-002).

Working draft EIA Report consultation

3.2.7 The working draft EIA Report was formally consulted upon between 13 September and 7 November 2016. Parallel consultations on the working draft EQIA and Design Refinements were also undertaken during this period. As part of the process of consultation, stakeholders were invited to comment on the Proposed Scheme and the

[18] UK Government: HS2 Phase 2a: HS2 Phase Two: West Midlands to Crewe Property Consultation 2015. Available online at: https://www.gov.uk/government/consultations/hs2-phase-two-west-midlands-to-crewe-property-consultation-2015
[19] UK Government: HS2 Phase 2a: HS2 Phase Two West Midlands to Crewe property consultation 2015: government decision. Available online at: https://www.gov.uk/government/publications/hs2-phase-two-west-midlands-to-crewe-property-consultation-2015-government-decision
[20] UK Government: HS2 Phase 2a: West Midlands to Crewe Draft Environmental Impact Assessment Scope and Methodology Report consultation. Available online at: https://www.gov.uk/government/consultations/hs2-phase-two-west-midlands-to-crewe-draft-environmental-impact-assessment-scope-and-methodology-report-consultation

working draft EIA and working draft EQIA reports that informed it as well as the key design refinements to the Proposed Scheme which were being considered at the time.

3.2.8 Four hundred and seventy-five responses to the working draft EIA Report consultation were received in total.

3.2.9 These responses were analysed and the following themes and issues relevant to the Whitmore Heath to Madeley area included:

- impacts from works to the A53 Newcastle Road;
- impacts on PRoW;
- impacts associated with construction on communities and businesses in the Whitmore Heath to Madeley area;
- noise and vibration impacts from construction and operation of the Whitmore Heath tunnel;
- visual impacts associated with the height of the Proposed Scheme, in particular the Meece Brook viaduct, Meece embankments and River Lea viaduct;
- impacts on Whitmore Wood;
- impacts from works to local roads, including Manor Road, the A525 Bar Hill Road and Snape Hall Road; and
- landscape and visual impacts.

3.2.10 These consultations and wider feedback from ongoing stakeholder engagement have been considered as part of the ongoing design of the Proposed Scheme and the assessment and identification of mitigation for the Whitmore Heath to Madeley area.

3.2.11 A Working Draft Environmental Impact Assessment Report: Consultation Summary Report[2120] has been published alongside this ES summarising how the responses to the working draft EIA Report have been taken into consideration in the design and assessment of the Proposed Scheme. A separate consultation summary report has been prepared for the working draft EQIA Report[22].

3.2.12 Section 2 of this report describes the key changes made to the design in the Whitmore Heath to Madeley area since the working draft EIA Report.

3.3 Engagement and consultation with stakeholder groups

Technical and specialist groups

3.3.1 Engagement has been undertaken with technical and specialist organisations to provide appropriate specialist input to inform the design and assessment of the Proposed Scheme. This includes engagement with statutory bodies, local councils and utility companies operating within the Whitmore Heath to Madeley area.

[21] Volume 5: Appendix CT-008-000, Working Draft Environmental Impact Assessment Report: Consultation Summary Report.
[22] Working Draft Equality Impact Assessment Report: Consultation Summary Report. Available online at: www.gov.uk/hs2

3.3.2 Direct engagement with county and borough councils within the Whitmore Heath to Madeley area took place in order to collate local baseline information, identify and understand issues and concerns, and provide a mechanism for ongoing dialogue and discussion on the assessment and design development.

3.3.3 Engagement has focused on the technical areas that inform the assessment, including landscape and visual, sound, noise and vibration and traffic and transport, amongst others topics. It has also informed the design of the Proposed Scheme, as summarised in Table 5.

3.3.4 Briefings were offered to specialist and technical stakeholders along the route of the Proposed Scheme during the period of consultation on the working draft EIA Report to provide information on the evolving design and assessment of the Proposed Scheme in their respective areas.

3.3.5 Table 5 includes engagement undertaken with technical and specialist groups and how this has informed the design and assessment of the Proposed Scheme in the Whitmore Heath to Madeley area.

Table 5: Engagement to date with technical and specialist groups

Stakeholder	Area of focus for design and assessment	How this has informed the design and assessment of the Proposed Scheme
Statutory		
Department for Environment, Food and Rural Affairs (Defra)	Agricultural and land quality issues	Identifying local agricultural and land quality issues, including sites of particular interest such as foot and mouth burial sites.
Canal & River Trust	The landscape and visual assessment methodology with specific reference to the selection and location of representative viewpoints for the assessment and for photomontages.	Informing the selection of draft representative viewpoint and photomontage locations, with particular focus on intersections of the Proposed Scheme with Canal & River Trust's estate and assets. Understanding the potential impact of the Proposed Scheme on landscape character and key recreational visual receptors at important sites in the Canal & River Trust's estate.
Environment Agency	Water and flood risk issues	Providing information on water and flood risk issues along the line of route.
Food and Environment Research Agency (FERA)	Land contamination issues	Identification of local land quality issues.
Forestry Commission	Ecology and landscape related issues	Informing understanding of methodological approach and detailed local conditions and factors to be taken into consideration in the assessment.
Highways England	Traffic and transport assessment	Informing the assessment of road network capacity and identification of proposed future works.
Historic England	Nationally designated heritage assets and the heritage assessment methodology	Informing the methodology for assessing setting and impacts on historic landscape at national and regional level. Identification and assessment methodology of designated and non-designated heritage assets with particular focus on Madeley Manor and the tumulus near Manor Farm, Madeley.
Natural England	Ecology and landscape and visual related issues	Providing further information regarding potential ancient woodland sites. Understanding of

Stakeholder	Area of focus for design and assessment	How this has informed the design and assessment of the Proposed Scheme
	Agricultural land quality and land restoration issues	methodological approach and detailed local conditions and factors to be taken into consideration in the assessment.
Local authorities		
Staffordshire County Council	Cultural heritage	Identifying heritage assets to protect these assets and their settings.
	Water and flood risk issues	Understanding local infrastructure and conditions, including flood risks.
	Ecology and biodiversity issues	Understanding sensitive ecological sites and appropriate mitigations and compensation for habitat loss associated with the Proposed Scheme.
	Traffic and transport in relation to the construction of the Proposed Scheme	Understanding the local road network, its current use and levels of traffic and congestion to inform construction traffic route.
	Landscape and visual effects of the Proposed Scheme	Identifying representative viewpoint and photomontages locations.
	Potential health effects of the Proposed Scheme on local communities	Understanding local demographic and determinants of health and wellbeing.
	Air quality assessment	Understanding local conditions and factors to inform scheme design and EIA.
	Sound noise and vibration assessment	Understanding local conditions and factors to inform scheme design and EIA.
Newcastle-under-Lyme Borough Council	Local planning developments	Identifying local plans, policy and committed developments, to inform Proposed Scheme development.
	Landscape and visual effects of the Proposed Scheme	Identifying locations and photomontages to inform assessment.
	Potential health effects of the Proposed Scheme on local communities	Understanding local demographic and determinants of health and wellbeing.
Utilities		
National Grid	Utilities, gas and electricity networks	Informing route-wide considerations around utilities network and factors to be considered in the design and assessment of the Proposed Scheme.
Severn Trent Water	Potential connections and proximity of the Proposed Scheme to Severn Trent Water assets	Understanding of local utilities and factors to consider in the design, construction and operation of the Proposed Scheme, in particular the Whitmore ground water abstraction site and Source Protection Zone.
Other specialist stakeholders		
Central Association of Agricultural Valuers (CAAV)	Potential impacts of the Proposed Scheme on agricultural businesses.	Understanding the concerns of the agricultural industry in relation to the Proposed Scheme.

Stakeholder	Area of focus for design and assessment	How this has informed the design and assessment of the Proposed Scheme
County Land and Business Association (CLA)	Potential impacts of the Proposed Scheme on agricultural businesses	Understanding the concerns of the agricultural industry in relation to the Proposed Scheme.
National Farmers Union (NFU)	Potential impact of the Proposed Scheme on farmers and agricultural businesses	Understanding the concerns of farmers affected by the Proposed Scheme.
North Staffordshire Bridleways Association	Potential impact of the Proposed Scheme on local bridleways.	Informing the scheme design of key bridleway routes within the area.
Royal Society for the Protection of Birds (RSPB)	Ecology and biodiversity issues	Informing the ecology survey programme, and strategic mitigation opportunities.
Staffordshire Wildlife Trust	Local and regional ecology and biodiversity issues	Understanding of local wildlife assets and informing potential off site and strategic mitigation.
Woodland Trust	The route and associated effects to local woodland habitats	Informing understanding of local woodland habitats and how to mitigate and offset impacts to these.

3.3.6 Further information about topic-specific engagement with technical and specialist groups is provided in Sections 4 to 15, where relevant.

Communities

3.3.7 Community stakeholders in the Whitmore Heath to Madeley area include a range of local interest groups, local facility and service providers and schools as well as member of the public. The purpose of this engagement has been to give affected communities the opportunity to raise issues during the development of the design and assessment of the Proposed Scheme.

3.3.8 As part of the formal consultation on the working draft EIA Report, members of local communities and other interested parties were notified, provided with information and invited to engage on issues pertinent to the working draft EIA Report and the development of the Proposed Scheme design. Details of the local consultation events were provided on the HS2 Ltd website, via social media, on posters at local venues, through regional advertising and direct mail out to properties within 1km of the Proposed Scheme.

3.3.9 In the Whitmore Heath to Madeley area consultations on the working draft EIA Report, working draft EQIA Report and on the key design refinements were held at:

- Whitmore and District Village Hall on 30 September 2016; and
- The Madeley Centre on 15 October 2016.

3.3.10 HS2 Ltd staff and consultants attended the events, including engineers, environmental and property specialists, for members of the public to speak to.

3.3.11 An overview of how these responses have been taken into consideration in the ES is contained in the Working Draft Environmental Impact Assessment Report: Consultation Summary Report.

3.3.12 Engagement has also been undertaken with members of the community via the local parish councils and residents, as outlined in Table 4. Engagement with parish councils and residents has been used to understand local community concerns and issued in relation to the Proposed Scheme. Table 6 summarises key engagement undertaken with community stakeholders, including the focus of the engagement and how this has informed the design and assessment of the Proposed Scheme.

3.3.13 Table 6 sets out meetings undertaken with community stakeholders in the Whitmore Heath and Madeley area.

Table 6: Meetings held with communities and community stakeholders

Stakeholder	Area of focus	How this has informed the design and assessment of the Proposed Scheme
Baldwin's Gate HS2 Action Group	To provide an update on the Proposed Scheme and understand the local conditions and factors to inform scheme design and EIA.	Understanding local conditions and factors to inform scheme design and EIA.
Whitmore Parish Council	To provide an update on the Proposed Scheme and discuss the working draft EIA Report, working draft EQIA Report and Design Refinement consultation documents and understand the local conditions and factors to inform scheme design and EIA.	Understanding local conditions and factors to inform scheme design and EIA.
Madeley Parish Council		
Whitmore residents	To provide an update on the Proposed Scheme and understand the local conditions and factors to inform scheme design and EIA.	Understanding local conditions and factors to inform scheme design and EIA.
Whitmore Heath Action Group		Understanding local conditions and factors to inform scheme design and EIA.

Directly affected individuals, landowners and businesses

3.3.14 Engagement was undertaken with land owners, whose operations, land and/or property will be directly affected by the Proposed Scheme whether permanently or temporarily. This included individual property and land owners, commercial and educational entities, and farmers and growers, including through the land and property consultation and through ongoing dialogue. Engagement also occurred with the Madeley Conservation Group and the Whitmore Estate.

3.3.15 Thirteen visits were undertaken to farmers and growers in the Whitmore Heath to Madeley areas during the assessment and design development. Engagement was also carried out with land agents and key representatives of the farmers and growers industry.

3.3.16 Key areas of focus for the engagement with landowners and their representatives were: the refinement of locations of balancing ponds, access roads and environmental mitigation; the design of access and accommodation bridges; and maintaining operational access to land and businesses.

4 Agriculture, forestry and soils

4.1 Introduction

4.1.1 This section provides a description of the current baseline for agriculture, forestry and soils and the likely impacts and significant effects of the construction and operation of the Proposed Scheme within the Whitmore Heath to Madeley area. Consideration is given to the extent and quality of the soil and land resources underpinning the primary land use activities of farming and forestry, and the physical and operational characteristics of enterprises engaged in these activities. Consideration is also given to diversification associated with the primary land uses, and to related land-based enterprises, notably equestrian activities.

4.1.2 Engagement with farmers and landowners has been undertaken. The purpose of the engagement has been to obtain baseline information on the scale and nature of the farm and forestry operations and related farm-based uses, and to provide farmers and landowners with the opportunity to raise issues and discuss mitigation in relation to the Proposed Scheme. Engagement undertaken with farmers and landowners will be documented in a farm pack for each farm holding[23].

4.1.3 Details of published and publicly available information used in the assessment, and the results of surveys undertaken within this area, are contained in Volume 5: Appendix AG-001-004 and shown on Map Series AG-01 (Agricultural Holdings), AG-02 (Soil Associations) and AG-04 (Agricultural Land Classification) (Volume 5: Agriculture, forestry and soils Map Book).

4.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

4.2 Scope, assumptions and limitations

4.2.1 The assessment scope, key assumptions and limitations for the agriculture, forestry and soils assessment are set out in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[24], and the SMR Addendum[25].

4.2.2 The study area for the agriculture, forestry and soils assessment covers all land required for the construction and operation of the Proposed Scheme. The resources and receptors that are assessed within this area are agricultural land, forestry land and soils, together with farm and rural holdings. The assessments of the impacts on agricultural land quality and forestry land are made with reference to the prevalence of best and most versatile (BMV) land and forestry land in the general locality, taken as a 4km corridor centred on the route of the Proposed Scheme.

4.2.3 The quality of agricultural land in England and Wales is assessed according to the Agricultural Land Classification (ALC)[26] system, which classifies agricultural land into

[23] Part 3 of the HS2 Phase 2a Guide for Farmers and Growers, Available online at: www.gov.uk/hs2
[24] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[25] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.
[26] Ministry of Agriculture, Fisheries and Food (1988), Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land.

five grades from excellent quality Grade 1 land to very poor quality Grade 5 land. Grade 3 is subdivided into Subgrades 3a and 3b. The main issue in the assessment of the impacts on agricultural land is the extent to which land of BMV agricultural quality (Grades 1, 2 and 3a) is affected by the Proposed Scheme.

4.2.4 Forestry is considered as a land use feature, and the impacts have been calculated quantitatively. The qualitative effects on forestry land and woodland are addressed principally in Section 8, Ecology and biodiversity, and Section 11, Landscape and visual.

4.2.5 Soil attributes, other than for food and biomass production, are identified in this section, but the resulting function or service provided is assessed in other sections, notably Section 7, Cultural heritage; Section 8, Ecology and biodiversity; Section 11, Landscape and visual; and Section 15, Water resources and flood risk. The function of soil as a carbon store is described in Volume 3: Route-wide effects (Section 4).

4.2.6 The main issue for farm holdings is disruption by the Proposed Scheme of the physical structure of agricultural holdings and the operations taking place upon them, during both construction and operational phases.

4.2.7 Common assumptions that have been used in assessing the effects of the Proposed Scheme are set out in Volume 1 (Section 8). These assumptions include the restoration of agricultural land that is required temporarily for construction to agricultural use, and the handing back of land used temporarily to the original landowner. It is also assumed that capital items demolished will not be replaced as replacement assets are not included in the Proposed Scheme and will ultimately be at the discretion of the landowner. In the majority of cases, the details of land use have been obtained from face-to-face interviews. Where this has not been possible, holding data has been obtained from publicly available sources.

4.3 Environmental baseline

Existing baseline

4.3.1 This section sets out the main baseline features that influence the agricultural and forestry use of land within the Whitmore Heath to Madeley area. These include the underlying soil resources that are used for food and biomass production, as well as providing other services and functions for society, and the associated pattern of agricultural and other rural land uses.

Soil and land resources

Geology and soil parent materials

4.3.2 A full description of the geological characteristics of the Whitmore Heath to Madeley area is provided in Section 10, Land quality and Section 15, Water resources and flood risk, and shown on Map WR-02-204 (Volume 5: Water resources and flood risk Map Book). The bedrock geology mapped by the British Geological Survey (BGS)[27] in the south of the study area is sandstone of the Wilmslow Sandstone Formation. Whitmore Heath is underlain by sandstone and conglomerate of the Kidderminster

[27] British Geological Survey (2017). Geology of Britain viewer. Available online at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Formation. Both are part of the Sherwood Sandstone Group. The Salop Formation borders the sandstones to the north. This mostly comprises red-brown mudstone, although it also includes narrow bands of sandstone, pebbly sandstone and conglomerate, extending to the west of Hey Sprink.

4.3.3 Sandstone and mudstone of the Halesowen Formation is found west of Hey Sprink and northwards to the west of Madeley. The Chester Formation occurs to the west of Madeley, with the Sidmouth Mudstone Formation further west and north. The Chester Formation is part of the Sherwood Sandstone Group and includes conglomerate, pebbly sandstone and subordinate mudstone, whilst the Sidmouth Mudstone Formation, part of the Mercia Mudstone Group, is contrasting and includes structureless mudstone and siltstone, which continues northwards to Wrinehill.

4.3.4 There are no superficial deposits mapped over the sandstone formations across substantial areas in the south of the study area. Alluvial deposits are associated with the Meece Brook, the River Lea and the Checkley Brook. These deposits mostly comprise consolidated silty clay, but also contain silt, sand, peat and gravel. A limited area of River Terrace Deposits comprising sand and gravel is also mapped on the eastern valley side to the south of Whitmore.

4.3.5 Peat deposits are shown in the Lea Valley west of Whitmore Heath and Whitmore Wood. Superficial till deposits are also mapped on the eastern valley side on the shallow, lower slopes, extending north-west of Whitmore Heath. These comprise unsorted material ranging in size from clay to boulders (hence it is also commonly referred to as Boulder Clay), deposited by glaciers.

4.3.6 In the northern part of the study area, glaciofluvial deposits interspersed with till deposits overlie the bedrock. The glaciofluvial deposits comprise sand and gravel and are typically found on the shallower, lower slopes. The Glacial Till is typically found on moderate, mid-slopes.

Topography and drainage

4.3.7 Topography in this study area reflects the sandstone geology, into which the River Lea has cut a broad valley floor to the south of Madeley and a more incised valley as it runs north to Wrinehill. The sandstone plateau is around 165m to 170m above Ordnance Datum (AOD), with steep valley sides to the River Lea, the Meece Brook and the Checkley Brook. The floor of the River Lea valley is around 120m AOD in the south of the study area, falling to 80m AOD in the north at Wrinehill.

4.3.8 Land at risk of flooding by rivers is widespread throughout the study area, particularly from Baldwin's Gate to the south of Madeley, and in the north to the west of Wrinehill. In the south, at Whitmore, the flood risk is associated with the Meece Brook, whilst to the west of Whitmore Heath and Whitmore Wood and as far north as Madeley the flood risk is associated with the River Lea and, further north, also with Checkley Brook. This land is classed as predominantly Flood Zone 3, in which there is a 1 in 100 or greater annual probability of flooding. Further details are provided in Section 15, Water resources and flood risk.

Description and distribution of soil types

4.3.9 The characteristics of the soils are described by the Soil Survey of England and Wales[28] and shown on the National Soil Map[29]. The soils are grouped into associations of a range of soil types. They are described in more detail in Volume 5: Appendix AG-001-004 and their distribution is shown on Map AG-02-104.

4.3.10 There are three groups of soil associations in this study area. The presence of each group has been confirmed by detailed soil survey data obtained from published survey records and surveys undertaken for the purpose of this assessment. The first comprises coarse-textured topsoils of loamy sand, sandy loam or organic sand, overlying sandy loam, sand or sandstone. The associations included in this group are Bridgnorth, Goldstone and Wick 1. Soil profiles are well drained, of Wetness Class[30] (WC) I. Goldstone soils are characteristically very acidic, and are mostly under woodland or heath.

4.3.11 The second group comprises clay loam, silty clay loam or sandy clay loam topsoils over clay or clay loam subsoils of the Brockhurst 1, Whimple 3, Hodnet and Clifton associations. These soils are typically imperfectly (WC III) or poorly (WC IV) drained.

4.3.12 The third group comprises peat of the Altcar 1 association. Where drained, these soils are typically of WC I. Where undrained, they are susceptible to waterlogging and are poorly to very poorly drained (WC IV to VI).

Soil and land use interactions

Agricultural land quality

4.3.13 The principal soil/land use interaction is the quality of the agricultural land resource. The ALC is based on the identification of physical limitations to the agricultural capability of land resulting from the interactions of soil, climate and the study area.

4.3.14 The main soil properties that affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility.

4.3.15 Climate has an overriding limitation to Grade 2 at Whitmore Wood and west of Madeley. The interactions of climate with soil characteristics are also important in determining the wetness and droughtiness[31] limitations of the land.

4.3.16 The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point dataset[32] for three points within the study area and are set out in Volume 5: Appendix AG-001-004. The data show climate in the area to be cool and moist. The number of Field Capacity Days (FCDs), when the soil moisture deficit[33] is zero, ranges from 187 to 191 days per annum. This is higher than average for

[28] Soil Survey of England and Wales (1984), *Soils and their use in Midland and Western England*, Soil Survey of England and Wales, Bulletin No. 12, Harpenden.
[29] Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale.* Cranfield University: National Soil Resources Institute.
[30] The Wetness Class of a soil is classified according to the depth and duration of waterlogging in the soil profile and has six categories from WC I which is well drained to WC VI which is very poorly drained.
[31] A measure of the likely moisture stress in a crop arising from the crop's requirement for water exceeding the available water capacity in the soil
[32] Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*.
[33] The moisture deficit is a crop-related meteorological variable which represents the balance between rainfall and potential evapotranspiration calculated over a critical portion of the growing season.

lowland England (150 days) and generally constrains agricultural cultivations and soil handling for relatively long periods over winter. Soil moisture deficits, which give an indication of the liability of soils to droughtiness in summer, are moderate to moderately small.

4.3.17 Site factors include gradient and microrelief, which are limiting to agricultural land quality in some places throughout this study area. The valley slopes to the River Lea are steep throughout and limit land quality variably to Subgrade 3b and Grade 4. Flood risk is also likely to affect agricultural land quality within the River Lea valley and south-east of Checkley, limiting land quality to Subgrade 3b. Further details are provided in Section 15, Water resources and flood risk.

4.3.18 The main physical limitations that result from interactions between soil, climate and site factors are soil wetness, soil droughtiness and a localised susceptibility to erosion. For soil wetness, each soil can be allocated a Wetness Class based on soil structure, evidence of waterlogging and the number of FCDs. The topsoil texture then determines its ALC grade. Soil droughtiness is determined by the soil textures and thicknesses of each soil horizon, together with the crop moisture deficits.

4.3.19 The first group of soil associations, comprising well drained (WC I), coarse-textured soil profiles in the Bridgnorth, Goldstone and Wick 1 associations, is affected mostly by soil droughtiness. The severity of limitation is determined by factors such as topsoil texture, stone content and depth to the sandstone bedrock. As crop moisture deficits are moderate to moderately small, droughtiness limitations are mostly slight to Grade 2. Survey data has confirmed that sandy loam topsoils over loamy sand subsoils to the west of Madeley Park Wood are classified as Grade 2 on soil droughtiness. The Goldstone association comprises very acidic, very stony, sandy and coarse loamy soils, which are likely to have a more severe droughtiness limitation to Grade 4, as reflected in the typical land use of heath and woodland.

4.3.20 The second group comprising imperfectly drained (WC III) profiles with medium loamy topsoils (Brockhurst 1, Whimple 3, Hodnet and Clifton associations) are limited mostly by soil wetness and workability to Subgrade 3a, or to Subgrade 3b where topsoils are heavy loams. Poorly drained (WC IV) profiles with medium loamy topsoils are Subgrade 3b, whilst those in WC IV with heavier loamy topsoils are Grade 4. Survey data has confirmed that Clifton soils at Wrinehill are classified as Subgrade 3b.

4.3.21 The third group is associated with the Meece Brook and River Lea and comprises peat soils of the Altcar 1 association. These soils can be of WCI or IV, depending on whether underdrainage has been installed. Peaty profiles will have sufficient water holding capacity to prevent any drought stress to crops and, if well drained, may have only slight or no physical limitation to agricultural land quality. However, these soils are susceptible to compaction when wet and wind erosion when soils are dry. Peaty profiles of WC IV would be limited to Subgrade 3a by wetness and workability. If more severely or even permanently waterlogged, of WC V or VI, as is likely to be the case in the Lea Valley where the area is classified as Flood Zone 3, the profiles would be classified as Grade 4.

4.3.22 As set out in the SMR, the sensitivity of BMV land in the study area is determined relative to the abundance of such land in the area, set as a 4km corridor centred on the route of the Proposed Scheme. Department for the Environment, Food and Rural

Affairs (Defra) mapping[34] shows that there is a high likelihood of encountering BMV agricultural land in the locality, which makes such land a resource of low sensitivity in this study area.

4.3.23 The distribution of agricultural land quality in the study area is described in more detail in Volume 5: AG-001-004 and shown on Map AG-04-113b to Map AG-04-115a (Volume 5: Agriculture, forestry and soils Map Book).

Other soil interactions

4.3.24 Soil fulfils a number of functions and services for society in addition to those of food and biomass production, which are central to social, economic and environmental sustainability. These are outlined in sources such as the Soil Strategy for England[35] and the Government's White Paper, The Natural Choice: securing the value of nature[36], and include:

- the storage, filtration and transformation of water, carbon and nitrogen in the biosphere;
- the support of ecological habitats, biodiversity and gene pools;
- support for the landscape;
- the protection of cultural heritage;
- the provision of raw materials; and
- the provision of a platform for human activities, such as construction and recreation.

4.3.25 Forestry resources represent a potentially multifunctional source of productive timber, landscape amenity, biodiversity and carbon storage capacity. An assessment of the value and sensitivity of woodland resources is reported in Section 8, Ecology and biodiversity.

4.3.26 The floodplains of the Meece Brook, the River Lea and the Checkley Brook occupy land where water has to flow or be stored in times of flood, as set out in Section 15, Water resources and flood risk. The soils and floodplains in this study area function as water stores for flood attenuation, as well as providing ecological habitat.

Land use

Land use description

4.3.27 Agricultural land use in this study area is predominantly pasture, and used mostly to support dairy herds, with a number of beef cattle and sheep enterprises also present. The fields are regular in shape and medium to large in scale, reflecting the size of the farm holdings. The area also includes equestrian enterprises north of Madeley.

[34] Defra (2005), *Likelihood of Best and Most Versatile Agricultural Land*.
[35] Defra (2009), *Soil Strategy for England.*
[36] HM Government (2011), *The Natural Choice: securing the value of nature.*

4.3.28 Woodland is found predominantly around Whitmore Heath, although there are some smaller blocks near Madeley. The larger blocks in the area include ancient woodlands at Whitmore Wood, Hey Sprink, Barhill Wood and Wrinehill Wood. The majority of Whitmore Wood is managed as commercial forestry. It was replanted with mostly larch for commercial extraction approximately 40 years ago, has been thinned and is intended to be extracted once mature. A full description of woodland in the Whitmore Heath to Madeley area is set out in Section 8, Ecology and biodiversity.

4.3.29 The proportion of woodland as a land use in the general locality, taken as a 4km corridor centred on the route of the Proposed Scheme, is around the national average at 9.9%; as such, woodland as a land use is a resource of medium sensitivity in this study area.

4.3.30 A number of environmental designations potentially influence land use within the study area. The whole area is a nitrate vulnerable zone, where statutory land management measures apply that seek to reduce nitrogen losses from agricultural sources to water.

4.3.31 Some agricultural land is also subject to agri-environment management prescriptions that seek to retain and enhance the landscape and biodiversity qualities and features of farmland. These are associated with the Environmental Stewardship Scheme (the Entry Level Scheme (ELS) or Higher Level Scheme (HLS)), or the Countryside Stewardship Scheme (CSS), which since 2015 is the main agri-environment scheme in England. The CSS incorporates elements of Environmental Stewardship, the English Woodlands Grant scheme and Catchment Sensitive Farming grants.

4.3.32 Most Environmental Stewardship agreements, which were extensive and covered approximately 70% of agricultural land in England, have now ended although existing agreements will run their course. The CSS is more focussed than Environmental Stewardship, with applications for funding being competitive and the area covered by the scheme less than that covered under Environmental Stewardship. Holdings that have land entered into an agri-environment scheme are identified in Table 7.

Number, type and size of holdings

4.3.33 Table 7 sets out the main farm holdings within this study area.

4.3.34 Dairy farming predominates in the Whitmore Heath to Madeley area, with the herds being medium to large-scale, and mostly over 500 milking cows. The dairy farms are the largest holdings in the area at an average of over 300ha. The remainder of the agricultural land in the area is mostly grazed by livestock, particularly beef cattle and sheep, on smaller-scale holdings, which average slightly under 100ha. There are also three equestrian holdings. The boundaries of the holdings are shown on Maps AG-01-113b to AG-01-115a (Volume 5: Agriculture, forestry and soils Map Book) along with the location of the main farm buildings. Field drainage is prevalent throughout the study area and critical for the dairy enterprises in order to maintain high grassland productivity and extend the length of the grazing season.

4.3.35 Table 7 also sets out the sensitivity of individual holdings to change. This is determined by the extent to which they have the capacity to absorb or adapt to impacts, which in turn is determined primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, can

better absorb impacts and are less sensitive. Units that rely on the use of buildings (such as intensive livestock and dairy farms, and horticultural units) are less able to accommodate change and have a higher sensitivity. Non-commercial land uses and units, such as pony paddocks associated with residential properties, have a low sensitivity. The holding reference provides a unique identifier and relates to Maps AG-01-113b to AG-01-115a (Volume 5: Agriculture, forestry and soils Map Book) and Volume 5: Appendix AG-001-004.

Table 7: Summary characteristics of holdings

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment scheme	Sensitivity to change
CA4/1 Whitmore Hall Farm	Dairy	365	Telecommunications mast; commercial shoot; commercial forestry; commercial fishery; composting business; livery; and music festival venue	ELS and HLS	High
CA4/2* Baldwin's Gate Farm	Dairy	254	Not known	None	Medium (affected land not part of grazing block)
CA4/3* Rose Cottage	Rough pasture	1	None	None	Low
CA4/4* New House Farm	Beef cattle	20	Not known	None	Medium
CA4/5 Moat Farm	Beef cattle	89	None	None	Medium
CA4/6 Snape Hall Farm	Dairy	108	Commercial forestry	None	High
CA4/7* Woodhouse Farm	Beef cattle and sheep	46	Not known	None	Medium
CA4/8 Netherset Hey Farm	Dairy; free range poultry	324	Shoot	None	High
CA4/9 Madeley Park Farm	Beef cattle, sheep and pigs	91	Farm abattoir and shop (butchers)	ELS	Medium
CA4/10 Manor Farm	Dairy	152	Woodland let for paintballing; ponds let for fishing; barn conversions let; and shoot	ELS	High
CA4/11 Land at Wood Croft	Equestrian (semi-commercial)	6	None	None	Low

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment scheme	Sensitivity to change
CA4/12 Baa Hill Farm	Sheep, pigs and cattle	36	Farm butchery and shop; and pond let for fishing	Formerly ELS Woodland planted under Woodland Grant Scheme	Medium
CA4/13* Peak's Farm	Dairy	44	Not known	None	High
CA4/14* Land at Bar Hill	Grassland	2	Not known	None	Low
CA4/15* Chells Hill Farm	Off-lying grassland	25	Marina (at Chells Hill)	None	Low
CA4/16 Bar Hill Farm	Beef cattle and arable	233	Shoot and agricultural contracting	None	Medium
CA4/17* Land at Moor Hall	Equestrian (non-commercial)	1	Not known	None	Low
CA4/18 Bower End Farm	Beef cattle and sheep	25	None	None	Medium
CA4/19 Beechwood Farm	Beef cattle and sheep	105	Shoot	Countryside Stewardship	Medium
CA4/20 Wrinehill Hall Farm	Dairy	230	None	None	High
CA4/21 Wrinehill Mill Farm	Equestrian	22	Buildings let to Wrinehill Hall Farm; and building let for children's swimming lessons	None	Medium

* No Farm Impact Assessment interview conducted; data estimated.

Future baseline

Construction (2020)

4.3.36 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

4.3.37 No committed developments have been identified in this study area that will materially alter the baseline conditions in 2020 for agriculture, forestry and soils.

Operation (2027)

4.3.38 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

4.3.39 No committed developments have been identified in this study area that will materially alter the baseline conditions in 2027 for agriculture, forestry and soils.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 During the development of the design, the following measures have been incorporated to avoid or mitigate adverse impacts on agriculture, forestry or soils:

- provision of agricultural and forestry access to severed land at Whitmore Wood and Snape Hall Farm (CA4/6) from Whitmore Wood overbridge;
- agricultural crossing incorporated into Manor Road overbridge at Manor Farm (CA4/10);
- agricultural crossing incorporated into the Madeley Bridleway 1 accommodation green overbridge at Baa Hill Farm (CA4/12); and
- agricultural crossing incorporated into the Madeley Bridleway 2 accommodation underbridge at Wrinehill Hall Farm (CA4/20).

4.4.2 The effect of severance of agricultural land for various holdings is also reduced by the ability of agricultural machinery to pass under the Meece Brook viaduct, the River Lea viaduct and the Checkley Brook viaduct.

4.4.3 Other design refinements to reduce the impact of the Proposed Scheme on agriculture, forestry and soil resources have included:

- rationalisation of balancing ponds to seek to locate them in least sensitive agricultural locations;
- locally slackened or steepened slopes to improve agricultural land use;
- rationalisation of road realignments to reduce the area of agricultural land required;
- incorporation of agricultural tracks to gain access to severed land; and
- rationalisation and relocation of mitigation planting to reduce the area of agricultural land required and reduce impacts on holdings.

4.4.4 In addition, there is a need to avoid or reduce environmental impacts to soils during construction. Soil resources from the areas required temporarily and permanently for the Proposed Scheme will be stripped and stored. This will enable agricultural land that is required temporarily for construction to be returned to agricultural use. It will also enable soils to be returned to other uses, such as to support landscape planting and biodiversity, and to a suitable condition whereby they will be able to fulfil the identified function.

4.4.5 Compliance with the Code of Construction Practice[37] (CoCP) will avoid or reduce environmental impacts during construction. Those measures that are particularly relevant to agriculture, forestry and soils are set out in the draft CoCP and relate to:

- the reinstatement of agricultural land that is used temporarily during construction to agriculture, where this is the agreed end use (Section 6);
- the provision of a method statement for stripping, handling, storing and replacing agricultural and woodland soils to reduce risks associated with soil degradation on areas of land to be returned to agriculture and woodland following construction, based on detailed soil survey work to be undertaken prior to construction. This will include any remediation measures necessary following the completion of works (Section 6);
- a requirement for contractors to monitor and manage flood risk and other extreme weather events, insofar as reasonably practicable, that may affect agriculture, forestry and soil resources during construction (Sections 5 and 16);
- arrangements for the maintenance of farm and field accesses affected by construction (Section 6);
- the protection and maintenance of existing land drainage and livestock water supply systems, where reasonably practicable (Sections 6 and 16);
- the protection of agricultural land adjacent to the construction site, including the provision and maintenance of appropriate stock-proof fencing (Sections 5, 6, 9 and 12);
- the adoption of measures to control the deposition of dust on adjacent agricultural crops (Section 7);
- the control of invasive and non-native species; and the prevention of the spread of weeds generally from the construction site to adjacent agricultural land (Section 9);
- the adoption of measures to prevent, insofar as reasonably practicable, the spread of soil-borne, tree, crop and animal diseases from the construction area (Sections 6 and 9); and
- liaison and advisory arrangements with affected landowners, occupiers and agents, as appropriate (Sections 5 and 6).

4.4.6 Upon completion of construction, soils replaced for agricultural, forestry or landscape uses will be monitored to identify any unsatisfactory growing conditions during the five-year aftercare period.

4.4.7 Where agricultural uses are to be resumed on land disturbed during the construction of the Proposed Scheme, the design objective is to avoid any reduction in long term capability, which would downgrade the quality of the disturbed land, through the adoption of good practice techniques in handling, storing and reinstating soils on that

[37] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

land. Some poorly or very poorly drained land or land with heavier textured soils (such as the Altcar 1, Brockhurst 1 and Clifton association soils) may also require particularly careful management, such as the timing of cultivation and livestock grazing, during the aftercare period to ensure this outcome.

Assessment of impacts and effects

4.4.8 The acquisition and use of land for the Proposed Scheme will interfere with existing uses of that land and, in some locations, preclude existing land uses or sever and fragment individual fields and operational units of agricultural and forestry land. This could result in potential effects associated with the ability of affected agricultural interests to access and effectively use residual parcels of land. There may also be the loss of, or disruption to, buildings and operational infrastructure such as drainage. The Proposed Scheme seeks to reduce this disruption and, where appropriate and reasonably practicable, incorporate inaccessible severed land as part of environmental mitigation works.

4.4.9 Land used to construct the Proposed Scheme will fall into the following main categories when work is complete:

- part of the operational railway and kept under the control of the operator;
- returned to agricultural use (with aftercare management to ensure stabilisation of the soil structure);
- used for drainage or replacement floodplain storage areas, which may also retain some agricultural use; or
- used for ecological and/or landscape mitigation.

Temporary effects during construction

Impacts on agricultural land

4.4.10 During the construction phase, the total area of agricultural land used within the Whitmore Heath to Madeley area will be approximately 336ha as shown in Table 8. Of this total, it is anticipated that approximately 147ha will be restored and available for agricultural use following construction.

Table 8: Agricultural land required for the construction of the Proposed Scheme

Agricultural land quality	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Grade 1	0	0	0
Grade 2	66.6	20	34.4
Subgrade 3a	73.4	22	36.0
BMV subtotal	140.0	42	70.4
Subgrade 3b	189.2	56	72.2
Grade 4	7.1	2	4.0
Grade 5	0	0	0

Agricultural land quality	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Total agricultural land	336.3	100	146.6

4.4.11 The disturbance during construction to approximately 140ha of BMV land is assessed as an impact of medium magnitude, comprising 42% of the agricultural land requirement. BMV land is assessed as a receptor of low sensitivity because of its relative abundance in this area. The effect of the Proposed Scheme on BMV land during the construction phase is therefore assessed as minor adverse, which is not significant.

4.4.12 Following completion of construction, temporary facilities will be removed and the topsoil and subsoil reinstated in accordance with the agreed end use for the land. Some permanently displaced soils may be used to restore land to agriculture or other uses with slightly deeper topsoil and subsoil layers, where appropriate. This could improve the quality of agricultural land locally, for example where droughty soils are limited by soil depth, subject to the soil resource plans to be prepared during the detailed design stage.

Nature of the soil to be disturbed

4.4.13 The sensitivity of the soils disturbed by construction activity reflects their textural characteristics, in the light of local rainfall conditions, as set out in the SMR. In areas of heaviest rainfall, and during the wettest times of the year, soils with high clay and silt fractions are most susceptible to the effects of handling during construction and the re-instatement of land; whereas soils with a high sand fraction in areas of lowest rainfall and during the driest times of the year are the least susceptible.

4.4.14 Successful soil handling is dependent upon movements being undertaken under appropriate weather and ground conditions using the appropriate equipment. The principles of soil handling are well established and set out in advisory material such as Defra's Code of Practice for the Sustainable Use of Soils[38]. These principles will be followed throughout the construction period.

4.4.15 Peaty, clayey and seasonally waterlogged soils (including Altcar 1, Brockhurst 1 and Clifton associations) are least able to remain structurally stable if moved in wet conditions or by inappropriate equipment. They are susceptible to compaction and smearing, which could affect successful reinstatement. Implementation of the measures set out in the draft CoCP will ensure the magnitude of impact on soil will be low and the significance of the effect will be negligible and not significant.

4.4.16 The disturbance of peat soils has implications for carbon emissions and biodiversity. The Proposed Scheme seeks to reduce disturbance of any deep peat soils insofar as reasonably practicable. Where disturbance cannot be avoided, the peat soils will be handled with particular care to avoid compaction when wet and wind erosion when dry. When reinstated, opportunities will be taken to use peat soils to create habitats, enhance biodiversity and build carbon reserves.

[38] Defra (2009), *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.*

4.4.17 The proposed borrow pit west of Netherset Hey Farm (CA4/8) will be used to extract material that is suitable for engineering purposes, from beneath the topsoil and subsoil (i.e. the whole soil profile). It is anticipated that borrow pits will be restored with materials generated from construction of the Proposed Scheme, typically clay, which does not have suitable characteristics for use as construction or engineering fill. The existing soil survey data indicates that the entire agricultural soil profile (i.e. the topsoil and subsoil) is likely to be available for agricultural restoration so that agricultural soils can be returned to the same condition as their pre-excavated state, as good practice techniques will be used to handle, store and reinstate soils. Given the permeable nature of the existing material beneath the agricultural soil profile, agricultural land drainage works will be required when restoring the borrow pit to achieve this condition and to ensure ongoing agricultural management of the restored land.

Impacts on holdings

4.4.18 Land may be required for the Proposed Scheme from holdings temporarily, during the construction period, or permanently. In most cases, the temporary and permanent land requirement will occur simultaneously at the start of the construction period and it is the combined effect of both that will have the most impact on the holding. During the construction period, some agricultural land will be restored and the impact on individual holdings will reduce.

4.4.19 The effects of the Proposed Scheme on individual agricultural and related interests during the construction period are summarised in Table 9. The table shows the total area of land required from a particular holding in absolute terms and as a percentage of the total area farmed. It also shows the area of land that could be returned to the holding following the construction period. The degree of impact is based on the proportion of the holding required rather than the absolute area of land.

4.4.20 The effects of severance during construction are judged on the ease and availability of access to severed land. With the implementation of the measures set out in the draft CoCP, these will generally be the same during and post construction. The disruptive effects, principally of construction noise and dust, are assessed according to their effects on land uses and enterprises. Impacts on residential properties on farm holdings are assessed, as required, in Section 5, Air quality; Section 6, Community; and Section 13, Sound, noise and vibration. Full details of the nature and significance of effects are set out in Volume 5: Appendix AG-001-004.

4.4.21 Wrinehill Mill Farm (CA4/21) has land in both the Whitmore Heath to Madeley area and the South Cheshire area (CA5). The impacts and effects are assessed and reported in the Whitmore Heath to Madeley area (this report) as the main farm buildings are in this area.

Table 9: Summary of effects on holdings during construction

Holding reference/name/sensitivity	Total area required from holding	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
CA4/1 Whitmore Hall Farm High sensitivity	85.3ha (23%) High	Low	Low	Major adverse due to proportion of land required	18.7ha

Holding reference/name/sensitivity	Total area required from holding	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
CA4/2 Baldwin's Gate Farm Medium sensitivity	7.0ha (3%) Negligible	Negligible	Negligible	Negligible	3.4ha
CA4/3 Rose Cottage Low sensitivity	1.0ha (100%) High	Negligible	Negligible	Moderate adverse due to proportion of land required	0ha
CA4/4 New House Farm Medium sensitivity	0.2ha (1%) Negligible	Negligible	Negligible	Negligible	0.2ha
CA4/5 Moat Farm Medium sensitivity	6.8ha (8%) Low	Negligible	Negligible	Minor adverse	2.3ha
CA4/6 Snape Hall Farm High sensitivity	44.0ha (41%) High	Medium	Medium	Major adverse due to proportion of land required	11.6ha
CA4/7 Woodhouse Farm Medium sensitivity	1.6ha (4%) Negligible	Negligible	Negligible	Negligible	0ha
CA4/8 Netherset Hey Farm High sensitivity	74.1ha (23%) High	Low	Low	Major adverse due to proportion of land required	49.5ha
CA4/9 Madeley Park Farm Medium sensitivity	6.9ha (8%) Low	Negligible	Negligible	Minor adverse	3.8ha
CA4/10 Manor Farm High sensitivity	49.1ha (32%) High	Medium	Medium	Major adverse due to proportion of land required	28.0ha
CA4/11 Land at Wood Croft Low sensitivity	5.2ha (86%) High	Low	Low	Moderate adverse due to proportion of land required	0.2ha
CA4/12 Baa Hill Farm Medium sensitivity	12.6ha (35%) High	Medium	High	Major/moderate adverse due to proportion of land required and disruptive effects on farm shop	5.5ha
CA4/13 Peak's Farm High sensitivity	1.0ha (2%) Negligible	Negligible	Negligible	Minor adverse	0ha
CA4/14	0.2ha (10%)	Negligible	Negligible	Negligible	0.2ha

Holding reference/name/sensitivity	Total area required from holding	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
Land at Bar Hill Low sensitivity	Low				
CA4/15 Chells Hill Farm Low sensitivity	0.7ha (3%) Negligible	Negligible	Negligible	Negligible	oha
CA4/16 Bar Hill Farm Medium sensitivity	11.2ha (5%) Negligible	Negligible	Medium (effect on shoot)	Moderate adverse due to disruptive effect on shoot during construction	1.8ha
CA4/17 Land at Moor Hall Low sensitivity	0.2ha (24%) High	Negligible	Negligible	Moderate adverse due to proportion of land required	0.1ha
CA4/18 Bower End Farm Medium sensitivity	8.8ha (35%) High	Negligible	Low	Major/moderate adverse due to proportion of land required	2.4ha
CA4/19 Beechwood Farm Medium sensitivity	5.3ha (5%) Negligible	Negligible	Negligible	Negligible	oha
CA4/20 Wrinehill Hall Farm High sensitivity	33.4ha (15%) Medium	Low	Medium	Major/moderate adverse due to proportion of land required and proximity of construction activity to farm buildings	17.1ha
CA4/21 Wrinehill Mill Farm Medium sensitivity	0.3ha (2%) Negligible	High	Negligible	Major/moderate adverse due to severance during construction	0.2ha

4.4.22 Overall, 21 holdings in the Whitmore Heath to Madeley area will be affected during construction, of which 12 will experience moderate, moderate/major or major adverse effects, which are significant.

4.4.23 The temporary construction effects on four of the main dairy farms in the study area are assessed as major adverse due to the high proportion of land required; these are Whitmore Hall Farm (CA4/1), Snape Hall Farm (CA4/6), Netherset Hey Farm (C4/8) and Manor Farm (C4/10). Most of the temporary requirement for land at Netherset Hey Farm is for the borrow pit. These farms will also be severed, but access will be available as set out above under 'Avoidance and mitigation measures'.

4.4.24 Three holdings: Baa Hill Farm (CA4/12); Bower End Farm (CA4/18); and Wrinehill Hall Farm (CA4/20) will experience major/moderate adverse effects during construction, due to the proportion of land required during the construction period. In the case of Baa Hill Farm (CA4/12), one of the diversified uses is a butchery and farm shop which is dependent on selling meat reared on the holding. The combination of a high proportion of land required and the proximity of major construction activity

associated with the Madeley tunnel is likely to jeopardise the ongoing viability of both farm and shop. A fourth holding, Wrinehill Mill Farm (CA4/21), will experience major/moderate adverse effects due to severance during the construction period.

4.4.25 Four holdings will experience moderate adverse effects, mostly due to high proportions of land required from small land holdings (Rose Cottage (CA4/3); Land at Wood Croft (CA4/11); and land at Moor Hall (CA4/17). The remaining moderate adverse effect arises from disruption during construction to the shoot at Bar Hill Farm (CA4/16).

Permanent effects of construction

Impacts on agricultural land

4.4.26 Following construction and restoration, the area of agricultural land that will remain permanently required will be approximately 190ha, as shown in Table 10.

Table 10: Agricultural land required permanently

Agricultural land quality	Total area required (ha)	Percentage of agricultural land
Grade 1	0	0
Grade 2	32.2	17
Subgrade 3a	37.4	20
BMV subtotal	69.6	37
Subgrade 3b	117.0	62
Grade 4	3.1	1
Grade 5	0	0
Total agricultural land	189.7	100

4.4.27 Of this total requirement, approximately 59.5ha (31%) will comprise newly planted woodlands for visual screening and habitat creation to mitigate environmental effects arising from the Proposed Scheme. These areas are described in Section 8, Ecology and biodiversity and Section 11, Landscape and visual. This includes approximately 36ha of woodland planting linking the retained area of Whitmore Wood to Hey Sprink.

4.4.28 A total area of approximately 5.2ha of agricultural land shown on CT-06-229 and CT-06-232 (Volume 2: CA4 Map Book) will be engineered to provide replacement floodplain storage, some of which is BMV land and could be subject to marginal downgrading in agricultural land quality. This agricultural assessment assumes that this land will return to agricultural use.

4.4.29 The permanent requirement for approximately 70ha of BMV land within the Whitmore Heath to Madeley area is assessed as an impact of medium magnitude, comprising 37% of the overall agricultural land requirement. BMV land is assessed as a receptor of low sensitivity because of its relative abundance in this area. The permanent effect on BMV land is therefore assessed as minor adverse, which is not significant.

Impacts on forestry land

4.4.30 The total area of woodland required in the Whitmore Heath to Madeley area as a result of the Proposed Scheme will be approximately 23.7ha, as set out in Section 8, Ecology and biodiversity, out of a total permanent land requirement (including non-agricultural land) of approximately 220ha (11%). Of this total, 7ha will be required from ancient woodland, including 6ha from Whitmore Wood. Whitmore Wood is managed mostly as commercial forestry and the impacts on that resource will primarily relate to reduced timber revenues as the remainder of Whitmore Wood will be replanted with native broadleaved woodland and will be incorporated as part of a woodland enhancement and restoration strategy which will be prepared.

4.4.31 The permanent requirement for woodland is assessed as an impact of high magnitude in land use terms (11% of the total permanent land requirements). The area of woodland is similar to the average national woodland cover (10%) such that the effect on forestry land is considered to be significant in quantitative terms, and in terms of the agriculture, forestry and soils assessment. The qualitative assessment of loss of woodland is addressed in Section 8, Ecology and biodiversity.

Impacts on holdings

4.4.32 The permanent effects from the construction of the Proposed Scheme on individual agricultural and related interests are summarised in Table 11. The land required column refers to the area of land required to operate the Proposed Scheme in absolute terms and as a percentage of the overall area farmed. The scale of effect is based on the likely proportion of land required from the holding. The effects of severance are judged on the ease and availability of access to severed land once construction is completed. The impact on farm infrastructure refers mainly to the loss of or damage to farm capital, such as property, buildings and structures, and the consequential effects on land uses and enterprises. Full details of the nature and scale of effects are set out in Volume 5: Appendix AG-001-004.

Table 11: Summary of permanent effects on holdings from construction

Holding reference/name/sensitivity	Land required from holding	Severance	Infrastructure	Scale of effect
CA4/1 Whitmore Hall Farm High sensitivity	66.6ha (18%) Medium	Low	Negligible	Major/moderate adverse due to proportion of land required
CA4/2 Baldwin's Gate Farm Medium sensitivity	3.6ha (1%) Negligible	Negligible	Negligible	Negligible
CA4/3 Rose Cottage Low sensitivity	1.0ha (100%) High	Negligible	Negligible	Moderate adverse due to proportion of land required
CA4/4 New House Farm Medium sensitivity	0ha (0%) Negligible	Negligible	Negligible	Negligible

Holding reference/name/sensitivity	Land required from holding	Severance	Infrastructure	Scale of effect
CA4/5 Moat Farm Medium sensitivity	4.5ha (5%) Negligible	Negligible	Negligible	Negligible
CA4/6 Snape Hall Farm High sensitivity	32.4ha (30%) High	Medium	High	Major adverse due to proportion of land required and loss of a farm building
CA4/7 Woodhouse Farm Medium sensitivity	1.6ha (4%) Negligible	Negligible	Negligible	Negligible
CA4/8 Netherset Hey Farm High sensitivity	24.6ha (8%) Low	Low	Negligible	Moderate adverse due to area of land required and severance
CA4/9 Madeley Park Farm Medium sensitivity	3.1ha (3%) Negligible	Negligible	Negligible	Negligible
CA4/10 Manor Farm High sensitivity	21.1ha (14%) Medium	Low	Medium	Major/moderate adverse due to proportion of land required and importance of drainage for dairy system operated on the farm
CA4/11 Land at Wood Croft Low sensitivity	5.0ha (83%) High	Negligible	Negligible	Moderate adverse due to proportion of land required
CA4/12 Baa Hill Farm Medium sensitivity	7.1ha (20%) Medium	Low	Low	Moderate adverse due to proportion of land required
CA4/13 Peak's Farm High sensitivity	1.0ha (2%) Negligible	Negligible	Negligible	Minor adverse
CA4/14 Land at Bar Hill Low sensitivity	0ha (0%) Negligible	Negligible	Negligible	Negligible
CA4/15 Chells Hill Farm Low sensitivity	0.7ha (3%) Negligible	Negligible	Negligible	Negligible
CA4/16 Bar Hill Farm Medium sensitivity	9.4ha (4%) Negligible	Negligible	Negligible	Negligible
CA4/17	0.1ha (10%)	Negligible	Negligible	Negligible

Holding reference/name/sensitivity	Land required from holding	Severance	Infrastructure	Scale of effect
Land at Moor Hall Low sensitivity	Low			
CA4/18 Bower End Farm Medium sensitivity	6.4ha (26%) High	Negligible	Medium	Major/moderate adverse due to proportion of land required
CA4/19 Beechwood Farm Medium sensitivity	5.3ha (5%) Negligible	Negligible	Negligible	Negligible
CA4/20 Wrinehill Hall Farm High sensitivity	16.3ha (7%) Low	Low	Low	Moderate adverse due to proportion of land required, permanent severance and impacts on infrastructure
CA4/21 Wrinehill Mill Farm Medium sensitivity	0.1ha (<1%) Negligible	Negligible	Negligible	Negligible

4.4.33 Overall, the construction of the Proposed Scheme will affect 19 holdings in the Whitmore Heath to Madeley area permanently, with nine holdings experiencing moderate, major/moderate or major adverse permanent effects, which are significant. The effects on the remaining 10 holdings are assessed as minor adverse or negligible.

4.4.34 Five dairy units, which are generally more susceptible to the effects of severance than other farm holdings, will be permanently affected: Whitmore Hall Farm (CA4/1), Snape Hall Farm (CA4/6), Netherset Hey Farm (CA4/8), Manor Farm (CA4/10) and Wrinehill Hall Farm (CA4/20). However, the severance effects on these holdings and dairy operations have been mitigated insofar as reasonably practicable through the design of the Proposed Scheme, such that the permanent severance impact on these holdings is assessed as low or negligible.

4.4.35 Nevertheless, there is still a major adverse effect assessed for Snape Hall Farm (CA4/6) due to the proportion of land required permanently and the loss of a farm building. Although the farm will be severed along its length, access will be available across the alignment using the Whitmore Wood overbridge.

4.4.36 Whitmore Hall Farm (CA4/1) and Manor Farm (CA4/10) are assessed as incurring major/moderate adverse effects due to the proportion of land required and, in the case of Manor Farm, the importance of drainage for the particular form of operations undertaken at the farm.

4.4.37 The other farm holding assessed as incurring a major/moderate adverse effect is Bower End Farm (CA4/18) due to the high proportion of land required from a relatively small holding. The remaining significant effects are assessed as moderate adverse, and arise from high land requirements from small land holdings (Rose Cottage (CA4/3) and Wood Croft (CA4/11)), medium land requirements and severance impacts on medium sensitivity farms (Baa Hill Farm (CA4/12)) and low land requirements and severance impacts on high sensitivity farms (Netherset Hey Farm (CA4/8) and

Wrinehill Hall Farm (CA4/20)). Rose Cottage (CA4/3) and Wood Croft (CA4/11) are unlikely to remain as farm holdings due to the high land requirements of the Proposed Scheme.

4.4.38 Although financial compensation will be available, there can be no certainty that this will be used to reduce the above adverse effects by the purchase of replacement land or the construction of replacement buildings. Therefore, the above assessment should be seen as the worst case, which could be reduced if the owner and/or occupier is able, and chooses, to use compensation payments to replace assets.

Other mitigation measures

4.4.39 Soils and their associated seed banks from the ancient woodlands will be stored separately and utilised in species translocation, as discussed in Section 8, Ecology and biodiversity.

4.4.40 Other mitigation will incorporate climate change adaptation and resilience measures, insofar as reasonably practicable. For example, restored soils in areas that could be prone to drought with climate change could potentially be replaced at greater depths than at present to make them resilient to drought.

4.4.41 A farm pack is being provided to all farmers and landowners that sets out baseline conditions on the farm and the assurances and obligations that HS2 Ltd will accept upon entering the land. This will include advice and appropriate assistance where there is a need for the landowner to relocate or re-provide agricultural buildings displaced by the Proposed Scheme.

Summary of likely residual significant effects

4.4.42 During construction, the total area of agricultural land required will be approximately 336ha, of which approximately 140ha is BMV land. This is assessed as a temporary minor adverse residual effect, which is not significant.

4.4.43 Twenty-one holdings will be affected temporarily, of which 12 will experience temporary moderate, major/moderate or major adverse residual effects, which are significant. One holding and the associated farm shop at Baa Hill Farm is at risk of closure due to the construction of the Proposed Scheme.

4.4.44 Once the construction process is complete and land required temporarily has been restored, the residual permanent requirement for agricultural land will be 190ha of which 70ha is BMV land. This is assessed as a permanent minor adverse residual effect, which is not significant.

4.4.45 Nineteen holdings will be affected permanently, of which nine will experience moderate, moderate/major or major permanent effects following construction, which is significant. Two of the smaller holdings are unlikely to remain (Rose Cottage (CA4/3) and Land at Wood Croft (CA4/11)).

Cumulative effects

4.4.46 There are no cumulative effects arising from the construction of the Proposed Scheme as a consequence of other development projects affecting agricultural land in the locality.

4.5 Effects arising from operation

Avoidance and mitigation measures

4.5.1 No measures are required to mitigate the operational effects of the Proposed Scheme on agriculture, forestry and soils.

Assessment of impacts and effects

4.5.2 Potential impacts arising from the operation of the Proposed Scheme will include:

- noise emanating from moving trains; and
- the propensity of operational land to harbour noxious weeds.

4.5.3 Operational airborne sound at the following sensitive livestock receptors have been included in the assessment and the results are presented in Volume 5: Appendix SV-002-004:

- Snape Hall Farm (CA4/6);
- Baa Hill Farm (CA4/12);
- Wrinehill Hall Farm (CA4/20); and
- Wrinehill Mill Farm (CA4/21).

4.5.4 The predicted sound levels have been considered against the criteria defined in the SMR Addendum. Taking into consideration the noise mitigation included within the Proposed Scheme, as shown on Map Series SV-02 (Volume 5: Sound, noise and vibration Map Book), no likely significant effects from noise on livestock are identified.

4.5.5 The propensity of linear transport infrastructure to harbour and spread noxious weeds is a consequence of:

- the management of the highway and railway land; and
- the propensity of the weeds to spread onto such land from adjoining land, which could be exacerbated by the effects of climate change.

4.5.6 The presence of noxious weeds (particularly ragwort) will be controlled using an appropriate management regime that identifies and remedies areas of weed growth that might threaten adjoining agricultural interests.

Other mitigation measures

4.5.7 No other mitigation measures have been identified.

Summary of likely residual significant effects

4.5.8 No residual significant effects on agriculture, forestry and soils have been identified as a result of the operation of the Proposed Scheme.

Cumulative effects

4.5.9 There are no cumulative effects arising from the operation of the Proposed Scheme as a consequence of other development projects affecting agriculture, forestry or soil in the study area.

Monitoring

4.5.10 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

4.5.11 On the basis of there being no significant residual operational effects, there are no area-specific requirements for monitoring agriculture, forestry and soil effects during the operation of the Proposed Scheme in the Whitmore Heath to Madeley area.

5 Air quality

5.1 Introduction

5.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality arising from the construction and operation of the Proposed Scheme within the Whitmore Heath to Madeley area. Oxides of nitrogen (NOx) including nitrogen dioxide (NO2), fine particulate matter (PM10, PM2.5)[39] and dust have been considered in the assessment. Emissions of all or some of these air pollutants are likely to arise from construction activities, demolition, site preparation works, borrow pits and the use of haul routes. Emissions will also arise from road traffic during construction and operation of the Proposed Scheme.

5.1.2 Engagement with Newcastle-under-Lyme Borough Council (NBC) and Stafford County Council (SCC) has been undertaken. The purpose of this engagement has been to obtain relevant baseline information, which includes monitoring data in this area. Detailed reports on the air quality data and assessments for this area, are contained within Volume 5: Appendix AQ-001-004.

5.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book. Air quality mapping is presented in the Volume 5: Air quality Map Book, Map AQ-01-104.

5.1.4 In addition, the traffic data used for the air quality assessment is set out in Background Information and Data (BID)[40], (see BID-AQ-002-000: Traffic data used for the air quality assessment).

5.2 Scope, assumptions and limitations

5.2.1 The scope, assumptions and limitations for the air quality assessment are set out in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[41], the SMR Addendum[42] and Volume 5: Appendix AQ-001-004.

5.2.2 The study areas for the air quality assessment have been determined on the basis of where impacts on local air quality may occur[43]:

- from construction and/or mineral extraction activities (for borrow pits);

[39] PM2.5 and PM10 describe two size fractions of airborne particles that can be inhaled and therefore are of concern for human health. The designations refer to particles of size less than 2.5 and 10 microns in diameter.
[40] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2
[41] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[42] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.
[43] The assessment of construction dust emissions has been undertaken where sensitive receptors are located up to a distance of 350m from dust generating activities. The assessment of mineral dust emissions has been undertaken for sensitive receptors located within a distance of 250m from a borrow pit site. The assessment of traffic emissions has been undertaken where sensitive receptors are located up to a distance of 200m from roads screened in for further assessment.

- from changes in the nature of traffic during construction and operation, for example increases in traffic flows during construction or where road closures or restrictions cause diversions and heavier traffic on adjacent roads; or
- where road alignments have changed.

5.2.3 The assessment has incorporated HS2 Ltd's policies on vehicle emissions[44]. These include the use of Euro VI heavy goods vehicles (HGVs), Euro 4 petrol and Euro 6 diesel cars and light goods vehicles (LGVs) during construction of the Proposed Scheme.

5.2.4 The assessment of construction traffic emissions has used traffic data based on an estimate of the average daily flows at the peak year during the construction period (2020-2026). The assessment assumes vehicle emission rates and background pollutant concentrations from year 2020. This is because both pollutant emissions from vehicle exhausts and background pollutant concentrations are anticipated to reduce year by year as a result of vehicle emission controls, and so the year 2020 represents the worst case for the construction assessment.

5.3 Environmental baseline

Existing baseline

Background air quality

5.3.1 The main sources of air pollution in the Whitmore Heath to Madeley area are emissions from road vehicles and agricultural activities. The main roads within the area are: the M6; the A53 Newcastle Road (which continues as the A53 Whitmore Road); the A525 Bar Hill Road; the A51 London Road; and the A5182 Trentham Road.

5.3.2 There is one industrial installation (regulated by the Environment Agency) with a permit for emissions to air within the area, namely Red Industries Limited, Walleys Quarry Landfill Site. Details of their location are presented in Volume 5: Appendix AQ-001-004. The contribution of all industrial processes and other emission sources to local air quality is included within the background concentrations.

5.3.3 Estimates of background air quality have been obtained from the Department for Environment Food & Rural Affairs (Defra)[45] for the baseline year of 2016. The data are estimated for 1km grid squares for NOx, NO2, PM10 and PM2.5. Background concentrations are within the air quality standards as defined in the SMR and the SMR Addendum, for all pollutants within the Whitmore Heath to Madeley area.

Local monitoring data

5.3.4 There is currently one diffusion tube site located within the Whitmore Heath to Madeley area for monitoring NO2 concentrations. This is located on the A53 Newcastle Road in Madeley. Measured concentrations at this site in 2015[46] were

[44] HS2 Phase 2a Information Paper E14: Air Quality.
[45] Department for Environment, Food and Rural Affairs (Defra) (2013) Defra Background Pollutant Concentration Maps; http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013
[46] At the time of assessment, measurements for 2015 were the latest published annual monitoring data.

within the air quality standard. Details of the location and data measurements are presented in Volume 5: Map AQ-01-104 and Appendix AQ-001-004.

Air quality management areas

5.3.5 There is one air quality management area (AQMA) within the Whitmore Heath to Madeley area that has been declared for exceedances of the annual mean NO2 standard. The AQMA consists of a single dwelling and extends from the southbound carriageway of the M6, to the A525 Bar Hill Road/Newcastle Road.

Receptors

5.3.6 Several locations have been identified in the area as sensitive receptors, which are considered to be susceptible to changes in air quality due to their proximity to dust-generating activities or traffic routes during construction or operation of the Proposed Scheme. Details of their location are presented in Volume 5: Map AQ-01-104 and Appendix AQ-001-004.

5.3.7 Most of the receptors located close to the route of the Proposed Scheme are residential. Other receptors include Baldwin's Gate CE Primary School, Sir John Offley CE Primary School and Moss Lane Surgery.

5.3.8 There are no statutory designated ecological sites identified close to the Proposed Scheme. Non-statutory sensitive ecological sites, identified close to the Proposed Scheme, include Barhill Wood and the local wildlife sites and ancient woodlands of both Whitmore Wood and Hey Sprink. The ancient woodlands at Grafton's Wood, Wrinehill Wood and The Lum have been scoped out of the assessment based on their distance from construction activities. Further details of the ecological receptors are set out in Section 8, Ecology and biodiversity.

Future baseline

5.3.9 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to be implemented by 2020.The potential cumulative impact from committed developments on air quality in conjunction with the effects from the construction and operation of the Proposed Scheme have been considered as part of this assessment. This has been achieved by including changes in traffic predicted as a result of the committed developments within the traffic data used for the air quality assessments for construction and operation. The future air quality baselines are defined as the 'without the Proposed Scheme' scenarios at each stage.

Construction (2020)

5.3.10 Future background pollutant concentrations have been sourced from the Defra background maps for the first year of construction in 2020[47], which predict NO2, PM10 and PM2.5 levels in 2020 to be lower than in the 2016 baseline and within the relevant air quality standards.

[47] Department for Environment, Food and Rural Affairs (Defra) (2013) Defra Background Pollutant Concentration Maps; Available online at:http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2020

5.3.11 Committed developments that have been included as future receptors in the assessment of air quality impacts during construction of the Proposed Scheme are identified in in Volume 5: AQ-001-004. No additional committed developments have been identified in this area that will materially alter the baseline conditions in 2020 for air quality.

Operation (2027)

5.3.12 Future background pollutant concentrations have been sourced from the Defra background maps for 2027[48], which predict NO2, PM10 and PM2.5 levels in 2027 to be lower than in the 2016 baseline and within the relevant air quality standards.

5.3.13 Committed developments that have been included as future receptors in the assessment of air quality impacts during operation of the Proposed Scheme are identified in Volume 5: AQ-001-004. No additional committed developments have been identified in this area that will materially alter the baseline conditions in 2027 for air quality.

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 Emissions to the atmosphere will be controlled and managed during construction through the route-wide implementation of the Code of Construction Practice[49](CoCP). The draft CoCP includes a range of mitigation measures that are accepted by the Institute of Air Quality Management (IAQM) as being suitable to reduce impacts to as low a level as is reasonably practicable. These measures are generally sufficient to avoid any significant effects from dust during construction.

5.4.2 The assessment has assumed that the general measures detailed in Section 7 of the draft CoCP will be implemented. These include:

- contractors being required to manage dust, air pollution, odour and exhaust emissions during construction works;
- inspection and visual monitoring, undertaken in consultation with the local authorities, to assess the effectiveness of the measures taken to control dust and air pollutant emissions;
- cleaning (including watering) of vehicle routes and designated vehicle waiting areas to suppress dust;
- the use of water spray systems on demolition sites to dampen down fugitive dust;
- keeping soil stockpiles away from sensitive receptors where reasonably practicable, also taking into account the prevailing wind direction relative to sensitive receptors;

[48] Department for Environment, Food and Rural Affairs (Defra) (2013) Defra Background Pollutant Concentration Maps 2027; Available online at: http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013
[49] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

- the use of enclosures to contain dust emitted from construction activities; and
- soil spreading, seeding and planting of completed earthworks as soon as reasonably practicable following completion of earthworks.

5.4.3 The draft CoCP includes the requirement for site-specific traffic management measures, such as the use of site haul routes for construction vehicles to minimise the need to use public roads.

5.4.4 The use of borrow pits is intended to reduce the need for longer distance transport and import of materials, therefore reducing the volume and impact of road traffic on local roads and communities.

Assessment of impacts and effects

Temporary effects

5.4.5 Impacts from construction of the Proposed Scheme could arise from dust-generating activities and emissions from construction traffic. As such, the assessment of construction impacts has been undertaken for dust and exposure to NO2, PM10 and PM2.5 concentrations.

Construction dust effects

5.4.6 Construction activities, such as demolition of existing buildings, earthworks, construction of new structures and trackout[50], have been assessed for their risk of having an effect on dust soiling, human health[51] and ecological sites. There are residential and ecological receptors located within 350m of these activities in the Whitmore Heath to Madeley area.

5.4.7 It has been identified that there would be a negligible to low risk of dust effects and a negligible risk of human health effects from demolition activities. For earthworks, there would be a low to medium risk of dust effects and a low risk of human health effects. For construction, there would be a low to medium risk of dust effects and a low risk of human health effects. For trackout, there would be a low to high risk of dust effects and a low risk of human health effects.

5.4.8 There would be a negligible to low risk of ecological effects from all dust generating activities.

5.4.9 With the application of the mitigation measures contained in the draft CoCP, no significant effects are anticipated from these risks associated with the dust generating activities. The basis for this conclusion can be found in Volume 5: Appendix AQ-001-004, where the scale of dust emissions and the sensitivity of the area and receptors are fully described.

Mineral dust effects

5.4.10 The operation of borrow pits during the construction of the Proposed Scheme has been assessed for the potential of effects on dust soiling, human health and ecological

[50] Trackout refers to the transport of dust and dirt from the construction site(s) onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.
[51] Human health effects relate mainly to short-term exposure to particles of size between 2.5µm to 10µm, measured as PM10.

sites in the surrounding area. There will be one borrow pit in operation in the Whitmore Heath to Madeley area, in the land adjacent to the West Coast Main Line (WCML) and River Lea, located entirely within agricultural land associated with Netherset Hey Farm. The borrow pit will be excavated for sands and gravels, which are classified as soft rock in the assessment. There are residential and ecological receptors within 250m of the borrow pit.

5.4.11 Assessment of the borrow pit activities has indicated that, in the absence of mitigation, there would be moderate adverse impacts of 'disamenity'[52] dust at Netherset House and slight adverse impacts at Hey House, Netherset Hey and Netherset Industrial Estate. Hey Sprink would also experience negligible impacts from the borrow pit activities. Impacts to human health from borrow pit activities are not anticipated to be significant due to the low existing PM10 background concentrations in the area.

5.4.12 With the application of the mitigation measures contained in the draft CoCP, no significant effects are anticipated from the potential impacts arising from the operation of the borrow pit in this area. The basis for this conclusion can be found in Volume 5: Appendix AQ-001-004.

Construction traffic effects

5.4.13 Construction activity could also have the potential to affect local air quality through the additional traffic generated on local roads as a result of construction vehicles and through changes to traffic patterns arising from temporary road diversions and realignments.

5.4.14 The assessment of construction traffic emissions has been undertaken for a 'without the Proposed Scheme' scenario and a 'with the Proposed Scheme' scenario. The traffic data for each scenario includes the additional traffic from future committed developments.

5.4.15 Construction traffic data in the study area has been screened to identify roads that required further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in the construction period. These were primarily the main roads within the Whitmore Heath to Madeley area, including the M6, the A51 London Road; the A5182 Trentham Road, the A525 Bar Hill Road; and the A53 Newcastle Road.

5.4.16 No significant effects are predicted at any sensitive receptors during construction of the Proposed Scheme. Concentrations of NO2, PM10 and PM2.5 are within the relevant air quality standards both with and without the Proposed Scheme.

5.4.17 No significant effects are anticipated at any of the ecological receptors in the area.

Permanent effects

5.4.18 No permanent effects on local air quality are likely to arise during construction of the Proposed Scheme.

[52] 'Disamenity' dust refers to coarse dust particles arising from the operational of a borrow pit that can reduce amenity in the local community due to visible dust plumes and dust soiling.

Other mitigation measures

5.4.19 No other mitigation measures in relation to air quality are considered necessary during construction of the Proposed Scheme in the Whitmore Heath to Madeley area.

Summary of likely residual significant effects

5.4.20 No significant residual effects are anticipated for air quality in this area during construction of the Proposed Scheme.

Cumulative effects

5.4.21 The data used for the air quality assessment takes account of predicted changes in traffic as a result of committed developments in the area. It is assumed that dust emissions from construction of other developments in the area would be controlled by appropriate measures as set out within their respective environmental management controls and therefore no cumulative effects for air quality would be anticipated.

5.5 Effects arising from operation

Avoidance and mitigation measures

5.5.1 No specific mitigation measures for air quality are proposed during operation of the Proposed Scheme.

Assessment of impacts and effects

5.5.2 Impacts from the operation of the Proposed Scheme could arise from vehicle emissions and relate to changes in the volume, composition and distribution of road traffic and changes in road alignment. There will be no direct atmospheric emissions from the operation of the Proposed Scheme trains that will cause an impact on air quality and therefore no assessment is required. Indirect emissions from sources such as rail and brake wear have been assumed to be negligible.

5.5.3 The assessment of operational traffic emissions has been undertaken for two scenarios in the operation year 2027; a 'without the Proposed Scheme' scenario and a 'with the Proposed Scheme' scenario. The traffic data for each scenario includes the additional traffic from future committed developments.

5.5.4 Traffic data in the Whitmore Heath to Madeley area has been screened to identify roads that required further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2027. These were the proposed re-aligned or diverted roads within the Whitmore Heath of Madeley area, namely the A53 Newcastle Road, Manor Road and the A525 Bar Hill Road.

5.5.5 No significant effects are predicted at any sensitive receptor in the operation year. Concentrations of NO_2, PM_{10} and $PM_{2.5}$ are predicted to be within the relevant air quality standards both with and without the Proposed Scheme.

5.5.6 No significant effects are anticipated at any of the ecological receptors in the area.

Other mitigation measures

5.5.7 No other mitigation measures are proposed in relation to air quality in this area during operation of the Proposed Scheme.

Summary of likely residual significant effects

5.5.8 No significant residual effects are anticipated for air quality in this area during operation of the Proposed Scheme.

Cumulative effects

5.5.9 The data used for the air quality assessment take account of predicted changes in traffic as a result of committed developments in the area, and therefore, their impacts have been included within the assessment.

Monitoring

5.5.10 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

5.5.11 On the basis of there being no significant residual operational effects, there are no area specific requirements for monitoring air quality effects during the operation of the Proposed Scheme in the Whitmore Heath to Madeley area.

6 Community

6.1 Introduction

6.1.1 This section of the report describes the impacts and likely significant effects on local communities resulting from the construction and operation of the Proposed Scheme within the Whitmore Heath to Madeley area.

6.1.2 Further details of the community assessments undertaken within the Whitmore Heath to Madeley area are contained in Volume 5: Appendix CM-001-004.

6.1.3 Community assessment maps are provided in the Map Series CM-01 in Volume 5: Community Map Book. Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

6.2 Scope, assumptions and limitations

6.2.1 The assessment scope, key assumptions and limitations for the community assessment are set out in Volume 1 (Section 8) and the Scope and Methodology Report (SMR)[53] and SMR Addendum[54].

6.2.2 The study area includes the areas of land required both temporarily and permanently for the Proposed Scheme. It also includes a wider corridor within which receptors or resources could be affected by a combination of significant residual effects drawing from the findings of other technical disciplines: noise, vibration, air quality, traffic (in relation to heavy goods vehicle (HGV[55])) and visual intrusion. In addition, the study area has regard to the proposed routes of construction traffic and takes account of catchment areas for community facilities that could be affected where intersected by the Proposed Scheme. Overall, the study area is taken as the area of land that encompasses the likely significant effects of the Proposed Scheme.

6.3 Environmental baseline

Existing baseline

6.3.1 The Whitmore Heath to Madeley area covers approximately 9.1km of the Proposed Scheme passing through the parishes of Whitmore, Baldwin's Gate and Madeley, within the Newcastle-under-Lyme Borough Council (NBC) and Staffordshire County Council (SCC) areas. The boundary between Swynnerton Parish and Whitmore Parish forms the southern boundary of this area. The boundary between Madeley Parish and Checkley cum Wrinehill Parish forms the northern boundary of this area.

6.3.2 The area is predominantly rural, made up of a few small settlements with limited community facilities. In general, the majority of community facilities, such as GP surgeries, schools and community meeting places, lie within the village centres, with

[53] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[54] Volume 2: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.
[55] HGV effects are increases in HGV construction traffic flows identified as significant by the Traffic and Transport topic. They contribute to in-combination effects on sensitive community resources which are located adjacent to a designated construction traffic route which experiences a significant increase in HGV traffic flows or a site haul route which experiences a significant number of HGV movements.

the majority of these facilities found in Baldwin's Gate, Whitmore and Madeley. The area is characterised by small clusters of dwellings and individual dwellings within rural areas close to the Proposed Scheme.

Settlements

6.3.3 Whitmore is a village located off the A53 Whitmore Road with approximately 38 residential properties. The village provides a small number of community facilities, including a church and village hall. Whitmore Heath is an adjacent community to the west with approximately 56 residential properties.

6.3.4 Madeley Park Wood is a village located along Manor Road to the west of Whitmore Wood, with approximately 145 residential properties. Further north along Manor Road, between the Stoke to Market Drayton Railway and the A525 Bar Hill Road, there are a number of sparsely located residential properties.

6.3.5 Madeley is a village located along the A525 Bar Hill Road with approximately 1,595 residential properties. The village provides a number of community facilities, including three schools, a church, a community centre, post office and a number of convenience stores.

Recreation facilities

6.3.6 Unreal Paintball is a paintball facility operating from Manor Farm on Manor Road to the south of Madeley. The facility operates on six purpose built paintball playing areas, plus a large area of woodland. The facility offers a membership scheme and runs regular tournaments, training and events. The site is available for corporate events and parties, and offers activities suitable for both juniors and adults.

Open space and public rights of way

6.3.7 Madeley Cemetery is located on Manor Road to the south of Madeley. On site facilities include car parking, an information board and seating.

6.3.8 The Newcastle Way is a long distance footpath that extends approximately 40km from Mow Cop in Cheshire to Market Drayton in Shropshire. The footpath passes through Kidsgrove Bank, Red Street, Black Bank, Madeley, Black Brook and Loggerheads. Within the Whitmore Heath to Madeley area, the Newcastle Way passes to the east of Baldwin's Gate, along Madeley Footpath 15, along Manor Road and along Madeley Footpath 33 to the south of Madeley village.

Future baseline

Construction (2020)

6.3.9 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

6.3.10 The following committed development has been identified in this area that will materially alter the baseline conditions in 2020 for community resources, as set out in Table 12.

Table 12: Committed developments relevant to community

Map book Reference[56]	Planning reference	Description
CA4/7	15/00281/FUL	Erection of a detached dwelling and formation of new accesses at Plot 37 on Birch Tree Lane, Whitmore Heath

6.3.11 This committed development forms part of the future baseline for the assessment of community effects during construction of the Proposed Scheme.

Operation (2027)

6.3.12 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

6.3.13 No additional committed developments have been identified in this area that will materially alter the baseline conditions in 2027 for community resources.

6.4 Effects arising during construction

Avoidance and mitigation measures

6.4.1 The following measures have been incorporated into the Proposed Scheme design as part of the design development process to avoid or minimise, insofar as reasonably practicable, the environmental impacts during construction:

- the realignment of the A525 Bar Hill Road has been designed to minimise the number of residential property demolitions; and
- the area of land required for the construction of Madeley cutting and Madeley tunnel porous portals has been limited to reduce effects on nearby residential properties.

6.4.2 The draft Code of Construction Practice[57] (CoCP) includes a range of provisions that will help mitigate community effects associated with construction within this area, including:

- implementation of a community engagement framework to provide appropriate information and resolve community issues (Section 5);
- sensitive layout of construction sites to reduce nuisance as far as possible (Section 5);
- maintenance of public rights of way (PRoW) during construction where reasonably practicable (Section 14);
- monitoring and management of flood risk and other extreme weather events, where reasonably practicable, that may affect community resources during construction (Section 16); and

[56]Volume 5 Map Book: Maps CT-13-113b to CT-13-115a-R1.
[57] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

- specific measures in relation to air quality and noise and the avoidance of HGVs operating adjacent to schools during drop off and pick up periods (Section 7, 13 and 14).

Assessment of impacts and effects

Temporary effects

Residential properties

6.4.3 It will be necessary to carry out minor utility works or minor highways works associated with the construction of the Proposed Scheme within land which falls within the boundaries of some residential properties. The scale of impact will be small, and the duration will be short (up to three months), resulting in minor adverse effects, which are not significant. A full description of the affected properties is included within Volume 5: Appendix CM-001-004.

6.4.4 Works adjacent to The Hill residential property on the A53 Newcastle Road will include the raising of the A53 Newcastle Road on embankment, creation of a new access to the property, creation of mitigation planting areas and a low voltage utility connection. These works will temporarily require part of the outside space at The Hill for up to one year. The temporary loss of this small area of land will not impact on the ability of the residents to use their property and access will be maintained to the property throughout the construction works. This will result in a minor adverse effect, which is not significant.

6.4.5 Works to the A53 Newcastle Road, including the reinstatement of the existing road and creation of the temporary diversion, will temporarily require part of the driveway of two residential properties on the A53 Newcastle Road, Whitmore (Coney Greave and Old Rectory) for up to one year. The temporary loss of this small area of land will not impact on the ability of the residents to use their properties and access will be maintained to the properties throughout the construction works. This will result in a minor adverse effect, which is not significant.

6.4.6 Works to the A53 Newcastle Road, including the reinstatement of the existing road and creation of a temporary site haul route, will temporarily require a small area of outside space at Whitmore Lea residential property on the A53 Newcastle Road, Whitmore for up to three years and six months. The temporary loss of this small area of land will not impact on the ability of the residents to use their property and access will be maintained to the property throughout the construction works. This will result in a minor adverse effect, which is not significant.

6.4.7 A group of residential properties in Whitmore and Whitmore Heath (including a proposed dwelling under planning permission 15/00281/FUL) will be in proximity to the construction of the Proposed Scheme. The works will include the use of the A53 Newcastle Road and Snape Hall Road as construction traffic routes, construction of Whitmore Heath tunnel and portals, and associated activities including the temporary diversion of the A53 Newcastle Road. These works will result in significant noise effects during the daytime on 29 residential properties due to construction works and construction traffic. Residents of all 29 residential properties will experience significant adverse visual effects due to views of the construction works. The significant noise and visual effects will result in an in-combination effect on the

amenity of residents at these 29 properties for up to five years and seven months in total. This will result in a major adverse effect, which is significant.

6.4.8 A group of residential properties on Manor Road in Madeley Park Wood and Madeley will be in proximity to the construction of the Proposed Scheme. The works will include the construction of the cutting through Whitmore Wood, the River Lea viaduct, Lea South embankment and the realignment of Manor Road. These works will result in significant noise effects during the daytime for 20 properties due to construction traffic noise. Residents of all 20 properties will experience significant adverse visual effects due to views of the construction works. The significant noise and visual effects will result in an in-combination effect on the amenity of residents at these properties for up to five months in total. This will result in a major adverse effect, which is significant.

6.4.9 The minor modifications to the West Coast Main Line (WCML) infrastructure and utility diversions associated with the Proposed Scheme will temporarily require part of the driveway of Hey House, Manor Road for approximately six months. The temporary loss of this small area of land will not impact on the ability of the residents to use their property and access will be maintained to the property throughout the construction works. This will result in a minor adverse effect, which is not significant.

6.4.10 The widening of Madeley Bridleway 1 (Red Lane) will temporarily require part of the driveway of Fairmont residential property on the A525 Bar Hill Road, Madeley for up to six months. The temporary loss of this small area of land will not impact on the ability of the residents to use their property and access will be maintained to the property throughout the construction works. This will result in a minor adverse effect, which is not significant.

6.4.11 A group of residential properties located on the A525 Bar Hill Road and Mallard Close to the west of Madeley will be in proximity to the construction of the Proposed Scheme. The works will include the construction of Madeley cutting, Madeley tunnel, the realignment of the A525 Bar Hill Road and the A525 Bar Hill overbridge. Approximately 43 residential properties will experience significant adverse visual effects due to views of the construction works. In addition, the use of the A525 Bar Hill Road as a construction traffic route will result in a significant increase in HGVs passing all of the properties on the A525 Bar Hill Road. There will be significant noise effects on 42 of the properties during the daytime due to construction works and construction traffic, and nine of these properties will also experience significant noise effects during the night-time due to tunnelling activity. The significant visual and HGV effects on all 43 properties, and noise effects on 42 of the properties, will result in an in-combination effect on the amenity of residents at these properties for up to two years and six months in total. This will result in a major adverse effect, which is significant.

6.4.12 A group of approximately five properties at Moor Hall Farm and Bower End Farm on the A525 Bar Hill Road in Madeley will be in proximity to the construction of the Proposed Scheme. The works will include the construction of Madeley tunnel, upgrade and widening of Bower End Lane and the realignment of the A525 Bar Hill Road. These works will result in significant noise effects on all five of the properties due to construction works including tunnelling, and construction traffic. All of the properties will experience significant adverse visual effects due to views of the

construction works. In addition, the presence of site haul routes will result in a significant increase in HGVs passing all of the properties. The significant noise, visual and HGV effects will result in an in-combination effect on the amenity of residents at these properties for up to two years and seven months in total. This will result in a major adverse effect, which is significant.

Community facilities

6.4.13 No temporary effects on community facilities are anticipated in the Whitmore Heath to Madeley area.

Recreational facilities

6.4.14 No temporary effects on recreational facilities are anticipated in the Whitmore Heath to Madeley area.

Open space and public rights of way

6.4.15 The construction works in the vicinity of Madeley Cemetery will include the construction of the Proposed Scheme over Manor Road and realignment of Manor Road. These works will result in significant noise effects during the daytime on the cemetery due to construction works and construction traffic. Visitors to the cemetery will experience significant adverse visual effects due to views of the construction works. In addition, the use of Manor Road as a construction traffic route will result in a significant increase in HGVs passing the cemetery. The significant noise, visual and HGV effects will result in an in-combination effect on amenity for visitors to the cemetery for up to one year in total. This will result in a major adverse effect, which is significant.

Permanent effects

Residential properties

6.4.16 The widening of Snape Hall Road will permanently require a small area of outside space at four properties in Whitmore Heath (White House on Heath Road, and Rose Cottage, Heath House and Foxdene on Snape Hall Road). The permanent loss of these small areas of outside space will not impact on the ability of the residents to use their properties and access will be maintained. This will result in a minor adverse effect, which is not significant.

6.4.17 The realignment of Manor Road will permanently require a small area of outside space at Manor Farm Cottage, Manor Road. The permanent loss of this small area of outside space will not impact on the ability of the residents to use their property and access will be maintained. This will result in a minor adverse effect, which is not significant.

6.4.18 The construction of Lea North embankment will require the demolition of one residential property, Hey House Lodge, on Manor Road, Madeley. This residential property will be permanently lost.

6.4.19 The construction of Madeley cutting will require the demolition of two residential properties on Bower End Lane (property numbers 82 and 84 Barhill Cottages). These residential properties will be permanently lost.

6.4.20 The construction of a turning circle on the A525 Bar Hill Road will permanently require a small area of outside space and part of the driveway at one residential property on the A525 Bar Hill Road, Madeley (property number 56). The loss of this small area of outside space will not impact on the ability of the residents to use their property and access will be maintained. This will result in a minor adverse effect, which is not significant.

6.4.21 The upgrade and widening of Bower End Lane to form a HS2 maintenance and emergency access route will permanently require a small area of outside space at the four properties at Moor Hall Farm off the A525 Bar Hill Road, Madeley (Moor Hall Farm, The Paddocks, The Old Barn and Swallow Barn). The loss of these small areas of outside space will not impact on the ability of the residents to use their properties and access will be maintained. This will result in a minor adverse effect, which is not significant.

Community facilities

6.4.22 No permanent effects on community facilities are anticipated in the Whitmore Heath to Madeley area.

Recreational facilities

6.4.23 The construction of Manor Road overbridge will permanently require an area of the land associated with Manor Farm, which is understood to be used for paintballing activities operated by Unreal Paintball. The nature of this use means it is likely that this particular activity could be undertaken elsewhere on site and so it is unlikely that the facility will be affected to such an extent as to require its relocation. This will result in a negligible adverse effect, which is not significant.

Open space and public rights of way

6.4.24 The Newcastle Way is a promoted PRoW, which currently runs along Manor Road to the south of Madeley. The footpath will be permanently diverted to follow the realigned Manor Road, which will cross the route of the Proposed Scheme on the Manor Road overbridge. This will result in a negligible adverse effect, which is not significant.

Other mitigation measures

6.4.25 No other mitigation measures are proposed.

Summary of likely residual significant effects

6.4.26 The construction of the Proposed Scheme will result in significant temporary in-combination effects on the following resources:

- twenty-nine properties in Whitmore and Whitmore Heath due to the combination of noise and visual effects;
- twenty properties on Manor Road due to the combination of noise and visual effects;

- forty-three properties located on the A525 Bar Hill Road and Mallard Close due to the combination of visual and HGV effects, 42 of these properties will also experience noise effects, in addition to the visual and HGV effects;
- five properties at Moor Hall Farm and Bower End Farm due to the combination of noise, visual and HGV effects; and
- Madeley Cemetery due to the combination of significant noise, visual and HGV effects.

Cumulative effects

6.4.27 No cumulative effects on community resources have been identified in the Whitmore Heath and Madeley area.

6.5 Effects arising from operation

Avoidance and mitigation measures

6.5.1 The following measures have been incorporated into the scheme design as part of the design development process to avoid or minimise, insofar as reasonably practicable, the environmental impacts during operation:

- provision of a noise fence barrier on the River Lea viaduct, which will reduce noise impacts on residential properties on Manor Road, Madeley; and
- provision of a noise fence barrier within the Madeley cutting, which will reduce noise impacts on properties on the A525 Bar Hill Road, Madeley.

Assessment of impacts and effects

Residential properties

6.5.2 A group of residential properties on Snape Hall Road in Whitmore Heath (including a proposed dwelling under planning permission 15/00281/FUL) will be in proximity to the Proposed Scheme. The operation of the Proposed Scheme will result in significant noise effects during the daytime and night-time on the properties due to the running of trains. All seven of the properties will experience significant adverse visual effects due to views of the Proposed Scheme as it emerges in cutting from the northern porous portal of the Whitmore Heath tunnel and runs across the eastern valley side through Whitmore Wood. The significant noise and visual effects will result in an in-combination effect on the amenity of residents at these properties. This will result in a major adverse effect, which is significant.

6.5.3 A group of residential properties on the A525 Bar Hill Road and Red Lane in Madeley will be in proximity to the Proposed Scheme. The operation of the Proposed Scheme will result in significant noise effects during the daytime and night-time on approximately 14 residential properties due to trains running. All of the properties will experience significant adverse visual effects due to views of Madeley cutting, the Madeley tunnel and southern porous portal, the A525 Bar Hill overbridge, the Madeley Bridleway 1 accommodation green overbridge and the Manor Road overbridge. The significant noise and visual effects will result in an in-combination effect on the

amenity of residents at these properties. This will result in a major adverse effect, which is significant.

Community facilities

6.5.4 No operational effects on community facilities are anticipated in the Whitmore Heath to Madeley area.

Recreational facilities

6.5.5 No operational effects on recreational facilities are anticipated in the Whitmore Heath to Madeley area.

Open space and public rights of way

6.5.6 Madeley Cemetery will be in proximity to the Proposed Scheme. The operation of the Proposed Scheme will result in significant noise effects during the daytime on the cemetery due to trains running. Visitors to the cemetery will experience significant adverse visual effects due to views of Lea North embankment, Manor Road overbridge road embankment, and overhead line equipment. The significant noise and visual effects will result in an in-combination effect on amenity for visitors to the cemetery. This will result in a major adverse effect, which is significant.

Other mitigation measures

6.5.7 No other mitigation measures are proposed.

Summary of likely residual significant effects

6.5.8 The operation of the Proposed Scheme will result in significant permanent in-combination effects on the following resources:

- seven properties on Snape Hall Road in Whitmore Heath due to the combination of noise and visual effects;
- fourteen properties on the A525 Bar Hill Road and Red Lane in Madeley due to the combination of noise and visual effects; and
- Madeley Cemetery due to the combination of noise and visual effects.

Cumulative effects

6.5.9 No cumulative effects on community resources have been identified in the Whitmore Heath and Madeley area.

Monitoring

6.5.10 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

6.5.11 There are no area-specific community monitoring requirements during operation of the Proposed Scheme. Any area-specific operational monitoring requirements in relation to air quality effects, noise and vibration effects, traffic effects and visual effects that have contributed to the in-combination assessments, are described in the relevant topic chapters.

7 Cultural heritage

7.1 Introduction

7.1.1 This section of the report provides a description of the current baseline for heritage assets and the likely impacts and significant effects resulting from the construction and operation of the Proposed Scheme within the Whitmore Heath to Madeley area. Consideration is given to the extent and value (significance) of heritage assets including archaeological and palaeoenvironmental remains, historic buildings, the built environment and historic landscape.

7.1.2 Engagement has been undertaken with Historic England and Staffordshire County Council (SCC). The purpose of this engagement has been to understand the nature of heritage assets within the area, to obtain relevant baseline information and to inform the design development and assessment of the Proposed Scheme.

7.1.3 Throughout this section, heritage assets within the study areas are identified with a unique reference code (for example, WHM001). Further detail on these heritage assets can be found in the gazetteer in Volume 5: Appendix CH-002-004. Detailed reports on cultural heritage baseline and historic landscape character within the Whitmore Heath to Madeley area are contained in the Volume 5 Appendices. These are:

- Appendix CH-001-004 – Cultural heritage baseline report;
- Appendix CH-002-004 – Gazetteer of heritage assets; and
- Appendix CH-003-004 – Cultural heritage impact assessment table.

7.1.4 In addition there are two route-wide cultural heritage appendices:

- Appendix CH-005-000 – Historic landscape character report; and
- Appendix CH-006-000 – Geoarchaeological desk study report.

7.1.5 Maps showing the location of all designated and non-designated heritage assets can be found in Volume 5: Cultural heritage Map Book.

7.1.6 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

7.1.7 In addition, survey reports for the Whitmore Heath to Madeley area, incorporating geophysical survey and remote sensing studies, are available in Background Information and Data (BID)[58], (BID-CH-004-004: Cultural heritage survey reports).

[58] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2

7.2 Scope, assumptions and limitations

7.2.1 The scope, key assumptions and limitations for the cultural heritage assessment are set out in full in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[59], and the SMR Addendum[60].

7.2.2 The assessment focuses on the extent to which the Proposed Scheme will affect designated and non-designated heritage assets. Impacts on assets as a result of the Proposed Scheme will occur largely through the physical removal and alteration of heritage assets and changes to their setting.

7.2.3 The study area within which a detailed assessment of all assets, designated and non-designated, has been carried out is defined as the land required for the Proposed Scheme plus 500m. This is referred to in the remainder of this assessment as the 500m study area.

7.2.4 The setting of all designated heritage assets within the zone of theoretical visibility (ZTV) up to 2km from the land required for the Proposed Scheme has been considered. This is referred to in the remainder of this report as the 2km study area.

7.2.5 Impacts on the setting of heritage assets within the ZTV beyond 2km have been considered where professional judgement indicates that a significant effect may occur. No such impacts have been identified within the Whitmore Heath to Madeley area.

7.2.6 The cultural heritage methodology includes the consideration of the intra-project effects of a number of topic assessments, for example, landscape and visual, ecology and biodiversity, and water resources and flood risk. Consequently, these interactions have been included in the assessment of impacts and effects.

7.2.7 Where noise is considered, this is within the context of the contribution that this makes to the heritage significance of the assets, and is not a reference to absolute noise levels or sound, or the noise or vibration impacts on the health and quality of life of people who live in or visit the area. Where measurements identified in the sound noise and vibration studies[61] indicate a significant effect, this has triggered an assessment of the contribution that tranquillity makes to the significance of the heritage asset.

7.2.8 The baseline studies informing this assessment have been drawn from a wide and comprehensive range of information sources. These have been supported by a programme of non-intrusive survey, including extensive geophysical survey.

7.2.9 Heritage assets within the land required to construct the Proposed Scheme are assumed to require complete removal and the assessment has been undertaken on that basis. With respect to overhead line diversions/realignments in particular, it is likely that the majority of the heritage assets can in fact be retained, as the land is only required to allow for raising or lowering of pylons and/or re-stringing of cables, or to provide an access route to the works.

[59] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[60] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.
[61] Volume 5: Appendix SV-002-004: CA4 Whitmore Heath to Madeley. Sound, noise and vibration report, Tables 15 and 16.

7.2.10 Common features of the historic landscape such as marl pits, field boundaries and former areas of ridge and furrow are not individually considered and have not been included in the baseline, and impacts on them are not assessed individually. However, they are considered to contribute to the historic landscape character of the area and are considered within the overall assessment of impacts on historic landscape.

7.2.11 In undertaking the assessment, the following limitations were identified:

- although the LiDAR[62] data examined covers the majority of the 500m study area, there were some areas for which data was unavailable[63]; and
- not all areas within the 500m study area were available for field survey (due to limited land access and site conditions) such as site reconnaissance visits and geophysical survey[64].

7.2.12 Limitations in the LiDAR data were not considered to be of a scale or significance that would have any impact on the robustness of the assessment.

7.2.13 Where survey data are limited, a precautionary baseline has been built up according to the guidance reported in the SMR and the SMR Addendum.

7.3 Environmental baseline

Existing baseline

7.3.1 Documentary baseline data was collated from a variety of sources in compiling this assessment, as set out in Volume 5: Appendix CH-001-004, including:

- Staffordshire Historic Environment Record (HER)[65];
- Staffordshire Record Office collections;
- material held at the William Salt Library, Stafford;
- historic Ordnance Survey mapping; and
- other published sources (full references are provided in Volume 5: Appendix CH-001-004).

7.3.2 In addition to collating this baseline data, the following surveys were undertaken, as set out in the Background Information and Data document (BID-CH-004-004: Cultural heritage survey reports):

- non-intrusive geophysical surveys;
- targeted fieldwalking surveys;
- detailed and systematic transcription of remote sensing data including LiDAR and aerial photographs;

[62] Light detection and ranging (LiDAR) is a high resolution remote sensing technique to capture 3D data.
[63] For details see the Remote Sensing Survey Report in the Background Information and Data document, BID-CH-004-004.
[64] For details see the Geophysical Survey Report in the Background Information and Data document, BID-CH-004-004.
[65] Staffordshire Historic Environment Record. Available online at: https://www.staffordshire.gov.uk/environment/eLand/planners-developers/HistoricEnvironment/Historic-Environment-Record/HistoricEnvironmentRecord.aspx

- walkover and site reconnaissance of sites and buildings of potential heritage significance; and
- setting assessments of all accessible designated heritage sites within 2km of the land required for the Proposed Scheme.

Designated assets

7.3.3 The following designated heritage assets are located partially or wholly within the land required for the Proposed Scheme (see Volume 5: Cultural heritage Map Book: Maps CH-02-206b and CH-02-207a):

- a triangular cast-iron milepost on the A525 Bar Hill Road, Madeley, of probable mid to late 19th century date (WHM049);
- a milepost, which is grade II listed, on the A53 Newcastle Road at Baldwin's Gate, Whitmore (WHM015); and
- Whitmore Conservation Area (WHM019).

7.3.4 The following designated heritage assets are located partially or wholly within the 2km study area (see Volume 5: Cultural heritage Map Book: Maps CH-2002-206b to and CH-02-207a):

- four scheduled monuments: Old Madeley Manor (WHM035); the multivallate[66] hillfort at Berth Hill (WHM017); a medieval moated site[67] and associated fishpond at Sillenhurst (WHM106); and a Bronze Age bowl barrow[68] near Pipe Gate (WHM107);
- three Grade I listed buildings: Whitmore Hall (WHM020); Whitmore Hall Lodge (both part of Whitmore Conservation Area (WHM019)); and Church of All Saints and the Old Hall Madeley (part of Madeley Conservation Area (WHM056));
- four Grade II* listed buildings: Whitmore Hall, old Stable block (part of a group at Whitmore Hall (WHM020)); St Mary and All Saints Church, Whitmore (part of Whitmore Conservation Area (WHM019)); Lea Head Manor (WHM081); and the Old Hall, Madeley (WHM057);
- sixty seven Grade II listed buildings, predominantly within the settlements at Whitmore (WHM019) and Madeley (WHM056);
- individual Grade II listed buildings lying outside settlements including:
  - Snape Hall Farm (WHM023), a mid-17th century stone farmhouse situated at the base of the slope to the north-east on which Whitmore Wood and Whitmore Heath are located. To the west lie numerous farm buildings;
  - Hey House (WHM034), a large early 18th century house, extended in the early 19th century. Its setting has been altered as a result of the construction of the

[66] Double banked defended enclosure.
[67] A platform, generally square, surrounded by a ditch marking the former site of a medieval manorial/high status residence.
[68] A prehistoric burial mound.

West Coast Main Line (WCML) 100m to the east, and features associated with its current use as a boarding kennel and cattery to the south. On the western and northern sides, its relationship with the surrounding garden and landscape survive largely unaltered;

- Offley Well Head (WHM048), a stone well head on a platform with multiple spouts and decorative carving erected as an amenity for the adjacent allotments in 1850. It is currently out of use and in poor condition; and
- Bridge Cottage (Ye Olde House), Madeley is of 16th century origins, extensively remodelled in approximately 1700 (WHM046);

- Maer Hall, Grade II registered park and garden (WHM017); and
- two further conservation areas: Maer Conservation Area (WHM018) and Madeley Conservation Area (WHM056).

Non-designated assets

7.3.5 All non-designated heritage assets within the 500m study area are listed in the gazetteer in Volume 5: Appendix CH-002-004 and identified on Maps CH-01-213b to CH-01-215a (Volume 5: Cultural heritage Map Book).

7.3.6 The following non-designated assets of moderate value lie wholly or partially within the land required for the Proposed Scheme:

- evidence for a palaeolake in the valley north of Baldwin's Gate and west of Hey Sprink, a buried linear feature believed to date to the end of the last glaciation containing sediments with high potential for palaeoenvironmental and also associated early prehistoric buried remains (WHM083);
- linear features identified in the 2016 geophysical survey (WHM027), north of the River Lea and east of Manor Road. It is possible that they represent traces of a former mill stream although they have also been interpreted as possible First World War practice trenches (WHM022); and
- anomalies indicating the footings of a masonry building identified in the 2016 geophysical survey, in the area of the proposed Madeley tunnel northern porous portal. A review of the layout of these features indicates they may date to the Roman period (WHM061).

7.3.7 The following non-designated assets of low value lie wholly or partially within the land required for the Proposed Scheme:

- locally listed buildings including the former booking office at Whitmore Railway Station (WHM072) and Dab Green Farm (WHM073);
- a reservoir (WHM074) and a signal box (WHM043) associated with the Grand Junction Railway;
- the Stoke to Market Drayton Railway, a part of the North Staffordshire Railway network, completed in 1870 and closed to passenger traffic in 1964 (WHM026);

- the Leycett to Madeley Mineral Railway built in the 1830's. It survives as earthworks to the north-east of the M6 (WHM076);
- incised historic country lanes of Bar Hill, including Audlem and Woore Turnpike Lane (WHM060) and Manor Road (WHM089),
- Madeley Great Park, including remains of the deer park boundary and extensive surviving ridge and furrow (WHM021);
- earthwork features in the southern fringe of Madeley that could represent remains of former linear settlement (WHM029);
- extensive earthworks near Barhill Wood including surviving ridge and furrow and field boundaries (WHM062); and
- 19th century brickworks at Wrinehill shown on historic mapping (WHM066).

7.3.8 There are a number of non-designated heritage assets within the 500m study area, the setting of which may be affected by the Proposed Scheme, as follows:

- a large mound, perhaps a Bronze Age barrow, to the north of Madeley Old Manor (WHM028);
- possible Bronze Age barrows near Bar Hill (WHM063);
- historic farmstead of Moss House Farm, a courtyard farm of historic brick buildings shown on maps since the late 18th century (WHM059);
- earthwork remains on the site of Old Madeley Mill (WHM022);
- a medieval moated site at Moor Hall Farm (WHM058);
- Wrinehill Hall Garden, known to have been established by the mid-18th century but now partially covered by large modern farm buildings (WHM067); and
- Wrinehill Mill, historic mill buildings beside a large millpond north of Wrinehill Hall (WHM068).

Historic landscape

7.3.9 Analysis has been undertaken of the historic landscape character within and around the land required for the Proposed Scheme. This was based on the outputs of the SCC Historic Landscape Characterisation (HLC), geological and geographical data sources, site visits and professional judgement. For the purpose of assessment, the Proposed Scheme has been divided into a number of Historic Landscape Character Areas (HLCAs) (Volume 5: Appendix CH-005-000). Within the Whitmore Heath to Madeley area these are as follows:

- HLCA 14 Onneley, Maer and Baldwin's Gate: this HLCA is based around the dominant feature of the Maer Hills and Camp Wood, a large wooded space in the centre of the HLCA. The WCML forms the eastern boundary, with the A53 Newcastle Road/A53 Whitmore Road running east to west across it. Settlements are concentrated around Baldwin's Gate with dispersed farms

such as Aston Cliff and Radwood Hall to the north and larger hamlets of Coombesdale and Chapel Chorlton to the south. This HLCA contains a number of heritage assets including Maer Hall, a Grade II registered park and garden, and a multivallate hillfort at Berth Hill, a scheduled monument. The heritage value of this HLCA is considered to be moderate;

- HLCA 15 Whitmore and Valley Woods: this HLCA is bounded by the WCML to the west, the Madeley Chord and the Stoke to Market Drayton Railway to the north, and the fields above Swynnerton Forest to the south. Whitmore village, Whitmore Heath and strips of preserved ancient woodland with associated early piecemeal enclosure comprise the dominant forms. The heritage value of this HLCA is considered to be moderate; and
- HLCA 16 Madeley: the key characteristics comprising this HLCA include the historic village of Madeley, the WCML, the Madeley Chord, the Stoke to Market Drayton Railway, the A525 Bar Hill Road, and fairly uniform fields and dispersed farms covering the clay and redlands. Madeley is an historic village surrounded by a mix of field systems and historic country roads. The heritage value of this HLCA is considered to be moderate.

Cultural heritage overview

7.3.10 This overview of the cultural heritage baseline is drawn from the more detailed analysis set out in the Cultural heritage baseline report (Volume 5: Appendix CH-001-004). This also contains references and a timeline setting out the chronological limits of the periods referred to below. This overview refers to heritage assets within the wider 500m study area, unless specified otherwise.

7.3.11 At the end of the last glaciation, the ice sheet covering the landscape began to retreat, depositing unsorted boulder clays and sands and gravels in the glacial outwash and creating the kettle holes[69] in which developed the meres and mosses that are characteristic of the Staffordshire-Shropshire border and north into Cheshire. Research into the geoarchaeological potential of the area, based on geological and topographical evidence[70], indicates the survival of Pleistocene deposits in the Whitmore Heath to Madeley area, particularly around the Madeley area, where a palaeolake is recorded (WHM083). There is some debate about the greatest extent of the Devensian ice sheet in this area, with several areas containing potential for deposits of till and organic sediments.

7.3.12 The earliest known prehistoric evidence for the area dates from the Mesolithic period, where a number of flint tools were found in Madeley Parish, near Bar Hill. The landscape to the south-west of the route of the Proposed Scheme at Maer suggests a Late Prehistoric landscape, with the scheduled monument of a multivallate hillfort at Maer (WHM017). To the west of the study area, adjacent to the route of the Proposed Scheme, is a low ridge running through to Madeley and Bar Hill along which are a

[69] A hollow created during glacial retreat when buried blocks of glacier ice separated from the main glacier melt. These can eventually fill with sediment.
[70] Volume 5: Appendix CH-006-000, Geoarchaeological desk study report.

number of mounds, interpreted as probable Bronze Age Round Barrows (WHM028 and WHM063).

7.3.13 The two main settlements in the area, Whitmore (WHM012) and Madeley (WHM020), are both mentioned in the Domesday Book. The estate at Madeley forms the subject of a charter of 975, recording a grant made by King Edgar to Æthelwold, bishop of Winchester. The town of Madeley is recorded in the Domesday Book as a manor given to the Staffords in 1066, supporting four deer parks and a mill. Old Madeley Manor (WHM035) is recorded as early as 1348, when a licence to fortify the Manor was granted to Ralph de Stafford, Lord Stafford. In 1540 the manor was sold to Thomas Offley, who became Lord Mayor of London in 1556. After the union of the Offley and Crewe families in 1679 the manor house was abandoned. A market charter was granted to the current town of Madeley in 1341. The church, manor, and associated village at Madeley developed to the east of the Proposed Scheme around a crossroads.

7.3.14 Its entry in the Domesday Book suggests that Whitmore was a small settlement in a landscape that appears to have been heavily wooded in the early medieval period, with enough arable to support three plough teams, as well as meadow. A chapel is first mentioned in 1175, when it belonged to Trentham Priory. The estate had passed into the hands of the Boterel family by the early 13th century and subsequently via marriage to the Mainwaring family in 1519 who have remained owners of the estate ever since. Whitmore Hall was rebuilt in brick in the later 17th century. It has an associated very well-preserved Elizabethan stable block (grouped together as WHM020).

7.3.15 Other smaller settlements surrounding Madeley and Whitmore include Baldwin's Gate and Onneley, to the south-west of the Proposed Scheme, and Acton, to the north-east of the Proposed Scheme. The study area contains a number of earthworks that indicate the presence of former hamlets. These include the shrunken village at Whitmore (WHM012) and the possible deserted medieval village (DMV) north of Wood Farm, Wrinehill (WHM064). There does not appear to be a consistent pattern for siting of extant villages in the area. Some are on high ground, for instance Whitmore, whilst others are sited in valleys, such as Madeley, which developed for agricultural reasons. The village at Whitmore may have developed through association with the iron and forge industry. Enclosure of the fields in the area also affected the landscape during the post medieval period and was probably associated with the development of local farmsteads.

7.3.16 By the late medieval period, much of the study area comprised open fields, probably farmed by inhabitants of these scattered settlements. Around Madeley, at Castle Lane, former field plots occur as small re-planned enclosure, implying earlier field systems had been in place.

7.3.17 A 19th century addition to the historic landscape of Madeley is provided by the Grand Junction Railway, which was opened in 1837. A reservoir (WHM074), on the west side of the Grand Junction Railway, was built to supply locomotive watering troughs.

7.3.18 The geology surrounding Madeley contains good clay deposits, limestone and accessible coal seams. The extraction industry, which developed around this geology, led to rapid development of Madeley Heath to the west of town in the 19th century.

The clay was used for pottery and tile manufacture. Growth of the area was assisted by the addition of the (now out of use) Stoke to Market Drayton Railway (WHM026), the Madeley Chord, and the Leycett to Madeley Mineral Railway (WHM076). Bricks in older properties at Madeley evidence this use of local geology in texture variations and pebble inclusions resulting from local hand-fired kilns. Such kilns occur to the north near Lowermill House and at Wrinehill Hall (WHM066).

7.3.19 There was also extensive 19th century gravel quarrying on Whitmore Heath, as indicated on historic maps. Whitmore Heath was subsequently developed, starting in the 1950s, with numerous large, detached residential properties.

Future baseline

Construction (2020)

7.3.20 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

7.3.21 No committed developments have been identified in this area that will materially alter the baseline conditions in 2020 for heritage assets.

Operation (2027)

7.3.22 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

7.3.23 No committed developments have been identified in this area that will materially alter the baseline conditions in 2027 for heritage assets.

7.4 Effects arising during construction

Avoidance and mitigation measures

7.4.1 The design of the Proposed Scheme avoids physical impacts on any scheduled monuments, registered parks or gardens or registered battlefields within the Whitmore Heath to Madeley area.

7.4.2 The following measures have been incorporated into the design of the Proposed Scheme which will reduce impacts on the following assets:

- planting which will reduce the effect on the setting of the Grade II listed Snape Hall Farm (WHM023);
- planting which will reduce the effect on the setting of the non-designated barrow near Manor Farm, Madeley (WHM028); and
- planting which will reduce the effect on the setting of the non-designated barrow north of A525 Bar Hill Road (WHM063).

7.4.3 Section 8 of the draft Code of Construction Practice[71] (CoCP) sets out the measures that will be adopted, insofar as reasonably practicable, to control effects on heritage assets. These include:

- management measures that will be implemented for heritage assets that are to be retained within the land required for the Proposed Scheme;
- route-wide principles, standards and techniques for works affecting heritage assets; and
- a programme of historic environment investigation and recording (including archaeology and historic buildings) to be undertaken prior to or during construction works affecting the heritage assets.

Assessment of impacts and effects

7.4.4 Impacts on all heritage assets described above have been assessed[72]. However, only those leading to significant effects are described in the construction assessment set out below.

Temporary effects

7.4.5 The construction works, comprising excavations and earthworks and including temporary works, such as construction compounds, storage areas, and diversion of existing roads and services, have the potential to affect heritage assets during the construction period. Impacts will occur to assets both within the land required for the Proposed Scheme and assets in the wider study area due to the visibility of plant, cranes and equipment.

7.4.6 The following significant effects are expected to occur as a result of temporary impacts on designated or non-designated heritage assets due to changes to their settings.

7.4.7 A Grade II listed milepost (WHM015), an asset of moderate value, will be subject to a temporary change in its setting. The milepost is located on the A53 at Baldwin's Gate. Its historic significance is directly associated with this road and will be therefore be affected by the road improvement works at this location. This will constitute a medium adverse impact and moderate adverse significant effect. Construction activity will take place over approximately one year and nine months.

7.4.8 Snape Hall Farm (WHM023), an asset of moderate value, will be subject to a temporary change in its setting. The historical and functional relationship of the farmhouse with the hill-slopes above it and the historic setting of the building in relation to Snape Hall Road, a feature visible on the 1st Edition Ordnance Survey map, are important elements of its significance. The construction of Whitmore Heath tunnel northern porous portal and the Whitmore North cutting, approximately 130m to the north, will alter the farmhouse's relationship with the hill-slopes. Activities associated with the modifications to Snape Hall Road and the permanent closure of a section of Snape Hall Road to the north of the farmhouse will also affect the historic

[71] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.
[72] These are set out in detail in the Impact Assessment Table, Volume 5: Appendix CH-003-004, Cultural heritage impact assessment table.

setting of the building. This will constitute a medium adverse impact and moderate adverse significant effect. Construction activity will take place over approximately one year and six months.

7.4.9 Hey House (WHM034), an asset of moderate value, will be subject to a temporary change in its setting. The building has already been altered as a result of the construction of the WCML, 100m to the east, and by its current use as commercial kennels and cattery. However, on its western and northern sides its historic relationships with the surrounding garden and landscape survive largely unaltered. Construction of the Lea North embankment and Manor Road overbridge, approximately 130m to the south, will alter the building's rural setting. This will constitute a medium adverse impact and moderate adverse significant effect. Construction activity will take place over approximately two years and six months.

7.4.10 A Grade II listed milepost (WHM049), an asset of moderate value, will be subject to a temporary change as a result of the construction works. The milepost is located on the A525 Bar Hill Road, east of the Proposed Scheme. The milepost will have to be temporarily removed during the realignment of the A525 Bar Hill Road. It will be replaced as close to its original position as possible before operation of the Proposed Scheme commences. This will constitute a medium adverse impact and moderate adverse significant effect. Construction activity will take place over approximately one year and nine months.

7.4.11 Offley Well Head (WHM048), an asset of moderate value, will be subject to a temporary change in its setting. The peaceful, horticultural surroundings of the adjacent allotment are an essential part of its value. Noise and movement from construction works associated with the realignment of Manor Road and the A525 Bar Hill Road will affect the setting of the ornate Well Head. This will constitute a medium adverse impact and moderate adverse significant effect. Construction activity will take place over one year and nine months.

7.4.12 Bridge Cottage (WHM046), an asset of moderate value, will be subject to a temporary change in its setting. The cottage faces the A525 Bar Hill Road, and although an existing overbridge obscures the views of traffic using the road, noise due to increased construction traffic and construction works during realignment of the A525 Bar Hill Road and construction of the A525 Bar Hill overbridge will affect the setting of the building. This will constitute a medium adverse impact and moderate adverse significant effect. Construction activity will take place over approximately one year and nine months.

7.4.13 No significant temporary effects on HLCAs will result from the construction of the Proposed Scheme in the Whitmore Heath to Madeley area.

Permanent effects

7.4.14 Permanent significant effects can occur either as a result of physical impacts on heritage assets within the land required for the Proposed Scheme, or through changes to the setting of heritage assets through the presence of the Proposed Scheme.

7.4.15 The following significant effects are expected to occur as a result of permanent physical impacts on heritage assets within the land required for the Proposed Scheme.

7.4.16 Features of unknown purpose and date seen as cropmarks and earthworks associated with boundaries of Madeley Great Park (WHM021), assets of low value, will be partially removed during construction of the River Lea viaduct. This will constitute a high adverse impact and a moderate adverse significant effect.

7.4.17 Features seen as cropmarks and identified during geophysical survey to the south of Hey House, potentially channels associated with the former Madeley Manor Mill (WHM027), assets of low value, will be partially removed during excavation of the replacement floodplain storage area at the River Lea viaduct. This will constitute a high adverse impact and will result in a moderate adverse significant effect.

7.4.18 A late glacial palaeolake (WHM083), an asset of moderate value, will be partially removed during the construction of the Lea South embankment and the River Lea viaduct. This will constitute a high adverse impact and a major adverse significant effect.

7.4.19 Geophysical evidence for a building that may date to the Roman period (WHM061), an asset of moderate value, will be partially removed during construction of the Madeley tunnel southern porous portal. This will constitute a high adverse impact and a major adverse significant effect.

7.4.20 An extensive medieval and post-medieval agricultural landscape with fields, boundaries, and hollow ways, east of Beechfields (WHM062), assets of low value, will be partially removed during construction of the Madeley cutting. This constitutes a high adverse impact and a moderate adverse significant effect.

7.4.21 The following significant effects will occur as a result of permanent impacts on designated or non-designated heritage assets as a result of changes to their settings.

7.4.22 Hey House (WHM034), an asset of moderate value, will be subject to a permanent change in its setting. Its elegant main façade looks westwards across the rural landscape of the Lea Valley, these views being an important part of its historic interest. Consequently, the house will be subject to a change in its setting due to the presence of the Lea North embankment and Manor Road overbridge obstructing views to the north and west. This will constitute a medium adverse impact and a moderate adverse significant effect.

7.4.23 No significant permanent effects on HLCAs will result from the construction of the Proposed Scheme in the Whitmore Heath to Madeley area.

Other mitigation measures

7.4.24 Refinements to the mitigation measures incorporated into the design of the Proposed Scheme or included in the draft CoCP will be considered during detailed design to reduce further the significant effects described above. These refinements will include the identification of:

- suitable locations for advance planting, to reduce impacts on the setting of heritage assets; and
- locations where the physical impacts on below ground heritage assets can be reduced through the design of earthworks.

7.4.25 Milestones and/or mileposts that have to be removed during construction will be, wherever it is reasonably practicable to do so, returned to their original location before operation commences.

Summary of likely residual significant effects

7.4.26 The temporary effects of construction activity on the setting of heritage assets have been considered. However, they are largely reversible in nature and will be restricted to the duration of the construction works.

7.4.27 As no mitigation beyond that described above has been identified the residual effects are the same as those reported under permanent effects.

Cumulative effects

7.4.28 No cumulative effects on heritage assets during construction have been identified in the Whitmore Heath to Madeley area.

7.5 Effects arising from operation

Avoidance and mitigation measures

7.5.1 The following measures have been incorporated into the design of the Proposed Scheme to reduce the impacts and effects on heritage assets, as shown on the CT-06 Map Series within the Volume 2: CA4 Map Book:

- noise fence barriers on the Whitmore North cutting to reduce noise effects on the setting of the Snape Hall Farm (WHM023);
- noise fence barriers on the Madeley cutting to reduce noise effects on the setting of Madeley Conservation Area (WHM056); and
- landscape planting will increasingly reduce impacts on the setting of the assets within the area as it matures.

Assessment of impacts and effects

7.5.2 The assessment considers the Proposed Scheme once operational and all effects are considered to be permanent. There will be no physical impacts on buried archaeological remains or other heritage assets arising from the operation of the Proposed Scheme. Impacts on heritage assets due to changes in their settings arising from the physical presence of the Proposed Scheme are described as permanent, occurring within the construction phase and are not repeated here, although they will endure through the operation of the Proposed Scheme. Where there is a combined effect on the setting of an asset from the presence of the constructed Proposed Scheme and its operation, this is reported in the assessment of operation.

7.5.3 A significant effect will occur as a result of permanent changes to the setting of the following asset arising from the impacts of railway operation.

7.5.4 Hey House (WHM034), an asset of moderate value, will be subject to a permanent change in its setting as a result of the noise of the passing trains running on the Lea North embankment, approximately 180m away. The historic significance of the building as a country house will be changed and adversely affected by the operation of

the Proposed Scheme. In combination with the permanent effects of the Proposed Scheme the effect will remain as moderate adverse significant.

7.5.5 No significant effects on HLCAs will result from the operation of the Proposed Scheme in the Whitmore Heath to Madeley area.

Other mitigation measures

7.5.6 The Proposed Scheme includes a number of design measures to address potential impacts and significant effects. No additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified. Potential opportunities for further mitigation such as planting and noise fencing have not been identified at this stage, but will be considered as part of the detailed design process.

Summary of likely residual significant effects

7.5.7 As no mitigation beyond that described has been identified, the residual effects are the same as those reported in the assessment of effects during operation.

Cumulative effects

7.5.8 No cumulative effects on heritage assets during operation have been identified in the Whitmore to Madeley area.

Monitoring

7.5.9 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

7.5.10 There are no area-specific heritage monitoring requirements during operation of the Proposed Scheme. It is assumed that all heritage assets within the land required for the Proposed Scheme will be removed during construction unless expressly excluded as a result of the mitigation process. Where there are likely residual significant effects at Hey House the specific operational monitoring requirements in relation to noise which, which will contribute to the operation effect, are described in Section 13, Sound, noise and vibration.

8 Ecology and biodiversity

8.1 Introduction

8.1.1 This section of the report describes the ecological baseline and identifies likely impacts and significant ecological effects that will arise from the construction and operation of the Proposed Scheme in the Whitmore Heath to Madeley area. This includes effects upon sites recognised or designated on the basis of their importance for nature conservation.

8.1.2 Engagement has been undertaken with national organisations and regional and local stakeholders including: Natural England; Environment Agency; Forestry Commission; Staffordshire Wildlife Trust; Royal Society for the Protection of Birds (RSPB); Woodland Trust; and Staffordshire County Council (SCC). The purpose of this engagement has been to obtain relevant baseline information and inform the design development and assessment of the Proposed Scheme.

8.1.3 Volume 5 contains supporting information to the ecological assessment reported in this section, including:

- ecological baseline data - designated sites (see Volume 5: Appendix EC-001-000); and
- an ecology register of local level effects, which are not reported individually in Volume 2 (see Volume 5: Appendix EC-016-004).

8.1.4 Map Series EC-01 showing statutory and non-statutory designated sites of relevance to the assessment in the Whitmore Heath and Madeley area is provided in the Volume 5: Ecology Map Book.

8.1.5 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

8.1.6 In addition, ecological baseline data relating to habitats and species recorded in the Whitmore Heath and Madeley area is set out in Background Information and Data (BID)[73] (BID-EC-002-000 to BID-EC-014-000) and accompanying Map Series EC-02 to EC-12 (BID Ecology Map Books).

8.2 Scope, assumptions and limitations

8.2.1 The scope, assumptions and limitations for the ecological assessment are set out in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[74] and the SMR Addendum[75].

8.2.2 A route-wide Water Framework Directive (WFD) compliance assessment has been undertaken in conjunction with the environmental assessment (Section 15, Water

[73] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2
[74] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[75] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.

resources and flood risk). Details of the assessment are presented in Volume 5: Appendix WR-001-000.

8.2.3 Access was obtained to the majority of land where general habitat survey (Phase 1 habitat survey) was proposed. However, access could not be gained in time for seasonally constrained surveys at a number of locations that have potential to support key ecological features. These include: Grafton's Wood; Barhill Wood; and an unnamed woodland at The Lum (River Lea corridor) Local Wildlife Site (LWS). Further details are provided in Background Information and Data: BID-EC-002-000 to BID-EC-014-000.

8.2.4 Where data are limited, such as due to the absence of field surveys, a precautionary baseline has been built up according to the guidance reported in the SMR and the SMR Addendum. This constitutes a 'reasonable worst case' basis for the subsequent assessment and development of mitigation. Background Information and Data: BID-EC-002-000 to BID-EC-014-000 identifies these survey locations. Where the assessment has been based upon limited data, the ecological receptor is described as 'of up to' a specific value.

8.2.5 The precautionary approach to the assessment that has been adopted identifies the likely significant ecological effects of the Proposed Scheme. Unless otherwise stated, the description of effects assumes that land within the Bill limits will be subject to habitat loss resulting from development of the Proposed Scheme, with the land required for construction purposes only being reinstated following completion of construction. With respect to overhead line diversions/realignments in particular, it is likely that the majority of the habitats within the land required for the Proposed Scheme can in fact be retained, and land is only required to allow for raising or lowering of pylons and/or re-stringing of cables, or to provide an access route to the works.

8.3 Environmental baseline

Existing baseline

8.3.1 This section describes the ecological baseline relevant to the assessment: the designated sites, habitats and species recorded in this area. Further details are provided in the reports presented in Volume 5: Appendix EC-001-000 and Background Information and Data: BID-EC-002-000 to BID-EC-015-000, and maps presented in Volume 5: Map Series EC-01 and BID Ecology Map Books: Map Series EC-02 to EC-12. Statutory and non-statutory designated sites are shown on Volume 5: Map EC-01-313b to EC-01-315a.

8.3.2 Land required for and adjacent to the Proposed Scheme in the Whitmore Heath to Madeley area consists mainly of agricultural land, woodland, and residential settlements. It includes blocks of ancient woodland at Whitmore Wood and Barhill Wood, and marshy grassland within the Lea Valley to the south of Madeley.

Designated sites

8.3.3 There are no statutory designated sites of international importance within 2km of the Proposed Scheme in the Whitmore Heath to Madeley area.

8.3.4 There are no statutory designated sites of national importance within 500m of the Proposed Scheme in the Whitmore Heath to Madeley area.

8.3.5 The land required for the Proposed Scheme is not located within the Natural England Impact Risk Zone[76] for any Site of Special Scientific Interest (SSSI).

8.3.6 There are six Local Wildlife Sites (LWS) of potential relevance to the assessment in the Whitmore Heath to Madeley area, each of which is of county value. Five of these sites are also listed on the Ancient Woodland Inventory (AWI). They are:

- Whitmore Wood LWS, covering an area of approximately 16.6ha, all of which plus an additional 1.3ha of woodland is listed as an AWI site. The LWS is designated for deciduous and ancient woodland. The LWS comprises a large area of plantation on ancient woodland site (PAWS) and a stand of semi-natural broadleaved woodland. The areas containing the most diverse ground flora are along rides and tracksides than within the heavily-shaded plantation areas. A stream supports wet woodland vegetation. This LWS is located north of Snape Hall Road, and is partially within the land required for the Proposed Scheme. The remainder of the LWS is included in the land required for the Proposed Scheme for woodland restoration;
- Moat Wood and Brickyard Wood LWS and AWI site, covering an area of approximately 6.5ha, is designated for open broadleaved woodland and ground flora. This LWS is located north of Whitmore Wood LWS and immediately south-east of the land required for the Proposed Scheme;
- Hey Sprink (wood south-west of) LWS, covering an area of approximately 2.7ha, is designated for its broadleaved semi-natural woodland containing a number of ancient woodland indicator species in the ground flora. This LWS encompasses a narrow ravine, south-east of the West Coast Main Line (WCML).The LWS is located partially within the land required for the Proposed Scheme.
- Grafton's Wood LWS and AWI site, covering an area of approximately 5ha, is designated for its ancient semi-natural woodland of alder carr. The ground flora includes ancient woodland indicators, some of which are typical of wet woodland. This River Lea flows through the woodland in a north-westerly direction. The LWS is located west of Madeley, adjacent to the land required for the Proposed Scheme;
- The Lum (River Lea Corridor) LWS and AWI site, covering an area of approximately 2.1ha, is designated for its ancient semi-natural woodland with a rich ground flora. This LWS is located west of Madeley and borders the WCML, adjacent to the land required for the Proposed Scheme; and
- Wrinehill Wood LWS and AWI site, covering an area of approximately 26.2ha, is designated for its exemplar ancient semi-natural woodlands in Staffordshire, with intact typical ancient woodland ground flora. The wood has no ancient

[76] The Impact Risk Zones are a GIS tool developed by Natural England to make a rapid initial assessment of the potential risks to SSSIs posed by development proposals and indicate the types of development proposal which could potentially have adverse impacts.

trees because it was clear felled during the First World War. This LWS is located south of Checkley Brook, adjacent to the land required for the Proposed Scheme.

8.3.7 There are four Biodiversity Alert Sites (BAS), of relevance to the assessment in the Whitmore Heath to Madeley area, each of which is of district/borough value. They are:

- Manor Road Verges BAS, covering an area of approximately 0.4ha, is designated for verges supporting a rich diversity of ancient woodland indicators as well as species that indicate unimproved neutral grassland. This BAS is located at Manor Road, within the land required for the Proposed Scheme;
- Radwood Copse and Railway Verges BAS, covering an area of approximately 4.2ha, is designated for a stand of birch with a heavily grazed turf ground flora. This BAS is located south of Manor Road, adjacent to the land required for the Proposed Scheme;
- Red Lane BAS, covering an area of approximately 1.1ha, is designated for its well-developed hedgerows. The southern hedgerow contains oak, ash, silver birch and sycamore as occasional stands throughout. This BAS is located south of Barhill Wood, within the land required for the Proposed Scheme; and
- Wrinehill Wood (east of) BAS, covering an area of approximately 1.3ha, is designated for its linear woodland characterised by locally abundant sycamore (to the north) and locally dominant oak (to the south). This BAS is located east of Wrinehill Wood, adjacent to the land required for Proposed Scheme.

8.3.8 There are a total of seven AWI sites of potential relevance to the assessment in the Whitmore to Madeley area, all of which are of county value. Five of these AWI sites are also LWS as described above. The other two are:

- Barhill Wood AWI, covering an area of approximately 5.4ha, is located south-west of Madeley, partially within the land required for the Proposed Scheme; and
- Hey Sprink AWI, covering an area of approximately 39.3ha, is located south-east of the WCML, adjacent to the land required for the Proposed Scheme.

8.3.9 On the basis of the heritage review undertaken by HS2 Ltd, Natural England has confirmed that three woodlands of potential relevance to the assessment in the Whitmore Heath to Madeley area will be added to the AWI, each of which are of county value. These are:

- woodland at Hey Sprink (wood south-west of), covering an area of approximately 3.2ha, which includes approximately 2.6ha designated as a LWS. The woodland is located between Hey Sprink and Whitmore Wood, partially within the land required for the Proposed Scheme;
- an unnamed wood south of Hey Sprink, covering an area of approximately 0.9ha, located to the south east of Hey Sprink, north of the West Coast Mainline and partially with the land required for the Proposed Scheme; and

- Wrinehill Wood (east of), covering an area of approximately 3.6ha, part of which is located within Wrinehill Wood (east of) BAS. This includes a small easterly extension of Wrinehill Wood, to the east of Wrinehill Wood and south of Checkley Brook, located partially within the land required for the Proposed Scheme.

Habitats

8.3.10 The following habitat types that occur in the Whitmore Heath to Madeley area are relevant to the assessment.

Woodland

8.3.11 Two woodlands listed on the AWI include areas of both ancient semi-natural woodland and PAWS. The semi-natural areas are likely to qualify as lowland mixed deciduous woodland, a habitat of principal importance as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006[77]) and a conservation priority of the Staffordshire Biodiversity Action Plan[78] (local BAP). These woodlands are:

- Whitmore Wood, covering an area of approximately 17.9ha, which includes semi-natural woodland dominated by downy birch with occasional rowan and hazel. This habitat resembles the National Vegetation Community (NVC[79]) for W9a Fraxinus excelsior-Sorbus aucuparia- Mercurialis perennis woodland typical sub-community. The middle and the south-west corner sections of the woodland is PAWS dominated by larch and western red cedar. Eleven vascular plant species indicative of ancient woodland were recorded, including bluebell, yellow archangel, moschatel and ramsons. The woodland is located partially within the land required for the Proposed Scheme, with the remainder within land required for woodland restoration. The woodland habitats are of county value; and

- Hey Sprink, covering an area of approximately 39.3ha, which includes semi-natural woodland dominated by downy birch and sycamore, with occasional hazel. The species composition of this habitat is characteristic of NVC W9a Fraxinus excelsior-Sorbus acucuparia- Mercurialis perennis woodland typical sub-community. Nine vascular plant species indicative of ancient woodland were recorded, including bluebell, yellow archangel, wood millet and wood speedwell. The woodland is located to the east of the WCML and south of Netherset Hey Farm, immediately adjacent to the land required for the Proposed Scheme. The woodland habitats are of county value.

8.3.12 The five other woodlands listed on the AWI comprise lowland mixed deciduous woodland, a habitat of principal importance and a conservation priority of the local BAP. These are:

[77] Natural Environment and Rural Communities Act 2006 (2006 CHAPTER 16). Her Majesty's Stationery Office, London.
[78] Staffordshire Biodiversity Partnership. *Staffordshire Biodiversity Action Plan* [online]. Available at: http://www.sbap.org.uk/.
[79] NVC is a detailed survey and classification system that is used to compare plant communities within a range of defined community types.

- Moat Wood, covering an area of approximately 4.5ha, comprises open broadleaved woodland. The woodland is located north-east of Whitmore Heath, immediately adjacent to the land required for the Proposed Scheme. The woodland habitat is of up to county value;
- Barhill Wood, covering an area of approximately 5.4ha, comprises a canopy co-dominated by sycamore and pedunculate oak. Rowan and sycamore dominate the understory with occasional elder. Five vascular plant species that are indicative of ancient woodland were recorded. The species composition of this habitat is characteristic of NVC W9a Fraxinus excelsior- Sorbus aucuparia-Mercurialis perennis woodland typical sub-community. The woodland is located north of the A525 Bar Hill Road, partially within the land required for the Proposed Scheme. The woodland habitat is of county value;
- Grafton's Wood LWS, covering an area of approximately 5ha, comprises alder carr woodland. The woodland is located to the west of the WCML, immediately adjacent to the land required for the Proposed Scheme. The woodland habitat is of up to county value;
- an unnamed broadleaved woodland at the Lum (River Lea corridor) LWS, covering an area of approximately 2.1ha. The woodland is located to the east of the WCML, immediately adjacent to the land required for the Proposed Scheme. The woodland habitat is of up to county value; and
- Wrinehill Wood LWS, covering an area of approximately 26.2ha, has a canopy of alder, silver birch, rowan and oak. The woodland is located to the north west of Bower End Lane, adjacent to the land required for the Proposed Scheme. The woodland habitat is of county value.

8.3.13 The three woodlands to be added to the AWI are lowland mixed deciduous woodland, a habitat of principal importance and a conservation priority of the local BAP. These are:

- Hey Sprink (wood south-west of) LWS, covering an area of approximately 3.2ha, 2.6ha of which is designated as LWS, comprises species including birch, alder, rowan and hawthorn. The woodland is located to the south-east of the WCML, partially within the land required for the Proposed Scheme. The woodland habitat is of county value;
- an unnamed wood south of Hey Sprink, covering an area of approximately 0.9ha, comprising species including oak, alder, goat willow and holly. The woodland is located to the north of Whitmore Heath and east of the WCML, partially within the land required for the Proposed Scheme. The woodland habitat is of up to county value; and
- Wrinehill Wood (east of), covering an area of approximately 3.6ha, comprising mainly of broadleaved semi-natural woodland dominated by alder, silver birch, rowan and oak. It consists of a number of narrow, scattered woodland remnants. The woodland is located north-west of Madeley and north-east of Onneley, partially within the land required for the Proposed Scheme. The woodland habitat is of up to county value.

8.3.14 There are three other woodlands that qualify or are likely to qualify as lowland mixed deciduous woodland, a habitat of principal importance. These are:

- woodland at Whitmore Heath, covering an area of approximately 13.3ha, is dominated by silver birch, sessile oak and downy birch. The species composition of this habitat is characteristic of NVC W16B Quercus spp- Betula spp- Descampsia flexusosa woodland Vaccinium myrtillus – Dryopteris dilatata sub-community. The woodland is located north-east of Snape Hall Road, partially within the land required for the Proposed Scheme. The woodland habitat is of district/borough value;
- an unnamed woodland, covering an area of approximately 5ha, connecting to the south-west boundary of Hey Sprink. This woodland borders the Stoke to Market Drayton Railway and located partially within the land required for the Proposed Scheme. The woodland of up to district/borough value; and
- woodland covering an area of approximately 11ha along the WCML corridor, north of Manor Road. In the absence of survey it is assumed that woodland is semi natural broadleaved woodland. The woodland is of up to district/borough value.

8.3.15 In addition to those described above, the Whitmore Heath to Madeley area has a series of small scattered woodlands comprising areas of young mixed deciduous woodland and plantation woodland within or immediately adjacent to the land required for the Proposed Scheme. These small woodlands are each of up to local/parish value.

Grassland

8.3.16 Species-rich marshy grassland, covering an area of approximately 5.6ha, occurs to the east of Meece Brook. This area of grassland is characteristic of NVC community MG5b Cynosurus cristatus-Centaurea nigra grassland Galium verum sub-community. MG5b grassland is representative of lowland meadow habitat of principal importance and a conservation priority of the local BAP. This grassland is located within the land required for the Proposed Scheme and is of county value.

8.3.17 An area of marshy grassland, covering an area of approximately 21.3ha, occurs south of Hey Sprink and the WCML. Species present include tall sedges, common reed, soft rush, meadowsweet and reedmace. This grassland is assumed to qualify as floodplain grazing marsh, a habitat of principal importance. This grassland is located partially within the land required for the Proposed Scheme and is of up to county value.

8.3.18 Neutral unimproved grassland covering an area of approximately 3.2ha is located south of the A53 Newcastle Road. The grassland is dominated by Yorkshire-fog, rough meadow-grass and yellow oat-grass. Herbaceous plants include common knapweed, hedge bedstraw, lady's bedstraw, meadow crane's- bill, field scabious, common birds-foot trefoil, musk mallow, ribwort plantain, meadow buttercup, yellow-rattle, common sorrel, ragged-robin and bladder campion. The grassland is representative of lowland meadow, a habitat of principal importance. This grassland is located within the land required for the Proposed Scheme solely for the purposes of habitat enhancement for amphibian mitigation. This grassland is of county value.

8.3.19 Neutral semi improved grassland, covering an area of approximately 3.7ha, occurs within a field north of Whitmore Heath and east of Whitmore Wood. Species present include meadow buttercup, field woodrush, pignut, cuckooflower, common sorrel, bluebell, cat's-tail, common mouse-ear, sweet vernal-grass and meadow foxtail. The grassland is representative of lowland meadow, a habitat of principal importance. This grassland is located partially within the land required for habitat creation as part of the Proposed Scheme and it is of county value.

8.3.20 Neutral semi improved grassland; covering an area of approximately 1.2ha occurs within a field to the north-east of Whitmore Wood ancient woodland. Species present include creeping bent, daisy, common mouse-ear, crested dog's tail, perennial rye-grass and creeping buttercup. There are also rare occurrences of creeping thistle and occasional wet areas with tufted hair-grass and soft rush. The grassland is representative of lowland meadow, a habitat of principal importance. This grassland is located within the land required for the Proposed Scheme solely for the purposes of woodland habitat creation and it is of district/ borough value.

8.3.21 In addition to those described above, the Whitmore Heath to Madeley area has a series of smaller semi improved and species poor semi improved neutral grassland totalling approximately 16.6ha. These areas of grassland are each of up to local/parish value.

8.3.22 Acid grassland, covering an area of approximately 0.2ha, occurs north of Barhill Wood. The habitat is dominated by bent grass with other species including tormentil, bird's foot trefoil, scabious, cat's ear, sheep's sorrel, harebell and mouse ear. The grassland is representative of lowland dry acid grassland, a habitat of principal importance and a conservation priority of the local BAP. This grassland is located partially within the land required for the Proposed Scheme solely for the purposes of habitat creation/ enhancement. This grassland is of district/ borough value.

Hedgerows

8.3.23 There are approximately 22.7km of hedgerows within the land required for the Proposed Scheme in the Whitmore Heath to Madeley area. Hedgerow with at least 80% cover of native woody species is a habitat of principal importance. Hedgerows within the land required for the Proposed Scheme comprise approximately :

- 8.7km of native species-poor; and
- 14km of native species-rich; of which 3.8km are also classified as 'Important' according to the 'Wildlife and Landscape' criteria described in The Hedgerows Regulations 1997[80].

8.3.24 Of the 22.7km of hedgerow a total of 7.7km have not been subject to survey. To accord with Phase 1 habitat descriptions un-surveyed hedgerows are mapped as native species-rich on Map Series EC-02 and they are included as native species-rich in the list above. This is highly precautionary, and based on ratios from the surveyed hedgerows in this area, it is likely that part of the un-surveyed hedgerow network will be species-poor.

[80] The Hedgerow Regulations 1997 (No. 1160). Her Majesty's Stationery Office, London.

8.3.25 As part of the precautionary assessment, it is assumed that further important hedgerows will be found within land that was not surveyed, but which will be required for the Proposed Scheme. The hedgerows within the area also function as wildlife corridors. The hedgerow network as a whole is of district/borough value.

Watercourses

8.3.26 Meece Brook, the River Lea and several smaller watercourses and drainage ditches will be crossed by the route of the Proposed Scheme. The River Lea and Meece Brook may qualify as habitats of principal importance and local BAP habitats. These watercourses and associated habitats are intrinsically important and provide corridors for wildlife dispersal, and they are of county value. The smaller watercourses are of up to district/borough value.

Water bodies

8.3.27 There are 37 ponds located within, or partially within, the land required for the Proposed Scheme, and a further 72 ponds within 250m of the land required for the Proposed Scheme. On the precautionary basis it is assumed that all ponds are habitats of principal importance or local BAP habitats and are of district/borough value unless surveys have shown that they are of local/parish value only.

Ancient and veteran trees

8.3.28 Ancient and veteran[81] trees with potential relevance to the assessment in the Whitmore Heath to Madeley area have been considered.

8.3.29 On the basis of the surveys undertaken there are 13 trees within the land required for the Proposed Scheme that are considered to be of a sufficient age and/or support features to indicate they are of veteran status. Each of the trees is considered to be of up to district/borough value. These are:

- a veteran oak, located within a field to the east of Bent Lane;
- a veteran oak, located within a field north of the A53 Newcastle Road/A53 Whitmore Road and south of Whitmore;
- three veteran oaks, located within fields north of the A53 Newcastle Road/A53 Whitmore Road and north of Baldwin's Gate;
- a veteran oak, located on the southern edge of Whitmore Wood;
- a veteran ash, located on the eastern edge of the unnamed wood south of Hey Sprink;
- a veteran oak, located within a field east of Manor Road and south of Hey House Lodge;

[81]An ancient tree is one that has passed maturity and is old, or aged, in comparison with other trees of the same species. Veteran trees are younger than ancient trees, but have features found on ancient trees such as decay in the trunk, branches and/or roots. Ancient and veteran trees are included on the Ancient Tree Inventory.

- a veteran oak, located on the boundary of a field west of Red Lane and south-east of Barhill Wood;
- a veteran oak, located on the boundary of a field west of Red Lane and east of Barhill Wood;
- a veteran ash, located on the boundary of a field west of Red Lane and west of Madeley;
- a veteran large-leaved lime, located on the boundary of a field west of the A525 Bar Hill Road; and
- a veteran oak, located within a field east of Wrinehill Wood.

Protected and notable species

8.3.30 A summary of the likely value of protected and/or notable species of relevance to the assessment is provided in Table 13.

Table 13: Protected and notable species within the Whitmore Heath to Madeley area.

Resource/feature	Value	Receptor	Baseline and rationale for valuation
Bats	County	Bat assemblage associated with the habitats in the Whitmore area	Results from bat activity and static field surveys within Whitmore Wood recorded high levels of foraging and commuting activity for common and soprano pipistrelle bats and lower levels of activity for Myotis species bats both within and adjacent to the land required. Solitary Nyctalus/Eptesicus species passes were detected in June 2016 and July 2016 as well as a solitary serotine pass. Field surveys recorded a maternity roost, a day/summer roost and potential hibernation roost for brown long-eared bat in residential buildings within this area. A day/summer roost for a Myotis species was recorded in an ash tree, and a day/summer roost of two soprano pipistrelle bats recorded in an oak tree. These roosts are within and adjacent to the land required for the Proposed Scheme. Soprano pipistrelle and brown long-eared bats are species of principal importance[82]. Common and soprano pipistrelle are both also conservation priorities of the local BAP. Serotine bats are considered uncommon and are largely restricted to the south of England[83].
	County	Bat assemblage associated with habitats between Hey Sprink and Barhill Wood	Field surveys recorded a maternity roost within a residential building indicative of Pipistrellus species, a day/summer roost within a building containing a single common pipistrelle and two soprano pipistrelles, and two day/summer roosts of Myotis species bats were recorded in trees. Two day/summer roosts containing individual soprano pipistrelle were also recorded in trees during field surveys. A single bat of unidentified species was recorded roosting in a tree within the land required for the Proposed Scheme, north of Manor Road. As species is unknown it is assumed to be of a rarer species.

[82] http://www.legislation.gov.uk/ukpga/2006/16/section/41
[83] Bat Conservation Trust (2014). The State of the UK's bats: National Bat Monitoring Programme Population Trends 2014. BCT, London

Resource/feature	Value	Receptor	Baseline and rationale for valuation
			These roosts were recorded both within and adjacent to the land required for the Proposed Scheme.
	Up to county	Bat assemblage associated with habitats north of the Barhill area	Field surveys recorded one day/ summer roost containing brown long-eared droppings within a residential building and one night/feeding perch containing Pipistrellus species droppings recorded in a garage. Two day roosts were also recorded in a residential building and a tree respectively. Species in both roosts were unknown, and therefore, assumed to be of a rarer species. These roosts were recorded within and adjacent to the land required for the Proposed Scheme.
	County	Population of noctule bats associated with habitats in the Checkley area	Field surveys recorded a summer/day roost for two noctule bats in a tree approximately 80m from the land required for the Proposed Scheme. Noctule are considered to be a rarer species[84], are listed as a species of principal of importance and are also a conservation priority of the local BAP.
	Local/parish	Soprano pipistrelle population associated with habitats at Meece Brook	Field surveys recorded a day/summer roost for soprano pipistrelle in two individual trees during surveys south-west of Brent Lane, close to Meece Brook and within the land required for the Proposed Scheme.
Amphibians	Up to county	A meta-population[85] (AMP4.1) of great crested newt across a network of two ponds situated between Whitmore and Baldwin's Gate, south of the A53 Newcastle Road/A53 Whitmore Road	Field surveys recorded an assumed medium meta-population of great crested newts, which includes a small population in one pond. The two ponds are both located within the land required for the Proposed Scheme. The landscape surrounding this pond is intensively farmed and the one adjacent pond was found to be dry in 2016.There is suitable terrestrial habitat (such as hedgerows) that could provide connectivity for this metapopulation to other terrestrial habitats flanking the Meece Brook and along the railway embankments. Great crested newt is an Annex 2[86] species, a species of principal importance, and a conservation priority of the local BAP.
	Up to county	A meta-population (AMP4.2) of great crested newt in 28 ponds, situated north-west of Whitmore Heath	Field surveys recorded an assumed medium meta-population of great crested newts, which includes a small population in one pond. This pond sits within a wider network of 28 ponds that are located close enough to allow for great crested newts to move between them. The ponds are located within and up to approximately 290m from the land required for the Proposed Scheme. The landscape surrounding this pond is generally grazed pasture bordered by hedgerows and woodland, including Whitmore Wood, Hey Sprink, and an unnamed wood south of Hey Sprink. All of these areas provide continuous connectivity for this meta-population through suitable

[84] Wray et al 2010 *Valuing Bats in Ecological Impact Assessment.* IEEM In-practice.
[85] A metapopulation is a group of spatially separated populations which interact. Metapopulations are described in BID-EC-007-000, Ecological baseline data - amphibian and pond surveys.
[86] Annex 2 of the EU's Habitats Directive (1992) lists priority species whose conservation requires the designation of Special Areas of Conservation.

Resource/feature	Value	Receptor	Baseline and rationale for valuation
			terrestrial habitat linking the large number of ponds together.
	County	A meta-population (AMP4.3) of great crested newt in 11 ponds, situated west of Onneley	A medium meta-population of great crested newt was recorded in five of the ponds during field surveys, one with a medium population, three with a small population and one where presence was confirmed through (eDNA[87]) field surveys. These ponds sit within a wider network of 11 ponds, which are located within and up to approximately 310m from the land required for the Proposed Scheme. The landscape surrounding these ponds is largely grazed pasture bordered with hedgerows. Suitable terrestrial habitat exists to the west within Upper Bitterns Wood and to the north within Barhill Wood.
	Up to county	Populations of great crested newt within un-surveyed ponds within the Whitmore Heath to Madeley area	Ponds that have not been surveyed are assumed to support breeding populations of great crested newt of medium size class.
	Local/parish	Populations of other amphibian species including palmate newt, smooth newt, common toad and common frog within the Whitmore Heath to Madeley area	These common amphibian species have been identified within some ponds throughout the Whitmore Heath to Madeley area during field surveys and are assumed to be present within the ponds that have not yet been surveyed. Woodland, rough grassland and hedgerow habitats are likely to be utilised by these species during their terrestrial phase for foraging, dispersal and shelter. Each of these species is common and widespread throughout the UK. Common toad is a species of principal importance.
Birds	Up to county	A pair of barn owl east of Whitmore	Desk study records have shown presence of breeding barn owls within 250m of the land required for the Proposed Scheme. This area supports agricultural land with large arable fields with rough grassland margins, well established hedgerows, pockets of woodland, mature trees and agricultural buildings, all of which offer potential foraging and nesting opportunities for barn owl.
	Local/parish	Breeding bird assemblage at Meece meadows	Field surveys recorded a total of 31 species at Meece Meadows within the land required for the Proposed Scheme which includes five Red List[88] species. The species recorded are typical of this habitat and were present in low numbers. The recorded breeding bird assemblage comprised six species of principal importance and/or conservation priorities of the Local BAP.
	Local/parish	Wintering bird assemblage at Meece meadows	Field surveys recorded a total of 36 species at Meece Meadows within the land required for the Proposed Scheme which includes 10 Red List species. The species recorded are typical of the habitat present. The recorded wintering bird assemblage comprised nine species of principal importance and/or conservation priorities of the Local BAP.

[87] eDNA, Environmental DNA surveys determine the presence/ absence of Great Crested Newts from DNA analysis.
[88] Bird of Conservation Concern 4: the Red List for Birds. British Trust for Ornithology (BTO). https://www.bto.org/science/monitoring/psob.

Resource/feature	Value	Receptor	Baseline and rationale for valuation
	Local/parish	Breeding bird assemblage at Whitmore Wood	Field surveys recorded a total of 21 species at Whitmore Wood within the land required for the Proposed Scheme which includes two Red List species. The species recorded are typical of this habitat and were present in low numbers. The recorded breeding bird assemblage comprised three species of principal importance and/or conservation priorities of the Local BAP.
	Local/parish	Wintering bird assemblage at Whitmore Wood	Field surveys recorded a total of 32 species at Whitmore Wood within the land required for the Proposed Scheme which includes seven Red List species. The species recorded are typical of this habitat and were present in low numbers. The recorded wintering bird assemblage comprised five species of principal importance and/or conservation priorities of the Local BAP.
	Local/parish	Wintering bird assemblage at marshy grassland west of Whitmore Wood and the WCML	Field surveys recorded a total of 12 species within the land required for the Proposed Scheme which includes one Red List species. The species recorded species typical of this habitat. The recorded wintering bird assemblage comprised two species of principal importance and/or conservation priorities of the Local BAP, these are lapwing and snipe.
Otter	Up to district/ borough	Small population of otter throughout the Whitmore Heath to Madeley area	Otter occur at low density throughout the Whitmore Heath to Madeley area. Desk study records and field survey results indicate otter presence along the River Lea, including a potential holt on a River Lea tributary adjacent to land required for the Proposed Scheme. An incidental sighting of an otter print was confirmed during field surveys indicating that otters are likely to use the Meece Brook and associated waterbodies for foraging and as a corridor for movement. Otter is an Annex 2 species, and is also a species of principal importance and a conservation priority of the local BAP.
Water vole	Up to district/borough	Populations of water vole using the Meece Brook, River Lea and other watercourse in the Whitmore Heath and Madeley Area	No direct evidence of water voles were identified in the desk study or field surveys. However, habitats along the Meece Brook and River Lea are suitable and small populations are assumed to be present. Water vole is a species of principal importance and is also a conservation priority of the local BAP.
Fish	Up to district/borough	Fish assemblage in Meece Brook	Desk study records indicate the presence of a diverse fish assemblage in the Meece Brook. Records for roach, perch, three-spined stickleback and stone loach were reported adjacent to and upstream of the land required for the Proposed Scheme. Approximately 4km downstream from the land required for the Proposed Scheme a desk study record for a bullhead was also identified. A desk study record for European eel on the Meece Brook approximately 12km downstream of the land required for the Proposed Scheme was also identified. In the absence of obvious barriers, it is assumed these species could occur within the waterway passing through the land required for the Proposed Scheme.

Resource/feature	Value	Receptor	Baseline and rationale for valuation
			Bullhead is an Annex 2 species. European eel is a species of principal importance.
	Up to district/borough	Fish assemblage in the River Lea	Desk study records show presence of bullhead and brown trout approximately 1.3km upstream of the land required for the Proposed Scheme on the River Lea. In the absence of obvious barriers, it is assumed these species could occur within the part of the waterway passing through land required for the Proposed Scheme. Brown trout is a species of principal importance.
Vascular plants	District/borough value	Field scabious and quaking grass recorded in an areas of grassland east of Meece Brook	Field surveys recorded field scabious and quaking grass in an area of grassland east of Meece Brook within the land required for the Proposed Scheme. These species are listed as near threatened on Staffordshire Rare Plant list[89] and are of local concern on the UK Rare Plant List[90]. These species are listed as frequent in the county.
	Local/ parish	Wood sorrel at Whitmore Wood and Hey Sprink	Field surveys identified wood sorrel within the land required for the Proposed Scheme at Whitmore Wood and Hey Sprink. Wood sorrel is nationally scarce on Staffordshire Rare Plant Register and locally common on the UK Rare Plant List.
	Local/parish	Bluebell reported at locations throughout the Whitmore Heath to Madeley area	Field surveys and desk study records identified Bluebell within and adjacent to the land required for the Proposed Scheme. Specifically, this species was reported at Whitmore Wood, near Manor Road, at woodland south of Randilow, near Grange Farm, north and west of Moss House, and near Manor Road Verges. Bluebells are listed as very common on the Staffordshire Flora Checklist 2017[91].
Badger	Local/parish	At least 11 social groups in undisclosed locations in the Whitmore Heath to Madeley area	A common and widespread species recorded during field surveys in the Whitmore heath to Madeley area. Five main setts have been identified within the land required for the Proposed Scheme. A further six main setts have been identified within 100m of the land required for the Proposed Scheme.
Polecat	Local/parish	Potential populations using suitable habitats present in the Whitmore Heath to Madeley area	Desk study records identified polecat along the A53 Newcastle Road/A53 Whitmore Road corridor at Whitmore and near Westbury Park. Polecat is relatively widely distributed in Staffordshire. Polecat potentially occurs within the Whitmore Heath to Madeley area, and is most likely to be present within networks of farmland with hedgerows and small woods. Polecat is a species of principal importance.
Harvest mouse	Up to local/parish	Potential populations using suitable habitats present in	Although no confirmed evidence of this species has been observed during field surveys, it is possible that populations of harvest mouse are present in

[89] Hawksford, J.E. and Hopkins, I.J.2017, County (Staffordshire) Rare Plant Register. Staffordshire Wildlife Trust.

[90] A Checklist of the Flora of Staffordshire Revised 2017. Available at: http://bsbi.org/staffordshire

Resource/feature	Value	Receptor	Baseline and rationale for valuation
		the Whitmore Heath to Madeley area	hedgerows, arable land, areas of taller grassland and woodland edge. Harvest mouse is a species of principal importance.
European hedgehog	Local/parish	Potential populations using suitable habitats present in the Whitmore Heath to Madeley area	There are desk records for European hedgehog within 120m of the land required for the Proposed Scheme. This species is widely distributed throughout the UK and is likely to be present in suitable habitats throughout the Whitmore Heath to Madeley area including woodland, hedgerows, grassland, scrub and gardens. European hedgehog is a species of principal importance.
Brown hare	Local/parish	Potential populations using suitable habitats present in the Whitmore Heath to Madeley area	There are desk study records of brown hare within 250m south-west of the land required for the Proposed Scheme. Brown hare is likely to be present in areas of open arable and grassland habitats throughout this Whitmore Heath to Madeley area. Brown hare is a species of principal importance and a conservation priority of the local BAP.
Fallow deer	Local/parish	Populations of fallow deer in and around the Whitmore Heath to Madeley area	Incidental sightings and stakeholder feedback have indicated populations of fallow deer, including white individuals, are present around the Whitmore Heath to Madeley area. Fallow deer are common and widespread in England and are not a species of principal importance or a conservation priority of the local BAP.
Reptiles	Up to local/parish	Potential small populations of common reptiles in the Whitmore Heath to Madeley area	No reptiles were found during field surveys. Suitable habitat that was not surveyed was generally constrained to field margins, edges of woodland and scrub habitat or isolated small patches of overgrown grassland. These habitats are within a generally intensively farmed landscape, offering limited opportunities for reptiles. It is, therefore, assumed that any reptiles located within the land required for the Proposed Scheme are present in low numbers. Grass snake, slow-worm and common lizard are all species of principal importance. Grass snake is also a conservation priority of the local BAP.
Hazel dormouse	Negligible	Potential dormouse populations using suitable woody habitats in the Whitmore Heath to Madeley area	No evidence has been found for the presence of hazel dormouse during field surveys of woodland at Whitmore Wood, Wrinehill Wood, woodland south-east of Whitmore Wood, and Hey Sprink wood. Although suitable habitat is abundant, there is only a single record of hazel dormouse present within Wrinehill Wood from 2013. Given the lack of confirmed presence during survey work, it is considered unlikely that any populations exist within the land required for the Proposed Scheme.
White-clawed crayfish	Negligible	Potential populations using watercourse in the Whitmore Heath to Madeley area	There are no desk study records of this species from within this area. Due to the declining status of the white-clawed crayfish within Staffordshire, and increasing prevalence of signal crayfish, it is considered that native white-clawed crayfish are absent from the area.

Future baseline

Construction (2020)

8.3.31 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

8.3.32 No committed developments have been identified in this area that will materially alter the baseline conditions in 2020 for ecological receptors.

Operation (2027)

8.3.33 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

8.3.34 No committed developments have been identified in this area that will materially alter the baseline conditions in 2027 for ecological receptors.

8.4 Effects arising during construction

Avoidance and mitigation measures

8.4.1 The following measures have been included as part of the design of the Proposed Scheme (additional to the landscape planting as shown on the Map Series CT-06 along the route of the Proposed Scheme, which will be largely a mixture of woodland/scrub and grassland), and will contribute towards limiting effects on habitat and species:

- provision of the Meece Brook viaduct and the River Lea viaduct over the River Lea will avoid direct effects on the Meece Brook and the River Lea respectively and allow free passage of wildlife beneath them;
- provision of a retaining wall along the north-east of Whitmore North cutting to reduce the area of land within Whitmore Wood required for construction of the Proposed Scheme and the subsequent loss of ancient woodland and habitat; and
- the twin bore section of the Whitmore Heath tunnel will avoid direct impacts on broadleaved semi-natural woodland and the Madeley tunnel will avoid direct impacts upon semi-improved and improved grassland.

8.4.2 The assessment assumes implementation of the measures set out within the draft Code of Construction Practice[92] (CoCP) which includes sensitive construction practices and the preparation of habitat management plans.

8.4.3 Section 9 of the draft CoCP requires contractors to implement a range of measures to protect ecological receptors including the following:

[92] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

- manage impacts from construction, including the timing of works, on designated sites, protected and notable species and other features of ecological importance such as ancient woodlands and watercourses;
- reduce habitat loss by keeping the working area to the reasonable minimum;
- reinstatement of areas of temporary habitat loss;
- restoration and replacement planting;
- implement management measures for potential ecological impacts to control dust, water quality and flow, noise and vibration, and lighting;
- provision of a watching brief, where relevant;
- relocation or translocation of species, soil and/or plant material, as appropriate;
- consultation with Natural England, the Environment Agency, local wildlife trusts and relevant planning authorities prior to and during construction; and
- compliance with all wildlife licencing requirements, including those for protected and invasive species and designated sites.

Assessment of impacts and effects

8.4.4 Effects arising during construction that are significant at the district/borough level or above are described below. Effects on ecological features of significance at the local/parish level are listed in Volume 5: Appendix EC-016-004.

Designated sites

8.4.5 Construction of Whitmore North cutting, Whitmore Wood retaining wall and Whitmore Wood overbridge will result in the permanent loss of approximately 6ha (34%) of ancient woodland at Whitmore Wood LWS and AWI site. This includes approximately 1.6ha of broadleaved semi-natural ancient woodland and approximately 4.4ha of PAWS. The loss of ancient woodland will result in a permanent adverse effect on the structure and function of the site that is significant at the county level.

8.4.6 The realignment of Manor Road will result in the permanent loss of approximately 0.4ha (100%) of species-rich grassland within Manor Road Verges BAS. The loss of grassland will result in a permanent adverse effect on the structure and function of the BAS that is significant at district/borough level.

8.4.7 Construction of Madeley cutting will result in the permanent loss of approximately 0.2ha (4%) of ancient woodland from Barhill Wood AWI. The loss of ancient woodland will have a permanent adverse effect on this habitat that is significant at county level.

8.4.8 Construction of Lea South embankment will result in the permanent loss of approximately 0.2ha (22%) of ancient woodland from the unnamed wood south of Hey Sprink AWI. The loss of ancient woodland will have a permanent adverse effect on this habitat that is significant at county level.

8.4.9 Construction of Lea South embankment will result in the permanent loss of approximately 0.2ha (6%) of ancient woodland from Hey Sprink (wood south-west of) LWS. The loss of ancient woodland will have a permanent adverse effect on this habitat that is significant at county level.

8.4.10 Construction of the Madeley tunnel and Checkley South embankment will result in the permanent loss of approximately 0.4ha (11%) of ancient woodland from Wrinehill Wood (east of) BAS. The loss of ancient woodland will have a permanent adverse effect at the county level.

Habitats

Woodland

8.4.11 As well as the effects on ancient woodlands described in the designated sites section, one other woodland will be affected by the construction of the Proposed Scheme at a level of significance greater than local/parish level. Construction of the River Lea viaduct will result in the permanent loss of approximately 1.9ha (38%) of broadleaved woodland bordering the Stoke to Market Drayton Railway. The loss of semi natural broadleaved woodland will result in a permanent adverse effect that is significant at the district/borough level.

Grassland

8.4.12 Construction of Stableford North embankment and the Meece Brook viaduct, and the realignment of Meece Brook will result in the permanent loss of approximately 5.6ha (100%) of grassland to the east of Meece Brook. The loss of this grassland will result in a permanent adverse effect on lowland meadow habitat that is significant at county level.

8.4.13 Construction of the River Lea viaduct will result in the permanent loss of approximately 4.5ha (21%) of marshy grassland south of Hey Sprink ancient woodland and the WCML. The loss of this grassland will result in a permanent adverse effect on floodplain grazing marsh habitat that is significant at up to county level.

8.4.14 Construction of the Whitmore north cutting satellite compound will result in the permanent loss of 1.2ha (32%) of neutral semi improved grassland within a field north of Whitmore Heath and east of Whitmore Wood. The loss of this grassland will result in a permanent adverse effect on lowland meadow habitat that is significant at county level.

8.4.15 Woodland planting will result in the loss of 1.2ha (100%) of semi improved neutral grassland to the north-east of Whitmore Wood. The loss of this grassland will result in a permanent adverse effect on lowland meadow habitat that is significant at district/ borough level.

8.4.16 The realignment of Manor Road will result in the permanent loss of approximately 0.4ha (100%) of unimproved neutral grassland within Manor Road Verges BAS. The loss of this habitat will result in a permanent adverse effect that is significant at district/borough level.

Hedgerows

8.4.17 On a precautionary basis, it is assumed that all hedgerows (approximately 22.7km) within the land required to construct the Proposed Scheme in the Whitmore Heath to Madeley area will be permanently lost and the remaining hedgerow network fragmented. This includes the native species-rich hedgerows at Red Lane BAS. This total, however, includes some hedgerows that are likely to be retained, such as those located within land required for overhead line diversions/realignments and those located within land required for the creation of woodland and grassland habitat. The combined loss and severance of hedgerows within the land required for the Proposed Scheme will have a permanent adverse effect that is significant at district/borough level.

Watercourses

8.4.18 The route of the Proposed Scheme will cross Meece Brook via the Meece Brook viaduct. This watercourse will, however, need to be realigned around the viaduct piers for a length of approximately 60m. This realignment will result in the permanent loss of valuable stream corridor habitats and will result in a permanent adverse effect that is significant at up to district/borough level.

8.4.19 A number of smaller watercourses (approximately eight) will also be permanently diverted, realigned or culverted for the Proposed Scheme, severing the habitat corridors that follow these watercourses. Such a loss of habitat and fragmentation will result in a permanent adverse effect that is significant at up to district/borough level.

Water bodies

8.4.20 On a precautionary basis, it is assumed that all 37 ponds located within the land required for the Proposed Scheme in the Whitmore Heath to Madeley area will be permanently lost. This total, however, includes some ponds that are likely to be retained, such as those located within land required for overhead line diversions/realignments and those located within land required for the creation of woodland and grassland habitat. Where survey has not been possible, a precautionary approach to the assessment has been undertaken. The loss of ponds within the land required for the Proposed Scheme could lead to a permanent adverse effect on the conservation status of water bodies that will be significant, in each case, at up to the district/borough level.

Ancient and veteran trees

8.4.21 It is assumed that nine veteran trees recorded within the land required for the Proposed Scheme in the Whitmore Heath to Madeley area will be permanently lost. Four other veteran trees occur within land required for habitat creation only and they will be retained. Ancient and veteran trees are an irreplaceable resource and their potential loss will result in a permanent adverse effect that is significant at district/borough level in each case. Where reasonably practicable, measures will be taken to protect and retain veteran trees within and adjacent to the proposed works area to reduce the number of veteran trees that will be impacted. On a precautionary basis, veteran trees are assumed to be lost as a result of:

- works associated with the Stableford North embankment which will result in the loss of a veteran oak located within a field to the east of Bent Lane;
- works associated with the A53 temporary roundabout which will result in the loss of a veteran oak, located within a field north of the A53 Newcastle Road/A53 Whitmore Road, south of Whitmore;
- works associated with Whitmore Heath tunnel which will result in the loss of a veteran oak, located within a field north of the A53 Newcastle Road/A53 Whitmore Road and north of Baldwin's Gate;
- works associated with a balancing pond which will result in the loss of two veteran oaks, located within the same field north of the A53 Newcastle Road/A53 Whitmore Road and north of Baldwin's Gate;
- works associated with Whitmore North cutting which will result in the loss of a veteran oak, located on the southern edge of Whitmore Wood;
- works associated with Madeley cutting which will result in the loss of a veteran oak, located on the boundary of a field west of Red Lane and east of Barhill wood and a veteran large leaved lime, located on the boundary of a field west of the A525 Bar Hill Road; and
- works associated with a temporary diversion of Madeley Bridleway 1 which will result in the loss of a veteran ash, located on the boundary of a field west of Red Lane and west of Madeley.

Species

Bats

8.4.22 The removal or disturbance of habitat features that are utilised by bats during breeding, hibernation or migrating between roosts is considered to have the potential to result in adverse effects on the bat populations or assemblages during construction. However, the point at which such impacts are considered likely to result in adverse significant effects on the conservation status of the population concerned will differ depending on the status of the species concerned.

8.4.23 The impact of disturbance on bat populations will generally be localised and limited to the period of construction. Bats utilising retained habitats may be subject to irregular and localised disturbance from lighting, noise and movement during the construction period where works in autumn, winter and spring may be carried out for short periods after dusk or prior to dawn. These impacts would only temporarily deter bats from using foraging and commuting habitats and the implementation measures that are described in the draft CoCP will reduce potential disturbance affects to a level that is not significant.

8.4.24 Construction of the Whitmore Heath tunnel northern porous portal and the Whitmore North cutting will result in the permanent loss of one maternity roost, one day roost and one day/hibernation roost for brown long-eared bat, a day roost for soprano pipistrelle, and a day roost for a Myotis species. Construction of Whitmore North cutting, Whitmore Wood retaining wall and Whitmore Wood overbridge will result in the permanent loss of approximately 6ha of woodland at Whitmore Wood, which is

used as foraging and commuting habitat for the assemblage of bats present in the Whitmore area. This will both reduce the availability of foraging habitat, as well as cause fragmentation of the remaining parcels of Whitmore Wood. Despite the woodland at Whitmore Heath, which provides habitat connectivity to Whitmore Wood, being largely retained as a result of the Whitmore Heath tunnel, the direct loss of roosts and the loss and fragmentation of foraging habitat will result in a permanent adverse effect on the assemblage of bats present in the Whitmore area, which will be significant at the county level.

8.4.25 Construction of the Lea North embankment, Lea South embankment and the Madeley cutting will result in the permanent loss of two day roosts for soprano pipistrelle and one day roost for an unconfirmed species. The loss of roots will result in a permanent adverse effect on the assemblage of bats present in the areas between Hey Sprink Wood and Barhill Wood, which will be significant at the county level.

8.4.26 Construction of the Madeley tunnel southern porous portal will result in the permanent loss of a day roost for an unknown species. Construction of the Madeley cutting will result in the permanent loss of approximately 0.2ha of woodland at Barhill Wood. It is assumed that the bat assemblage in the area north of Barhill Wood use this and nearby woodland areas including Grafton's Wood for foraging and commuting. Despite the woodland habitat around the Barhill area being largely retained, the direct loss of roosts and the loss and fragmentation of foraging and commuting habitat will result in a permanent adverse effect on the assemblage of bats associated with habitat north of the Barhill area, which will be significant at up to the county level.

8.4.27 Loss of other suitable habitats within the land required for the Proposed Scheme may require some bats to travel further, and expend more energy during day to day foraging and movement throughout their home range for the duration of construction. However, such effects alone are for all species considered unlikely to result in sufficient disturbance of the populations or assemblages concerned to result in a permanent adverse effect on their conservation status.

Amphibians

8.4.28 An assumed metapopulation of great crested newts (AMP 4.1) has been identified across a network of two ponds situated between Whitmore and Baldwin's Gate, south of the A53 Newcastle Road/A53 Whitmore Road. The construction of the Whitmore South cutting and reinstatement of the A53 Newcastle Road will result in the loss of both ponds, one of which is confirmed as supporting a population of great crested newts, and hedgerows, woodland and grassland that offer terrestrial habitat opportunities for great crested newt foraging, dispersal and shelter. This will result in a permanent adverse effect on the great crested newt metapopulation between Whitmore and Baldwin's Gate, south of the A53 Newcastle Road/A53 Whitmore Road which will be significant at up to the county level.

8.4.29 An assumed medium metapopulation of great crested newts (AMP 4.2) has been identified across a network of 28 ponds situated north-west of Whitmore Heath. The construction of Lea South embankment, Whitmore Wood retaining wall and Whitmore North cutting will result in the loss of nine ponds, none of which have been confirmed as supporting great crested newt populations, and hedgerows, woodland and grassland that offer terrestrial habitat opportunities for great crested newt

foraging, dispersal and shelter. This will result in a permanent adverse effect on the great crested newt metapopulation situated north-west of Whitmore Heath, which will be significant at up to the county level.

8.4.30 A medium metapopulation of great crested newts (AMP 4.3) has been identified across a network of 11 ponds situated west of Onneley. The construction of Madeley cutting, including the associated temporary material stockpile, will result in the loss of two ponds, one of which has been confirmed as supporting great crested newt populations. Terrestrial habitat comprising hedgerows, woodland and grassland that offer opportunities for great crested newt foraging, dispersal and shelter will also be lost. Additionally there will be fragmentation effects associated with large areas of construction, such as Madeley cutting. This will result in a permanent adverse effect on the great crested newt metapopulation situated west of Onneley, which will be significant at the county level.

8.4.31 Of the 37 ponds within the land required for the Proposed Scheme within the Whitmore Heath to Madeley area, 15 ponds have been assessed as unsuitable for great crested newts, six have been accessible for presence/absence survey and, of these, three have been confirmed as supporting great crested newts. In the absence of survey information, the remaining 16 ponds are assumed to support populations of great crested newts. This is precautionary and it is likely that a proportion of the un-surveyed ponds do not support great crested newt populations. The loss of any ponds supporting great crested newts would result in a permanent adverse effect on amphibian populations that will be, in each case, significant at up to county level.

Birds

8.4.32 Construction of the Proposed Scheme between Meece embankment and the Lea South embankment through the Whitmore Heath to Madeley area will result in the loss of barn owl foraging habitat in the form of large areas of arable, grassland and field margins and the loss of potential roosting sites within mature trees and buildings lost. This loss represents a permanent adverse effect on the barn owl population identified east of Whitmore, which will be significant at the county level.

Other mitigation measures

8.4.33 This section describes other mitigation measures designed to reduce or compensate for significant ecological effects. These include habitat creation and habitat enhancement.

Habitats

Woodland

8.4.34 The Proposed Scheme will result in the combined loss of approximately 7ha of ancient woodland, which is irreplaceable, from Whitmore Wood, Barhill Wood, the unnamed wood south of Hey Sprink AWI, Hey Sprink (wood south-west of) LWS and Wrinehill Wood (east of) BAS. In each case this represents a residual adverse significant effect at the county level.

8.4.35 In addition, the Proposed Scheme will result in the loss of approximately 1.9ha of lowland mixed deciduous woodland bordering the Stoke to Market Drayton Railway, which is significant at the district/borough level. There is a further loss and

fragmentation from twelve small woodlands across the Whitmore Heath and Madeley area, including loss of approximately 1.3ha of lowland mixed deciduous woodland and 13.5ha of other woodland habitat as reported within the register of local/parish effects (Volume 5: Appendix EC-016-004). The combined loss and fragmentation of these woodland habitats from these woodlands is significant at the district/borough level.

8.4.36 In accordance with the Ecological Principles of Mitigation in the SMR Addendum, a route-wide, integrated strategic approach has been developed to compensate for loss of woodland. The planting in this area is required to fulfil the objective of no net loss as far as possible in the local area as well as to ensure that the populations of protected and notable species including bats are maintained. With these objectives in mind, where reasonably practicable, the locations of woodland planting have been located so as to increase the size of existing higher quality woodland habitat and to increase connectivity.

8.4.37 The loss of ancient woodland will be partly compensated through a range of measures, including the planting of native broadleaved woodland as follows:

- approximately 35ha of woodland planting will be provided east of Whitmore South cutting and Whitmore North cutting. This woodland will enhance linkages between the retained area of Whitmore Wood and Hey Sprink ancient woodlands. In addition, the remaining area of approximately 11.9ha of Whitmore Wood will be incorporated within the land required for the Proposed Scheme for woodland enhancement. This will partly compensate for the loss of approximately 6ha of ancient woodland at Whitmore Wood, the loss of approximately 0.2ha of ancient woodland at an unnamed wood south of Hey Sprink and the loss of 0.2ha of ancient woodland at Hey Sprink (wood south-west of);

- approximately 3.9ha of woodland planting will be provided to the south-west of Madeley cutting, directly adjacent to Barhill Wood. This woodland will partly compensate for the loss of approximately 0.2ha of ancient woodland at Barhill Wood as well as loss of other non-ancient woodland in the vicinity; and

- approximately 5.2ha of woodland planting will be provided to the south of the Madeley tunnel northern porous portal. This woodland will link Wrinehill Wood (east of) to Wrinehill Wood and will partly compensate for the loss of approximately 0.4ha of ancient woodland from Wrinehill Wood (east of) and other non-ancient woodland in the vicinity.

8.4.38 Woodland planting to partly compensate for the loss of ancient woodlands will include further measures such as translocation of ancient woodland soil with its associated seed bank where appropriate. Other measures such as planting native trees and shrubs of local provenance and translocation of coppice stools and dead wood will be undertaken in accordance with the Ecological Principles of Mitigation within the SMR Addendum.

8.4.39 Within the Whitmore Heath to Madeley area, approximately 8.1ha of further woodland habitat creation will be undertaken to compensate primarily for adverse effects upon non-ancient woodland, at locations including the following:

- approximately 4.7ha to the east and west of Meece Brook;

- approximately 1.2ha to the north of the Stoke to Market Drayton Railway; and
- approximately 1.3ha to the west of Red Lane and east of Bar Hill Road.

8.4.40 The target habitat type for woodland planting is lowland mixed deciduous woodland habitat of principal importance. The new areas of woodland habitat will connect and help maintain the integrity of remaining areas of woodland. A temporary adverse effect is expected until these woodland areas have become established, after which there will be a permanent beneficial effect on lowland mixed deciduous woodland that is significant at district/borough level.

8.4.41 In addition, there will be further areas of landscape planting of native broadleaved woodland, which will also contribute to habitat creation.

Grassland

8.4.42 The Proposed Scheme will result in the loss of approximately 4.5ha of floodplain grazing marsh to the south of Hey Sprink and the WCML, and the combined loss of approximately 8.4ha of lowland meadow at Manor Road Verges BAS, to the east of Meece Brook, to the north of Whitmore Heath and east of Whitmore Wood, and to the north-east of Whitmore Wood. In each case this represents an adverse significant effect at the county or district/borough level.

8.4.43 There is a further loss of approximately 36.8ha of semi-improved grassland within the Whitmore Heath to Madeley area, area as reported within the register of local/parish effects (Volume 5: Appendix EC-016-004). The combined loss of semi-improved grassland from these areas is significant at the district/borough level.

8.4.44 In accordance with the Ecological Principles of Mitigation in the SMR Addendum a route-wide, integrated strategic approach has been developed to compensate for loss of lowland meadow habitat. The species rich grassland creation in this area is required to fulfil the objective of no net loss as far as possible in the local area as well as to ensure that the populations of protected and notable species including great crested newts and barn owls are maintained. With these objectives in mind, where reasonably practicable, the locations of grassland creation have been located so as to increase the size of existing higher quality habitat and to increase connectivity.

8.4.45 Within the Whitmore Heath to Madeley area, grassland habitat creation will be undertaken at locations including the following:

- approximately 2.3ha of species-rich grassland will be created on land to the east of Manor Road, south-west of Manor Road overbridge, to compensate for grassland losses including that of approximately 0.4ha of lowland meadow within Manor Road Verges BAS;
- approximately 15.6ha of marshy grassland will be created on the Meece Brook floodplain to compensate for grassland losses including loss of approximately 5.6ha of lowland meadow to the east of Meece Brook and approximately 4.5ha of floodplain grazing marsh south of Hey Sprink wood and the WCML;
- approximately 2.7ha of species-rich grassland will be created on land to the north of Snape Hall Farm and to the north-west of Whitmore Heath, and approximately 2ha of species-rich grassland will be created on land to

southwest of Woodhouse farm and northwest of Whitmore Heath. This will compensate for the losses including the loss of 1.2ha of grassland north of Whitmore Heath and east of Whitmore Wood, and the loss of 1.2ha of grassland north-east of Whitmore Wood; and

- approximately 1.6ha of species-rich grassland will be created on land to the east of Baldwin's Gate and north of the WCML.

8.4.46 The target habitat type for grassland habitat creation is lowland meadow or floodplain grazing marsh habitat of principal importance, depending on location. A temporary adverse effect upon grassland habitats within the Whitmore Heath to Madeley area is expected until grassland creation areas have become established, after which these measures will reduce the cumulative effect on grassland to a level that is not significant.

Hedgerows

8.4.47 New hedgerows will be planted as replacement for those lost as a result of the Proposed Scheme. Where practicable, the hedgerow to be lost at Red Lane BAS will be translocated to the nearest suitable habitat creation areas. Approximately 19.9km of new hedgerows will be planted and the species composition will be characteristic of the surrounding area. This represents a net loss in hedgerow of approximately 2.8km after mitigation, which is a residual adverse effect that is significant at the district/borough level. However, opportunities will be sought to retain or replace hedgerows within the land required for the Proposed Scheme for temporary works only. Reinstatement of existing hedgerows within the land required for temporary works would provide approximately 10.1km of hedgerow in addition to the mitigation described.

Watercourses

8.4.48 The realigned section of Meece Brook will be naturalised with a profile to promote the establishment of marginal vegetation and pools. Once the vegetation has developed, the adverse effect on this watercourse will be reduced to a level that is not significant.

8.4.49 Where smaller watercourses are diverted, the channel will be naturalised, where reasonably practicable, with a profile to promote the establishment of marginal vegetation and pools. Once the vegetation has developed the adverse effect on these watercourses will be reduced to a level that is not significant.

Water bodies

8.4.50 At least one pond will be created for every pond lost within the Proposed Scheme. New ponds will be established in accordance with the Ecological Principles of Mitigation in the SMR Addendum. Once established, it is anticipated that any adverse effect on pond habitats will be reduced to a level that is not significant.

Ancient and veteran trees

8.4.51 Where practicable measures will be taken to protect the nine impacted veteran trees. Where loss is unavoidable, the trees will be soft felled and sections placed within retained habitats to provide a continued deadwood resource. Ancient and veteran

trees are irreplaceable and the loss of these trees represents a residual adverse effect that is significant at the district/borough level.

Species

Bats

8.4.52 To replace roosts that will be lost to construction, artificial roosting provision will be provided across the Proposed Scheme in accordance with the Ecological Principles of Mitigation within the SMR Addendum. The habitat creation measures detailed above for mitigation of habitat loss, including creation of areas of grassland, hedgerows, new ponds, and semi-natural woodland, will compensate for those bat foraging habitats lost within the land required for the Proposed Scheme as detailed below.

8.4.53 The loss of roosts associated with the bat assemblage in the Whitmore area will be addressed by the provision of replacement roosting structures in the areas of retained woodland within Whitmore Wood. Once established, woodland planting east of Whitmore South cutting and Whitmore North cutting (totalling approximately 35ha) will address the loss of foraging habitat associated with the same assemblage. New woodland planting that connects the retained eastern section of Whitmore Wood with other retained woodland at Whitmore Heath, as well as new planting east of the Proposed Scheme that will connect Whitmore Wood with the other parcels of woodland, will address the fragmentation of habitat caused by construction of the cutting. Following the implementation of these measures, the adverse effects on the conservation of the bat assemblage in the Whitmore area will be reduced to a level that is not significant.

8.4.54 The loss of roosts associated with the bat assemblage in the area between Hey Sprink and Barhill Wood will be addressed by the provision of replacement roosting structures in the areas of woodland planting between Hey Sprink and Barhill Wood. New woodland planting in these areas will also connect the replacement roosts with suitable foraging habitat associated with nearby woodlands such as Whitmore Wood, Hey Sprink and Barhill Wood. Following the implementation of these measures, the adverse effects on the conservation of the bat assemblage in the area between Hey Sprink and Barhill Wood will be reduced to a level that is not significant.

8.4.55 The loss of roosts associated with the bat assemblage in the area north of Barhill Wood will be addressed by the provision of replacement roosting structures in the areas of retained woodland at Barhill and areas of new woodland planting south of Madeley cutting. Once established, woodland planting around Barhill Wood, south of Grafton's Wood and north-east of Wrinehill Wood (totalling approximately 3.8ha) will address the loss of small amounts of foraging habitat associated with the same assemblage. To address the effect of habitat fragmentation on bats, the Madeley Bridleway 1 accommodation green overbridge is greened primarily to provide connectivity for bats on a precautionary basis. It is designed to support vegetation that will connect to areas of retained and newly created habitat on either side of the Proposed Scheme and will provide a safe crossing point for bats over the route of the Proposed Scheme. New woodland planting that connects Wrinehill Wood and Grafton's Wood will further improve connectivity and reduce any effects of fragmentation caused by the construction of the Madeley cutting. Following implementation of these measures, the adverse effects on the conservation of the bat

assemblage in the area north of Barhill Wood will be reduced to a level that is not significant.

8.4.56 HS2 Ltd will seek to continue to survey within the vicinity of the proposed Madeley Bridleway 1 accommodation green overbridge location during the period up to construction, and if it is demonstrated that any of the above measures are not required to maintain connectivity and/or the conservation status of target species, then the mitigation provision may be revised accordingly.

Amphibians

8.4.57 Provision of ponds, species-rich neutral grassland and broadleaved woodland will be designed to compensate for the loss of breeding sites, foraging habitat and places of shelter used by great crested newts and other amphibian species. Compensation will be provided within the ecological habitat creation areas near the Meece Brook viaduct, near Whitmore Wood, between Whitmore Wood and Hey Sprink, near Madeley Bridleway 1 accommodation overbridge, and north of Wrinehill Wood. Ponds, grassland and woodland will be established in accordance with the Ecological Principles of Mitigation within the SMR Addendum. Following implementation of these measures, the adverse effect on amphibian populations will be reduced to a level that is not significant. HS2 Ltd will continue to survey ponds for great crested newt populations. Where it is confirmed that populations are absent, then pond and terrestrial habitat provision will be re-assessed.

Birds

8.4.58 Habitat creation measures to be provided to address the adverse effects on a pair of barn owls to the east of Whitmore includes the provision of 14.4ha of wet grassland habitat in the floodplain of the Meece Brook. This will provide new foraging opportunities for these barn owls. Once the habitats have become established, the adverse effect resulting from the loss of foraging habitat on barn owl populations within the east of Whitmore will be reduced to a level that is not significant.

Badger

8.4.59 Although there will be no significant effects on badger populations in this area, mitigation measures to address the potential disturbance of badgers will be provided in accordance with the Ecological Principles of Mitigation within the SMR Addendum. This will include the provision of badger proof fencing and replacement setts where necessary.

Summary of likely residual significant effects

8.4.60 This section describes anticipated significant residual ecological effects during construction, taking into account the mitigation and compensation proposed.

8.4.61 Ancient woodland is irreplaceable and the loss of 7ha of this habitat will result in a permanent adverse residual effect upon ancient woodland that is significant at the county level.

8.4.62 However, extensive new woodland planting at several sites within the Whitmore Heath to Madeley area will increase the area of broadleaved woodland and enhance

woodland connectivity. This will result in a permanent beneficial residual effect on lowland mixed deciduous woodland habitat that is significant at district/borough level.

8.4.63 On a precautionary basis, it is assumed that there is a net loss in hedgerow of approximately 2.8km, which will result in a permanent adverse residual effect that is significant at the district/borough level. However, restoration of land required only for the construction of the Proposed Scheme to its current use, offers potential for reinstatement of a further 10.1km of existing hedgerow. The provision of the majority of this reinstated hedgerow would reduce the residual effect to a level that is not significant.

8.4.64 The assumed loss of nine veteran trees will result in a permanent adverse residual effect that is significant at district borough/level in each case.

Cumulative effects

8.4.65 No cumulative effects on ecological receptors have been identified in the Whitmore Heath to Madeley area.

8.5 Effects arising from operation

Avoidance and mitigation measures

8.5.1 Within this section of the Proposed Scheme the following elements of the design will avoid or reduce impacts on features of ecological value during operation:

8.5.2 Meece Brook viaduct and the River Lea viaduct will provide ecological connectivity under the route of the Proposed Scheme to adjacent habitats. Ecological connectivity beneath the route of the Proposed Scheme will be maintained for a length of 1km of viaduct in the Whitmore Heath to Madeley area. This will reduce habitat fragmentation, allowing free passage of wildlife at these locations:

- tunnel sections beneath Whitmore Heath and Madeley will provide ecological connectivity above the route of the Proposed Scheme for a length of 1.6km;
- Madeley Bridleway 1 accommodation green overbridge will support vegetation to provide ecological connectivity adjacent habitats. This will reduce habitat fragmentation by providing a wildlife movement corridors over the route of the Proposed Scheme at these locations;
- one further overbridge and one underbridge will maintain farm access and/or public access on footpaths or bridleways across the route. This overbridge increase connectivity by facilitating wildlife movement across the Proposed Scheme;
- where the route of the Proposed Scheme crosses a watercourse a culvert or dry tunnel will be provided to allow passage of for mammal such as otter and water vole; and
- where significant populations of deer are known to present, fencing will be installed to exclude these species and reduce the risk of collision with trains. The nature of this fencing will be such that the route will remain permeable to many smaller species of wildlife.

Assessment of impacts and effects

8.5.3 Significant effects arising during operation at the district/ borough level or above are described below. Significant effects on ecological features at the local/parish level are listed in Volume 5 Appendix: EC-016-004.

Species

Bats

8.5.4 The operation of the Proposed Scheme has the potential to result in a variety of impacts on bat populations including those as a result of collision with passing trains, turbulence and noise. The point at which such impacts are considered to result in a significant adverse effect on the conservation status of the population concerned will differ between species. As a consequence, the following assessment of operational impacts takes into account the differing character and nature of the bat populations and/or assemblages concerned in determining the likely effects of the Proposed Scheme on each of these receptors.

8.5.5 Due to the large areas over which bats forage it is likely that any loss of, or displacement from, suitable foraging habitat in the vicinity of the Proposed Scheme will in itself amount to only a small proportion of the wider available resource. However, the impact of any such disturbance or displacement could be greatly increased if bats are hampered in moving between breeding sites, hibernation sites and other roosts which they commonly utilise.

8.5.6 Noise, vibration and lighting associated with passing trains have the potential to disturb bat species foraging and commuting within habitats close to the Proposed Scheme. Understanding of the impact of noise on bats caused by passing trains is limited. Research suggests that gleaning bats, such as brown long-eared, will have reduced foraging success within areas where there is persistent noise from busy roads[93]. However, noise generated from passing trains will be regular but temporary and as such will differ from that resulting from a busy road.

8.5.7 Where the route of the Proposed Scheme bisects, or is located in proximity to existing features known to be utilised regularly by foraging or commuting bats, there is an increased risk that bats could be killed or injured as a result of collisions with passing trains or associated turbulence. The significance of any such effect will be dependent on both the flight height range of the species and the vertical alignment of the Proposed Scheme (i.e. whether the railway is in cutting, at grade or on embankment) at the point the impact occurs.

8.5.8 Woodland planting between Whitmore and Hey Sprink and grassland and wetland habitat creation along the Meece Brook will encourage bats to use safe crossing areas across the route of the Proposed Scheme, including beneath the Meece Brook viaduct. Where the route will be in tunnel beneath Madeley and Whitmore Heath existing habitat and new planting will provide safe crossing points. The planting will provide improved connectivity to existing foraging areas to the east and west of the Proposed Scheme including Hey Sprink, Aldersley's Rough, Whitmore Heath and

[93] Schaub, A., Ostwald, J. & Simeers, B.M. (2008). Foraging bats avoid noise. *Journal of Experimental Biology*, 211, 3174-3180.

Barhill Wood. Further north, new grassland and wetland creation along the River Lea will encourage bats to cross the Proposed Scheme beneath the River Lea viaduct, and new woodland and hedgerow planting along Red Lane will encourage bats to use the safe crossing point provided at the Madeley Bridleway 1 accommodation green overbridge which is designed to support vegetation that will connect to existing habitat on either side of the Madeley cutting.

8.5.9 Although it is possible that there may be infrequent incidental mortality of individual bats, due to the avoidance measures described above and the availability of alternative foraging and commuting habitat on either side of the Proposed Scheme, this is unlikely to result in a significant adverse effect on the conservation status of the bat assemblages present in the Whitmore Heath to Madeley area.

Birds

8.5.10 The majority of bird species that are known to be present in the area are not considered to be particularly vulnerable to collision with trains. However, barn owls hunt low over the rough grassland habitats that are associated with railway embankments and are slow moving and therefore subject to likely collision with high speed trains. Two pairs of barn owls breeding in the vicinity of the Proposed Scheme will be affected, east of Whitmore. Research undertaken by the British Trust for Ornithology on behalf of HS2 Ltd suggests that there may be effects on barn owls up to 3km away[94]. This means that more barn owls are likely to be affected than those in the vicinity of the Proposed Scheme identified above. This would result in a permanent residual adverse effect that will be significant at the county level.

Other mitigation measures

8.5.11 HS2 Ltd will seek to identify opportunities to provide barn owl nesting boxes and enhance barn owl habitat at least 3km from the Proposed Scheme in consultation with local landowners. A barn owl action plan will be prepared to identify the measures that can be implemented to help offset the effects. As the availability of nesting sites is a limiting factor for this species the implementation of these measures would be likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

Summary of likely residual significant effects

8.5.12 The mitigation, compensation and enhancement measures described above are likely to reduce the residual ecological effects during operation to a level that is not significant, except for barn owl. Collision with trains is likely to result in the loss of barn owls that nest within 3km of the route resulting in a residual significant effect at the county level. However, provided the proposed mitigation measures for barn owl are implemented through liaison with landowners, the residual effect on barn owl would be reduced to a level that is not significant.

[94] Pringle, H., Siriwardena, G. & Toms, M. (2016) Informing best practice for mitigation and enhancement measures for Barn Owls. British Trust for Ornithology, Research Report 692. BTO, Thetford

Cumulative effects

8.5.13 No cumulative effects on ecological receptors have been identified in the Whitmore Heath area.

Monitoring

8.5.14 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

8.5.15 There are no area-specific requirements for monitoring ecology and biodiversity effects or mitigation during the operation of the Proposed Scheme in the Whitmore Heath to Madeley area.

9 Health

9.1 Introduction

9.1.1 This section identifies the communities within the Whitmore Heath to Madeley area that will be subject to impacts associated with the Proposed Scheme and reports changes that are considered to be potentially important for the health and wellbeing of people within these communities, where these effects are considered to be consequential.

9.1.2 Engagement with key public health bodies has been undertaken to inform the health assessment process. The assessment also draws on health-related information and views expressed in consultation responses from Staffordshire County Council (SCC), Newcastle Borough Council (NBC) and the parish councils of Madeley, Whitmore, and Maer and Aston.

9.1.3 This section deals specifically with impacts at a local level within the Whitmore Heath to Madeley area. Health effects across the Proposed Scheme as a whole are assessed in Volume 3: Route-wide effects.

9.1.4 Further details of the health assessment, including the application of assessment criteria supporting the conclusions presented in this section are contained in Volume 5: Appendix HE-001-004, Health assessment matrix.

9.1.5 Maps showing the location of the key environmental features (Map Series CT-10), construction features (Map Series CT-05), and key operational features (Map Series CT-06) of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

9.1.6 In addition, the community health profile for the Whitmore Heath to Madeley area is set out in Background Information and Data (BID)[95] (BID-HE-002-004).

9.2 Scope, assumptions and limitations

9.2.1 The scope, assumptions and limitations for the health assessment are set out in Volume 1 and the Scope and Methodology Report (SMR)[96].

9.2.2 As set out in the SMR, the health assessment is based on a broad understanding of health, consistent with the World Health Organization (WHO) definition of health as 'a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity'[97]. An individual's health is mostly determined by genetics and lifestyle factors, but for a large enough population many other factors, or 'health determinants', are known to be important, and these factors may be affected by the Proposed Scheme.

9.2.3 The assessment has considered the impacts of the Proposed Scheme on a range of environmental and socio-economic health determinants, which could result in adverse or beneficial effects on health and wellbeing. This process is documented in the health

[95] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2

[96] Volume 5: Appendix CT-001-000, Environmental Impact Assessment Scope and Methodology Report.

[97] World Health Organization, 1948: Constitution of the World Health Organization Basic Documents, 45th edition supplement. Available online at: www.who.int/governance/eb/who_constitution_en.pdf

assessment matrices in Volume 5: Appendix HE-001-003. Based on this a professional judgement has been made to identify those effects on population health and wellbeing that are sufficiently important to report within the health assessment sections found in this report and Volume 3, Route-wide assessment.

9.2.4 The health determinant impacts of relevance within the Whitmore Heath to Madeley area are:

- impacts during construction (temporary and permanent):
  - neighbourhood quality;
  - access to green space, recreation and physical activity;
  - social capital; and
- impacts during operation (permanent):
  - neighbourhood quality.

9.2.5 The geographic extent of the health assessment covers those areas where impacts on health determinants are predicted to occur.

9.2.6 The health assessment methodology is based, in part, on a review of published evidence showing how impacts on health determinants are linked to health 'outcomes' (i.e. effects) in a large enough population. The evidence varies in its strength; for example, the evidence linking physical activity to health outcomes is strong, whereas the evidence linking social capital with health outcomes is moderate. The strength of evidence does not necessarily determine the importance of a health effect, but is an indication of the level of certainty in the assessment. Additionally, there is greater certainty in the prediction of an impact on a health determinant than the consequent effect on health.

9.2.7 There is no established or widely recognised framework for assessing the 'significance' of health effects caused by a development proposal. The SMR sets out a methodology for describing the impacts on health determinants in terms of the magnitude and duration of the change and the extent of the population exposed to this change. It also draws attention to the strength of evidence that links a change in health determinant with health effects. This framework permits the assessment to describe the impacts on determinants in a largely qualitative manner, with some structure to the relative scale of these impacts to give a sense of the importance of the potential health effects. However, this does not provide a definitive basis for drawing conclusions as to whether a health effect is likely to be 'significant'.

9.3 Environmental baseline

Existing baseline

Demographic and health profile of the Whitmore Heath to Madeley area

9.3.1 The Whitmore Heath to Madeley area covers approximately 9.1km of the Proposed Scheme in Staffordshire. The route will run through predominantly rural areas comprising agricultural land interspersed with small villages and isolated dwellings

and farmsteads. The villages of Whitmore and Madeley lie close to the route of the Proposed Scheme, which will pass under the village of Whitmore Heath in tunnel.

9.3.2 The Proposed Scheme will be located in proximity to the settlements of Whitmore, Baldwin's Gate and Madeley Park Wood. The majority of community facilities in the area, such as GP surgeries, schools and community meeting places, lie within the village centres of Baldwin's Gate, Whitmore and Madeley. The city of Stoke-on-Trent is located to the east of the Proposed Scheme and also provides community facilities that serve the Whitmore Heath to Madeley area. The Proposed Scheme will cross the A53 Newcastle Road and the A525 Bar Hill Road as well as numerous roads linking the rural community to services and facilities in the larger settlements.

9.3.3 The wards directly affected by the Proposed Scheme in the Whitmore Heath to Madeley area have a relatively small total population, commensurate with the rural nature of the land use. Data provided by the Office of National Statistics[98] and the Association of Public Health Observatories[99] show that this population across the three wards[100] is, by comparison with national averages, generally in good health and experiences low levels of deprivation.

9.3.4 The population in this area is considered to be generally more resilient than the national average with regard to changes in the relevant health determinants, and with relatively few vulnerabilities. One vulnerability in this population is a slightly higher than average proportion of older people (the 65 – 84 years category) across the Whitmore Heath to Madeley area. Additionally, it is noted that Madeley has higher than average health and disability deprivation levels (ranked in the 20% most deprived nationally), and there is a higher than average prevalence of long term health problems or disability in households across the Whitmore Heath to Madeley area (possibly related to the age profile of the population). The Whitmore part of the area is ranked within the 10% most deprived for access to housing and social services, in common with many other rural areas of the country.

9.3.5 The available data permit a profile to be made of the whole population in the Whitmore Heath to Madeley area and provide detail down to ward level. The description of the whole population and the populations within wards does not exclude the possibility that there will be some individuals or small groups of people who do not conform to the overall profile. Detailed community profile data are presented in Background Information and Data: BID-HE-002-004, Community area health profile.

9.3.6 The Whitmore Heath to Madeley area contains a number of community resources whose users may be impacted by the Proposed Scheme. These are described in detail in the health assessment matrix in Volume 5: Appendix HE-001-004.

9.3.7 For the purpose of the health assessment, the Whitmore Heath to Madeley area is divided into communities as described below.

[98] The Office of National Statistics provides spatial data on levels of deprivation, using indicators of: 'multiple deprivation', 'employment', 'education', 'barriers to housing and social services',' crime' and 'living environment'. These data are based on the 2011 census and available by Lower Super Output area.

[99] Public Health Observatories (PHOs) are part of Public Health England. They produce information, data and intelligence on people's health and health care for practitioners, commissioners, policy makers and the wider community. Available online at: http://www.apho.org.uk/

[100] Electoral wards are the spatial units used to elect local government councillors. National Census data are published at ward level.

Description of communities in the Whitmore Heath to Madeley area

Whitmore Heath, Baldwin's Gate and surrounds

9.3.8 This area comprises mainly rural farmland between Bent Lane to the east and the West Coast Main Line (WCML) crossing to the west. It centres around the village of Whitmore Heath, which the Proposed Scheme will pass beneath in tunnel, and the village of Baldwin's Gate to the south of Whitmore Heath. The two villages lie on the A53 Newcastle Road, on either side of the WCML, in the Borough of Newcastle-under-Lyme. Baldwin's Gate contains approximately 150 dwellings, a public house, a post office, a general store, a primary school and a Methodist Church. Whitmore Heath contains approximately 56 residential properties.

9.3.9 The surrounding rural landscape comprises farmland with scattered farms and individual dwellings. To the north of Whitmore Heath, Whitmore village lies on the A53 Whitmore Road and includes a small number of community facilities including a church and a village hall. This village comprises of approximately 38 residential properties. To the west of Whitmore Heath, the village of Madeley Park Wood is located along Manor Road, with approximately 145 residential properties.

9.3.10 Public rights of way (PRoW) that will be directly affected by the Proposed Scheme include Whitmore Footpaths 4, 5, 6 and Madeley Footpath 14.

Madeley and surrounds

9.3.11 This area comprises mainly rural farmland to the west of the WCML. It includes the village of Madeley, which lies to the north-east of the route of the Proposed Scheme on the A525 Bar Hill Road, and houses along the A525 Bar Hill Road, which will be crossed by the route of the Proposed Scheme. Madeley village comprises of approximately 1,595 residential properties and a small number of community facilities, including three schools, a church, a community centre, a post office and a number of convenience stores.

9.3.12 PRoW that will be directly affected by the Proposed Scheme include Madeley Bridleways 1, 2 and 5, and Madeley Footpaths 14, 24, 26, and 28. The Newcastle Way long distance footpath, which extends approximately 40km from Mow Cop in Cheshire to Market Drayton in Shropshire, will be crossed by the Proposed Scheme east of Bar Hill.

Future baseline

9.3.13 A future baseline profile of the Whitmore Heath to Madeley area has been established to forecast the changing demographic characteristics and potential health needs of local communities. The population in Newcastle-under-Lyme is expected to grow by approximately 4% between 2015 and 2025, with significant growth in people aged 65 and over (16 %) and in particular those aged 85 and over (35%)[101]. The projected ageing population may put pressure on certain areas of the health service; for example, the prevalence of dementia is forecast to increase from 1,770 cases in 2015

[101] Staffordshire Observatory; Locality Profiles, 2016; https://www.staffordshireobservatory.org.uk/publications/thestaffordshirestory/LocalityProfiles.aspx#.WOq1PU1Mpow

to 2,720 by 2030[102]. Furthermore, the proportion of the total population in Staffordshire aged between 16 and 64 is forecast to decrease by between 3-5 percentage points by 2021[103]A detailed review of future baseline data is presented in Background Information and Data: BID-HE-002-004, Community health profile.

Construction (2020)

9.3.14 Volume 5: Appendix CT-004-000 provides details of committed developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

9.3.15 The committed developments that materially affect the baseline conditions in this area and form part of the future baseline assessment of the effects during construction and operation are listed in Table 14.

Table 14: Committed developments relevant to health

Map book reference[104]	Planning reference	Description
CA4/2	13/00426/OUT	113 dwellings and associated works as an extension to the north-west edge of Baldwin's Gate.
CA4/17	13/00990/OUT	Up to 42 dwellings.
CA4/11	15/00277/FUL	Four dwellings and demolition of extension to 12 Station Road.

Operation (2027)

9.3.16 Volume 5: Appendix CT-004-000 provides details of committed developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

9.3.17 No further committed developments have been identified in this area that will alter the baseline conditions in 2027 for health receptors.

9.4 Effects arising during construction

Avoidance and mitigation measures

9.4.1 Consideration of potential health issues is an integral part of the planning and design of the Proposed Scheme, alongside consideration of other environmental, community and economic issues. Adverse impacts on health determinants have been reduced insofar as reasonably practicable through mitigation measures incorporated into the design of the Proposed Scheme.

9.4.2 The mitigation measures incorporated into the design of the Proposed Scheme in the Whitmore Heath to Madeley area include:

[102] Staffordshire Partnership; Staffordshire Joint Strategic Needs Assessment, 2013; https://www.staffordshirepartnership.org.uk/Health-and-Wellbeing-Board/Staffordshire-E-JSNA-2013-FINAL.pdf
[103] Staffordshire County Council; Staffordshire and Stoke-on-Trent Economic Review, 2016; http://www.staffordbc.gov.uk/live/Documents/Forward%20Planning/Examination%20Library%202013/E15-STAFFORDSHIRE-AND-STOKE-ON-TRENT-ECONOMIC-REVIEW-2013.pdf
[104] Volume 5 Map Book: Maps CT-13-113b to CT-13-115a-R1.

- reducing the loss of property and community assets, insofar as reasonably practicable, through design of the route of the Proposed Scheme. For example, tunnels at Whitmore Heath and Madeley will reduce direct impacts on a number of receptors including residential properties;
- reducing the proximity of the Proposed Scheme to property and community assets, insofar as reasonably practicable. For example, the route has been moved further away from gardens of residential properties on the A525 Bar Hill Road. Construction areas associated with the Madeley cutting and Madeley tunnel have also been consolidated to reduce effects on nearby residential properties;
- maintaining accesses across the route of the Proposed Scheme, including at Madeley (via the Madeley Bridleway 2 accommodation underbridge and the Madeley Bridleway 1 accommodation green overbridge), at A53 Newcastle Road (via the A53 Newcastle Road overbridge), at Whitmore Wood (via the Whitmore Wood overbridge), at Manor Road (via the Manor Road overbridge) and at Bar Hill (via the AA525 Bar Hill overbridge);
- reducing visual intrusion and noise, insofar as reasonably practicable; and
- temporary diversions of roads and PRoW to maintain access during construction, and so far as reasonably practicable to maintain the PRoW network.

9.4.3 HS2 Ltd will require its contractors to comply with the environmental management regime for the Proposed Scheme, which will include the Code of Construction Practice (CoCP), which provides a general basis for route-wide construction environmental management.

9.4.4 The CoCP will be the means of controlling the construction works associated with the Proposed Scheme to ensure that the effects of the works upon people and the natural environment are reduced or avoided so far as reasonably practicable.

9.4.5 The CoCP will require the nominated undertaker and its contractors to produce and implement a community engagement framework and provide appropriately experienced community relations personnel to implement the framework, to provide appropriate information and to be the first point of contact to resolve community issues. The nominated undertaker will take reasonable steps to engage with the community, particularly focusing on those who may be affected by construction impacts, including local residents, businesses, landowners and community resources, and the specific needs of protected groups (as defined in the Equality Act 2010).

Assessment of impacts and effects

Neighbourhood quality

9.4.6 The term 'neighbourhood quality' is used in this assessment to describe a combination of factors that have the potential to affect residents' feelings about their local environment. If these factors are altered to a sufficient degree, there would be effects on mental health and wellbeing. The Proposed Scheme will affect the quality of neighbourhoods through environmental changes resulting from the presence of

construction sites, construction activities and construction traffic on local roads. This section assesses how changes to neighbourhood quality may influence people's level of satisfaction with their local environment and perceptions about issues such as personal safety and security.

9.4.7 A review of published research evidence linking neighbourhood quality with health and wellbeing can be found in Volume 5: Appendix HE-003-000[105]. The evidence linking the individual aspects of neighbourhood quality with health outcomes ranges from moderate to strong. The environmental effects of the Proposed Scheme related to this section are assessed in Section 5, Air quality, Section 11, Landscape and visual, Section 13, Sound, noise and vibration and Section 14, Traffic and transport.

9.4.8 The assessment of neighbourhood quality is guided by the findings from other assessments, but does not rely on significance thresholds used in these assessments since these do not relate specifically to health. Instead, it assesses qualitatively how the Proposed Scheme is likely to alter local amenity and perceptions about neighbourhood quality and consequently may affect health and wellbeing.

9.4.9 A review of the pathways through which the construction of the Proposed Scheme may impact on neighbourhood quality, and the potential for health effects, is documented in Volume 5: Appendix HE-001-004. The air quality assessment shows that, following mitigation, impacts on air quality (including dust) resulting from the construction and operation of the Proposed Scheme will be very small and are not expected to affect health and wellbeing adversely, air quality impacts are not considered to contribute to any impacts on neighbourhood quality in this area.

9.4.10 This assessment has, therefore, considered temporary and, where applicable, permanent impacts including:

- noise emissions, affecting local amenity;
- visual impacts affecting residents' satisfaction with their living environment and 'sense of place'; and
- construction traffic on local roads, causing dissatisfaction with the local environment and concerns about safety.

9.4.11 The construction of the Proposed Scheme will have temporary and permanent impacts on neighbourhood quality in areas close to construction sites, including Whitmore Heath, Baldwin's Gate and Madeley. Impacts on neighbourhood quality have the potential to affect the wellbeing of residents adversely during the construction phase, by giving rise to negative feelings in relation to quality of life and the local environment, and potentially changing behaviours, such as deterring the use of outdoor space.

9.4.12 Whitmore Heath will be affected by the construction of Whitmore Heath tunnel and the presence of the Whitmore Heath tunnel north portal satellite compound and the Whitmore Heath (north) tunnelling facility and logistics area will impact neighbourhood quality for properties on the north side of Whitmore Heath. Construction at the north tunnel portal will be visible from Snape Hall Road and on the

[105] Volume 5: Appendix HE-003-000, Route-wide commentary on health evidence base.

north side of Whitmore Heath, while noise from construction activities will be noticeable across the village. Heavy goods vehicles (HGV) will be present on Common Lane, Snape Hall Road and Heath Road, all of which are roads running around the edge of the residential area. Snape Hall Road and Common Lane will also require widening works. Residents of Whitmore Heath are likely to experience these features of the Proposed Scheme as changing the quality of their neighbourhood, and to regard these changes as adverse, in reducing the sense of rural character and tranquillity. The presence of construction traffic, including HGVs, on rural roads is also likely to give rise to concerns about road safety, which may affect perceptions of neighbourhood quality.

9.4.13 Temporary road diversions, temporary site haul routes, road widening and utilities work will impact properties in Whitmore and Whitmore Heath. There will be direct impacts on the outside space to facilitate these works at properties along the A53 Newcastle Road, Three Mile Lane and Common Lane. Outside space will also be required from properties in Whitmore Heath. The residents of these properties are likely to experience reduced levels of satisfaction with their living environment as a result of these changes.

9.4.14 In Baldwin's Gate and Whitmore, HGVs will be present on the A53 Newcastle Road. Residents in these areas will experience visual and noise impacts of HGVs. The presence of construction traffic, is also likely to give rise to concerns about road safety, which may affect perceptions of neighbourhood quality.

9.4.15 At Madeley Park Wood, the construction of the Lea South embankment will be visible from rear gardens of properties on the east side of this residential area. HGVs will pass this area along Manor Road, and noise from construction works and traffic will be noticeable across parts of this residential area. Residents of Madeley Park Wood are likely to experience these features of the Proposed Scheme as changing the quality of their neighbourhood, and to regard these changes as adverse.

9.4.16 To the south of Madeley, construction of the Madeley cutting, Madeley tunnel and the A525 Bar Hill Road realignment will take place in proximity to residential properties on Bar Hill, as well as Moor Hall Farm and Bower End Farm, and the allotments on Manor Road. The works will be highly visible from these areas and construction noise will be noticeable. HGVs will be present on Manor Road and Bar Hill. Residents on Bar Hill and the south side of Madeley are likely to experience these features of the Proposed Scheme as changing the quality of their neighbourhood, and to regard these changes as adverse, in reducing local amenity. The presence of construction traffic, including HGVs, on rural roads is also likely to give rise to concerns about road safety, which may affect perceptions of neighbourhood quality.

Access to green space, recreation and physical activity

9.4.17 There is moderate evidence to show that access to green space contributes to good mental health. There is also moderate evidence that environmental factors such as access to high quality green space, safety and amenity, can influence participation in physical activity. Physical activity is strongly linked to health outcomes. A review of published research evidence linking access to green space, recreation and physical activity with health and wellbeing can be found in Volume 5: Appendix HE-003-000.

9.4.18 A review of the pathways through which the construction of the Proposed Scheme may impact on levels of access to green space and physical activity, and the potential for health effects, is documented in Volume 5: Appendix HE-001-004. This has identified:

- impacts on PRoW, including temporary closures, diversions and loss of amenity, which may deter the use of these routes by walkers, cyclists and equestrians; and
- the presence of construction traffic, including HGVs, on the local road network, which may deter their use by walkers, cyclists and equestrians.

9.4.19 The route of the Proposed Scheme will intersect seven PRoW including three bridleways. A further five PRoW in the area will be affected either temporarily or permanently. Additionally, Swynnerton Footpath 10 in the adjoining Stone and Swynnerton area (CA3) will be partially diverted into the Whitmore Heath to Madeley area. This change is reported in the assessment for the Stone and Swynnerton area (Volume 2: Community area 3, Stone and Swynnerton). The surveys undertaken to inform the traffic and transport assessment showed that there were fewer than 10 people a day recorded on each of the PRoW in the area. The presence of construction works is likely to affect the amenity value of PRoW in the vicinity of the Proposed Scheme and may detract from their appeal for recreational users, reducing levels of physical activity and associated health and wellbeing benefits.

9.4.20 Construction traffic will mainly utilise the site haul routes along the Proposed Scheme alignment. However, some construction traffic, including HGVs, will be present on local roads within the Whitmore Heath to Madeley area. Section 14, Traffic and transport has identified the potential for construction traffic to obstruct or deter pedestrians, cyclists and equestrians on the following routes:

- A53 Newcastle Road, Snape Hall Road and Common Lane between Whitmore Heath and Baldwin's Gate; and
- A525 Bar Hill Road and through Madeley.

9.4.21 The presence of HGVs is likely to deter some non-motorised users from using the affected routes. In the case of recreational users, it is considered that alternative routes will be available. However, for those using these routes for active travel to work or to access shops and services, there is a possibility that people will choose instead to travel by car, temporarily reducing levels of physical activity and associated health and wellbeing benefits.

Social capital

9.4.22 The connections between the individuals within communities, and the increased likelihood that arises through these networks for individuals to feel valued, to feel a sense of belonging, to have companionship and to support each other, is important for health and wellbeing. A measure of the effectiveness of these connections within communities is termed 'social capital' and is a recognised determinant of health. The Office for National Statistics defines social capital as follows:

'In general terms, social capital represents social connections and all the benefits they generate. Social capital is also associated with civic participation, civic-minded

attitudes and values which are important for people to cooperate, such as tolerance or trust.'[106]

9.4.23 A review of published research evidence linking social capital with health and wellbeing can be found in Volume 5: Appendix HE-003-000. There is moderate evidence for a link between social capital and health and wellbeing outcomes. A decrease in social capital has the potential to reduce the beneficial health effects that are gained through social contact and support. Adverse effects on health from changes in social capital could be experienced as a reduction in wellbeing or as physiological effects on the body's hormonal and immune systems, with increased susceptibility to mental and physical illness.

9.4.24 A review of the pathways through which the construction of the Proposed Scheme may impact on levels of social capital, and the potential for health effects, is documented in Appendix HE-001-004, Health assessment matrix. This has identified temporary wellbeing effects associated with the introduction of a temporary construction workforce.

9.4.25 The villages along the route support small communities with well-established communities. Feedback from community consultation indicates that people's levels of trust in their communities and community cohesion are strong. The size of the temporary workforce will be substantial relative to these communities.

9.4.26 In the areas close to construction compound access points on the A525 Bar Hill Road and around Whitmore Heath, the presence of construction workers is likely to be very noticeable, with construction vehicles using local roads to access compounds, and workers potentially using local facilities such as shops, restaurants and public houses within Whitmore and Baldwin's Gate.

9.4.27 It is well understood that the introduction of a temporary construction workforce into communities which have the characteristics identified above has the potential to alter people's perceptions about their communities and reduce levels of trust. Such a reduction in social capital has the potential to affect wellbeing adversely, and may influence behaviours that are beneficial to wellbeing such as the use of community facilities.

9.4.28 The draft CoCP[107] includes a commitment to produce and implement a community engagement framework and provide appropriately experienced community relations personnel. HS2 Ltd will engage with local authorities and community representatives to identify measures aimed at fostering and maintaining good relationships between the workforce and local communities. Any measures identified will be included within the community engagement framework as appropriate.

9.4.29 There is also a potential for the presence of the temporary workforce to have a beneficial effect on local communities through increased use of local services and opportunities for social interaction.

[106] Office for National Statistics- Measuring Social Capital: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171766_371693.pdf

[107] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

Other mitigation measures

9.4.30 HS2 Ltd will engage with local authorities and community representatives in the development of the Community Engagement Framework with the aim of fostering positive relationships between local communities and the temporary construction workforce.

Cumulative effects

9.4.31 No cumulative health effects have been identified.

9.5 Effects arising from operation

Avoidance and mitigation measures

9.5.1 Adverse impacts on health determinants have been reduced insofar as reasonably practicable through mitigation measures incorporated into the design of the Proposed Scheme to reduce adverse effects on people. The mitigation measures incorporated into the design of the Proposed Scheme in the Whitmore Heath to Madeley area include measures to integrate the Proposed Scheme into the landscape and to provide visual and noise screening, including:

- noise barriers and bunds to provide acoustic screening at Whitmore Heath, Madeley Park Wood and Madeley; and
- earthworks to soften viaduct abutments, and landscape earthworks, with planting to integrate the Proposed Scheme into the surrounding landscape at Graftons Wood, Wrinehill Hall Farm, Manor Road, Bent Lane, Meece Brook, Whitmore Wood and Madeley.

Assessment of impacts and effects

9.5.2 This section assesses the health effects of the operation of the Proposed Scheme on the health and wellbeing of communities. Permanent construction impacts on health determinants resulting from the construction of the Proposed Scheme are assessed as permanent construction impacts in Section 9.4.

Neighbourhood quality

9.5.3 Noise and visual impacts from passing trains will result in permanent operational impacts on neighbourhood quality in the communities in proximity to the Proposed Scheme, including at Whitmore Heath and Madeley. These operational impacts will be experienced alongside permanent construction impacts, including the presence of the railway infrastructure within the local landscape. Impacts on neighbourhood quality have the potential to affect the wellbeing of residents adversely during the operational phase, by giving rise to negative feelings in relation to quality of life and the local environment, and potentially changing behaviours, such as deterring the use of outdoor space.

9.5.4 The presence of trains running on the Meece Brook viaduct and the loss of landscape features such as trees and hedgerows in the locality will affect neighbourhood quality in the sparsely populated area north of Hill Chorlton. The viaduct and passing trains will be visible and train noise will be noticeable.

9.5.5 At Whitmore Heath, train noise will be noticeable in the northern parts of the settlement closest to the Whitmore Heath tunnel north portal and the railway will be visible from Snape Hall Road. The closure of Snape Hall Road on the north side of Whitmore Heath and the widening of Snape Hall Road on the west side of the village will change the layout and visual appearance of the area. Outside space from some properties will be permanently required for the widening of this road.

9.5.6 At Madeley, Madeley cutting, Madeley tunnel portals and the A525 Bar Hill Road realignment will be in proximity to properties on Bar Hill. Noise from passing trains will be noticeable in private gardens on the A525 Bar Hill Road and Red Lane.

9.5.7 Residents of these areas are likely to experience these features of the Proposed Scheme as changing the quality of their neighbourhood, and to regard these changes as adverse, in reducing the sense of rural character and tranquillity.

Cumulative effects

9.5.8 No cumulative health effects have been identified.

Other mitigation measures

9.5.9 No further mitigation measures are proposed.

Monitoring

9.5.10 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

9.5.11 No specific monitoring of health effects during the operation of the Proposed Scheme is proposed.

10 Land quality

10.1 Introduction

10.1.1 This section of the report presents the baseline conditions that exist along the Proposed Scheme in the Whitmore Heath to Madeley area in relation to land quality, and reports the likely impacts and significant effects resulting from construction and operation of the Proposed Scheme. Consideration is given to land that potentially contains contamination and land that has special geological significance, from a scientific, historical, mineral exploitation or mineral resources point of view, including geological sites of special scientific interest (SSSI, local geological sites (LGS), and areas of designated mineral resources. Consideration is also given to petroleum (gas) prospects and licencing. Mitigation measures are presented and any residual significant effects are summarised.

10.1.2 Engagement has been undertaken with the British Geological Survey (BGS), Staffordshire County Council (SCC), Newcastle-under-Lyme Borough Council (NBC), the Environment Agency, the Food and Environment Research Agency and the Animal and Plant Health Agency. The purpose of this engagement has been to discuss the Proposed Scheme and potential effects, and obtain relevant baseline information.

10.1.3 Details of baseline information, conceptual site models (CSM) and risk assessments are outlined in Volume 5: Appendix LQ-001-004: and presented in Maps LQ-01-113b to LQ-01-115a (Volume 5: Land quality Map Book).

10.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

10.1.5 Land contamination issues are closely linked with those involving water resources and waste. Issues regarding groundwater resources are addressed in Section 15, Water resources and flood risk. Issues regarding the disposal of waste materials, including contaminated soils, are addressed in Volume 3: Route-wide effects (Section 15).

10.2 Scope, assumptions and limitations

10.2.1 The scope, assumptions and limitations for the land quality assessment are set out in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[108], and Volume 5: Appendix LQ-001-004.

10.2.2 In accordance with the SMR, a risk based approach has been undertaken to identify contamination that may have an impact upon the construction of the Proposed Scheme. To support this, a desk based assessment has been undertaken for the study area, defined as the land required for the Proposed Scheme plus a 250m buffer from the edge of proposed construction activities. In the case of groundwater data, this is increased to 1km.

10.2.3 New and diverted utilities will be laid in the boundaries of existing highways within normal road construction layers and natural soils below or land close by. These have

[108] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.

been considered in the context of the CSM approach, and the lack of contact with nearby potentially contaminated sites, and the absence of sensitive receptors within the roadways reduces the risk of an impact occurring to very low levels. The impact of laying these new and diverted utilities has therefore been scoped out of the assessment as they are unlikely to cause any significant land quality effects.

10.2.4 Potentially contaminated areas of land have been identified that could affect, or be affected by, the construction of the Proposed Scheme (e.g. contaminated soils may need to be removed or construction may alter existing contamination pathways). Each of these areas has been studied to evaluate the scale of potential impacts caused by existing contamination (if present) and what needs to be done to avoid significant consequences to people and the wider environment.

10.2.5 The location of the Proposed Scheme was viewed from points of public access initially. In addition, visits to some key sites have been undertaken to verify desktop information.

10.2.6 A CSM approach has been used to provide an understanding of the types of contaminants that may be present, the likely sources and/or pathways by which contamination can spread and the potential receptors (i.e. people and the wider environment) that could be affected. It indicates the types of impacts that existing contamination may be having at present and may have during and after construction.

10.2.7 The minerals assessment is based upon the minerals identified on published mineral plans, existing planning or licensed areas. Any inference of the presence of minerals provided by geological maps/reports is excluded (except where these are covered by the Mineral Local Plan (MLP)).

10.2.8 The geo-conservation assessment is based upon local geological trust records.

10.3 Environmental baseline

Existing baseline

10.3.1 Baseline data has been collected from a range of sources including Ordnance Survey mapping, the BGS, Coal Authority, NBC, SCC, Public Health England, the Environment Agency, Natural England, the Animal and Plant Health Agency and the Food and Environment Research Agency records, as well as web sources such as local geological trusts.

10.3.2 Unless otherwise stated, all features described in this section are presented in Maps LQ-01-113b to LQ-01-115a (Volume 5: Land quality Map Book).

Geology

10.3.3 This section describes the underlying ground conditions within the Whitmore Heath to Madeley area. Recent changes in lithostratigraphic classifications by the BGS have been incorporated where appropriate[109].

[109] British Geological Survey, (2014), *Lithostratigraphy of the Sherwood Sandstone. Research Report RR/14/01.* Available online at: http://www.bgs.ac.uk/downloads/start.cfm?id=2904

10.3.4 Table 15 provides a summary of the superficial and bedrock units underlying the Proposed Scheme from Whitmore Heath to Madeley.

Table 15: Summary of the superficial and bedrock units underlying the Proposed Scheme from Whitmore Heath to Madeley

Geology	Distribution	Formation description	Aquifer classification
Superficial			
Peat	Near Hey Sprink and south of the route of the Proposed Scheme near Whitmore Heath and Baldwin's Gate	Organic rich clay or humic deposits	Unproductive
Alluvium	Along the valley and tributaries of Meece Brook and Checkley Brook	Clay, silt, sand and gravel	Secondary A
River Terrace Deposits	Along the valley of Meece Brook and Checkley Brook	Sand and gravel	Secondary A
Glacial Till	A small discontinuous outcrop to the west of Whitmore Wood and near continuous cover from around Barhill Wood to the north of the study area	Gravel in a sandy silty clay matrix	Unproductive
Glaciofluvial Deposits	Outcrops at the River Lea crossing and discontinuous areas in the north of the study area. Additional outcrop at Baldwin's Gate	Sand and gravel	Secondary A
Bedrock[110]			
Mercia Mudstone Group – Sidmouth Mudstone	Outcrop underlying the northern part of the study area from Grafton's Wood	Red, less commonly green-grey, mudstone and siltstone with some halite-bearing units, thin beds of gypsum/anhydrite being widespread	Secondary B
Sherwood Sandstone Group - Wilmslow Sandstone (Wildmoor Sandstone)	Outcrop underlying approximately 2km of the southern section of the route of the Proposed Scheme	Fine- to medium-grained, bright orange-red to dark brick-red sandstone with subordinate siltstone and mudstone	Principal
Sherwood Sandstone Group - Wilmslow Sandstone (Wildmoor Conglomerate)	Small outcrop to the south-west of the route of the Proposed Scheme within the Wilmslow Sandstone outcrop	Conglomerate of mainly sand and gravel detrital material with a matrix of fine silt and clay	Principal
Sherwood Sandstone Group - Wilmslow Sandstone (Wilmslow Sandstone)	Outcrop to the east of the Wem fault	Fine- to medium-grained, bright orange-red to dark brick-red sandstone with subordinate siltstone and mudstone	Principal
Sherwood Sandstone Group - Chester Formation (Kidderminster Sandstone and Conglomerate Interbedded)	Outcrop in the vicinity of Whitmore Heath	Cross-bedded and pebbly reddish brown sandstone and conglomerate	Principal

[110] Names in brackets refer to previous naming convention.

Geology	Distribution	Formation description	Aquifer classification
Sherwood Sandstone Group - Chester Formation (Kidderminster Formation – Conglomerate)	Outcrop in the vicinity of Whitmore Heath	Pebble conglomerate with a reddish brown sandy matrix and pebbles consisting of mainly brown or purple quartzite, with quartz conglomerate and vein quartz	Principal
Sherwood Sandstone Group - Chester Formation (Chester Pebble Beds)	Outcrop to the east of the Wem fault as far south as Barhill Wood	Sandstone (pebbly gravel sandstone)	Principal
Warwickshire Group, Salop Formation	Outcrop underlying the route of the Proposed Scheme from the east of Whitmore Wood to the River Lea viaduct	Sandstone, siltstone and conglomerate with thin limestone layers in lower part of formation	Secondary A
Warwickshire Group, Halesowen Formation	Outcrop underlying the route of the Proposed Scheme from where it crosses the River Lea to Bar Hill	Mudstone, limestone, thin coalsand sandstone	Secondary A
Pennine Coal Measures Group	Lies below Warwickshire Group, no outcrop	Sandstone, grey siltstone and grey mudstone, with frequent coal seams	Secondary A

Made ground

10.3.5 Made ground is a term used to denote man-made deposits such as landfill, spoil heaps or earthworks associated with construction or ground improvement. Such deposits may be poorly mapped and are often very variable in composition. Minor deposits of made ground may be encountered within this area, for example where ponds, sand or marl pits have been backfilled. There is evidence of historical and authorised landfilling within the area, which may comprise more significant deposits of made ground. Whitmore Heath has been the site of historical sand and gravel excavation, and the base and sides of the previous quarries are likely to retain residual granular deposits. One part of the heath was landfilled in the 1950s.

10.3.6 Farm burial and pyre sites associated with the 2001 outbreak of foot and mouth disease are known to be present within the study area. In addition, older unrecorded sites may be present from the 1967 outbreak. In all cases, the records do not provide an exact location for the burial or pyre sites and other, unrecorded sites are likely to be present.

Superficial geology

10.3.7 The area of the Proposed Scheme is underlain by Alluvium and river terrace sand and gravel in the vicinity of Meece Brook and tributaries between Stableford and Whitmore.

10.3.8 Peat is indicated to be present approximately 500m north-west of Shelton under Harley Farm, and approximately 600m south of where the route of the Proposed Scheme will cross under the A53 Newcastle Road.

10.3.9 The Proposed Scheme between Whitmore Heath and the River Lea is underlain by deposits of Glacial Till ranging from clay to boulder sized particles. Peat is also present in this area of the Proposed Scheme.

10.3.10 The Proposed Scheme between the River Lea viaduct and Checkley Brook is underlain by glaciofluvial deposits.

10.3.11 Alluvium is present in the vicinity of the River Lea from Madeley to the confluence with Checkley Brook.

10.3.12 River Terrace Deposits are present in the vicinity of the River Lea and Checkley Brook at Wrinehill.

Bedrock geology

10.3.13 The bedrock underlying the area from Whitmore Heath to Madeley comprises rocks of the Sherwood Sandstone, Warwickshire and Mercia Mudstone Groups.

10.3.14 The Wilmslow Sandstone Formation, part of the Sherwood Sandstone Group, is found from the southern end of the Whitmore Heath to Madeley area, near Shelton under Harley, to a point south-east of Whitmore Heath. The Wilmslow Sandstone Formation typically comprises very weak, orange to red, clayey fine-grained sandstone.

10.3.15 Whitmore Heath is underlain by sandstone and conglomerate of the Chester Formation, part of the Sherwood Sandstone Group. The Chester Formation contains two distinct materials: a weak, red brown, medium to coarse-grained sandstone with some gravel; and a weak conglomerate/conglomeratic sandstone with frequent gravel clasts in a weak/very weak sand matrix.

10.3.16 North of Whitmore Heath, to just north of the River Lea viaduct (where the route of the Proposed Scheme will cross the West Coast Main Line (WCML)), the bedrock predominantly comprises the weak, red-brown mudstones, sandstones and conglomerates of the Salop Formation of the Warwickshire Group. The Salop Formation is reported to contain no main coal seams[111]; however, the Pennine Coal Measures Group beneath the Salop Formation has been extensively mined. Limestone beds and carbonate cemented sediments are noted in the lower part of the Salop Formation.

10.3.17 From the River Lea viaduct to the A525 Bar Hill overbridge, the bedrock mainly comprises the weak, grey-green mudstone, siltstone and sandstone of the Halesowen Formation, part of the Warwickshire Group. Thin coal, conglomerate and limestone beds may be present within the Halesowen Formation[112].

10.3.18 North of the A525 Bar Hill Road to a point approximately 1km west of Madeley, the bedrock predominantly comprises the Chester Formation which is part of the Sherwood Sandstone Group.

10.3.19 The remainder of the area north to Checkley Brook is underlain by red-brown mudstone and siltstone of the Sidmouth Mudstone Formation, which is part of the Mercia Mudstone Group. The Sidmouth Mudstone Formation is a weak, red brown, silty mudstone with variable amounts of carbonate (dolomite) and gypsum when unweathered. Breccias formed by the dissolution of salt are common throughout the

[111] BGS (2009), *A lithostratigraphical framework for the Carboniferous successions of southern Great Britain (onshore)*. Available online at: http://nora.nerc.ac.uk/8281/1/RR09001.pdf
[112] British Geological Survey; *The BGS Lexicon of Named Rock Units*. Available online at: http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=HA

formation. Gypsum/anhydrite also occurs throughout the formation as nodules and veins[113].

Radon

10.3.20 Radon is a radioactive gas formed by the radioactive decay of naturally occurring uranium in rocks and soils. Three sections of the Proposed Scheme in this study area lie within a radon affected area, as defined on Public Health England's UK Radon online maps[114]:

- the section of the Proposed Scheme between Stableford and approximately 200m to the east of Heath Road, Whitmore Heath;
- where the route of the Proposed Scheme will cross the WCML on the River Lea viaduct to just north of the A525 Bar Hill Road; and
- the section of the Proposed Scheme between a point approximately 300m north of Bower End Lane and Wrinehill Mill.

10.3.21 The maps show that between 1 and 3% of homes in these areas have radon levels above the action level of 200 Becquerels per cubic metre (Bq/m3) for residential properties. For the remainder of the Whitmore Heath to Madeley area, less than 1% of homes are indicated to be above the radon action level.

Groundwater

10.3.22 Four categories of aquifer have been identified within the Whitmore Heath to Madeley area, as defined by the Environment Agency:

- All of the formations in the Sherwood Sandstone Group have been designated as Principal aquifers;
- the Salop Formation, the Halesowen Formation, the Warwickshire Group, the glaciofluvial sand and gravel deposits, River Terrace Deposits and Alluvium, are all designated as Secondary A aquifers;
- the Sidmouth Mudstone Formation has been designated as a Secondary B aquifer; and
- Peat and Glacial Till are classified as Unproductive aquifers.

10.3.23 The Environment Agency reports that there are three licensed abstractions from groundwater sources within 1km of the Proposed Scheme in the Whitmore Heath to Madeley area. The Environment Agency licenced abstractions are located: at Manor Farm, to the west of Manor Road; Netherset Hey Farm, 660m east of the WCML; and adjacent to the west of Bent Lane, Whitmore. These are listed in Volume 5: Appendix WR-003-004.

[113] British Geological Survey; *The BGS Lexicon of Named Rock Units*. Available online at: http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=SIM
[114] Public Health England; *UK Maps of Radon*. Available online at: www.ukradon.org/information/ukmaps

10.3.24 The route of the Proposed Scheme will cross over Zone 1, Zone 2 and Zone 3 of a groundwater source protection zone (SPZ)[115], which corresponds with the location of a Severn Trent public supply abstraction at Whitmore. The study area crosses directly over the centre of SPZ1, which extends approximately 140m to the north-east and to 240m south-west of the route of the Proposed Scheme. SPZ2 and SPZ3 extend south of the Whitmore Heath to Madeley area into the South Cheshire area (CA5). SPZ3 extends to the northern border of Whitmore Heath, along Snape Hall Road. Beyond Snape Hall Road, the Proposed Scheme will not traverse any additional SPZ within the study area.

10.3.25 According to SBC records, there are three private groundwater abstractions that do not require a permit registered within the study area. It should be noted that all abstractions that are used directly or indirectly for human consumption are by default provided with SPZ. In such cases the abstraction point qualifies for a default 10m radius for SPZ1 and a default 250m radius for SPZ2. There is no default SPZ3 for total catchment with respect to this type of abstraction.

10.3.26 Further information on the groundwater in the Whitmore Heath to Madeley area is provided in Section 15, Water resources and flood risk.

Surface water

10.3.27 The main watercourses in this area are the Meece Brook and the River Lea. The route of the Proposed Scheme will cross the Meece Brook approximately 1km east of Baldwin's Gate. The route of the Proposed Scheme will cross the River Lea close to Hey Sprink woodland to the south of Madeley.

10.3.28 No surface water abstractions (licenced or unlicensed) have been identified within the study area.

10.3.29 Further information on surface water in the Whitmore Heath to Madeley area is provided in Section 15, Water resources and flood risk.

Current and historical land use

10.3.30 Current potentially contaminative land uses within the study area are mainly restricted to activities on farms, engineering works and light industrial units, including those located at Netherset Hey Lane Industrial Estate, Netherset Hey Lane, Madeley, and potentially active/recent landfill sites.

10.3.31 In the majority of this area the WCML runs parallel to the route of the Proposed Scheme. The out of use Stoke to Market Drayton Railway crosses over the WCML approximately 1.8km south east of Madeley.

10.3.32 There are a number of cemeteries in the study area. These include one located east of Manor Road in Madeley, at All Saints (CofE) Church on the corner of the A525 Bar Hill Road and Vicarage Lane, and a second, on the corner of the A53 Whitmore Road and Three Mile Lane in Whitmore, at the St Mary and All Saints Anglican Church.

[115] A groundwater SPZ is a defined area within which groundwater is extracted for potable water supply. The area is defined by the Environment Agency on the basis of the length of time taken for groundwater to migrate to the potable water supply.

10.3.33 There is evidence of fuel/storage tanks near the Coney Greave property near Baldwin's Gate, approximately 160m east of Netherset House and at Netherset Hey Lane Industrial Estate.

10.3.34 Other historical potentially contaminative land uses identified along the study area include the following:

- former mills including Chorlton Mill at Springfields, Wrinehill Mill, Lower Botteslow Mill and Upper Botteslow Mill. The latter three sites are located off an unnamed lane that extends from the A531 Main Road to Wrinehill Hall. The footprint of the former Lower Botteslow Mill overlies the WCML;
- former blacksmiths located on the junction of the A51 London Road and Stableford Bank in Stableford, and near the junction of the A53 Newcastle Road and Three Mile Lane in Whitmore;
- a former timber treatment works, east of Manor Road in Madeley;
- a former garage services facility, on the A525 Bar Hill Road in Madeley;
- a former engine shed between the Netherset Lane Industrial Estate and the WCML; and
- the former Botteslow Coal Wharf, located approximately 240m south of Wrinehill Bridge.

10.3.35 Historical human burial sites have been identified approximately 320m east of Manor Farm and approximately 430m south of Bower End Farm.

10.3.36 In addition, a number of former quarries or pits have been identified within the study area. It is possible that such features have been backfilled with waste materials.

10.3.37 Five historical landfill sites have been identified, and are detailed in Table 16.

Table 16: Landfill sites located in the study area

Name and Area Reference[116]	Location	Description
Whitmore Heath historical landfill 4-62	Snape Hall Road, Whitmore Heath, Newcastle-under-Lyme, Staffordshire. Volume 5: Map LQ-01-113b, 4-62	Site operated from 26 November 1949 to 16 April 1959. Material buried at site reported to include household waste.
Beechfields historical landfill 4-65	Bower End Lane, Madeley, Newcastle-under-Lyme, Staffordshire. Volume 5: Map LQ-01-115a, 4-65	No waste type is reported in the available data. The site is reported to have been active before 1976. Date of last input unknown.
Bowerend historical landfill 4-66	Bower End Lane, Madeley, Newcastle-under-Lyme, Staffordshire. Volume 5: Map LQ-01-115a, 4-66	Environment Agency data indicates that waste deposited at this site included unknown material. The site is reported to have been active before 1976. Date of last input unknown.
East of railway cutting historical landfill 4-73	Bower End Lane, Madeley, Newcastle-under-Lyme,	Waste types received are reported to include industrial, commercial and household wastes. Wastes are reported to include the following materials: ash, bottles, waste paper, finished

[116] The area reference is the unique identifying number for the site, shown on the Volume 5: Land quality Map Book.

Name and Area Reference[116]	Location	Description
	Staffordshire. Volume 5: Map LQ-01-115a, 4-73	plastics, foundry sand and dry inert materials, cardboard, timber, ash contaminated with solid animal fats, solid wool fat from carpet manufacture, tyres and asbestos. The site is reported to have first received waste in the 1950s. Date of last input unknown.
Reservoir historical landfill 4-74	Fairgreen Road, Baldwin's Gate, Newcastle-under-Lyme, Staffordshire. Volume 5: Map LQ-01-113b, 4-74	Site first received waste 1 January 1982. Date of last input unknown. Material buried at site reported to include industrial waste, specifically excavation waste.

10.3.38 Contaminants commonly associated with landfill sites could include metals, semi-metals, asbestos, organic and inorganic compounds. Landfills and infilled pits could also give rise to landfill gases, such as methane or carbon dioxide and leachate.

Other regulatory data

10.3.39 The regulatory data reviewed includes pollution incidents (major, significant and minor categories), radioactive and hazardous substances consents and environmental permits (previously landfill, Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) licences). There were no major or significant incidents and 18 minor pollution incidents reported over an eight year period between 1991 and 1999.

10.3.40 There are two discharge consents recorded within the study area relating to sewage discharge.

10.3.41 There are no nationally significant ecological designations, as defined in the land quality section of the SMR, located within the study area.

Mining/mineral resources

10.3.42 SCC is responsible for the overall mineral and waste local plans for the county. The Minerals Local Plan for Staffordshire (2015 to 2030)[117] was adopted in February 2017. It sets out the SCC policies aimed at controlling mineral related developments within Staffordshire up to the year 2030.

10.3.43 There are no proposed Minerals Local Plan Allocations within the study area.

10.3.44 Data provided by SCC indicates that the route of the Proposed Scheme will cross one mineral safeguarding area (MSA) contained in the Minerals Local Plan for Staffordshire. The route of the Proposed Scheme will cross over the MSA between the southern boundary of the study area to around Whitmore Heath, and between the WCML crossing to the northern boundary of the study area. The MSA relates to sand and gravel resources.

10.3.45 Data available on the SCC website[118] indicates that there are no operational mineral sites within the study area.

10.3.46 The SCC Minerals Local Plan indicates the following hydrocarbon and petroleum resources are present within the study area:

[117] The Minerals Local Plan for Staffordshire 2015 to 2030 (Adopted 16 February 2017) Staffordshire County Council.
[118] SCC planning website. Available online at: https://apps2.staffordshire.gov.uk/WEB/OnTheMap/planning;

- coal;
- conventional gas, where the gas is trapped in geological structures and reservoir rocks;
- coal mine methane, where the methane gas is drained from active or disused underground coal mine workings; and
- coal bed methane, which is contained within unworked coal seams; its extraction is feasible at depths of 200m – 1,500m.

10.3.47 Coal Measures are present at depth beneath the study area. BGS data[119] indicates that between the southern boundary of the Whitmore Heath to Madeley area and Bower End Lane, Madeley, Coal Measures are present at depths of between 50m - 1,200m. Between Bower End Lane and the northern part of the study area, the Coal Measures are indicated to be present at depths of greater than 1,200m.

10.3.48 Data from the UK Oil and Gas Authority website[120] indicates that the study area between a point approximately 740m north-west of Shelton under Harley and the A525 Bar Hill Road is covered by two Licences to Search and Bore For and Get Petroleum (Licence number PEDL40 and 56) held by Island Gas Limited and Regent Park Energy Limited.

10.3.49 Mineral extraction, in the form of one borrow pit, will be required as part of the works for the Proposed Scheme in this study area. The borrow pit is required to meet the shortfall of granular fill required to construct the Proposed Scheme rail embankments and is to be located in proximity to the route of the Proposed Scheme to obtain sands and gravels of an appropriate quality (see Volume 1, Section 6).

10.3.50 The borrow pit in the Whitmore Heath to Madeley area falls within the Glaciofluvial Deposits designated as a MSA and will be located west of Netherset Hey Farm.

10.3.51 The borrow pit will be operational during the construction phase of the Proposed Scheme. The estimated duration of use of the borrow pit is four years, which includes excavating and backfilling the borrow pit.

10.3.52 The borrow pit site has been derived from geotechnical desk study of mineral resources. Prior to construction of the Proposed Scheme, HS2 Ltd will undertake detailed ground investigations to help confirm the depth of granular deposits suitable for construction material, which will inform the surface area and depth of extraction required within the borrow pit site.

Geo-conservation resources

10.3.53 No geological SSSI or LGS have been identified within the study area. Therefore, no assessment of geo-conservation resources has been carried out.

[119] BGS; Geoindex Onshore. Available online at: http://mapapps2.bgs.ac.uk/geoindex/home.html?submit=Open+the+onshore+GeoIndex;
[120] Oil and Gas Authority. Available online at: https://itportal.decc.gov.uk/web_files/recent_licences/oglicences.htm;

Receptors

10.3.54 The sensitive receptors that have been identified within the study area are summarised in Table 17. A definition of receptor sensitivity is given in the SMR.

Table 17: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land contamination	People	Residents at existing properties, schools and study centres	High
		Workers and visitors at nearby facilities	Moderate
		Public using Public Rights of Way	Low
	Groundwater	Principal aquifers	High
		Secondary A aquifers	Moderate
		Secondary B aquifers	Low to moderate
		Unproductive aquifers	Low
	Surface waters	Meece Brook	Moderate
		River Lea	Moderate
		Unnamed tributaries, ponds and drains	Low to moderate
	Built environment	Underground structures and buried services	Low
		Buildings and property	Low to high
Impacts on mining/mineral and petroleum (gas) sites (severance and sterilisation)	Mining/mineral/petroleum (gas) sites	Sand and gravel MSAs	Medium
		Petroleum (gas) exploration and production	Low
		Coal deposits	Low

Future baseline

Construction (2020)

10.3.55 Volume 5: Appendix CT-004-000 provides details of all committed developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

10.3.56 The committed developments that materially affect the baseline conditions for land quality in this area and form part of the future baseline assessment of the effects during construction and operation are listed in Table 18.

Table 18: Committed developments relevant to land quality

Map Book Reference[121]	Planning Reference	Description
CA4/14	14/00691/FUL	Residential dwelling.
CA4/17	13/00990/OUT	Outline application for up to 42 dwellings.
CA4/16	14/00299/OUT	Residential dwelling.

Operation (2027)

10.3.57 Volume 5: Appendix CT-004-000 provides details of committed developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

10.3.58 There are no further committed developments which will affect the baseline conditions during operation of the Proposed Scheme.

10.4 Effects arising during construction

Avoidance and mitigation measures

10.4.1 The construction assessment takes into account the mitigation measures described in the draft Code of Construction Practice[122] (CoCP). The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme and includes requirements to ensure the effective management and control of work in contaminated areas.

10.4.2 The requirements in the draft COCP relating to work in contaminated areas will ensure the effective management and control of the work. These requirements include:

- methods to control noise, waste, dust, odour, gases and vapours (Sections 5, 7, 13 and 15);
- methods to control spillage and prevent contamination of adjacent areas (Section 5);
- the management of human exposure for both construction workers and people living and working nearby (Section 11);
- methods for the storage and handling of excavated materials (both contaminated and uncontaminated) (Sections 7 and 15);
- management of any unexpected contamination found during construction (Section 11);
- a post-remediation permit to work system (Section 11);
- storage requirements for hazardous substances such as oil (Section 16);

[121] Volume 5 Map Book: Maps CT-13-113b to CT-13-115a-R1
[122] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

- traffic management to ensure that there is a network of designated site haul routes to reduce compaction/degradation of soils (Section 7);
- methods to monitor and manage flood risk and other extreme weather events, where reasonably practicable, that may affect land quality during construction (Sections 5 and 16); and
- methods to manage discovery of unknown animal burial pits (Section 6).
- the excavation and restoration of borrow pits (Section 6, 7 and 12).

10.4.3 The draft CoCP requires that prior to and during construction, a programme of further detailed investigations, which may include both desk based and site based work, takes place in order to confirm the full extent of areas of contamination. It also requires a risk assessment to be undertaken to determine what, if any, site specific remediation measures are required to allow the Proposed Scheme to be constructed safely and to prevent harmful future migration of contaminants. The investigation and assessment of potentially contaminated sites will be undertaken in accordance with Environment Agency CLR11[123] and British Standards BS10175[124] and BS8576[125].

10.4.4 Where significant contamination is encountered, a remedial options appraisal will be undertaken to define the most appropriate remediation techniques. Where appropriate, this appraisal will be undertaken based on multi-criteria attribute analysis that considers environmental, resource, social and economic factors in line with the framework set out by the Sustainable Remediation Forum UK[126]. The preferred option will then be developed into a remediation strategy.

10.4.5 Contaminated soils excavated from within the site, where reasonably practicable, will be treated to remove or render any contamination inactive and reused within the Proposed Scheme where needed and suitable for use. Treatment techniques could include stabilisation, soil washing and bio-remediation. Contaminated soil removed off-site will be taken to a soil treatment facility, another construction site (for treatment, as necessary, and reuse) or to an appropriately permitted landfill.

Assessment of impacts and effects

10.4.6 Construction of the Proposed Scheme in this area will require earthworks, utility diversions, deep foundations, tunnels, a borrow pit (involving temporary dewatering) and other activities, including the construction of the various viaducts and road infrastructure works. These aspects of the Proposed Scheme, along with other construction features, are shown on the Map Series CT-05 in Volume 2: CA4 Map Book.

Land contamination

10.4.7 In line with the assessment methodology, as set out in the SMR, an initial screening process has been undertaken to identify areas of current or historical contaminative use within the study area and to consider which of these areas might pose

[123] Environment Agency, (2004), CLR11 Model Procedures for the Management of Land Contamination.
[124] British Standard, (2011), BS10175+A1:2013 Investigation of Potentially Contaminated Sites.
[125] British Standard, (2013) BS8576 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).
[126] Sustainable Remediation Forum UK, (2010), A Framework for Assessing the Sustainability of Soil and Groundwater Remediation.

contaminative risks for the Proposed Scheme. Sites that present a low risk have not been taken further in the assessment. Any moderate to high risk sites have been taken forward to more detailed risk assessments, in which the potential risks are assessed more fully. The majority of the areas that have undergone the more detailed risk assessments are historical landfills, a former timber treatment works, WCML active and disused lines, and infilled pits/ponds. All areas assessed are shown on Maps LQ-01-113b to LQ-01-115a (Volume 5: Land quality Map Book) and those considered as potentially posing a risk to the Proposed Scheme are labelled with a reference number.

10.4.8 CSMs have been produced for those areas taken to detailed risk assessments. The following factors determine the need for detailed risk assessments:

- whether the site is located on or off the route of the Proposed Scheme or associated off line works;
- the vertical profile of the route;
- the presence of underlying sensitive groundwater aquifers (Principal, Secondary A or Secondary B) or nearby watercourses; and
- the presence of adjacent residential properties or sensitive ecological receptors.

10.4.9 Clusters of potentially contaminated sites of a similar nature have been grouped, and assessed together, where appropriate.

10.4.10 A simple summary of the baseline CSM is provided in Table 19. A more detailed assessment of baseline risk is provided in Volume 5: Appendix LQ-001-004. The potential baseline risks presented are those before any mitigation is applied. The assessed baseline risk is based on the information provided at the time of the assessment. Where limited information is available, the assessment is based on precautionary, worst case assumptions and may, therefore, report a higher risk than that which actually exists. A screening assessment of the effects of contamination has been completed by comparing the detailed CSM developed for potential contaminated areas at baseline with construction and post-construction stages.

Table 19: Summary of baseline CSM for sites which may pose a contaminative risk for the Proposed Scheme

Area reference[127]	Area name	Human health risk	Groundwater risk	Surface water risk	Buildings risk
4-9	Sandpit quarry	Low to moderate/low	Moderate	Very low	Very low to moderate
4-11	Former timber treatment works	Low to moderate/low	Low	Very low	Low
4-18	Madeley Cemetery	Low to moderate/low	Moderate/low	Very low	Very low to moderate/low

[127] Each potentially contaminated site is allocated a unique reference number (See Volume 5: Appendix LQ-001-004 and Land quality Map Book).

Area reference[127]	Area name	Human health risk	Groundwater risk	Surface water risk	Buildings risk
4-19, 4-20, 4-21, 4-22, 4-28 and 4-29	Netherset Hey Lane Industrial Estate and associated fuel storage (4 areas) Historical engine shed Historical borrow pit	Low to moderate/low	Low	Low	Very low to moderate/low
4-36	WCML active lines	Low to moderate/low	Moderate	Low	Very low
4-39	WCML active and disused lines	Low to moderate/low	Moderate/low	Low	Very low
4-62	Whitmore Heath historical landfill	Low to moderate/low	Moderate	Moderate/low	Very low to moderate
4-65 and 4-66	Beechfields and Bowerend historical landfills	Low to moderate/low	Moderate/low	Very low	Low to moderate/low
4-72	Former garage (A525 Bar Hill Road, Madeley)	Low to moderate/low	Moderate/low	Very Low	Very low
4-73	East of railway cutting historical landfill	Low to moderate/low	Moderate/low	Very low	Very low to moderate
4-74	Reservoir historical landfill	Low to moderate/low	Moderate/low	Low	Very low to moderate
4-85 and 4-45	Fuel storage at Netherset Hey Farm and Coney Greave	Low to moderate/low	Moderate	Very low	Very low

Temporary effects

10.4.11 In order to identify potential temporary effects, the baseline and construction CSM have been compared to determine the change in level of risk at receptors during the construction stage, and thus to define the level of effect at the construction stage.

10.4.12 Where there is no change between the main baseline risk and the main construction risk, the temporary effect significance is deemed to be negligible even if the risk is deemed to be high. For example, this will be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the area required for construction.

10.4.13 A worsening risk at construction stage compared to baseline will result in a negative effect, and conversely, an improvement will result in a positive effect. The assessment assumes that any contamination will be controlled through the general measures described in the draft CoCP.

10.4.14 All of the sites set out in Table 19 have been assessed for the change in impact associated with the construction stage of the work. The assessment has shown that whilst there are a number of minor adverse and beneficial impacts at the construction stage, none of these would be regarded as significant in line with the methodology set out in the SMR. The details of the full assessment are presented in Volume 5: Appendix LQ-001-004.

10.4.15 In the event that unexpected contamination is encountered during the construction of the Proposed Scheme in this area, this will be assessed and remediated if required as described in the draft CoCP resulting in an overall beneficial effect.

10.4.16 Construction compounds located in the Whitmore Heath to Madeley area will include the storage of potentially hazardous substances, such as fuels and lubricating oils, and may also be used for temporary storage of potentially contaminated soils. Mitigation measures set out within the draft CoCP include management of risks from the storage of such materials.

Permanent effects

10.4.17 In order to identify potential permanent effects, a screening assessment has been undertaken comparing the baseline and post-construction CSM to assess the permanent (post-construction) effects.

10.4.18 All of the sites set out in Table 19 have been assessed for the change in impact associated with the post-construction (permanent) stage of the work. The assessment has shown that whilst there are a number of minor adverse and beneficial impacts at the post-construction stage, none of these would be regarded as significant in line with the methodology set out in the SMR. The details of the full assessment are presented in Volume 5: Appendix LQ-001-004.

10.4.19 Where remediation is carried out for sites within land required for the construction of the Proposed Scheme, there will be no permanent significant effects on land quality receptors.

10.4.20 Additional site-specific permanent remediation measures that could focus on source removal, pathway breakage or receptor protection, will be developed during the detailed design stage if required. These measures will ensure that risks to people and property from gas and vapours in the ground will be controlled to an acceptable level.

Mining/mineral resources

10.4.21 Construction of the Proposed Scheme has the potential to affect existing mineral resources, proposed areas of mineral exploitation and/or petroleum/gas reserves. This could occur by sterilisation of the resource through direct excavation during construction of the Proposed Scheme or through temporary and/or permanent severance[128] or isolation that may occur during the construction phase of the Proposed Scheme, possibly continuing through to its operation.

[128] In this context, severance refers to the Proposed Scheme splitting an actual or proposed mining/mineral site into two or more areas, such that separate accesses would be required to work the whole site.

10.4.22 The route of the Proposed Scheme will cross one MSA for sand and gravel extraction in three locations across the Whitmore Heath to Madeley area (Volume 5: Maps LQ-01-113b to LQ-01-115a).

Temporary effects

10.4.23 Temporary effects may occur during initial excavation of the borrow pit if areas of potentially contaminated land are identified during future ground investigation work. However, no areas of potentially contaminated land have been identified in the Whitmore Heath to Madeley borrow pit, as part of this study.

10.4.24 Temporary adverse effects may occur where construction compounds are proposed within MSA. In such cases, there may be a temporary sterilisation of the resource during construction works, but this is not considered to represent a significant effect, and the resource will not be lost permanently.

10.4.25 The following compounds fall within the MSA:

- Stableford North embankment satellite compound;
- Whitmore Heath tunnel satellite compound;
- Whitmore Heath tunnel south portal satellite compound;
- Whitmore Heath tunnel north portal satellite compound;
- Whitmore North cutting satellite compound;
- Whitmore North auto-transformer station satellite compound;
- River Lea viaduct satellite compound;
- Madeley cutting satellite compound;
- Madeley tunnel (south) satellite compound;
- Madeley tunnel (north) satellite compound;
- Madeley tunnel north portal satellite compound; and
- Checkley South embankment satellite compound.

10.4.26 The temporary effects on the hydrogeological regimes, as a result of the borrow pit extraction, are uncertain at this stage. The need for secondary aquifer dewatering is to be assumed as a worst case, which may lead to localised and temporary disturbance of groundwater flow directions. Further details regarding the temporary groundwater effects are given in Section 15, Water resources and flood risk.

Permanent effects

10.4.27 The majority of effects on mining and mineral sites will be permanent.

10.4.28 Section 2.3 of this report sets out the details of the borrow pit in the Whitmore Heath to Madeley area. The maximum excavation depth for the borrow pit will be 18m, comprising 1m of topsoil and subsoil and between 3.5 and 17m of sand and gravel extraction. The thickness of the available mineral resource is uncertain however, the

maximum mineral depth has been derived from geotechnical desk study of mineral resources. The area of the borrow pit is 28ha.

10.4.29 Excavation will be carried out in zones, until each zone is depleted. The exact size and number of zones will be assessed during detailed design.

10.4.30 Excavation of the borrow pit will avoid unnecessarily sterilising mineral deposits by excavating the sand and gravel to full depth unless there are engineering or construction constraints that prevent this. HS2 Ltd will seek to avoid sterilisation of mineral reserves wherever practicable.

10.4.31 Backfill material will arrive at the borrow pit location as soon as it becomes available. The borrow pit will be backfilled with natural clean excavated material from other areas of the Proposed Scheme, and capped off with the previously excavated topsoil and subsoil. Generally, backfill will be placed and compacted in even layers where needed to mitigate differential settlement across the site.

10.4.32 The backfill for the borrow pits will be predominantly cohesive material (e.g. silt and clay), and will include material derived from the Mercia Mudstone Group and the Glacial Till. The Mercia Mudstone Group contains evaporite minerals, mainly halite (sodium, chloride) and gypsum (hydrous calcium sulphate). The thicker halite beds in Staffordshire are at depths of 100m or more, and will not be encountered in excavation for cuttings or tunnels, although thinner layers may be encountered in the excavations. In addition, gypsum is found in thin layers or veins throughout the Mercia Mudstone Group. These minerals can cause changes in groundwater quality when dissolution occurs. However, if present in relatively small quantities, and surrounded by low permeability compacted clays and mudstones, the potential for dissolution is small, and the potential effect on groundwater quality will be relatively minor, and is not considered significant. If substantial horizons of halite are encountered in excavations, this will not be used for backfill in borrow pits.

10.4.33 The borrow pit site is currently in agricultural use. It is proposed to restore the land back to the current land use, post-excavation.

10.4.34 Use of the borrow pit is assessed as having a minor beneficial effect (Table 20) as it avoids depletion of local permitted reserves, which is not significant. It should be noted that extraction from below the structural footprint of the route of the Proposed Scheme will not occur, as the permanent railway will require good founding conditions. A plan will be discussed in advance of the construction works with the landowner, the mineral planning department at SCC, and any other relevant parties to assist in achieving effective management of minerals within the affected location of the MSA.

10.4.35 The effects of construction of the Proposed Scheme on the sand and gravel MSA will be permanent where underlain by the permanent works, with a strip of mineral becoming sterilised. However, as a proportion of the total MSA, this strip is less than 1% of the total, and the effect on the MSA is considered to be minor and therefore not significant.

10.4.36 The route of the Proposed Scheme will cross an area that is underlain by coal reserves in the Warwickshire Group coalfield. Construction of the Proposed Scheme may constrain the working of the coal resources in a strip of land below and surrounding

the route, however, it is understood there are no current plans to work the coalfield. Construction of the Proposed Scheme is unlikely to place a constraint on future exploitation of potential sources of coal bed methane.

10.4.37 The route of the Proposed Scheme will cross two Licence to Search and Bore For and Get Petroleum areas. It is possible that this could impact on future gas exploration and/or production activities. Similarly, opportunity for access to possible future shale gas exploration and/or production (subject to appropriate licensing) could be affected.

10.4.38 Table 20 reports the assessment of permanent effects from construction on the mining and mineral resources identified.

Table 20: Summary of effects for mining and mineral resources

Site name	Status	Description	Sensitivity/ value	Magnitude of impact	Effect and significance (Y/N)
Superficial sand and gravel	MSA	MSA for sand and gravel extraction, defined by SCC	Medium	Minor	Negligible (N)
Borrow pit	MSA	One area in MSA identified for use on Proposed Scheme	Medium	Positive	Minor beneficial (N)
PEDL 40 PEDL 56	Licenced by UK Oil and Gas Authority	Licence to Search and Bore For and Get Petroleum	Low	Minor	Negligible (N)
South Staffordshire Coalfield	Unknown	Coal seams	Likely to be of low sensitivity	Negligible	Negligible (N)

10.4.39 There will be negligible effects on mineral and gas resources, which are not significant. There will be a minor beneficial effect resulting from excavation of the borrow bit in the Whitmore Heath to Madeley area.

Geo-conservation sites

10.4.40 No geo-conservation areas such as SSSI or LGS have been identified in the study area.

Other mitigation measures

10.4.41 At this stage, no additional measures are considered necessary to mitigate risks from land contamination during the construction stage beyond those that are set out in the draft CoCP and/or instigated as part of the site specific remediation strategies that will be developed during the detailed design stage if required. These measures will ensure that risks to people, property and the environment from contaminants in the ground will be controlled such that they will not be significant. For example, measures might include excavation and treatment of contaminated soils or controls to manage movement of landfill gas and leachate.

10.4.42 It is considered unlikely that mitigation measures to manage the effects of the Proposed Scheme on petroleum (gas) or shale resources will be required.

Summary of likely residual significant effects

10.4.43 Based on the information currently available and with the application of the mitigation measures detailed above, no likely significant residual effects are anticipated with respect to land quality.

Cumulative effects

10.4.44 No significant cumulative temporary or permanent effects during construction with regard to land contamination, mineral resources or geo-conservation sites are anticipated.

10.5 Effects arising from operation

10.5.1 Users of the Proposed Scheme (i.e. rail passengers) are at all routine times within a controlled environment (i.e. within trains), and have therefore been scoped out of the assessment.

Avoidance and mitigation measures

10.5.2 Maintenance and operation of the Proposed Scheme will be in accordance with environmental legislation and good practice. Spillage and pollution response procedures similar to those outlined in the draft CoCP will be established for all high risk activities and employees will be trained in responding to such incidents.

Assessment of impacts and effects

10.5.3 The Proposed Scheme within this area includes two auto-transformer stations, Whitmore North auto-transformer station and Madeley North auto-transformer station. An auto-transformer station can, in principle, be a source of contamination through accidental discharge or leaks of coolant. However, in common with other modern substations, secondary containment appropriate to the level of risk would be included in the installed design.

10.5.4 The operation of the trains may give rise to minor contamination through leakage of hydraulic or lubricating oils. However, any such leakage or spillage is expected to be very small and unlikely to result in significant contamination.

Other mitigation measures

10.5.5 No other mitigation measures are expected to be required beyond what has already been outlined relating to land quality in the study area.

Summary of likely residual significant effects

10.5.6 No significant residual effects are anticipated associated with operation of the Proposed Scheme.

Cumulative effects

10.5.7 No cumulative effects during operation on land quality receptors have been identified in the Whitmore Heath to Madeley area.

Monitoring

10.5.8 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

10.5.9 Requirements for monitoring will be determined as part of the investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process. Monitoring requirements may include water quality, air quality and/or (landfill) gases, depending on the site being considered.

11 Landscape and visual

11.1 Introduction

11.1.1 This section of the report presents the assessment of the likely significant landscape and visual effects within the Whitmore Heath to Madeley area. It summarises the baseline conditions found within and around the route of the Proposed Scheme and describes the likely impacts and significant effects during construction and operation on landscape and visual receptors.

11.1.2 The operational assessment section refers not just to the running of the trains, vehicles on roads and associated lighting but also the presence of the new permanent infrastructure associated with the Proposed Scheme.

11.1.3 Engagement has been undertaken with Staffordshire County Council (SCC), Newcastle-under-Lyme Borough Council (NBC) and Natural England. The purpose of this engagement has been to discuss the assessment methodology, the extent of the landscape and visual study area, the distribution of visual receptor viewpoints and the location of verifiable photomontages.

11.1.4 Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in the Volume 5: Landscape and Visual Map Book and Volume 5: Appendix LV-001-004, which comprises the following:

- Part 1: Engagement with technical stakeholders;
- Part 2: Landscape character assessment;
- Part 3: Visual assessment; and
- Part 4: Assessment matrices.

11.1.5 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

11.1.6 The Volume 2: CA4 Map Book also includes Map Series LV-03 (Construction phase viewpoints), Map Series LV-04 (Operation phase viewpoints) and Map Series LV-01 (Verifiable photomontages), showing viewpoints that will be significantly affected.

11.1.7 A separate, but related, assessment of effects on historic landscape character and the setting of heritage assets is reported in Section 7, Cultural heritage.

11.2 Scope, assumptions and limitations

11.2.1 The scope, key assumptions and limitations for the landscape and visual assessment are set out in full in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[129] and the SMR Addendum[130].

[129] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[130] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.

11.2.2 Winter surveys for the landscape and visual assessment were undertaken from January to March 2016 and in January 2017 to inform the assessment. Summer field surveys, including photographic studies of landscape character areas (LCA) and visual assessment of viewpoints, were undertaken from July to September 2016. During the baseline survey, there were some areas that were inaccessible (such as private land, commercial premises and residential buildings). In these instances, professional judgement has been used to approximate the likely views from these locations.

11.2.3 The extent of the study area has been informed by construction and operational phase zones of theoretical visibility (ZTV). The ZTVs have been produced in line with the methodology described in the SMR Addendum, and are an indication of the theoretical visibility of the Proposed Scheme. In some locations, extensive vegetation cover will mean the actual visibility is substantially less than that shown in the ZTVs, and professional judgement on site visits has been used to further refine the study area to focus on likely significant effects.

11.2.4 Tall construction plant (for example cranes and piling rigs) is excluded from the ZTV for the construction phase, as there is a great degree of variability in the extent and timeframes of the visibility of construction activity and plant. Overhead line equipment rarely gives rise to significant effects if it is the only element visible and has, therefore, been excluded from the ZTV to give a better indication of the possible spread of significant effects to aid the assessment. Overhead line equipment is described and taken into account in the assessment of effects on LCAs and visual receptors.

11.2.5 Landscape and visual receptors within approximately 500m of the Proposed Scheme have been assessed as part of the study area. Long distance views of up to 1km have been considered at settlement edges, such as at Baldwin's Gate, Whitmore, Whitmore Heath, Madeley Park Wood and Madeley.

11.2.6 Professional judgements on landscape value, susceptibility and sensitivity are described in full in the baseline descriptions in the proformas in Volume 5: Appendix LV-001-004, Part 2.

11.3 Environmental baseline

Existing baseline

Landscape baseline

11.3.1 The study area extends from Whitmore Heath in the south to Madeley in the north. The West Coast Main Line (WCML) runs north to south through the central part of the study area and a short section of the M6 encroaches into the eastern edge of the study area near Madeley.

11.3.2 The southern part of the study area includes the Meece Brook valley, an area of arable fields and pastures. This is a narrow valley near Hill Chorlton, which then broadens out into a wide valley near Whitmore. In the central part of the study area, the upper reaches of the River Lea valley present a broad valley landscape of extensive low lying farmland, which forms part of the wider setting of Whitmore Heath, Madeley Park Wood and Baldwin's Gate. By contrast, the Madeley valley in the north of the study

area is defined by the meandering incised course of the River Lea, with woodland and areas of marsh in the valley floor rising to gorse-covered upper valley slopes.

11.3.3 On the higher ground, areas of heath are found in combination with mixed species woodland and ancient woodland, including Whitmore Wood, Hey Sprink, Barhill Wood, the Lum and Grafton's Wood. The field pattern is well-defined by typically well-maintained hedgerows with mature hedgerow trees.

11.3.4 Other key features are Whitmore Hall and its associated parkland, and the historic Whitmore village, plus remnant designed landscapes and parklands at Maer. There are a number of historic settlements linked by a network of rural lanes, notably Acton, Baldwin's Gate and Hill Chorlton.

11.3.5 Modern housing developments at Whitmore Heath and Madeley Park Wood are visually integrated into the landscape by the mature woodland within which they were developed. To the north of the study area is the larger nucleated village of Madeley, with a historic core surrounded by more recent residential development.

11.3.6 Linear transport corridors are a locally prominent feature of the area, notably the M6, the A51 London Road, the A53 Newcastle Road and the A525 Bar Hill Road as well as the WCML.

11.3.7 The LCAs have been determined as part of an integrated process of environmental characterisation, informed by the outcome from other topics, including the historic landscape character and ecological assessments. Use has been made of published landscape character assessments, historic landscape characterisation (HLC) and a wide range of supporting GIS data, aerial photography and Ordnance Survey mapping, plus desk study and fieldwork, and the findings of related topic assessments, such as cultural heritage. Landscape character assessments reviewed include the relevant National Landscape Character Areas[131] and the Staffordshire Landscape Guidelines[132]. More detail on the approach to the landscape characterisation is set out in the SMR Addendum.

11.3.8 For the purposes of this assessment, the study area for Whitmore Heath to Madeley has been subdivided into 18 LCAs. Full descriptions are contained within Volume 5: Appendix LV-001-004, Part 2.

Visual baseline

11.3.9 A summary description of the distribution and types of receptors most likely to be affected is provided below. The viewpoints are numbered to identify their locations and are shown on the landscape character areas and viewpoint locations maps (Volume 2: CA4 Map Book, Map Series LV-03 and LV-04). They are described and assessed in full in the proformas in Volume 5: Appendix LV-001-004, Part 3. In each case, the middle number (xxx.**xx**.xxx) identifies the type of receptor that is present in this area – 1: Protected views (none within this study area), 2: Residential, 3:

[131] Natural England (2013, 2014), *National Character Area profiles*. Available online at: https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles

[132] Staffordshire County Council, Development Services Department (2000), *Planning for Landscape Change*. Available online at: https://www.staffordshire.gov.uk/environment/eLand/planners-developers/landscape/NaturalEnvironmentLandscapeCharacterTypes.aspx

Recreational[133], 4: Transport, 5: Hotels/healthcare (none within this study area) and 6: Employment (none within this study area).

11.3.10 No protected views have been identified within the study area. Residential visual receptors within the study area are located in and around the larger settlements of Madeley and the smaller villages such as Baldwin's Gate, hamlets such as Hill Chorlton and the more recent residential developments of Whitmore Heath and Madeley Park Wood. Residential receptors are also associated with many dispersed residential properties and farmsteads.

11.3.11 Views from settlement edges are typically filtered and framed by intervening field boundary vegetation which, allied to low lying and gently undulating or rolling landform, partially restricts open views.

11.3.12 A range of recreational visual receptors are present, including Whitmore Cricket Club, Whitmore Hall, a woodland site used for paintballing off Manor Road, Manor Road allotments and the playing field south-west of Madeley, Cudmore Fisheries and users of the extensive public rights of way (PRoW) network.

11.3.13 Visitors to Madeley Cemetery at Manor Road and the graveyard at All Saints Church in Madeley are also identified as visual receptors.

11.3.14 Views from the majority of PRoW are relatively low lying and restricted by landform or by hedgerow and woodland cover.

11.3.15 Key transport visual receptors within the Whitmore Heath to Madeley area are located along the A51 London Road, the A53 Newcastle Road (which continues as the A53 Whitmore Road) and A525 Bar Hill Road. These roads pass through undulating or gently rolling rural farmland comprising pastures and arable fields. Hedgerow and field trees provide a degree of visual filtering and framing of views.

Future baseline

Construction (2020)

11.3.16 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

11.3.17 One development has been identified which will potentially materially alter future baseline conditions in 2020, as described in Table 21.

Table 21: Committed developments relevant to landscape and visual

Map Book Reference[134]	Planning Reference	Description
CA4/2	13/00426/OUT	113 dwellings and associated works as an extension to the north-west edge of Baldwin's Gate.

[133] Reference to specific civil parish numbers for footpaths is provided where available otherwise the adjacent road name is used as a reference to the footpath.
[134] Volume 5 Map Book: Maps CT-13-113b to CT-13-115a-R1.

11.3.18 This development has been included as part of the baseline conditions for the assessment of construction effects.

11.3.19 No additional committed developments have been identified in this area that will materially alter the baseline conditions in 2020 for landscape and visual receptors.

Operation (2027)

11.3.20 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

11.3.21 No committed developments have been identified in this area that will materially alter the baseline conditions in 2027 for landscape.

11.4 Temporary effects arising during construction

11.4.1 As is commonplace with major infrastructure works, the scale of the construction activities means that works will be visible from many locations and will have the potential to give rise to significant temporary effects that cannot practicably be mitigated. Such effects are temporary and will vary over the construction period depending on the intensity and scale of the works at the time. The assessment of landscape and visual effects has been based on the activities occurring during the peak construction phase, which is defined as the period during which the main construction works will take place, including the establishment of compounds, main earthworks and structure works.

11.4.2 The effects associated with the peak construction stage in this area are generally considered to be medium-term, based on the indicative construction programme in Section 2.3. The peak civil engineering stage in this area will be undertaken between the start of 2021 and the end of 2024. Effects during other stages of works are likely to be less intensive due to less construction equipment being required at the time and a reduced intensity of construction activity.

11.4.3 Section 2.2 sets out the key permanent features of the Proposed Scheme and Section 2.3 describes the construction compounds and associated temporary works that have been considered in this assessment.

Avoidance and mitigation measures

11.4.4 Effects during the construction period may be reduced by establishing planting early in the construction programme. Advanced planting is proposed in a number of specific locations, including adjacent to the Madeley tunnel (south) satellite compound, and close to Whitmore Heath (North) tunnelling facility logistics area. These mitigation measures will provide additional screening for receptors during construction (as well as beyond into operation), and will also help better integrate the Proposed Scheme into the landscape.

11.4.5 Measures that have been incorporated into Sections 12 and 14 of the draft Code of Construction Practice[135] (CoCP) to avoid or reduce landscape and visual effects, where reasonably practicable, during construction include the following:

- avoidance of unnecessary tree and vegetation removal, and protection of existing trees in accordance with BS 5837: Trees in relation to design, demolition and construction[136];
- use of well-maintained hoardings and fencing;
- prevention of damage to the landscape features adjacent to the construction sites due to movement of construction vehicles;
- design lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses; and
- replacement of any trees intended to be retained, which may die as a consequence of nearby construction works.

11.4.6 Implementation of these measures has been taken into account in the assessment of the construction effects.

Assessment of temporary impacts and effects

11.4.7 The most apparent changes to the landscape and to the views experienced by visual receptors during construction will relate to the presence of construction plant,compounds and soils and material storage and stockpiling. Key construction activities that will give rise to the most apparent changes to landscape and visual receptors are: the excavation of cuttings; erection of viaducts; construction of embankments, overbridges and underbridges; the removal of existing landscape elements, including trees and hedgerows; and the closure, diversion and realignment of existing roads and PRoW. Other key changes include the excavation and working of the borrow pit west of Netherset Hey Farm and demolitions of buildings and structures.

Landscape assessment

11.4.8 The following seven LCAs in Table 22 will be significantly affected during construction. Full details of effects are described in Volume 5: Appendix LV-001-004 Part 2.

Table 22: Construction phase significant landscape effects

Upper Meece Brook Valley Alluvial Lowlands	**Low-medium susceptibility and sensitivity**
The landscape will be impacted by construction activity associated with the Meece Brook viaduct, Meece embankment and Bent Lane (north) diversion. These, and the presence of site haul routes, cranes other construction plant, material stockpiles, and changes to the landform will intensify the severance currently experienced due to the presence of the WCML, and introduce new uncharacteristic features that will alter a substantial proportion of the landscape within this LCA. The cranes used for construction of the Meece Brook viaduct will also have an impact on skyline character and introduce activity to an area which currently has a strong sense of tranquillity and remoteness.	

[135] Volume 5: Appendix CT-003-000, Code of Construction Practice.
[136] BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations, 2012, British Standard.

Construction of the Proposed Scheme will result in a **high magnitude of change and major adverse effect** on this LCA, which is significant.

Upper Meece Brook Valley Ancient Redlands	**Low-medium susceptibility and medium sensitivity**

The landscape will be impacted by construction of the Stableford North embankment, Meece embankment, Whitmore South cutting, Whitmore Heath tunnel, the southern porous portal of Whitmore Heath tunnel and associated earthworks. These works and the presence of the A53 Newcastle Road transfer node, site haul routes, construction plant and material stockpiles will substantially change the rural character in terms of landform and the pattern of arable fields and pastures. The tranquillity currently experienced will also be reduced. Construction works associated with the Bent Lane (North) diversion, the A53 Newcastle Road overbridge and the A53 Newcastle Road temporary highway diversion will be very apparent in terms of changes to the landform and loss of pastures and vegetation, together with the loss of the mature roadside landscape along Bent Lane. The scale and intensity of activity means that the magnitude of change will be high, particularly in the western part of this LCA where the alterations to landform and land cover will further change the rural character, which is already affected by 20th century agricultural intensification.

Construction of the Proposed Scheme will result in a **high magnitude of change and a major adverse effect** on this LCA, which is significant.

Upper Lea Valley Ancient Redlands	**Medium susceptibility and sensitivity**

This is a linear LCA which will be directly and indirectly impacted by construction activity along much of its length. Construction of the northern porous portal of the Whitmore Heath tunnel (including night-time lighting of the tunnel boring works), removal of part of Whitmore Wood, Whitmore Wood retaining wall, Whitmore North cutting, Lea South embankment, the River Lea viaduct, Lea North embankment, the borrow pit west of Netherset Hey Farm, combined with the presence of the viaduct launching yard and associated site haul routes and construction plant, will substantially alter features which are distinctive to the landscape, in particular the loss of the shaws (linear tree belts) and severance of the rural landscape on the valley side. The presence of cranes for construction of the River Lea viaduct will also affect skyline character. The noise, movement and scale of the works will completely alter the character of the part of the LCA on the valley side and reduce the tranquillity of the River Lea valley through the introduction of visual and noise disturbance.

Construction of the Proposed Scheme will result in a **high magnitude of change and major adverse effect** on this LCA, which is significant.

Hey Sprink Ancient Redlands and Woodlands	**Medium-high susceptibility and medium sensitivity**

Much of this large LCA will be unaffected by construction of the Proposed Scheme. The western edge of the landscape will, however, be impacted by construction of the Whitmore Heath tunnel (including night-time lighting of the tunnel boring works), the porous portals (both northern and southern) and the tunnel head walls. These activities, combined with the presence of the Whitmore North cutting satellite compound, removal of part of Whitmore Wood on the valley slopes, and widening of Snape Hall Road (removing mature hedgerows and trees) will substantially alter the landscape character along the eastern valley slope of the River Lea valley. The introduction of visual disturbance, lighting and noise from the construction activities will reduce the tranquillity this area currently experiences, particularly on the less accessible plateau farmland. The visual relationship to the adjoining valley floor landscape (within the Upper Lea Valley Ancient Redlands LCA) will be disrupted.

The impacts on the western edge of the LCA will be greater, but only a small proportion of the wider LCA will be affected. In the context of the LCA as a whole therefore, the effects will be lower than may otherwise be expected.

Construction of the Proposed Scheme will result in a **medium magnitude of change and moderate adverse effect** on this LCA, which is significant.

Madeley Ancient Clay Farmlands	**Medium susceptibility and medium sensitivity**

Much of this large LCA will be unaffected by construction of the Proposed Scheme. The eastern side of the LCA will, however, be impacted by construction of the Madeley tunnel (plus night-time lighting of the tunnel boring works), the porous portals at either end of the Madeley tunnel, the tunnel head walls above both ends of the Madeley tunnel (particularly above the southern portal), Madeley cutting and the A525 Bar Hill overbridge. The landscape will also be impacted by the presence of the Madeley tunnel (south) and Madeley tunnel (north) satellite compounds, the Madeley tunnel (north) tunnelling facility/logistics area and material stockpiles.

A substantial part of the large hedged arable fields between Barhill Wood and Madeley village will be removed. The avenue of mature lime trees along the track leading to Moor Hall Farm will be retained and protected but there will be some removal of trees on the edge of Barhill Wood which will be very noticeable as they occupy an elevated situation. The tranquillity this area currently experiences will be reduced through the introduction of visual disturbance and lighting and noise from the construction activities.

The impacts on the eastern edge of the LCA will be greater, but only a small proportion of the wider LCA will be affected. Therefore, in the context of the LCA as a whole, the effects will be lower than may otherwise be expected.

Construction of the Proposed Scheme will result in a **medium magnitude of change and moderate adverse effect** on this LCA, which is significant.

Madeley Ancient Redlands	**Low-medium susceptibility and medium sensitivity**

Much of this large LCA will be unaffected by construction of the Proposed Scheme. West of Netherset Hey Lane there will be more substantial effects on the landscape due to the construction activity associated with the Madeley cutting, Madeley Bridleway 1 accommodation green overbridge and Manor Road realignment and overbridge and associated earth formations. These works will result in loss of the large scale pattern of arable fields and pastures. Excavation and working of the borrow pit west of Netherset Hey Farm will completely change the character of the landscape between Hey Sprink and Netherset Hey Industrial Estate, with extensive alteration to the local landform and loss of a large area of arable farmland, including some robust hedgerows. The noise, construction movement and scale of the works will reduce the sense of tranquillity currently experienced in this area.

Due to the presence of the borrow pit west of Netherset Hey Farm, the impacts on the western edge of the LCA will be greater, but only a small proportion of the wider LCA will be affected. In the context of the LCA as a whole therefore, the effects will be lower than may otherwise be expected.

Construction of the Proposed Scheme will result in a **medium magnitude of change and moderate adverse effect** on this LCA, which is significant.

Madeley Valley	**Medium-high susceptibility and medium sensitivity**

This LCA lies primarily in the Whitmore Heath to Madeley area, with a small part extending into the South Cheshire area (CA5). Around Wrinehill, construction activity associated with the Checkley South embankment and Checkley Brook viaduct will substantially alter the landform and character of the River Lea valley. The introduction of large scale construction works will change the perceptual characteristics of the local landscape with an increased sense of severance and a reduction in scenic quality. The tranquillity of the landscape and setting of the historic Wrinehill Mill and Wrinehill Hall will be reduced through the introduction of noise and disturbance into an area which is rural, relatively remote and accessed only by a private residential drive. The presence of cranes for construction of the River Lea viaduct will also affect character of the skyline.

The impacts on the narrow section of valley near Wrinehill Hall will be large but only a small proportion of the wider LCA will be affected. In the context of the LCA as a whole therefore, the effects will be lower than may otherwise be expected.

Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect** on this LCA, which is significant.

Visual assessment

Introduction

11.4.9 The following section describes the likely significant effects on visual receptors during construction. The construction assessment has been undertaken for the winter period, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of construction activities may be reduced during summer when vegetation, if present in a view, will be in leaf. Where residential receptors will experience significant effects at night-time arising from additional lighting, these are also presented in this section. Visual receptors who will experience non-significant effects are reported in Volume 5: Appendix LV-001-004.

11.4.10 Where a viewpoint represents multiple types of receptor, the assessment is based on the most sensitive receptor. Effects on other receptor types with lower sensitivity will be lower than those reported.

11.4.11 The visual assessment has identified locations where continuous night working and/or overnight working during construction will result in significant effects on residential receptors (summarised in Table 23 and described in detail in Volume 5: Appendix LV-001-004, Part 3).

11.4.12 Additional lighting will not give rise to significant effects due to the nature of the construction programme, except at Whitmore Heath tunnel and Madeley tunnel, where night-time working will be required for periods of time.

11.4.13 Table 23 describes the construction phase significant visual effects. These are described in detail in Volume 5: Appendix LV-001-004 and shown in Map Series LV-03 in the Volume 2: CA4 Map Book.

Table 23: Construction phase significant visual effects

View from residences at Hill Chorlton **(VP 20.02.006)**
Residents and users of the scenic Bent Lane will have middle distance views of construction activity associated with the Meece Brook viaduct, which will be clearly visible beyond the residential properties located on the elevated ground of Hill Chorlton. Also, the temporary materials stockpile located along Bent Lane will be partly visible through vegetation, with views further east to the Stableford North embankment satellite compound along the Bent Lane (North) diversion predominantly screened by the intervening properties and vegetation of Hill Chorlton. Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.
View from north-east from farmland north of Kennels Lane **(VP 020.03.008)**
Users of Chapel and Hill Chorlton Footpath 6 will have medium range to distant elevated views beyond the WCML of construction works associated with the Meece Brook viaduct and Meece embankment These works, associated earthworks, material stockpiles and the presence of the Stableford North embankment satellite compound, construction equipment and vehicles will result in new features that form incongruous elements in the views across the small-scale rolling pastoral landscape, interrupting the rural, relatively open views towards Swynnerton Old Park and the Hanchurch Hills. Cranes used for construction of the viaduct will be visible on the skyline. Users of the footpath will also have views of the works associated with the Bent Lane (North) diversion, which will involve excavation and earth moving as well as alterations to the local landform. Levelling of the sloping landform for the Stableford North embankment satellite compound and adjacent material stockpiles will intensify the overall effects. Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.
View north-east from farmland close to WCML **(VP 020.03.011)**
Users of Chapel and Hill Chorlton Footpath 2 will have close to medium range views beyond the WCML of construction works associated with the Meece Brook viaduct and Meece embankment, and the Stableford North embankment satellite compound. These works, associated earthworks, material stockpiles and the presence of construction equipment and vehicles will result in new features that form prominent, incongruous elements in the views across the small-scale rolling pastoral landscape, interrupting the rural, relatively open views towards Swynnerton Old Park and the Hanchurch Hills. Cranes used for construction of the Meece Brook viaduct will be visible on the skyline. Users of the footpath will also have views of the works associated with the Bent Lane (North) diversion, which will involve extensive excavation and earth moving as well as alterations to the local landform. Levelling of the sloping landform for the Stableford North embankment satellite compound and adjacent material stockpiles will intensify the overall effects. Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.
View north-east from western side of the Meece Brook valley **(VPs 020.03.010 and 020.03.022)**
Users of Chapel and Hill Chorlton Footpaths 2, 5, 6 and 21 will have medium range to distant open views of construction activity associated with the Meece embankment, Whitmore South cutting and associated earthworks. The works and the presence of the transfer node adjacent to the A53 Newcastle Road, materials stockpiles, construction equipment and movement of construction vehicles will introduce incongruous new elements in the views across the small–scale pastoral Meece Brook valley and will interrupt views towards the wooded skyline of Swynnerton Old Park on the distant horizon. Construction of the A53 Newcastle Road temporary diversion and A53 Newcastle Road overbridge and embankments will also be visible in the distance. Cranes for construction of the Meece Brook viaduct will affect views of the skyline. Although the construction activity will be extensive, it will only affect part of the view from these locations. Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.
View west from entrance drive to Whitmore Cricket Club **(VP 020.02.020)**
Residents and users of the Whitmore Cricket Club will have open, elevated medium range to distant views of construction of the Whitmore South cutting, the A53 Newcastle Road temporary highway diversion, A53 Newcastle Road overbridge and associated earthworks. These works and presence of the A53 Newcastle Road transfer node, material stockpiles, construction equipment and movement of construction vehicles will result in new features that form incongruous elements in the current views across the gently rolling pastures. Views towards the Maer Hills will be interrupted by the works. Nearby residents along Bent Lane will have screened and filtered views due to intervening landform and vegetation along the course of Meece Brook.

Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

The view of the Proposed Scheme from viewpoint 020.02.020 during construction (summer) is illustrated on the photomontage shown in figure LV-01-605 (Volume 5: Appendix LV-001-004).

View south-west from Rectory Lane

(VP 020.02.016)

Residents and users of and users of Whitmore Footpaths 3 and 4 will have close to medium range, elevated views of construction of the A53 Newcastle Road overbridge, the A53 Newcastle Road temporary diversion and medium range views of the construction of the Whitmore Heath tunnel and southern porous portal of the Whitmore Heath tunnel. They will also have close range views of the Whitmore Heath tunnel satellite compound. The associated earthworks will be extensive and complex, with large-scale excavation and movement of material, as well as prominent landform changes. Views will be partially filtered by the intervening landform and vegetation but the combined effects of the works will substantially change the rural visual character. A prominent avenue of mature trees on the crest of a localised ridge between Baldwin's Gate and Whitmore will be removed.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View east from the A53 Newcastle Road near The Hill

(VP 020.02.021)

Residents at The Hill and users of the A53 Newcastle Road will have foreground views of construction of the A53 Newcastle Road overbridge, the A53 Newcastle Road temporary diversion, the southern end of the Whitmore Heath tunnel and the southern porous portal of Whitmore Heath tunnel. They will also have close range views of the Whitmore Heath tunnel south portal satellite compound. The associated earthworks will be extensive and complex, with large-scale excavation and movement of material, as well as prominent landform changes. The combined effects of the works will completely alter the gently rolling pastoral and arable farmland and rural visual character of the landscape around The Hill.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Construction (at night):

At night, the lighting associated with tunnel boring works will be visible and will intensify the existing light spill from The Hill and properties along the A53 Newcastle Road and Rectory Lane. At night there will therefore be a **medium magnitude of visual change and moderate adverse effect**, which is significant

View north-east from the western side of the River Lea valley near Madeley Park Wood

(VP 021.02.005, VP 021.02.007 and 021.02.008)

Residents and users of Whitmore footpath 5 will have open, close to medium range views of the construction works associated with the Whitmore Heath tunnel, northern porous portal of the Whitmore Heath tunnel and associated earthworks. These works, presence of the Whitmore North cutting satellite compound, material stockpiles, construction equipment and movement of construction vehicles will substantially change the current rural outlook across the valley floor. A barn at Snape Hall Farm will be demolished. Works and cranes associated with the River Lea viaduct and Lea South embankment will also be visible in the distance. Levelling for the Whitmore North cutting satellite compound will intensify the changes to the landform in this area. The extensive excavation and movement of material, changes to the landform and tree removal within Whitmore Wood will be prominent.

Construction of the Proposed Scheme will result in **a high magnitude of visual change and major adverse effect**, which is significant.

View north-east from Madeley Park Wood Area

(VPs 021.02.010 and 21.02.011)

Residents will have distant, but open and elevated views associated with the Whitmore Heath tunnel, the northern porous portal of the Whitmore Heath tunnel and associated earthworks. These works, presence of the Whitmore North cutting satellite compound, material stockpiles, construction equipment and movement of construction vehicles will substantially alter the key characteristics of the Whitmore Wood, which will affect part of the distant panoramic views from these viewpoints. Works and cranes associated with the River Lea viaduct and Lea South embankment will also be visible in the distance.

Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

View east from Manor Road and to the north of Madeley Park

(VPs 021.03.013 and 022.02.001)

Residents and users of Whitmore Footpaths 19, 20 and 21 and users of Manor Road will have open, medium range views of the construction works associated with the River Lea viaduct, Lea South embankment, Whitmore North auto-transformer station and associated earthworks. The works, presence of the River Lea viaduct pre-cast yard and viaduct launching yard and associated earthworks, material stockpiles and the presence of construction equipment and movement of construction vehicles will introduce prominent, incongruous elements in the views across the open farmland of the River Lea valley and will sever the characteristic shaws on the opposite valley side. These elements and the presence of prominent new features on the skyline, including cranes used for the construction of the viaduct will substantially change the rural outlook and detract from views of Hey Sprink and the shaws on the opposite valley side. The construction works, although at some distance, will extend across the full width of the view.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect,** which is significant.

Views in a broadly easterly direction from Manor Road

(VPs 022-03-003 and 022-02-004)

Residents and users of Madeley Footpath 15 and Manor Road will have extensive close to medium range views of construction works associated with the River Lea viaduct, Lea North embankment, Manor Road realignment, Manor Road overbridge and associated earthworks. They will also have views of the River Lea viaduct satellite compound, material stockpiles, construction equipment and movement of construction vehicles. Cranes associated with construction of the viaduct will be visible on the skyline. On the opposite side of the valley, excavation and working of the borrow pit west of Netherset Hey Farm will occupy much of the distant view and will be particularly apparent from VP 022.02.004.

The current outlook across rolling pastures and arable fields, towards the WCML in the River Lea valley and the vegetated embankments of the Stoke to Market Drayton Railway and Madeley Chord, will be replaced by views of a large construction site. Changes to the landform and extensive tree removal around the former rail lines will be prominent. Distant skyline views towards Hey Sprink and the spire of All Saints Church and buildings in Madeley, will be interrupted.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View south-west from farmland near Netherset Hey

(VP 022.02.005 and 022.03.006)

Residents and users of Whitmore Footpath 14 will have extensive close range views of the excavation and working of the borrow pit west of Netherset Hey Farm and more distant views of the construction of the Lea North embankment, Manor Road realignment, Manor Road overbridge and associated earthworks. There will be large-scale movement of material and activity in this area which, together with the presence of material stockpiles, construction equipment and movement of construction vehicles will completely change the current outlook across the large, gently sloping pastures. More distant views of wooded farmland (including Hey Sprink) will be interrupted by the construction works.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View south-west from farmland near Hungerford House Farm

(VP 022.03.007)

Users of Madeley Footpath 67 will have medium range views of construction works associated with the excavation and working of the borrow pit west of Netherset Hey Farm and more distant views of the works associated with the Lea North embankment, Manor Road realignment, Manor Road overbridge and associated earthworks. The movement of material and activity, together with the presence of material stockpiles, construction equipment and movement of construction vehicles, will introduce new incongruous elements in the pastoral farmland, although views will be partially screened by the intervening rolling landform and vegetation, which will lessen the overall impact.

Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

View south and west from edge of Madeley Cemetery

(VP 022.03.024)

Visitors to the cemetery will have mainly open, close range views of construction of the Lea North embankment and the Manor Road overbridge. The nearby Hey House Lodge on Manor Road will be demolished. To the east the excavation and working of the borrow pit west of Netherset Hey Farm means that visitors to the cemetery will be largely surrounded by construction works. The rural outlook from this location will be completely altered due to the scale and prominence of the works, together with the loss of hedgerow field boundaries and trees in the middle ground of the view. Despite some localised screening by vegetation within the cemetery, views will be dominated by the proximity of extensive earthworks and movement of material. The tranquillity experienced within the cemetery will also be lost due the construction activity and movement of construction vehicles.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View from Red Lane

(VPs 022.02.013 and 022.03.014)

Residents at Red Lane and users of Madeley Bridleway 1 will have close range views of the construction works associated with the Madeley Bridleway 1 accommodation green overbridge (constructed along a section of Red Lane), A525 Bar Hill Road realignment and overbridge, Madeley cutting and associated earthworks. There will also be close range views of three satellite compounds, a tunnelling facility/ logistics area, material stockpiles, construction equipment and movement of construction vehicles. Two properties (no. 82 and 84 Barhill Cottages) will be demolished. Residents and users of Red Lane in this area will be surrounded by construction works and views of pastures will be replaced by a large-scale construction site, with new features that form prominent, incongruous elements in the view. The landform changes and vegetation removal will be very apparent.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect,** which is significant.

View from locations near residential properties on the A525 Bar Hill Road

(VPs 022.02.012, 022.02.018 and 022.02.022)

Residents, users of Madeley Footpath 24 and users of the A525 Bar Hill Road will have close range views of the construction works associated with the Madeley Bridleway 1 accommodation green overbridge, the A525 Bar Hill Road realignment and overbridge, Madeley tunnel and the southern porous portal of Madeley tunnel, the Bar Hill aqueduct and associated earthworks. Receptors will also have views of two satellite compounds, a tunnelling facility/ logistics area, transfer node, material stockpiles, construction equipment and movement of construction vehicles. The hedges either side of the A525 Bar Hill Road will be removed and a section of the carriageway temporarily widened (see Volume 4: Off-route effects). Two properties (no. 82 and 84 Barhill Cottages) will be demolished. Residents and users of the A525 Bar Hill Road in this area will be surrounded by construction works. Views of hedged pastures either side of the A525 Bar Hill Road will be replaced with large-scale construction activity. The landform changes will be prominent as will tree removal at Barhill Wood.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View west from farmland near Moor Hall Farm off the A525 Bar Hill Road

(VP 023.02.001)

Residents and users of Madeley Footpath 24 will have close range views of the construction works associated with the A525 Bar Hill Road realignment and overbridge, Madeley tunnel and the southern porous portal of Madeley tunnel, porous portal retaining wall, Bar Hill aqueduct, Madeley cutting and associated earthworks. There will also be views of the Madeley tunnel (south) satellite compound, tunnelling facility/ logistics area, transfer nodes, material stockpiles and the presence of construction equipment and movement of construction vehicles. Two properties (no. 82 and 84 Barhill Cottages) will be demolished. Receptors in this area will be surrounded by construction works and views of rolling pastures will be replaced by views of large-scale construction activity. The landform changes and vegetation removal will be very noticeable.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

The view of the Proposed Scheme from viewpoint 023.02.001 during construction (summer) is illustrated on the photomontage shown in figure LV-01-611 (Volume 5: LV-001-004).

View from Beechfield and farmland near Bower End Lane.

(VPs 023.02.006 and 023.03.007)

Residents of Beechfields and users of the Madeley Footpaths 6 and 48 will have medium range to distant views of construction activity associated with the Madeley tunnel and the northern porous portal of Madeley tunnel, associated tunnel boring activity, Checkley South embankment and associated earthworks. These works, presence of two satellite compounds, a tunnelling facility/logistics area, material stockpiles, construction equipment and movement of construction vehicles, will introduce prominent, incongruous elements into the views across the medium-scale pastoral landscape. The construction activity will interrupt the characteristic hedgerow field boundaries, copses of trees and the rural, relatively open visual character. Although at some distance and partially filtered by intervening hedgerows and trees, the works will extend across the full width of the view.

Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Views south from farmland near Grafton's Wood

(VP 023.03.012)

Users of Madeley Bridleway 5 and Madeley Footpath 28 will have open, close range views of the construction works associated with the Madeley tunnel and northern porous portal of the Madeley tunnel, Checkley South embankment, and associated earthworks. There will also be views of satellite compounds, the tunnelling facility/logistics area, material stockpiles, construction equipment and movement of construction vehicles. The current outlook across rolling pastures with managed hedgerows and mature trees will be replaced by views of a large-scale construction site. The loss of mature field boundary trees

and the landform changes will be particularly noticeable. Views across the River Lea valley to Wrinehill Wood will be interrupted by construction of the Checkley South embankment. Despite some localised screening of views by vegetation, the works will be very prominent.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View north from Wrinehill Wood

(023-03-010)

Users of Madeley Bridleway 2 will have medium range to distant views of construction activity associated with the Madeley tunnel and the northern porous portal of Madeley tunnel, associated tunnel boring activity, Checkley South embankment, and associated earthworks. Although some views will be screened and filtered by intervening landform and trees, the works and presence of the Madeley tunnel (north) satellite compound, the tunnelling facility/logistics area, material stockpiles, construction equipment and movement of construction vehicles, will introduce new prominent and incongruous elements in the views across the secluded, gently rolling and well-treed pastures, interrupting views to Wrinehill Wood and Grafton's Wood.

Construction of the Proposed Scheme will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

View south and west from Wrinehill Hall

(VP 023.02.016)

Residents and users of Madeley Bridleway 2 close to its intersection with Madeley Footpath 28 will have open, close range views of construction activity associated with the Checkley South embankment, the Checkley Brook viaduct, which is located in the South Cheshire area (CA5), Madeley Bridleway 2 accommodation underbridge and access track, and associated earthworks. There will also be views of the Checkley South embankment satellite compound, material stockpiles, construction equipment and movement of construction vehicles. Cranes associated with construction of the Checkley viaduct will be visible on the skyline. The works and large scale vegetation removal will introduce prominent, incongruous elements in the views across the rolling, small to medium-scale pastoral landscape within the River Lea valley, disrupting the characteristic hedgerow field boundaries and interrupting views to Wrinehill Wood. Bridleway and footpath users in this area will have wide ranging and open views of the construction works, with the changing landform and loss of vegetation being very apparent.

Construction of the Proposed Scheme will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Other mitigation measures

11.4.14 To reduce the significant effects described above, consideration will be given during the detailed design stage to where planting can be established early in the construction programme, including early planting in ecological mitigation sites, which will have the additional benefit of providing some visual screening. However, not all landscape and visual effects can be mitigated due to the visibility of construction activity and the sensitivity of surrounding receptors. No other mitigation measures are considered practicable during construction.

Summary of likely residual significant effects

11.4.15 The temporary residual significant effects during construction remain as described above. These effects will be temporary and reversible in nature lasting only for the duration of the construction works. These residual effects will generally arise from the widespread presence of construction activity and construction plant within the landscape and viewed from surrounding residential receptors, and users of PRoW and main roads within the study area.

11.4.16 The following significant landscape effects will remain after implementation of construction phase mitigation:

- major adverse significant effects in relation to three LCAs;
- moderate adverse significant effects in relation to four LCAs;
- major adverse significant effects at 16 residential viewpoint locations;

- major adverse significant effects at six recreational viewpoint locations;
- moderate adverse significant effects at five residential viewpoint locations;
- moderate adverse significant effects at six recreational viewpoint locations; and
- moderate adverse significant night-time effects at one residential viewpoint location.

Cumulative effects

11.4.17 No significant cumulative temporary or permanent effects during construction are anticipated.

11.5 Permanent effects arising from operation

11.5.1 The permanent features of the Proposed Scheme that have been taken into account in determining the effects arising during operation on landscape and visual receptors are presented in Section 2.2 of this report. Permanent changes within the landscape and views caused by the construction are assessed in this section.

Avoidance and mitigation measures

11.5.2 The operational assessment of impacts and effects is based on year 1 (2027), year 15 (2042) and year 60 (2087) of the Proposed Scheme. A process of iterative design and assessment has been employed to avoid or reduce adverse effects during the operation of the Proposed Scheme. Measures that will be incorporated into the design of the Proposed Scheme include:

- design of earthworks (such as the earthworks associated with the Meece embankment, Lea North and South embankments, Whitmore South and North cuttings, Madeley cutting and the Checkley South embankment) to tie the engineering earthworks for embankments and cuttings into their wider landscape context and to mitigate views of structures and overhead line equipment from sensitive receptors where reasonably practicable. The design of earthworks will have regard to their relationship to surrounding land uses and management, such as agriculture;
- compensatory woodland planting, using the same species composition and planting types, to provide enhanced landscape and green infrastructure connectivity, as well as connectivity of historic designed landscape features where reasonably practicable. This includes new woodland planting to help mitigate habitat lost at Whitmore Wood, in the River Lea valley around the River Lea viaduct and at the southern end of the Madeley tunnel;
- hedgerow replacement and restoration in areas of loss to restore connectivity and landscape pattern where reasonably practicable and to integrate the Proposed Scheme mitigation into the wider landscape character; and
- replacement of field ponds and wetland habitats with new wetlands, ecological ponds and biodiversity wetland features.

Assessment of impacts and effects

11.5.3 The likely effects on landscape and visual receptors during operation of the Proposed Scheme relate to the presence of new structures and elements in the landscape including viaducts, embankments, overbridges, underbridges, road and PRoW realignments and diversions. Other aspects include the presence of overhead line equipment, noise fence barriers, and the presence of auto-transformer stations. Landscape bunds and new planting will also influence how the Proposed Scheme affects landscape and visual receptors.

Landscape assessment

11.5.4 The following seven LCAs set out in Table 24 will be significantly affected during operation. Full details of effects are described in Volume 5: Appendix LV-001-004 Part 2.

Table 24: Operational phase significant landscape effects

Upper Meece Brook Valley Alluvial Lowlands	**Low-medium susceptibility and sensitivity**
Year 1: The landscape will be directly impacted by the Meece Brook viaduct and Meece embankment. At year 1, the landform and field pattern will appear substantially changed, and the viaduct and embankment will increase the severance currently experienced in the landscape due to the presence of the WCML. Introduction of artificial landforms and infrastructure into valley floor pastures, which already display a decline in traditional farming practices, will reduce scenic quality further. The Bent Lane (north) diversion will cut into the steeply sloping eastern valley side of the Meece Brook. Intermittent disturbance from passing trains will reduce landscape tranquillity particularly near the Bent Lane (North) diversion (in the Upper Meece Brook Valley Ancient Redlands LCA), where the WCML and the Proposed Scheme will run in proximity to each other. Operation of the Proposed Scheme in year 1 will result in a **high magnitude of change and major adverse effect** on the LCA, which is significant. **Year 15:** By summer of year 15, the Meece embankment, Meece Brook viaduct and the Bent Lane (North) diversion, will become more integrated within the landscape due to the maturing of the mitigation planting and the above landscape effects will be slightly reduced. Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of change and moderate adverse effect** on the LCA, which is significant. **Year 60:** By year 60, although the mitigation planting will have matured, the scale of the Meece embankment and Meece Brook viaduct means that they will still be prominent landscape features. Operation of the Proposed Scheme in year 60 will remain a **medium magnitude of change and moderate adverse effect** on the LCA, which is significant.	

Upper Meece Brook Valley Ancient Redlands	**Low - medium susceptibility and medium sensitivity**

Year 1:

The landscape will be impacted by the presence of the Stableford North embankment, Bent Lane (North) diversion, Meece embankment, Whitmore South cutting and southern porous portal of Whitmore Heath tunnel and the A53 Newcastle Road overbridge. Mitigation earthworks (including slackening of embankment slopes and landscape bunds) and planting will help to integrate these elements into the landscape but at year 1, before the planting matures, the rolling landform and land cover pattern will appear substantially changed. The Bent Lane (North) diversion will have a particularly noticeable effect on local landform and existing vegetation patterns as it will cut into a steeply sloping hillside.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of change and major adverse effect** on the LCA, which is significant.

Year 15:

By the summer of year 15, the maturing mitigation planting will help to integrate the different elements of the Proposed Scheme into the wider landscape and the overall impacts on this LCA will reduce. The Stableford North embankment and Meece embankment will still be prominent landscape features.

Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of change and moderate adverse effect** on the LCA, which is significant.

Year 60:

By year 60, the Stableford North embankment and Meece embankment will remain prominent landscape features, although the mature mitigation planting will help to integrate them into the landscape.

Operation of the Proposed Scheme in year 60 will remain a **medium magnitude of change and moderate adverse effect** on the LCA, which is significant.

Upper Lea Valley Ancient Redlands	**Medium susceptibility and medium sensitivity**

Year 1:

The landscape will be indirectly impacted by the presence of the northern porous portal of Whitmore Heath tunnel and associated infrastructure, the River Lea viaduct and associated embankments and the realigned section of Manor Road. At year 1, there will be a permanent change to features which are distinctive to the LCA, including the loss of part of the shaws and severance of the rural landscape on the eastern valley side. Scenic quality will be reduced due to the presence of new incongruous landscape features and artificial landforms. Mitigation earthworks and planting will help to integrate these elements into the landscape but in year 1, before the planting matures, the landform and land cover pattern will appear substantially changed.

The wooded landscape around the Stoke to Market Drayton Railway and Madeley Chord and the character of the skyline views will be largely lost due to the presence of the River Lea viaduct and its associated embankments. Intermittent disturbance from passing trains will reduce landscape tranquillity particularly around the River Lea viaduct where the WCML and Proposed Scheme will be in proximity to each other. The borrow pit west of Netherset Hey Farm will be returned to cultivation following reinstatement of the original landform and hedgerow field boundaries.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of change and major adverse effect** on the LCA, which is significant.

Year 15:

In year 15, the effects on the landscape will lessen as the maturing mitigation planting helps to integrate the new landform and infrastructure within the wider landscape. The effects will be locally greater around the River Lea viaduct, which due to its scale will remain a prominent local landscape feature.

Operation of the Proposed Scheme in year 15 will remain a **medium magnitude of change and moderate adverse effect** on the LCA, which is significant.

Year 60:

By year 60, further maturing of the mitigation planting will help to integrate elements of the Proposed Scheme described above into the landscape, although the River Lea viaduct will remain prominent.

Operation of the Proposed Scheme in year 60 will reduce to non-significant as reported in Volume 5: Appendix LV-001-004.

Hey Sprink Ancient Redlands and Woodlands	**Medium-high susceptibility and sensitivity**

Year 1:

The landscape at either end of the Whitmore Heath tunnel is located in the western edge of this large LCA. At year 1, the landscape will be directly impacted by the presence of the porous portals at either end of the Whitmore Heath tunnel, Snape Hall Road closure (resulting in permanent severance and changes to rural road character), Whitmore North cutting and Whitmore Wood retaining wall. The character of the rural landscape in terms of both landform and pattern of land cover will substantially alter due to the presence of these incongruous features in the landscape. Whitmore Wood will be permanently physically, visually and perceptually divided by the Whitmore North cutting. The closure of Snape Hall Road, together with the presence of the northern porous portal of Whitmore Heath tunnel and other infrastructure, will change the wooded character of

the north-western edge of Whitmore Heath. Extensive woodland mitigation planting is proposed along both sides of the Proposed Scheme, including the edges of the existing woodland and the shaws. This will help to visually connect Whitmore Wood and Hey Sprink and strengthen the pattern of shaws on the valley side, although the character of this part of the LCA will overall become more wooded and enclosed.

The impacts on the western edge of the LCA will be greater, but only a small proportion of the wider LCA will be affected. In the context of the LCA as a whole therefore, the effects will be lower than may otherwise be expected.

Operation of the Proposed Scheme in year 1 will result in a **medium magnitude of change and moderate adverse effect** on this LCA, which is significant.

Year 15 and year 60:

Operation of the Proposed Scheme will reduce to non-significant for year 15 and remain so for year 60 as the extensive mitigation planting along either side of the Proposed Scheme and alongside the existing woodland matures and helps to integrate the porous portal and other elements of the Proposed Scheme within the wider landscape as reported in Volume 5: Appendix LV-001-004.

Madeley Ancient Clay Farmlands	**Medium susceptibility and sensitivity**

Year 1:

This is a large LCA, much of which will be unaffected by the presence of the Proposed Scheme. At year 1, the eastern part of the LCA will be directly impacted by the presence of the A525 Bar Hill overbridge, the porous portals at either end of the Madeley tunnel and the Madeley cutting. The presence of these incongruous features and artificial landforms in the rural landscape will reduce scenic quality, alter the landform and land cover pattern and interrupt the historic hedgerow field pattern and small to medium landscape scale across the valley. The rural setting of Barhill Wood and the properties along the A525 Bar Hill Road will be substantially altered. The intervisibility between Barhill Wood, and properties on the A525 Bar Hill Road and the edge of Madeley will also be interrupted. The Proposed Scheme will intensify the effects of the WCML in terms of reduction in tranquillity and scenic quality.

The impacts on the eastern edge of the LCA will be greater, but only a small proportion of the wider LCA will be affected. In the context of the LCA as a whole therefore, the effects will be lower than may otherwise be expected.

Operation of the Proposed Scheme in Year 1 will result in a **medium magnitude of change and moderate adverse effect** on this LCA, which is significant.

Year 15 and year 60:

Operation of the Proposed Scheme will reduce to non-significant for year 15 and remain so at year 60 as the extensive woodland mitigation planting along either side of the Proposed Scheme and alongside Barhill Wood matures and helps to integrate the porous portal and other elements of the Proposed Scheme within the wider landscape as reported in Volume 5: Appendix LV-001-004.

Madeley Valley	**Medium-high susceptibility and sensitivity**

Year 1:

The northern part of this narrow and linear LCA will be directly impacted by the presence of the Checkley South embankment. Mitigation earthworks (including slackening of embankment slopes) and planting will help to integrate these elements into the landscape but in year 1, before the planting matures, the landform and land cover pattern will appear substantially changed. The presence of the embankment will affect the openness of the farmland, causing visual severance and interruption of landscape scale across the valley. An area of farmland between the WCML and the Proposed Scheme, which includes the historic Wrinehill Mill and Wrinehill Hall, will be encircled by rail infrastructure, increasing the sense of severance and reducing tranquillity and scenic quality.

The impacts on the part of this LCA close to Wrinehill Hall will be greater, but much of the wider LCA will be unaffected. In the context of the LCA as a whole therefore, the effects will be lower than may otherwise be expected.

Operation of the Proposed Scheme in Year 1 will result in a **medium magnitude of change and moderate adverse effect** on this LCA, which is significant.

Year 15 and year 60:

Operation of the Proposed Scheme in year 15 will reduce to non-significant for year 15 and remain so at year 60 as the extensive mitigation planting around the northern porous portal of Madeley tunnel and along the lower embankment slopes of Checkley South embankment matures and helps to integrate the elements of the Proposed Scheme described above within the wider landscape as reported in Volume 5: Appendix LV-001-004.

Visual assessment

Introduction

11.5.5 The following section describes the likely significant effects on visual receptors during operation year 1, year 15 and year 60. The assessment has been undertaken for the

winter period, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of the operational Proposed Scheme may be reduced during summer when vegetation, if present in a view, will be in leaf. Winter and summer scenarios are therefore considered for year 1 and summer scenarios of year 15 and year 60, to capture worst case and best case. Likely significant effects on residential receptors from additional lighting at night-time are also identified. Non-significantly affected visual receptors are reported in Volume 5: Appendix LV-001-004.

11.5.6 Where a viewpoint represents multiple types of receptor, the assessment is based on the most sensitive receptor. Effects on other receptor types with a lower sensitivity will be lower than those reported.

11.5.7 The assessment has not identified any locations within this study area where additional lighting in operation of the Proposed Scheme will result in significant visual effects at night.

11.5.8 The assessment has identified locations where the operation of the Proposed Scheme will result in significant effects (summarised in Table 25 and described in detail in the relevant proformas in Volume 5: Appendix LV-001-004, Part 3).

Table 25: Operational phase visual assessment

View from residences at Hill Chorlton (VP 020.02.006)
Year 1 - winter and summer: Residents at Hill Chorlton will have open mid-ground views of the earthworks and structures associated with the Meece Brook viaduct beyond the residential properties of Hill Chorlton. New woodland planting to the Meece Embankment will not provide effective mitigation in relation to the Proposed Scheme due to its immaturity, with all other elements within the view screened by intervening existing vegetation. In summer views of the Proposed Scheme will remain largely unchanged from the winter situation as there is little vegetation to provide additional summer screening. Operation of the Proposed Scheme in year 1 will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant. **Year 15 and year 60:** Operation of the Proposed Scheme in year 15 will reduce to non-significant and remain so at year 60 as the mitigation planting along the Meece embankment matures and helps to screen views and integrate the Meece Brook viaduct into the wider visual context as reported in Volume 5: Appendix LV-001-004. The view of the Proposed Scheme from viewpoint 020.02.006 during year 1 (winter) is illustrated on the photomontage shown in figure LV-01-549 (Volume 5: Appendix LV-001-004).
View from north-east from farmland close to WCML (VP 020.03.011)
Year 1 - winter and summer: Users of Chapel and Hill Chorlton Footpath 2 will have mainly open, close to medium range views across the WCML towards the Proposed Scheme as it runs through the Meece Brook Valley. There will be views of the Meece Brook viaduct and Meece embankment, overhead line equipment and passing trains. The lower parts of these features will be partly screened by landscape bunds at the southern end of the Whitmore South cutting, but the upper parts and particularly the Meece Brook viaduct, will be prominent. Footpath users will also have views of the Bent Lane (North) diversion, which will be cut into the side of the hill. The new features in the view, combined with changes to the valley's landform, visual severance and loss of existing landscape features, including hedgerows, trees and field boundaries, will add to the effects of the WCML and substantially change the rural outlook across the Meece Brook Valley resulting in a high magnitude of visual change. In summer views of the Proposed Scheme will remain largely unchanged from the winter situation as there is little vegetation to provide additional summer screening. Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant. **Year 15:** The Meece embankment and the Bent Lane (North) diversion will become less apparent in the view by year 15, as the mitigation planting on the embankments starts to mature and helps to both filter views and integrate the new features within

the wider visual context. The proximity of this viewpoint to the Meece Brook viaduct, however, means that it will remain a prominent feature within the view and the presence of the Meece embankment will continue to interrupt views.

Operation of the Proposed Scheme in year 15 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 60:

The Meece Brook viaduct will remain a prominent incongruous feature in the rural landscape of the Meece Brook valley landscape, and will continue to interrupt views across the valley.

Operation of the Proposed Scheme in year 60 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

View from east of Baldwin's Gate

(VPs 020.03.010 and 020.03.022)

Year 1 winter and summer:

Users of Chapel and Hill Chorlton Footpaths 2, 5, 6 and 21 will have mainly open, medium range to distant views towards the Proposed Scheme as it runs through the Meece Brook valley. There will be views of the Meece embankment, overhead line equipment and passing trains before the Proposed Scheme enters the Whitmore South cutting. Whilst the lower parts of these features will in places be screened by the landscape bunds at the southern end of the Whitmore South cutting, the upper parts and particularly the Meece Brook viaduct, will be prominent. Users of the footpaths will also have distant views of the A53 Newcastle Road overbridge. The new features in the view, combined with changes to the valley's landform, foreshortening of views and loss of existing landscape features, including hedgerows, trees and field boundaries, will add to the effects of the WCML and change the rural outlook across the Meece Brook Valley. Due to the distance of this viewpoint from the Proposed Scheme, only part of the view will be affected. In summer, views of the Proposed Scheme will remain largely unchanged from the winter situation as there is little vegetation to provide additional summer screening.

Operation of the Proposed Scheme in year 1 will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 15 and year 60:

Operation of the Proposed Scheme in year 15 will reduce to non-significant and remain so at year 60 as the mitigation planting along the Meece embankment matures and helps to screen views and integrate the Meece Brook viaduct into the wider visual context as reported in Volume 5: Appendix LV-001-004.

View south-west from Rectory Lane

(VP 020.02.016)

Year 1 - winter and summer:

Residents and users of the Whitmore Footpaths 3 and 4 will have medium range, slightly elevated southerly views of passing vehicles on the A53 Newcastle Road overbridge. The new overbridge and associated road embankments will be prominent and incongruous features in the rural landscape. Combined with the changes to the Meece Brook Valley landform and loss of landscape features, including hedgerows and trees, the outlook will be substantially altered. In summer, views will largely be screened and filtered by foliage on intervening vegetation.

Operation of the Proposed Scheme in year 1 will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 15 and 60:

Operation of the Proposed Scheme in year 15 will reduce to non-significant and remain so at year 60 as the mitigation planting around the A53 Newcastle Road overbridge matures and helps to screen views and integrate it into the wider visual context as reported in Volume 5: Appendix LV-001-004.

View north-east from residences along the A53 Newcastle Road near The Hill

(VP 020.02.021)

Year 1 - winter and summer:

The viewpoint is located on the section of the A53 Newcastle Road that will be reinstated, which means views from this location will be slightly more elevated than in the baseline description. There will also be a new roadside landscape of hedgerows with hedgerow trees. Residents are unlikely to have views of the northern porous portal of Whitmore Heath tunnel due to its location in cutting, but they will have close range views of the security fencing around the top of the portal. Vehicle movements on the A53 Newcastle Road will be more apparent than at present.

The new structures and reconfigured landform combined with the loss of landscape features, including the road landscape, hedgerows and mature trees, will substantially change this part of Whitmore Heath. In summer, views will remain open as the roadside vegetation described in the baseline will be removed as part of the reinstatement of the A53 Newcastle Road.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15 and year 60:

Operation of the Proposed Scheme in year 15 will reduce to non-significant and remain so at year 60 as the mitigation planting around the porous portal and Whitmore South cutting matures and helps screen views and integrate these new features with the wider visual context as reported in Volume 5: Appendix LV-001-004.

View north-east from the western side of the River Lea valley near Madeley Park Wood

(VP 021.02.005, 021.02.007 and 021.02.008)

Year 1 winter and summer:

Residents on the edge of Madeley Park Wood and users of the Whitmore Footpath 5 will have expansive medium-range views of the various elements of the Proposed Scheme, including the northern porous portal of the Whitmore Heath tunnel, the pumping station, tunnel portal building, Whitmore North cutting, Whitmore Wood retaining wall, the Whitmore Wood overbridge, noise fence barriers and overhead line equipment. The watercourse diversion at Snape Hall Road drop inlet culvert will also be visible in the foreground from VP 021.02.005. The orientation of the Whitmore Wood overbridge will be at variance with the existing broadly north-west to south-east landscape pattern. To the north, the upper parts of the overhead line equipment and passing trains will be visible above a noise fence barrier situated on the top of the Lea South embankment. The new structures and landform will be prominent landscape features and, combined with the loss of vegetation, including hedgerows, mature trees and a section of Whitmore Wood, will substantially change the rural outlook across the River Lea valley. In summer, views will be more filtered by vegetation in full leaf but the various elements of the Proposed Scheme will remain prominent.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

The view of the Proposed Scheme from viewpoint 021.02.005 during year 1 and year 15 operation (summer) is illustrated on the photomontage shown in figure LV-01-552 and LV-01-666 (Volume 5: LV-001-004).

Year 15:

Views will be filtered by the extensive maturing mitigation planting along the eastern side of the River Lea valley and the Proposed Scheme will be more integrated within the view. Given the proximity of this viewpoint to the Proposed Scheme and the open nature of the view, the elements of the Proposed Scheme described above will remain readily apparent.

Operation of the Proposed Scheme in year 15 will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 60:

Operation of the Proposed Scheme in year 60 will reduce to non-significant as the mature mitigation planting around the eastern side of the River Lea valley and the Proposed Scheme helps screen views and integrate these new features with the wider visual context as reported in Volume 5: Appendix LV-001-004.

View east from Manor Road and farmland to the north of Madeley Park

(VPs 021.03.013 and 022.02.001)

Year 1 - winter and summer:

Residents and users of Whitmore Footpaths 19, 20 and 21 and Manor Road will have open, medium range easterly views towards the Proposed Scheme as it crosses the River Lea valley on the Lea South embankment and River Lea viaduct. Users of Whitmore Footpath 21 will have open views of the River Lea viaduct, Lea South embankment and Whitmore North auto-transformer station, whilst the overhead line equipment and passing trains will be partly visible above the noise fence barriers, albeit seen within the context of the WCML and its associated overhead line equipment. The presence of prominent new skyline features, combined with the loss of vegetation, including hedgerows and mature trees, will substantially change the rural outlook and obscure some views of Hey Sprink Wood and the shaws on the opposite valley side. In summer, views will be more filtered by vegetation in full leaf but the Lea South embankment and River Lea viaduct will remain prominent.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15:

The Lea South embankment will become less apparent in the view by year 15, as the maturing mitigation planting on the embankment slopes helps to screen and filter views and integrate the new landform with the wider visual context. The River Lea viaduct and permanent loss of trees along the Stoke to Market Drayton Railway and Madeley Chord will remain very noticeable.

Operation of the Proposed Scheme in year 15 will result in a **medium magnitude of visual change and moderate adverse effect,** which is significant.

Year 60:

The Lea South embankment will be substantially screened by the landscape mitigation planting, but the River Lea viaduct will remain prominent in views.

Operation of the Proposed Scheme in year 60 will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

View east from Manor Road near Manor Farm

(VPs 022.02.002, 022-03-003 and 022-02-004)

Year 1 - winter and summer:

Residents and users of Madeley Footpath 15 and Manor Road will have mainly open, and close to medium range views of the River Lea viaduct, Lea North embankment, a section of the realigned Manor Road and the Manor Road overbridge. The combination of the new structures, some of which will be prominent and incongruous skyline features, changes to the landform and loss of landscape features, including extensive tree removal around the Stoke to Market Drayton Railway and Madeley Chord will be very apparent. There may also be views of the restored landscape, including newly planted hedgerows associated with the former borrow pit west of Netherset Hey Farm.

There will be a substantial alteration to the key characteristics of the view. Residents at Manor Cottages and Manor Farm will be particularly affected due to their proximity to the embankment and the realigned section of Manor Road as it rises up to the Manor Road overbridge. In summer, views will be more filtered by vegetation in full leaf but the River Lea viaduct and Lea North embankment will still be prominent.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15 and 60:

Operation of the Proposed Scheme in year 15 will reduce to non-significant and remain so at year 60 as the mature mitigation planting around the Lea North embankment helps screen views and integrate the elements of the Proposed Scheme described above within the wider visual context as reported in Volume 5: Appendix LV-001-004.

View west from edge of Madeley Cemetery

(VP 022.03.024)

Year 1 - winter and summer:

Visitors to Madeley Cemetery will have mainly open, close range views of the overhead line and Lea North embankment and the Manor Road overbridge road embankment. Passing vehicles on the Manor Road overbridge will introduce visual and noise disturbance and impact on the sense of tranquillity currently experienced at this location. There will be a loss of landscape features, mature trees and hedgerows, and substantial change to the local landform. In summer, there will be some additional screening and filtering of views by vegetation within the cemetery, but the Lea North embankment and the embankments of the Manor Road overbridge will remain prominent due to their size and proximity.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15:

The maturing mitigation planting will help to screen views of passing vehicles and trains and integrate the new landform within the wider visual context. However, the Proposed Scheme will remain very apparent within the view due to its proximity.

Operation of the Proposed Scheme in year 15 will remain a **high magnitude of visual change and major adverse effect**, which is significant.

The view of the Proposed Scheme from viewpoint 022.03.024 during year 15 operation (summer) is illustrated on the photomontage shown in figure LV-01-645 (Volume 5: LV-001-004).

Year 60:

By year 60, due to proximity and the size of the road embankment the effects on views will remain. Noise from passing trains and vehicles on the Manor Road overbridge will disturb the tranquillity of the cemetery.

Operation of the Proposed Scheme in year 60 will remain a **high magnitude of visual change and major adverse effect**, which is significant.

View from Red Lane

(VP 022.03.014 and 022.02.013)

Year 1 - winter and summer:

Residents and users of Madeley Bridleway 1 at viewpoint 022.03.014 using the more elevated section of the Madeley Bridleway 1 accommodation green overbridge will have close range easterly views of the various elements of the Proposed Scheme, including the Manor Road overbridge, the A525 Bar Hill Road realignment and the A525 Bar Hill overbridge, the Madeley cutting, noise fence barriers and overhead line equipment. From viewpoint 022.02.013, landscape bunds running parallel with the eastern side of the Proposed Scheme south of the A525 Bar Hill overbridge will screen views of passing trains for residents at Woodcroft and users of Madeley Bridleway 1. At year 1, before the planting on the landscape bunds matures, the overhead line equipment will remain visible.

Users of Madeley Bridleway 1 at will also have medium range views towards the Manor Road overbridge and A525 Bar Hill overbridge. There will be a substantial alteration to the key characteristics of the view, with tree and hedgerow removal (including the copse of mature pondside trees in the field opposite), and large-scale changes to the landform. Residents at Woodcroft and footpath users will have extensive close range and open views from both the ground floor and particularly the upper floor. In summer, there is little vegetation to provide screening of views from viewpoint 022.03.014, but the remaining overgrown hedgerow and trees along the south side of Red Lane will provide some screening and filtering of views from viewpoint 022.02.013.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of change and major adverse effect**, which is significant.

Year 15:

The maturing mitigation planting, including that on the Madeley Bridleway 1 accommodation green overbridge, and hedgerow and woodland mitigation planting on the landscape bunds, will help to screen and integrate the Manor Road overbridge and Bar Hill Road overbridge within the wider visual context.

Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of change and moderate adverse effect**, which is significant.

The view of the Proposed Scheme from viewpoint 022.02.013 during year 15 operation (summer) is illustrated on the photomontage shown in figure LV-01-594 (Volume 5: LV-001-004).

Year 60:

Operation of the Proposed Scheme in year 60 will reduce to non-significant as the mature mitigation planting including that on the Madeley Bridleway 1 accommodation green overbridge, and hedgerow and woodland mitigation planting on the landscape bunds, helps screen views and integrate the elements of the Proposed Scheme described above within the wider visual context as reported in Volume 5: Appendix LV-001-004.

View from locations near residential properties on the A525 Bar Hill Road

(VPs 022.02.012, 022.02.018 and 022.02.022)

Year 1 - winter and summer:

Residents and users of Madeley Footpath 24 and the A525 Bar Hill Road will have close range views of the overhead line equipment, particularly in views south of the road. The junction of the A525 Bar Hill Road and Red Lane will be widened and together with the A525 Bar Hill overbridge, will be prominent in foreground views. There will also be medium range views towards the Madeley Bridleway 1 accommodation green overbridge and the Manor Road overbridge. The key characteristics of the view will be substantially altered through tree and hedgerow removal (including a section of Barhill Wood and a copse of mature pond-side trees in the field south of the road), and extensive change to the landform. Landscape bunds running parallel with the eastern side of the Proposed Scheme and south of the A525 Bar Hill overbridge will screen views of passing trains. At year 1, before the planting on the landscape bunds matures, the overhead line equipment will remain visible. Trees along the A525 Bar Hill Road will have been removed to facilitate construction works and therefore there will be little vegetation to provide additional screening of views in summer.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15:

The different elements of the Proposed Scheme will become less apparent in the view by year 15, as the maturing mitigation planting, including that on the Madeley Bridleway 1 accommodation green overbridge, and hedgerow and woodland mitigation planting on the landscape bunds, helps to both filter views and integrate the different elements of the Proposed Scheme, including the A525 Bar Hill overbridge within the wider visual context. The outlook will be one of developing woodland. Additionally, the maturing vegetation on the Madeley Bridleway 1 accommodation green overbridge will help to integrate it within the wider landscape and reduce the sense of landscape severance created by the Proposed Scheme.

Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 60:

Operation of the Proposed Scheme in year 60 will reduce to non-significant as the mature mitigation planting including that on the Madeley Bridleway 1 accommodation green overbridge, and hedgerow and woodland mitigation planting on the landscape bunds, helps screen views and integrate the elements of the Proposed Scheme described above within the wider visual context as reported in Volume 5: Appendix LV-001-004.

View west from access track to Moor Hall Farm off the A525 Bar Hill Road

(VP 023.02.001)

Year 1 - winter and summer:

Residents, and users of the Madeley Footpath 24 will have close range views of the fence around the top of the southern porous portal of Madeley tunnel. The tunnel head wall, Bar Hill aqueduct, and the access track to the tunnel portal building at the southern end of the Madeley tunnel and pump station will also be visible from this viewpoint. The A525 Bar Hill overbridge, will be a prominent landscape feature as will the porous portal retaining wall. There will be a substantial alteration to the key characteristics of the view, with major alterations to the loss of the characteristic field boundary hedgerows, tree copses and some mature trees on the edge of Barhill Wood. The gently undulating landform will be completely altered by the presence of the Madeley cutting and introduction of retaining walls. There are few trees to provide additional screening or filtering of views in summer. The hedgerows in the foreground will be removed as part of the construction works and the magnitude of visual change will remain high

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

The view of the Proposed Scheme from viewpoint 023.02.001 during year 1 operation (summer) is illustrated on the photomontage shown in figure LV-01-556 (Volume 5: LV-001-004).

Year 15:

The various elements of the Proposed Scheme will become less apparent in the view by year 15, as the maturing mitigation planting helps to both filter views and integrate the Madeley cutting and associated features at the southern end of the Madeley tunnel within the wider visual context. The outlook will be one of developing woodland.

Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 60:

Effects will reduce to non-significant in year 60 as the mature mitigation planting will further help screen views of the different elements of the Proposed Scheme at the southern end of Madeley tunnel. The A525 Bar Hill overbridge will still be visible but passing traffic, although more elevated will be slightly further from this viewpoint than currently as reported in Volume 5: Appendix LV-001-004.

Views south from near Grafton's Wood

(VP 023.03.012)

Year 1 - winter and summer:

Users of Madeley Bridleway 5 and Madeley Footpath 28 will have open, close range views of the overhead line equipment and passing trains on the Checkley South embankment. Although the embankment will be regraded to integrate it into the surrounding landform, it will still be a prominent, incongruous feature in the view, cutting across the rolling pastures and managed hedgerows. The key characteristics of the view will be altered through loss of landscape features, including trees and field boundary hedgerows. Views across the River Lea valley to Wrinehill Wood will be interrupted by the embankment. In summer, views of the Proposed Scheme will be more obscured and filtered by intervening hedgerows and field boundary trees in full leaf.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15:

The Proposed Scheme will become less apparent in the view by year 15, as the mitigation planting along the Checkley South embankment matures helps to both filter views and integrate the new features within their context. The new features will blend better into the wider scene of rolling, well treed farmland.

Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of visual change and moderate adverse effect,** which is significant.

Year 60:

The mitigation planting will have matured, but the Checkley South embankment will remain prominent in views and continue to interrupt views across the River Lea valley to Wrinehill Wood.

Operation of the Proposed Scheme in year 60 will remain a **medium magnitude of visual change and moderate adverse effect**, which is significant.

View north from Wrinehill Wood
(023.03.010)

Year 1 - winter and summer:

Users of Madeley Bridleway 2 near Wrinehill Wood will have elevated, medium range to distant views of the overhead line equipment and passing trains on the Checkley South embankment. Although the embankment will be regraded to help integrate it into the surrounding landform it will still be a prominent, incongruous feature in the view, cutting across the rolling pastures and managed hedgerows. Some of the key characteristics of the view such as hedgerows and trees, will be lost and the embankment will interrupt views across the River Lea valley to Grafton's Wood and The Lum. In summer, views of the Proposed Scheme will be more obscured and filtered by intervening hedgerows and field boundary trees in full leaf but due to the scale of the Checkley South embankment, it will remain prominent in views.

Operation of the Proposed Scheme in year 1 will result in a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 15 and 60:

Effects will reduce to non-significant in year 15 and remain so at year 60 as the maturing mitigation planting along the western side of the Checkley South embankment helps to both screen views and integrate the embankment within the wider visual context as reported in Volume 5: Appendix LV-001-004.

View west from Madeley Bridleway 2 close to intersection with Madeley Footpath 28
(VP 023.02.016)

Year 1 - winter and summer:

Residents and users of Madeley Bridleway 2 close to intersection with Madeley Footpath 28 will have open, close range views of overhead line equipment and passing trains on the Checkley South embankment, and of the Madeley Bridleway 2 accommodation underbridge and access track. Although the slopes of the embankment will be slackened to help integrate it within the wider landform, it will still be a prominent, incongruous feature in the view, cutting across the rolling pastures and managed hedgerows. Key characteristics of the view such as hedgerows and trees, will be lost and the embankment will interrupt views across the River Lea valley to Wrinehill Wood. There is little existing vegetation to provide screening or filtering of views in summer.

Operation of the Proposed Scheme in year 1 will result in a **high magnitude of visual change and major adverse effect**, which is significant.

Year 15:

Views of the Checkley South embankment will become more screened and filtered by the maturing mitigation planting and the embankment will be more integrated within the view by summer year 15. The outlook will be one of developing woodland, with only a small section of grassed embankment visible near the underbridge. Due to its proximity and scale, however, the embankment will remain a prominent feature and continue to interrupt views to Wrinehill Wood. For these reasons the magnitude of visual change will remain medium rather than reduce to low, with moderate adverse (significant) effects.

Operation of the Proposed Scheme in year 15 will reduce to a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Year 60:

By year 60, the mitigation planting will be mature but due to its proximity and scale, the Checkley South embankment will remain prominent and views to Wrinehill Wood will continue to be interrupted.

Operation of the Proposed Scheme in year 60 will remain a **medium magnitude of visual change and moderate adverse effect**, which is significant.

Other mitigation measures

11.5.9 The permanent effects of the Proposed Scheme on landscape and visual receptors have been reduced through incorporation of the measures described in this section. Effects in year 1 of operation may be further reduced by establishing planting early in the construction programme. This would provide additional screening and greater integration of the Proposed Scheme into the landscape. However, no other mitigation measures are considered practicable due to the high visibility of elements of the Proposed Scheme and the sensitivity of the surrounding receptors.

Summary of likely residual significant effects

11.5.10 In many cases, significant effects will reduce over time as the proposed mitigation planting matures and reaches its designed intention. However, the following likely residual significant effects will remain following year 15 of operation:

- moderate adverse significant effects in relation to four LCA;
- major adverse significant visual effects at two recreational viewpoint locations;
- moderate adverse significant visual effects at 11 residential viewpoint locations; and
- moderate adverse significant visual effects at three recreational viewpoint locations.

Cumulative effects

11.5.11 No cumulative effects on landscape or visual receptors have been identified in the Whitmore Heath to Madeley area during operation of the Proposed Scheme.

Monitoring

11.5.12 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

11.5.13 There are no area-specific requirements for monitoring landscape and visual mitigation during the operation of the Proposed Scheme in the Whitmore Heath to Madeley area.

12 Socio-economics

12.1 Introduction

12.1.1 This section reports on the environmental baseline, likely economic and employment impacts as well as significant effects during construction and operation of the Proposed Scheme within the Whitmore Heath to Madeley area. The assessment considers existing businesses, community organisations, local employment and local economies, including planned growth and development.

12.1.2 Engagement with Newcastle under Lyme Borough Council (NBC) and Staffordshire County Council (SCC) has been undertaken as part of the development of the Proposed Scheme. The purpose of the engagement was to increase the understanding of socio-economic characteristics identified through a review of publicly available data.

12.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

12.1.4 The socio-economic effects on levels of employment at a route-wide level are reported in Volume 3: Route-wide effects (Section 12).

12.1.5 In addition, business and labour market data is presented in Background Information and Data (BID)[137], (BID-SE-001-000: Business and labour market data).

12.2 Scope, assumptions and limitations

12.2.1 The scope, assumptions and limitations for the socio-economics assessment are set out in Volume 1 (Section 8) and the Scope and Methodology Report (SMR)[138].

12.3 Environmental baseline

Existing baseline

Study area description

12.3.1 The following provides a brief overview in terms of employment, economic structure, labour market, and business premises availability within the Whitmore Heath to Madeley area.

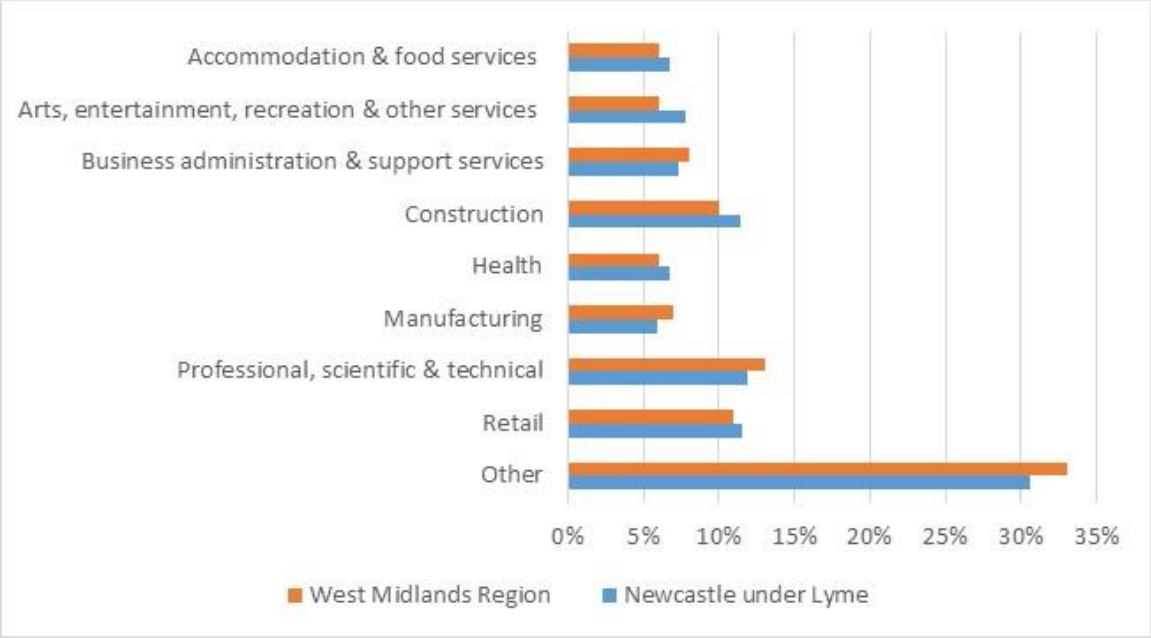
12.3.2 It lies within the administrative area of Newcastle Borough within the County of Staffordshire. It also falls within the Stoke-on-Trent and Staffordshire Local Enterprise Partnership (LEP) area[139] and the West Midlands region.

[137] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2
[138] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[139] Stoke-on-Trent and Staffordshire Local Enterprise Partnership, (2014), *Strategic Economic Plan Summary March 2014*.

Business and labour market

12.3.3 Within the NBC area there is a wide spread of business types reflecting a diverse range of commercial activities. The professional, scientific and technical sector and retail sector account for the largest proportion of businesses (12% each), followed by construction (11%). This is shown in Figure 7. For comparison, within the West Midlands region the largest sectors were professional, scientific and technical (13%), followed by retail (11%) and construction (10%)[140].

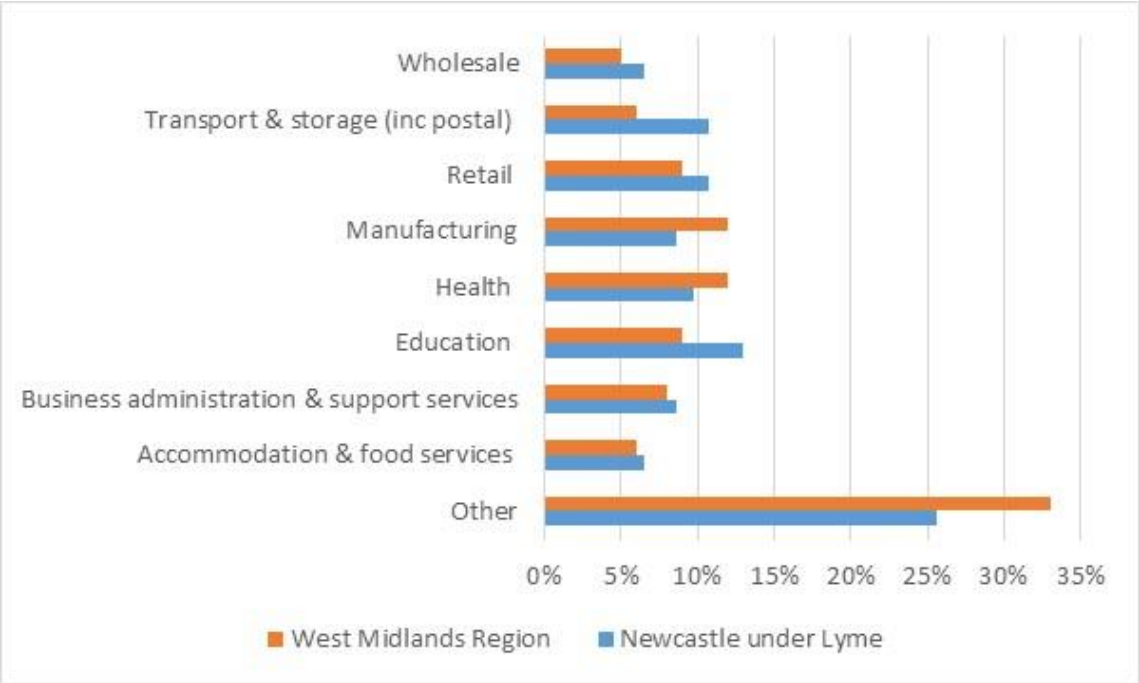
Figure 7: Business sector composition in NBC area and the West Midlands [141]



12.3.4 In 2015[142], approximately 47,000 people worked in the NBC area. According to the Office for National Statistics Business Register and Employment Survey 2015, the top five sectors in terms of share of employment in NBC were: education (13%); retail (11%); transport and storage including postal (11%); health (10%) and manufacturing and business administration and support services (9% each). These compare with the top five sectors for the West Midlands region, which were: health and manufacturing (12% each); retail and education (9% each) and business administration and support services (8%). This is shown in Figure 8[143].

[140] Office for National Statistics; UK Business Counts – Local Units 2015. Available online at: http://www.nomisweb.co.uk
[141] "Other" includes: Wholesale; Agriculture, forestry & fishing; Information & communication; Transport & storage (inc. postal); Motor trades; Education; Property; Financial & insurance; Public administration & defence; Mining, quarrying & utilities.
[142] Office of National Statistics, (2015) Business Register and Employment Survey; Available online at: http://www.nomisweb.co.uk
[143] Office of National Statistics, (2015) Business Register and Employment Survey; http://www.nomisweb.co.uk

Figure 8: Employment by industrial sector in the NBC area and the West Midlands [144]



12.3.5 According to the Annual Population Survey (2016)[145], the employment rate[146] within the NBC area was 79% (63,200 people), which is higher than that recorded for both the West Midlands (71%) and England (74%). In 2016, unemployment[147] in the NBC area was 4%, which was lower than the West Midlands (6%) and England (5%).

12.3.6 According to the Annual Population Survey (2016)[148], 37% of NBC residents aged 16-64 were qualified to National Vocational Qualification Level 4 (NVQ4) and above, compared to 31% in the West Midlands and 38% in England, while 11% of residents had no qualifications, which was slightly lower than that recorded for West Midlands (12%) but higher compared to England (8%).

Property

12.3.7 A review of employment land in 2015[149] identified a need for 5.1ha per year to 2039 for general business land in the NBC area and that sufficient provision existed at that time. The importance of developing a range of employment sites to support growth has been highlighted in the LEP Strategic Economic Plan[150].

[144] 'Other' includes construction; arts, entertainment, recreation and other services; professional, scientific & technical; motor trades; information & communication; public administration and defence; financial & insurance; property; mining, quarrying and utilities; agriculture, forestry and fishing.
[145] Annual Population Survey, (2016), NOMIS; http://www.nomisweb.co.uk
[146] The proportion of working age (16-64 year olds) residents that is in employment.
[147] Refers to people without a job who were available to start work in the two weeks following their interview and who had either looked for work in the four weeks prior to interview or were waiting to start a job they had already obtained. As the unemployed form a small percentage of the population, the APS unemployed estimates within local authorities are based on very small samples so for many areas would be unreliable. To overcome this ONS has developed a statistical model that provides better estimates of total unemployed for unitary authorities and local authority districts (unemployment estimates for counties are direct survey estimates), NOMIS.
[148] Annual Population Survey, (2016), NOMIS; http://www.nomisweb.co.uk;
[149] NLP (2015) Joint Newcastle-under-Lyme and Stoke-on-Trent Employment Land Review. Based on 133ha of employment land required between 2013 and 2039 (upper scenario).
[150] Stoke-on-Trent & Staffordshire LEP (undated), Stoke-on-Trent & Staffordshire Economic Growth Strategy 2012 - 2026, v2.1

12.3.8 The average vacancy rate for industrial and warehousing property in the NBC area in April 2017 has been assessed as 6% based on marketed space against known stock[151].

Future baseline

Construction (2020)

12.3.9 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

12.3.10 Implementation of all outstanding development consents and land allocations that can be built could result in approximately 20 additional jobs by 2020.The existing composition and numbers of employers, employees and economic sectors in the area is likely to change over time in ways that cannot be accurately forecast. These developments are considered in the cumulative assessment of the construction phase of the Proposed Scheme.

Operation (2027)

12.3.11 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

12.3.12 No committed developments have been identified in this area that will materially alter the baseline conditions in 2027 for business receptors.

12.4 Effects arising during construction

Avoidance and mitigation measures

12.4.1 The draft Code of Construction Practice[152] (CoCP) includes a range of provisions that will help mitigate socio-economic effects associated with construction within this area, including:

- reducing nuisance through sensitive layout of construction sites (Section 5);
- consulting businesses located close to hoardings on the design, materials used and construction of the hoarding, to reduce impacts on access to and visibility of their premises (Section 12);
- applying best practicable means (BPM) during construction works to reduce noise (including vibration) at sensitive receptors and monitor and manage flood risk and other extreme weather events that may affect socioeconomic resources during construction (Section 13);
- site specific traffic management measures including requirements relating to the movement of traffic from business and commercial operators of road vehicles, including goods vehicles (Section 14); and

[151] Vacant space is based on marketed space identified from Estates Gazette data (EGi); stock data is taken from information supplied by the Valuation Office (VOA).
[152] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

- maintaining access to businesses for the duration of construction works where reasonably practicable (Section 14).

Assessment of impacts and effects

12.4.2 The proposed construction works are assessed for socio-economic effects in relation to:

- in-combination effects (e.g. air quality, noise, vibration, construction traffic and visual impacts) and isolation of an area that could affect a business's operations. Any resulting effects on employment are reported as part of the route-wide assessment (see Volume 3: Route-wide effects); and
- potential employment opportunities arising from construction in the local area (including in adjacent community areas).

Temporary effects

In-combination effects

12.4.3 No non-agricultural[153] businesses have been identified within the Whitmore Heath to Madeley area that are expected to experience significant in-combination effects as a result of the Proposed Scheme.

Isolation

12.4.4 No non-agricultural businesses have been identified within the Whitmore Heath to Madeley area that are expected to experience significant isolation effects as a result of the Proposed Scheme.

Construction employment

12.4.5 Twelve satellite construction compounds will be located in the Whitmore Heath to Madeley area. These sites could result in the creation of up to 1,620 person years of construction employment opportunities[154], broadly equivalent to 160 full-time jobs[155], which, depending on skill levels required and the skills of local people, are potentially accessible to residents in the locality and to others living further afield. The impact of the direct construction employment creation has been considered as part of the route-wide assessment (Volume 3: Route-wide effects).

12.4.6 Direct construction employment could also lead to opportunities for local businesses to supply the project or to benefit from expenditure by construction workers. The impact of the indirect construction employment creation has been considered as part of the route-wide assessment (Volume 3: Route-wide effects).

12.4.7 The resulting effects on employment are reported in aggregate at a route-wide level (Volume 3: Route-wide effects).

[153] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level.
[154] Construction labour is reported in construction person years, where one construction person year represents the work done by one person in a year composed of a standard number of working days.
[155] Based on the convention that ten employment years is equivalent to one full time equivalent job.

Permanent effects

Businesses

12.4.8 Businesses directly affected, comprising those that lie within land that will be required for the Proposed Scheme, are reported in groups, where possible, to form defined resources based on their location and operational characteristics. A group could contain either one or a number of businesses reflecting the fact that a building may have more than one occupier or that similar businesses and resources are clustered together.

12.4.9 A paintball operator uses land affected by the Proposed Scheme; however, the nature of the use makes it unlikely that the business activity will be disrupted sufficiently to require the relocation of the activity.

12.4.10 No significant direct effects on non-agricultural employment[156] have been identified within the study area. The Proposed Scheme is not anticipated to result in the displacement or possible loss of jobs within this area.

Other mitigation measures

12.4.11 The assessment has concluded that there will be no significant adverse effects arising during construction in relation to businesses directly affected by the Proposed Scheme.

12.4.12 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the line of route in terms of supplying goods and services and obtaining employment. HS2 Ltd is committed to working with its suppliers to build a skilled workforce that promotes further economic growth across the UK.

Summary of likely residual significant effects

12.4.13 There are no significant effects identified in the assessment that will arise during construction.

Cumulative effects

12.4.14 Cumulative effects arise in relation to the accumulation of individual resource based job displacement/losses on a local labour market. These effects are assessed as part of the route-wide assessment (Volume 3: Route-wide effects).

12.5 Effects arising from operation

Avoidance and mitigation measures

12.5.1 No mitigation measures are proposed in relation to business resources during operation of the Proposed Scheme.

[156] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level (Volume 3: Route-wide effects).

Assessment of impacts and effects

Resources with direct effects

12.5.2 There are no resources considered likely to experience significant direct socio-economic effects during the operation of the Proposed Scheme.

In-combination effects

12.5.3 No businesses have been identified within the area that are expected to experience significant in-combination effects as a result of the Proposed Scheme.

Operational employment

12.5.4 Direct operational employment created by the Proposed Scheme could lead to indirect employment opportunities for local businesses in terms of potentially supplying the Proposed Scheme or benefiting from expenditure by directly employed workers on goods and services.

12.5.5 The impact of operational employment creation has been assessed and reported at a route-wide level in Volume 3: Route-wide effects.

Other mitigation measures

12.5.6 The assessment has concluded that operational effects within the area will either be negligible or beneficial, and therefore, mitigation is not required.

Summary of likely residual significant effects

12.5.7 There are no significant effects identified in the assessment that will arise during operation of the Proposed Scheme.

Cumulative effects

12.5.8 No cumulative effects on socio-economic characteristics have been identified in the Whitmore Heath to Madeley area during operation.

Monitoring

12.5.9 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

12.5.10 On the basis of there being no significant residual operational effects, there are no area-specific requirements for monitoring socio-economic effects during the operation of the Proposed Scheme in the Whitmore Heath to Madeley area.

13 Sound, noise and vibration

13.1 Introduction

13.1.1 This section reports the assessment of the likely noise and vibration significant effects arising from the construction and operation of the Proposed Scheme within the Whitmore Heath to Madeley area on:

- people, primarily where they live ('residential receptors') in terms of individual dwellings and on a wider community basis, including any shared community open areas[157]; and
- community facilities, such as schools, hospitals, places of worship, and also commercial properties, such as offices and hotels, collectively described as 'non-residential receptors' and 'quiet areas'[158].

13.1.2 Engagement with Newcastle-under-Lyme Borough Council (NBC) has been undertaken with respect to the sound, noise and vibration assessment. The purpose of this engagement has been to obtain relevant information regarding residential and non-residential resources and existing baseline information, and to discuss the development of the mitigation to be included in the Proposed Scheme. NBC officers were also invited to attend and witness the baseline sound measurements being undertaken within this area.

13.1.3 More detailed information regarding the sound, noise and vibration assessment for the Whitmore Heath to Madeley area is available in the relevant appendices in Volume 5:

- sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000); and
- sound, noise and vibration baseline, construction and operation assessment report (Appendix SV-002-004).

13.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book. Mapping to support the sound, noise and vibration assessment is presented in Map Series SV-05 (Volume 2: CA4 Map Book) and Map Series SV-01, SV-02, SV-03 and SV-04 (Volume 5: Sound, noise and vibration Map Book).

13.1.5 The assessment of likely significant effects from noise and vibration on agricultural, community, heritage, ecological and health receptors and the assessment of tranquillity are presented in Section 4, Agriculture, forestry and soils; Section 6,

[157] 'Shared community open areas' are those that the National Planning Practice Guidance identifies may partially offset a noise effect experienced by residents at their dwellings and are either a) relatively quiet nearby external amenity spaces for sole use by a limited group of residents as part of the amenity of their dwellings or b) a relatively quiet external publicly accessible amenity space (e.g. park or local green space) that is nearby.
[158] Quiet areas are defined in the Scope and Methodology Report as either Quiet Areas as identified under the Environmental Noise Regulations or are resources, which are prized for providing tranquillity.

Community; Section 7, Cultural heritage; Section 8, Ecology and biodiversity; Section 9, Health; and Section 11, Landscape and visual of this report respectively.

13.2 Scope, assumptions and limitations

13.2.1 The approaches to assessing sound, noise and vibration, study areas and appropriate mitigation are outlined in Volume 1 (Section 8), the Scope and Methodology Report (SMR), and the SMR addendum[159] (Section 6).

13.2.2 In this assessment 'sound' is used to describe the acoustic conditions that people experience as a part of their everyday lives. The assessment considers how those conditions may change through time and how sound levels and the acoustic character of an area is likely to be modified through the introduction of the Proposed Scheme. Noise is taken as unwanted sound and hence adverse effects are noise effects and mitigation is, for example, by noise barriers.

13.2.3 Effects can either be temporary from construction or permanent from the operation of the Proposed Scheme. These effects may be direct, resulting from the construction or operation of the Proposed Scheme, and/or indirect, resulting from changes in traffic patterns on existing roads or railways that result from the construction or operation of the Proposed Scheme.

13.3 Environmental baseline

Existing baseline

13.3.1 The Whitmore Heath to Madeley area is characterised by a mix of small towns, villages, hamlets and isolated residential properties in a predominantly rural setting. There are several major roads within this area including the A53 Newcastle Road (continuing to the A53 Whitmore Road) at the southern end of the area and the A525 Bar Hill Road, which runs through Madeley. Trains on the Stafford to Crewe section of the West Coast Main Line (WCML) also contribute to the sound environment, along with other local sound sources.

13.3.2 Sound levels close to these main transportation routes are high during the daytime, and are lower at night. Further away from the roads the sound levels are lower and some areas, particularly villages distant from the busy roads, experience low daytime sound levels. Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for the Whitmore Heath to Madeley area in Volume 5: Appendix SV-002-004.

13.3.3 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[160]. The predicted vibration levels at all receptors as a result of the Proposed Scheme has, therefore been assessed using specific thresholds, below which receptors will not be affected by vibration. Further information is provided in Volume 1 (Section 8).

[159] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report and Volume 5 Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.
[160] Further information is available in the Volume 5: Appendix SV-001-000, Sound, noise and vibration methodology, assumptions and assessment report and the Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.

Future baseline

13.3.4 Without the Proposed Scheme, existing sound levels in this area are likely to increase slowly over time. This is primarily due to road traffic growth, which may be as a result of local or national trends or due to specific committed developments. Changes in car technology may offset some of the expected sound level increases due to traffic growth on low speed roads. On higher speed roads, tyre sound dominates[161] and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

13.3.5 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020 and 2027. Committed developments involving sound or vibration sensitive uses within the relevant study area have been included within the assessment and are reported for the Whitmore Heath to Madeley area in Volume 5: Appendix SV-002-004. Where applicable, sound, noise or vibration significant effects on these committed developments are discussed in the following sections.

Construction (2020)

13.3.6 The assessment of noise from construction activities assumes a baseline year of 2020, which represents the period immediately prior to the start of the construction period. As a reasonable worst case, it has been assumed that no change in baseline sound levels will occur between the existing baseline year of 2016 and the future baseline year of 2020.

Operation (2027)

13.3.7 The operational assessment is based upon the predicted change in sound levels that result from the operation of Proposed Scheme. The assessment initially considered a reasonable worst case (that would be likely to over-estimate the change in levels) by assuming that sound levels would not change from the existing baseline year of 2016. Where significant effects were identified on this basis, the effects have been assessed using a baseline year of 2027 to coincide with the proposed start of passenger services. The future baseline is the sound environment that would exist in 2027 without the Proposed Scheme. This is presented in Table 14 and Table 15 in Volume 5: Appendix SV-002-004.

13.4 Effects arising during construction

Local assumptions and limitations

Local assumptions

13.4.1 The construction arrangements that form the basis of the assessment are presented in Section 2.3 of this report and in Volume 1 (Section 8).

13.4.2 During certain construction processes, there may be the need to operate fixed construction plant such as generators[162] and water pumps for reasons of safety or

[161] Tyre noise typically becomes the dominant sound source for steady road traffic.
[162] As required by the CoCP. The use of diesel or petrol-powered generators will be reduced by using mains electricity or battery-powered equipment where reasonably practicable.

engineering practicability on a continuous basis. This equipment will be sited, or locally screened to control sound to neighbouring residential premises.

13.4.3 The following activities have been assumed to be undertaken during the evening and night-time for reasons of safety, engineering practicability or to reduce the impact on existing transport:

- works in proximity to the WCML, including construction of the piling platform, pile cap construction and installation of beams and concreting;
- Whitmore Heath tunnel, support activities including excavated material handling, erection of the tunnel boring machine, support installation and tunnel fit-out; and
- Madeley tunnel, support activities including excavated material handling, erection of the tunnel boring machine, support installation and tunnel fit-out.

13.4.4 It is assumed there will also be some night-time working during road and rail possession periods. It is expected that the noise effects from these works will be limited in duration and are therefore not be considered to be significant. Any noise effects arising from these short-term construction activities will be controlled and reduced by the management processes set out in the draft Code of Construction Practice[163] (CoCP).

13.4.5 The assessment takes account of people's perception of noise throughout the day. More stringent criteria are applied during evening and night-time periods, when people are more sensitive to noise, compared to the busier and more active daytime period.

13.4.6 Piling and vibratory compaction is likely to result in short-term[164] appreciable ground-borne vibration at a small number of dwellings, situated very close to these activities. These receptors will also be exposed to appreciable noise from the construction of the Proposed Scheme. The significance of the identified vibration effects has been assessed in combination with the airborne noise effects also identified at these receptors. The assessment is presented in Volume 5: Appendix SV-002-004.

Local limitations

13.4.7 There are a number of locations in this area where the land or property owners did not permit baseline sound level monitoring to be undertaken at their premises. However, sufficient baseline sound level information has been obtained at neighbouring representative locations to undertake the assessment. Further information is provided in Volume 5: Appendix SV-002-004.

Avoidance and mitigation measures

13.4.8 The assessment assumes the implementation of the principles and management processes set out in Section 13 of the draft CoCP, which are:

[163] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.
[164] Typically less than 1 month.

- best practicable means (BPM) as defined by the Control of Pollution Act 1974 (CoPA) and Environmental Protection Act 1990 (EPA), which will be applied during construction activities to minimise noise (including vibration) at neighbouring residential properties;
- as part of BPM, mitigation measures are applied in the following order:
  - noise and vibration control at source: for example, the selection of quiet and low vibration equipment, review of construction methodology to consider quieter methods, location of equipment on site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings;
  - screening, for example, local screening of equipment or perimeter hoarding; and
  - where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary re-housing will be offered in accordance with the HS2 noise insulation and temporary re-housing policy;
- lead contractors will seek to obtain prior consent from the relevant local authority under Section 61 of the CoPA for the proposed construction works. The consent application will set out BPM measures to minimise construction noise, including control of working hours, and provide a further assessment of construction noise and vibration, including confirmation of noise insulation/temporary re-housing provision;
- contractors will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to, and be reviewed by, the nominated undertaker and made available to the local authorities; and
- contractors will be required to comply with the terms of the CoCP and appropriate action will be taken by the nominated undertaker as required to ensure compliance.

13.4.9 In addition to this mitigation, to avoid or reduce likely community significant effects, taller screening[165], as described in the draft CoCP, has been assumed at the Whitmore Heath tunnel and Madeley tunnel construction compounds.

13.4.10 Noise insulation will be offered for qualifying buildings as defined in the CoCP. Noise insulation or where appropriate temporary re-housing will avoid residents being significantly affected by levels of construction noise inside their dwellings. The assessment reported in this section provides an estimate of the buildings that are likely to qualify for noise insulation. None are predicted to qualify for temporary rehousing.

13.4.11 Qualification for noise insulation and temporary re-housing will be confirmed as part of seeking prior consent from the local authority under Section 61 of the CoPA.

[165] As described in the draft CoCP, provided as necessary by solid temporary hoarding, temporary earth stockpiles, screening close to the activities or other means to provide equivalent noise reduction.

Qualifying buildings will be identified, as required in the draft CoCP, so that noise insulation can be installed, or any temporary re-housing provided, before the start of the works predicted to exceed noise insulation or temporary re-housing criteria.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

13.4.12 Taking account of the avoidance and mitigation measures set out above, the following six residential properties are forecast to experience noise above the eligibility criteria as defined in the HS2 noise insulation and temporary rehousing policy[166]. These residential dwellings are indicated on Map Series SV-03 (Volume 5: Sound, noise and vibration Map Book):

- Snape Hall Farm, Snape Hall Road, Whitmore Heath (assessment location ref.: 14094);
- The Old Barn, Bower End Lane, Madeley (assessment location ref.: 14185);
- The Paddocks, Bower End Lane, Madeley (assessment location ref.: 14185);
- Moor Hall Farm, Bower End Lane, Madeley (assessment location ref.: 14185);
- Swallow Barn, Bower End Lane, Madeley (assessment location ref.: 14185); and
- Bower End Farm, Bower End Lane, Madeley (assessment location ref.: 14189).

13.4.13 For construction, the trigger level for eligibility for noise insulation is 75dB[167] during the day, 65dB[168] during the evening and 55dB[169] during the night-time measured outdoors.

13.4.14 The mitigation measures, including noise insulation for the six residential properties, will reduce noise inside all dwellings such that it does not reach a level where it will significantly affect residents.

Residential receptors: direct effects – communities

13.4.15 The avoidance and mitigation measures in this area will avoid adverse airborne construction noise effects on the majority of receptors and communities. Residual temporary noise or vibration effects are identified later in this section. With regard to noise outside dwellings, the assessment of temporary effects takes account of construction noise relative to existing sound levels.

13.4.16 In locations with lower existing sound levels[170], construction noise effects are likely to be caused by changes to noise levels outside dwellings. These may be considered by the local community as an effect on the acoustic character of the area and hence be

[166] Further information is provided in HS2 Information Paper E13, Control of construction noise and vibration.
[167] $L_{pAeq,0700-1900}$ measured at the façade.
[168] $L_{pAeq,1900-2300}$ measured at the façade.
[169] $L_{pAeq,2300-0700}$ measured at the façade.
[170] Further information is presented in Volume 5: Appendix SV-001-000, Sound, noise and vibration methodology, assumptions and assessment report

perceived as a change in the quality of life for that community. These effects are considered for significance on a community basis taking account of the local context.

13.4.17 The temporary adverse effects on the residential areas identified in Table 26, including shared open areas, are considered to be significant on a community basis.

Table 26: Direct adverse effects on residential communities and shared open areas that are considered to be significant on a community basis

Significant effect number[171]	Type of significant effect	Time of day	Location	Cause (construction activities)	Assumed approximate duration of impact[172]
CSV04-C01	Combined construction site and traffic noise	Daytime	Approximately 15 dwellings on Whitmore Heath	Portal construction and retained cutting construction, earthworks and utilities and vehicles on Snape Hall Road. The typical and highest monthly noise levels of approximately 70dB and 75dB[173].	Up to 4 years and 8 months
CSV04-C02	Combined construction site and traffic noise	Daytime / evening and / or night-time	Approximately 30 dwellings at Bar Hill	Site establishment, earthworks, operation of the site haul route and the tunnelling worksite and vehicles on Bar Hill Road. The daytime typical and highest monthly noise levels are approximately 65dB and 70dB[174]. The night-time typical and highest monthly noise levels are approximately 50dB and 55dB[175].	Day: Up to 2 years and 6 months Night: Up to 10 months

13.4.18 For the purpose of the assessment it is assumed that a tunnel boring machine (TBM) will be used to excavate the tunnels. Each TBM is likely to generate ground-borne noise and vibration impacts, but only at receptors close to the centre line of the tunnels and only for short periods of time (a few days). Overall, the deeper the tunnel is, the lower the impact. The perceptible noise and vibration will increase as a TBM approaches and diminish as it moves away from the receptor. It is not considered that vibration from TBM will present a risk of building damage.

13.4.19 As the effects of vibration from TBM on building occupants will be short-term they are not considered to be significant. There will be engagement with communities in advance of TBMs passing underneath properties to inform the residents of the tunnelling progress and what to expect whilst the TBM passes.

13.4.20 Track laying, power system and signalling installation works are unlikely to result in significant construction noise effects, given the short duration close to any communities and, where included in the Proposed Scheme, the presence of the permanent noise fence barriers.

[171] Volume 5: Appendix SV-002-004, CA4 Sound, noise and vibration report.
[172] At the closest properties in the community.
[173] Equivalent continuous sound level at the facade, $L_{pAeq, 0700\text{-}1900}$.
[174] Equivalent continuous sound level at the facade, $L_{pAeq, 0700\text{-}1900}$.
[175] Equivalent continuous sound level at the facade, $L_{pAeq, 2200\text{-}0700}$.

Residential receptors: indirect effects

13.4.21 Construction traffic is likely to cause adverse noise effects on occupants of residential dwellings adjacent to Bower End Lane, between the route of the Proposed Scheme and Moss Lane. However, considering the small number of properties adjacent to this road, a likely significant construction traffic noise effect has not been identified.

13.4.22 Construction traffic is also likely to cause adverse noise effects on residential receptors along the following roads:

- Bent Lane between the Proposed Scheme and Whitmore Road, Whitmore. Approximately 10 dwellings located immediately adjacent to the road are forecast to experience a change in road traffic noise levels of around 7dB LpAeq, 0700 - 2300 during the peak months. A likely significant effect, denoted as CSV04-C03 as presented in Volume 5: Appendix SV-002-004 has been identified at the residential dwellings on this route;
- Snape Hall Road, Whitmore Heath between the northern portal of the Whitmore Heath tunnel and the A53 Whitmore Road. Approximately 25 dwellings located immediately adjacent to the road are forecast to experience a change in road traffic noise levels of around 17dB LpAeq, 0700 - 2300 during the peak months. A likely significant effect, denoted as CSV04-C04 as presented in Volume 5: Appendix SV-002-004 has been identified at the residential dwellings on this route;
- Manor Road, Madeley between the junction with the A525 Bar Hill Road and the A53 Newcastle Road at Baldwin's Gate. Approximately 50 dwellings located immediately adjacent to the road are forecast to experience a change in road traffic noise levels of around 4dB LpAeq, 0700 - 2300 during the peak months. A likely significant effect, denoted as CSV04-C05 as presented in Volume 5: Appendix SV-002-004 has been identified at the residential dwellings on this route; and
- the A525 Bar Hill Road, Madeley between the Proposed Scheme and Manor Road, Madeley. Approximately 40 dwellings located immediately adjacent to the road are forecast to experience a change in road traffic noise levels of around 4dB LpAeq, 0700 - 2300 during the peak months. A likely significant effect, denoted as CSV04-C02 as presented in Volume 5: Appendix SV-002-004 has been identified at the residential dwellings on this route.

13.4.23 These adverse effects would be a change in the acoustic character of the areas such that there is a perceived change in the quality of life for that community, and is therefore considered significant when assessed on a community basis taking account of the local context. Further information on traffic is provided in Section 14, Traffic and transport.

Non-residential receptors: direct effects

13.4.24 The assessment has identified the following non-residential receptors where the predicted airborne sound levels exceed both the relevant impact screening criteria and the noise change criterion (a change of greater than 3dB compared with the existing baseline sound level). These locations are identified in the Whitmore Heath to

Madeley area, as shown in Map Sv-03 (Volume 5: Sound, noise and vibration Map Book):

- Whitmore Village Hall (assessment location ref.: 14048(N));
- Office at Hey House, Manor Road, Madeley, Crewe, (assessment location ref.: 8427(N)); and
- Madeley Cemetery, Madeley (assessment location ref.: 14130(N)).

13.4.25 At each of the non-residential receptors identified above an assessment has been undertaken to determine if this impact would result in a significant effect, using the significance criteria set out in Annex A, Volume 5: Appendix SV-001-000.

13.4.26 Whitmore Village Hall, Whitmore, is a brick building with double glazed windows. The main hall does not have external windows, the building's windows serve adjacent ancillary areas such as kitchens, a meeting room, lobbies and toilets. The highest predicted daytime monthly construction noise level is 5dB(A) above the screening criteria defined in the SMR for this use[176] for a period of seven months. The typical monthly daytime construction noise level is below the screening criteria defined in the SMR. The screening criteria are defined on a precautionary basis to ensure that more detailed consideration is undertaken where appropriate. In this situation, considering the layout of the hall, specifically the omission of windows to the main hall, a likely significant construction noise effect has not been identified at Whitmore Village Hall.

13.4.27 Hey House is located on Manor Road to the north-east of the Proposed Scheme, and Edland Kennels/Cattery is operated from this building. Hey House is a two-storey Grade II listed building with windows that are opened to provide ventilation. The property includes an office associated with the kennels / cattery, which would be sensitive to noise. The highest predicted daytime monthly construction noise level is 2dB(A) above the screening criteria defined in the SMR for this use[177] for a period of eight months. The typical monthly daytime construction noise level is below the screening criteria defined in the SMR. Considering the duration of the effect, Edland Kennels/Cattery has been identified, on a precautionary basis, as being subject to a likely significant adverse effect denoted by CSV04-N01 in Table 7 of Volume 5: Appendix SV-002-004. No effect is identified on the animals themselves based upon the assessment approach defined in Annex F[178], Volume 5: Appendix SV-001-000. Hey House has also been assessed as a residential dwelling (assessment location ref.:14121).

13.4.28 Madeley Cemetery has been in use since 1996 and is located to the north-east of Proposed Scheme. The cemetery has been assessed as an external amenity space. The typical predicted daytime monthly construction noise level is below the screening criteria defined in the SMR, but the highest predicted daytime monthly construction noise level is 5dB(A) above the screening criteria for this use[179]. Madeley Cemetery has

[176] 50 dB $L_{pAeq,0700\text{-}2300}$ during the day (free-field) which is equivalent to 53 dB $L_{pAeq,0700\text{-}2300}$ during the day (façade).
[177] 50 dB $L_{pAeq,0700\text{-}2300}$ (free-field) during the day which is equivalent to 53 dB $L_{pAeq,0700\text{-}2300}$ (façade).
[178] Effects of noise on animals.
[179] Based upon a lower cut off value of 65 dB $L_{pAeq,0700\text{-}2300}$ during the day (façade).

been identified, on a precautionary basis, as being subject to a likely significant adverse effect denoted by CSV04-N02 in Table 7 of Volume 5: Appendix SV-002-004.

Non-residential receptors: indirect effects

13.4.29 Construction traffic is likely to cause an adverse noise effect on Madeley Cemetery, Madeley which is located adjacent to Manor Road. Increases in road traffic noise of around 4dB LpAeq, 0700 - 2300 from the additional construction vehicles[180], using this route during the peak months are predicted (further information on traffic is provided in Section 14, Traffic and transport). A likely significant effect, denoted as CSV04-N02 as presented in Volume 5: Appendix SV-002-004 has been identified at Madeley Cemetery. This may take the form of activity disturbance to people visiting the cemetery.

Summary of likely residual significant effects

13.4.30 The proposed avoidance and mitigation measures will reduce noise inside all dwellings from the construction activities such that residents will not be significantly affected[181].

13.4.31 The measures also reduce the construction noise effects on acoustic character in the majority of residential communities. Despite these measures, the effects on the acoustic character in the following local residential community areas are considered to be significant:

- Whitmore Heath; and
- Bar Hill, Madeley.

13.4.32 On a precautionary basis, noise from specific construction activities has been identified as resulting in significant residual temporary effects at Hey House offices (associated with Edland Kennels / Cattery) and Madeley Cemetery.

13.4.33 Construction traffic is likely to cause significant noise effects on adjacent residential and non-residential receptors on the following routes:

- Bent Lane between the Proposed Scheme and Whitmore Road, Whitmore;
- Snape Hall Road, Whitmore Heath between the northern portal of the Whitmore Heath tunnel and the A53 Whitmore Road;
- Manor Road, Madeley between the junction with Bar Hill Road and A53 Baldwin's Gate; and
- Bar Hill Road, Madeley between the Proposed Scheme and Manor Road, Madeley[182].

13.4.34 HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid these significant effects. In doing so HS2 Ltd will continue to engage with stakeholders to fully understand the receptor, its use and the benefit of the measures.

[180] Operatives' vehicles and vehicles delivering and removing materials from site.
[181] Refer to Volume 5: Appendix SV-001-000.
[182] Including Madeley Cemetery.

Cumulative effects

13.4.35 This assessment has considered the potential cumulative construction noise effects of the Proposed Scheme and other committed developments[183]. In this area, it is not anticipated that there will be any developments built of sufficient scale at the same time as the Proposed Scheme and accordingly, construction noise or vibration from the Proposed Scheme is unlikely to result in any significant cumulative noise effects.

13.5 Effects arising from operation

Local assumptions and limitations

Local assumptions

13.5.1 The effects of noise and vibration from the operation of the Proposed Scheme have been assessed based upon the highest likely train flows, considering the service pattern for Monday to Saturday including Phase One and Phase Two services. The expected passenger service frequency for Phase 2a, with both Phase One and Phase Two services operational, are described in Volume 1 (Section 4).

13.5.2 Passenger services will start at or after 05:00 from the terminal stations and in this area, with Phase One and Phase Two in operation will progressively increase to 12 trains per hour in each direction on the main lines with an operating speed of 330kph for 90% of services and 360kph for 10% of services. This number of services is assumed to operate every hour from 07:00 to 21:00. The number of services will progressively decrease after 21:00 and the last service will arrive at terminal stations by 24:00. Further information is presented in Volume 1 (Section 4).

Avoidance and mitigation measures

13.5.3 The development of the Proposed Scheme has sought to keep the route as low as is reasonably practicable and away from main communities.

Airborne noise

13.5.4 HS2 trains will be quieter than the relevant current European Union specifications, in line with the assumptions made for the HS2 Phase One ES. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph with current pantograph designs, drawing on proven technology in use in East Asia. The track will be specified to reduce noise, as will the maintenance regime. Overall these measures will reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on new track. Further information is provided in Volume 5: Appendix SV-001-000.

13.5.5 The Proposed Scheme incorporates noise barriers in the form of landscape earthworks and/or noise fence barriers to avoid or reduce significant adverse airborne noise effects. The assessment has been based on the assumption that noise fence barriers are acoustically absorbent on the railway side and are located 5m from the outer rail.

[183] Refer to Volume 5: Appendix CT-004-000, Planning data.

13.5.6 In the Whitmore Heath to Madeley area, noise barriers have been incorporated in the Proposed Scheme to avoid or reduce adverse effects due to airborne noise at the following communities:

- Whitmore Heath;
- Madeley Park Wood; and
- Madeley.

13.5.7 The location and height of these noise barriers are shown on Map Series SV-05 (Volume 2: CA4 Map Book).

13.5.8 In practice, barriers may differ from this general assumption while maintaining the required acoustic performance. For example, where noise barriers are in the form of landscape earthworks, they need to be higher above rail level to achieve similar noise attenuation to a noise fence barrier because the crest of the earthwork will be further than 5m from the outer rail.

13.5.9 Noise effects will be reduced in other locations along the route of the Proposed Scheme by landscape earthworks provided to avoid or reduce significant visual effects and engineering structures such as cuttings and safety fences on viaducts (where noise barriers are not required). The location of the landscape earthworks is shown on Map series SV-05 (Volume 2: CA4 Map Book).

13.5.10 Significant noise effects from the operational static sources such as line-side equipment will be avoided through their design and the specification of noise emission requirements. Further information is presented in Volume 5: Appendix SV-001-000.

13.5.11 Noise insulation measures will be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996[184] (the Regulations). The assessment reported in this section provides an estimate of the buildings that are likely to qualify under the Regulations based upon the currently available information. Qualification for noise insulation under the Regulations will be formally identified and noise insulation offered at the time the Proposed Scheme becomes operational. Where noise insulation is required, as well as improvements to noise insulation of windows facing the railway, ventilation will be provided so that windows can be kept closed to protect internal sound levels.

13.5.12 Noise insulation will avoid any residual significant effects on health and quality of life arising inside dwellings taking into account mitigation incorporated into the design of the Proposed Scheme.

13.5.13 Where the noise from the operation of the Proposed Scheme measured outside a dwelling exceeds the Interim Target defined by the World Health Organization (WHO)'s Night Noise Guidelines for Europe[185], residents are considered to be significantly affected by the resulting noise inside their dwelling. The Interim Target is

[184] Her Majesty's Stationery Office (1996), The Noise Insulation (Railways and Other Guided Transport Systems) Regulations, London.
[185] World Health Organization (2010), *Night time Noise Guidelines for Europe*.

a lower level of noise exposure than the trigger threshold for night noise in the Regulations, i.e. 55dB equivalent continuous level, LpAeq,23:00-07:00 measured without reflection from the front of buildings. The effect on people at night due to the maximum sound level as each train passes has also been assessed[186]. In line with these criteria, where night-time noise levels for the use of new or additional railways or altered roads authorised by the Bill are predicted following the methodology set out in the Regulations to exceed 55dB[187], or the maximum noise level as a train passes exceeds the relevant criteria, noise insulation will be offered for these additional buildings.

13.5.14 In the case of PRoW, they are by their nature transitory routes, with users not staying in any one location for long periods. Train sound from the Proposed Scheme will be intermittent and its level will vary as the PRoW moves closer to and further from the Proposed Scheme. No significant noise effects have therefore been identified on users of PRoW within the Whitmore Heath to Madeley area.

Ground-borne noise and vibration

13.5.15 Significant ground-borne noise or vibration effects will be avoided or reduced through the design of the track and track-bed.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

13.5.16 Taking account of the avoidance and mitigation measures incorporated into the Proposed Scheme, the assessment has identified the residential dwelling at Snape Hall Cottage, Whitmore Heath (assessment location ref.: 14087), close to the Proposed Scheme, where noise levels are predicted to exceed the daytime trigger threshold set out in the Regulations[188]. It is, therefore, anticipated that this building is likely to qualify for noise insulation under the Regulations. This dwelling is indicated on the Map Series SV-04 (Volume 5: Sound, noise and vibration Map Book).

13.5.17 The assessment has identified six additional residential buildings where the daytime forecast noise level does not exceed the threshold set in the Regulations but the predicted night-time noise level exceeds the World Health Organization's Interim Target of 55dB[187], or the maximum noise level as a train passes exceeds the relevant criteria[186]. These buildings, which are indicated on Map Series SV-04 (Volume 5: Sound, Noise and vibration Map Book) are:

- Snape Hall Farm, Snape Hall Road, Whitmore (assessment location ref.: 14094);
- Woodbury, Snape Hall Road, Whitmore (assessment location ref.: 14088);
- Foxdene, Snape Hall Road, Whitmore (assessment location ref.: 14088);

[186] During the night (2300-0700) a significant effect is also identified where the Proposed Scheme results in a maximum sound level at the façade of a building at or above: 85dB L_{pAFmax} (where the number of train pass-bys exceeding this value is less than or equal to 20); or 80dB L_{pAFmax} (where the number of train pass-bys exceeding this value is greater than 20).
[187] Equivalent continuous level, $L_{pAeq,23:00-07:00}$ measured without reflection from the front of buildings.
[188] Equivalent to a daytime the free-field level of 65 dB $L_{pAeq,0700-2300}$, and a night-time free-field level of 60 dB $L_{pAeq,2300-0700}$.

- Hey House, Manor Road, Madeley (assessment location ref.: 14121);
- 86 Bar Hill Road, Madeley (assessment location ref.: 14183); and,
- Wrinehill Hall Farm, Mill Lane, Wrinehill (assessment location ref.: 14200).

13.5.18 The mitigation measures, including noise insulation, will reduce noise inside all dwellings such that it will not reach a level where it will significantly affect residents.

13.5.19 The assessment has identified the following three properties above the proposed Whitmore Heath tunnel where the predicted ground-borne noise levels are greater than the significant observed adverse effect level (SOAEL) identified in the SMR, and the SMR Addendum (Volume 5: Appendix CT-001-001 and CT-001-002) for ground-borne noise. These buildings, which are indicated on Map series SV-04 (Volume 5: Sound, noise and vibration Map Book) are:

- The Brackens, Heath Road, Whitmore Heath (assessment location ref.:14241);
- West Ridge, Birch Tree Lane, Whitmore Heath (assessment location ref.: 14074); and,
- Wyndways, Heath Lane, Whitmore Heath (assessment location ref.: 14056).

13.5.20 On the basis of a reasonable worst case assumption, and given that at this stage no practicable mitigation has been identified to control the ground-borne noise levels within these properties to a level below SOAEL, on an individual property basis there may be a significant adverse effect on the health and quality of life of the occupants. HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid these significant effects.

Residential receptors: direct effects – communities

13.5.21 The proposed mitigation measures in the Whitmore Heath to Madeley area will avoid or reduce adverse effects due to airborne noise on the majority of receptors, and in the following communities:

- Stableford;
- Hill Chorlton;
- Whitmore;
- Baldwin's Gate;
- Whitmore Heath;
- Madeley Park; and
- Madeley.

13.5.22 Taking account of the envisaged mitigation, Map Series SV-05 (Volume 2: CA4 Map Book) shows the long term 40dB[189] night-time sound level contour from the operation

[189] Defined as the equivalent continuous sound level from 23:00 to 07:00 or $L_{pAeq,night}$).

of trains on the Proposed Scheme. The extent of the 40dB night-time sound level contour is equivalent to, or slightly larger than, the 50dB daytime contour[190]. In general, below these levels adverse effects are not expected.

13.5.23 Above 40dB during the night and 50dB during the day the community effect of noise is dependent on the baseline sound levels in that area and the change in sound level (magnitude of effect) brought about by the Proposed Scheme. The airborne noise impacts and effects forecast for the operation of the Proposed Scheme are presented on Map Series SV-05 (Volume 2: CA4 Map Book). The changes in noise levels shown on these maps are likely to affect the acoustic character of the area such that taking account of the local context[191], this may be significant when assessed on a community basis[192]

13.5.24 Approximately 15 isolated properties within the area have been identified as being subject to a likely adverse noise effect; these effects are likely to be received as an effect on the acoustic character of the area. However, as the affected properties are spatially remote from larger defined residential areas, are subject to smaller magnitudes of noise effect, or are small in number, the effects are not considered to be significant on a community basis.

13.5.25 In this study area, the direct adverse effects on the acoustic character of the areas of residential communities identified in Table 27 are considered to be significant on a community basis.

Table 27: Direct adverse effects on residential communities and shared open areas that are considered significant on a community basis

Significant effect number [193]	Source of significant effect	Time of day	Location and details
OSV04-C01	Airborne noise increase from new train services	Daytime and night-time	Hill Chorlton Approximately 15 dwellings in the vicinity of Kennels Lane. Forecast increases in sound from the Proposed Scheme are likely to cause a major adverse effect on the acoustic character of the area around the closest properties. The effect on the acoustic character of residential areas that are located further from the railway would be minor or moderate adverse. There are no shared open spaces identified as being affected in this community area.
OSV04-C02	Ground-borne noise increase from new train services	Daytime and night-time	Whitmore Heath Approximately 10 dwellings in the vicinity of Heath Road, Birch Tree Lane and Heath Rise are directly above the Whitmore Heath tunnel. Forecast increases in sound from the operation of the Proposed Scheme are likely to cause a major / moderate adverse effect on the acoustic character inside properties.
OSV04-C03	Airborne noise increase from new train services	Daytime and night-time	Whitmore Heath Approximately 10 dwellings in the vicinity of Snape Hall Road and Birch Tree Lane. Forecast increases in sound from the Proposed Scheme are likely to cause a major adverse effect on the acoustic character of the area around the closest properties. The effect on the acoustic character of residential areas that are located further from the railway would be minor or moderate adverse. There are no

[190] With the train flows described in the assumptions section of this CFA Report, the daytime sound level (defined as the equivalent continuous sound level from 07:00 to 23:00 or $L_{pAeq,day}$) from the Proposed Scheme would be approximately 10dB higher than the night-time sound level. The 40dB contour therefore indicates the distance from the Proposed Scheme at which the daytime sound level would be 50dB.
[191] Further information is provided in SV-001-000 and SV-002-004.
[192] Further information is contained in Volume 1.
[193] See Map Series SV-05 (Volume 2: CA4 Map Book).

Significant effect number [193]	Source of significant effect	Time of day	Location and details
			shared open spaces identified as being affected in this community area.
OSV04-C04	Airborne noise increase from new train services	Daytime and night-time	Bar Hill Road, Madeley Approximately 15 dwellings in the vicinity of the A525 Bar Hill Road, Mallard Close and Red Lane. Forecast increases in sound from the Proposed Scheme are likely to cause a major adverse effect on the acoustic character of the area around the closest properties. The effect on the acoustic character of residential areas that are located further from the railway would be minor. There are no shared open spaces identified as being affected in this community area.

Residential receptors: indirect effects

13.5.26 The assessment of operational noise and vibration indicates that significant indirect effects on residential receptors are unlikely to occur in this area.

Non-residential receptors: direct effects

13.5.27 The assessment has identified airborne sound levels greater than the relevant impact screening criteria and a change of greater than 3dB compared to the existing baseline sound level is identified at the following non-residential receptors in the Whitmore Heath to Madeley area, as shown in Map Series SV-04 (Volume 5: Sound, noise and vibration Map Book):

- Office at Hey House, Manor Road, Madeley, Crewe, (assessment location ref.: 8427(N)); and,
- Madeley Cemetery, Madeley (assessment location ref.: 14130(N)).

13.5.28 At these non-residential receptors, an assessment has been undertaken to determine if this impact would result in a significant effect, using the significance criteria for defined in Volume Annex A, Volume 5: Appendix SV-001-000.

13.5.29 Hey House is located on Manor Road to the north-east of the Proposed Scheme, and Edland Kennels / Cattery is operated from this building. Hey House is a two-storey Grade II listed building with windows that are opened to provide ventilation. The property includes an office associated with the kennels / cattery, which would be sensitive to noise. A major operational noise effect has been identified at the building based on the change in operational airborne sound level outside of the receptor of greater than 10dB compared to the future baseline sound level. Operational noise levels are predicted to exceed the impact screening criterion for offices of 55dB LpAeq,16hr by 8dB. The office at Hey House has been identified, on a precautionary basis, as being subject to a likely significant adverse effect, denoted by OSV04-N01 on Map Series SV-05 (Volume 2: CA4 Map Book). No effect is identified on the animals themselves based upon the assessment approach defined in Annex F[194], Volume 5: Appendix SV-001-000. Hey House has also been assessed as a residential dwelling (assessment location ref.:14121).

[194] Effects of noise on animals.

13.5.30 Madeley Cemetery has been in use since 1996 and is located to the north-east of Proposed Scheme. A moderate operational airborne noise effect has been identified based on the change in sound level in the cemetery of between 5 and 10dB compared to the future baseline sound level. Operational noise levels at the cemetery are predicted to exceed the impact screening criterion for external amenity spaces of 55dB LpAeq,16hr by 7dB. There are no buildings at the site of the cemetery and services will take place in the open air. Considering the magnitude of the impact the cemetery is identified, on a precautionary basis, as being subject to a significant adverse effect denoted by OSV04-N02 on Map Series SV-05 (Volume 2: CA4 Map Book).

13.5.31 The assessment of operational noise and vibration indicates that significant direct effects on non-residential receptors are likely on the non-residential receptors identified in Table 28. The assessment of effects on non-residential receptors has been undertaken on a reasonable worst case basis. Further information can be found in Volume 5: Appendix SV-001-000.

Table 28: Likely significant noise or vibration effects on non-residential receptors arising from operation of the Proposed Scheme

Significant effect number[195]	Type of significant effect and source	Time of day	Location and details
OSV04-N01	Activity disturbance for people working in the office resulting from operational airborne sound.	Daytime	Hey House Cattery, Madeley
OSV04-N02	Activity disturbance for people visiting the cemetery resulting from operational airborne sound.	Daytime	Madeley Cemetery, Madeley

Non-residential receptors: indirect effects

13.5.32 The assessment of operational noise and vibration indicates that significant indirect effects are unlikely to occur on non-residential receptors in this area.

Summary of likely residual significant effects

13.5.33 At the majority of individual residences, the proposed mitigation measures will reduce noise inside all dwellings such that it does not reach a level where it will significantly affect residents and, therefore, no likely residual significant effects are identified. However, a likely residual significant adverse ground-borne noise effect is identified at three individual residential properties in Whitmore Heath.

13.5.34 At the community level, the envisaged mitigation, including landscape earthworks and noise mitigations, described in this section, and presented in Map Series SV-05 (Volume 2: CA4 Map Book), will substantially reduce the potential airborne sound impacts and noise effects that would otherwise arise from the Proposed Scheme. Residual likely significant adverse airborne noise effects due to increased noise levels around the following communities have been identified:

- Hill Chorlton: occupants of residential properties in the vicinity of Kennels Lane, identified by OSV04-C01 on Map SV-05-113b;

[195] See Map Series SV-05 (Volume 2: CA4 Map Book).

- Whitmore Heath: occupants of residential properties in the vicinity of Snape Hall Road and Birch Tree Lane, identified by OSV04-C03 on Map SV-05-113b; and
- Bar Hill, Madeley: occupants of residential properties in the vicinity of the A525 Bar Hill Road, Mallard Close and Red Lane located closest to the Proposed Scheme, identified by OSV04-C04 on Map SV-05-104.

13.5.35 A likely residual significant adverse ground-borne noise due to HS2 trains passing through the Whitmore Heath tunnel has been identified at Whitmore Heath, at dwellings in the vicinity of Heath Road, Birch Tree Lane and Heath Rise that are located directly above the Whitmore Heath tunnel, identified by OSV04-C02 on Map SV-05-113b.

13.5.36 The assessment has identified a potential significant airborne noise effect at Hey House offices associated with Edland Kennels / Cattery and Madeley Cemetery.

13.5.37 HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid these significant effects. In doing so, HS2 Ltd will continue to engage with stakeholders to fully understand the receptor, its use and the benefit of the measures.

Cumulative effects

13.5.38 It is not anticipated that there will be any significant cumulative noise effects during operation of the Proposed Scheme.

Monitoring

13.5.39 Volume 1 (Section 9) sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

13.5.40 Operational noise and vibration monitoring will be carried out at different times during the lifetime of the Proposed Scheme at a combination of carefully selected monitoring locations including: adjacent or attached to moving vehicles, at fixed positions or in the vicinity of individual assets; and locations within the surrounding areas and communities alongside the railway corridor.

13.5.41 The expected noise and vibration performance of the Proposed Scheme, operational noise and vibration measurement data, associated asset information, description of corrective actions, results of measured performance compared to expected conditions, and monitoring reports will be shared with the relevant local authorities at appropriate intervals.

14 Traffic and transport

14.1 Introduction

14.1.1 This section describes the likely impacts on all forms of transport and the consequential significant effects on transport users arising from the construction and operation of the Proposed Scheme through the Whitmore Heath to Madeley area. The effects on traffic and transport are assessed quantitatively, based on existing baseline traffic conditions and future scenarios.

14.1.2 Engagement with Highways England and Staffordshire County Council (SCC) has been undertaken. An important focus of this engagement has been to obtain relevant baseline information.

14.1.3 A detailed report on traffic and transport impacts and surveys undertaken within the Whitmore Heath to Madeley area is contained in Volume 5: Appendix TR-001-000: Transport Assessment.

14.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and operation (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

14.1.5 Maps showing traffic and transport significant effects during construction (Map Series TR-03) and operation (Map Series TR-04) and construction traffic routes to compounds (Map Series TR-08) can be found in Volume 5: Traffic and transport Map Book.

14.1.6 In addition, further traffic survey data is set out in Background Information and Data (BID)[196], (BID-TR-001-000: Traffic assessment baseline data).

14.2 Scope, assumptions and limitations

14.2.1 The scope, key assumptions and limitations for the traffic and transport assessment are set out in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[197] and the SMR Addendum[198].

14.2.2 The study area for traffic and transport includes all roads affected by the Proposed Scheme including: the M6; the A51 London Road; the A53 Newcastle Road/Whitmore Road between Whitmore and Baldwin's Gate; Manor Road; the A525 Bar Hill Road; and local roads serving the settlements of Whitmore, Baldwin's Gate, Bar Hill, Madeley and Woore.

14.2.3 The baseline forecast traffic flows for the future years of assessment have been derived using the Department for Transport's (DfT) traffic forecasting tool, Trip End Model Presentation Program (TEMPro) and relevant traffic models (Highways England M6 J13-J15 Smart Motorways Project (SMP) Strategic Model). The

[196] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2
[197] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[198] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.

assessment covers the average weekday morning (08:00-09:00) and evening (17:00-18:00) peak periods.

14.2.4 Since it is not possible to forecast how services may change in the future, it has been assumed that bus services for the future years of assessment will be the same as those currently operating.

14.2.5 Forecast future year traffic flows with and without the Proposed Scheme have been based on an approach that does not take account of wider effects such as redistribution and reassignment of traffic. It is unlikely that these wider changes would affect the conclusions drawn in this section.

14.3 Environmental baseline

Existing baseline

14.3.1 Existing conditions in the study area have been determined through site visits, traffic and transport surveys, liaison with Highways England and SCC (including provision of information on public transport, public rights of way (PRoW) and accident data) and desktop analysis.

Surveys

14.3.2 Traffic surveys, comprising of automatic traffic counts, junction turning counts and queue surveys, of roads crossing the route of the Proposed Scheme or potentially affected by the Proposed Scheme were undertaken in: November and December 2015; February, March, July and November 2016; and March and April 2017. This data has been supplemented by existing traffic data from other sources where available, including from SCC. Assessment of the data indicates that the peak hours in the area are 08:00 – 09:00 and 17:00 – 18:00.

14.3.3 PRoW surveys were undertaken in May, June, July and November 2016 and April 2017 to establish their nature and usage by non-motorised users (pedestrians, cyclists and equestrians). The surveys included all PRoW and roads that will cross the route of the Proposed Scheme, and any additional PRoW and roads that may be affected by the Proposed Scheme. The majority of the surveys were undertaken during the weekend, when usage is expected to be highest, but some were undertaken on a weekday where routes may be influenced by commuting or other localised uses.

Highway network

14.3.4 The M6 is the only strategic road that runs through the Whitmore Heath to Madeley area. The M6 runs in a north-west/south-east alignment along the eastern boundary of the area. Junction 15 of the M6 is located on the south-east boundary of the area. The route of the Proposed Scheme will not intersect the M6 in this area.

14.3.5 There are four primary 'A' roads in the Whitmore Heath to Madeley area, these are: the A51 London Road, which traverses the western boundary of the area; the A53 Newcastle Road/Whitmore Road, which passes through Baldwin's Gate and Whitmore; the A525 Bar Hill Road/Newcastle Road, which passes through the settlements of Onneley, Madeley and Madeley Heath; and the A5182 Trentham Road, which connects the A53 Newcastle Road/Whitmore Road to the A519 Newcastle Road

located in the adjacent Stone and Swynnerton area (CA3). The strategic and primary road network can get busy at peak times and delays can be experienced.

14.3.6 The main local roads that will be affected by the Proposed Scheme are: Bent Lane, which connects the settlements of Whitmore and Stableford; Common Lane, Heath Road and Snape Hall Road, which provide access around Whitmore Heath; Manor Road, which serves Baldwin's Gate and connects to Madeley; and Bower End Lane, which connects a number of rural properties to the settlement of Madeley. The local road network in this area generally operates well, although some localised delays can be experienced, particularly at peak times.

14.3.7 Relevant accident data for the road network subject to assessment has been obtained from SCC. Data for the three year period (2012 to 2015[199]) has been assessed and any identified clusters have been examined. No substantial accident clusters were identified within the Whitmore Heath to Madeley area.

14.3.8 The Proposed Scheme will cross seven roads and roadside footways within the Whitmore and Madeley area. These are: Bent Lane (part of which is located in the Stone and Swynnerton area (CA3)); the A53 Newcastle Road; Heath Road; Snape Hall Road; Manor Road; the A525 Bar Hill Road; and Bower End Lane.

Parking and loading

14.3.9 There is no designated parking or loading identified in the Whitmore Heath to Madeley area that is expected to be impacted by the Proposed Scheme. Consequently, this topic is not considered further in this assessment.

Public transport network

14.3.10 There are two bus corridors that will cross the route of the Proposed Scheme in the Whitmore Heath to Madeley area. These are: the A53 Newcastle Road/Whitmore Road between Whitmore and Baldwin's Gate; and the A525 Bar Hill Road/Newcastle Road corridor, between Madeley and Woore. There is an additional bus corridor in the area, along the A51 London Road via Stableford and Woore, but it does not cross the route of the Proposed Scheme. The services that cross the route of the Proposed Scheme in each corridor are:

- the A53 Newcastle Road/Whitmore Road is served by one bus service, the 164, which provides connections to Newcastle-under-Lyme, Loggerheads and Hanley; and
- the A525 Bar Hill Road/Newcastle Road is served by two bus services, the 79 and 85B, which provide connections to Hanley, Newcastle-under-Lyme, Nantwich, Madeley and Crewe.

14.3.11 There are bus stops located to serve the main built-up areas. Where bus stops are expected to be affected by either the construction or operation of the Proposed Scheme these are referred to in the relevant assessment sections.

[199] Represents the last full year of data available at the time of undertaking the assessment.

14.3.12 The West Coast Mainline (WCML) traverses the Whitmore Heath to Madeley area in a broadly north-west/south-east alignment. The route of the Proposed Scheme will cross over the WCML, the Stoke to Market Drayton Railway and Madeley Chord on the River Lea viaduct.

14.3.13 There are no stations within the Whitmore Heath to Madeley area. National and local rail services are accessible via Stoke-on-Trent and Crewe stations and serve a range of destinations including London, Birmingham and Manchester. Rail users can interchange at both Stoke-on-Trent and Crewe for regional and local destinations.

Non-motorised users

14.3.14 There are pedestrian footways adjacent to many of the roads in the built up areas of Baldwin's Gate, Madeley and Woore. Footways vary in width and condition within these areas. Where there is no formal footway provision adjacent to a road, non-motorised user numbers are generally low.

14.3.15 The route of the Proposed Scheme will cross the existing route of seven PRoW including three bridleways in the Whitmore Heath to Madeley area. A further five PRoW in the area will be affected either temporarily or permanently due to, for example, temporary diversion of PRoW during construction and permanent upgrades for maintenance access to the Proposed Scheme. Additionally, Swynnerton Footpath 10 in the adjoining Stone and Swynnerton area (CA3) will be partially diverted into the Whitmore Heath to Madeley area. This change is reported in the assessment for the Stone and Swynnerton area (Volume 2: CA3, Stone and Swynnerton). The route with the greatest usage was Madeley Footpath 26 with 20 users observed during the survey day.

14.3.16 In the Whitmore Heath to Madeley area, there are few off-road cycle routes serving the settlements. There are a number of advisory cycle routes[200] passing through areas of Loggerheads, Ashley, Stableford, Baldwin's Gate, Madeley and Madeley Heath.

Waterways and canals

14.3.17 There are no navigable waterways situated within the Whitmore Heath to Madeley area. Consequently, this topic is not considered further in this assessment.

Air transport

14.3.18 There is no relevant air transport in the Whitmore Heath to Madeley area. Consequently, this topic is not considered further in this assessment.

Future baseline

14.3.19 The future baseline traffic volumes have been calculated by applying growth factors derived from TEMPro for the future years of 2023, 2027 and 2041. These represent the construction assessment year (2023), the year of opening (2027) and future assessment year (2041). Growth factors from TEMPro have been checked to ensure

[200] Advisory cycle routes are locally promoted routes for use by cyclists that do not generally have any formal cycle infrastructure provision, such as cycle lanes.

that committed developments and growth forecasts from the M6 J13-15 SMP strategic Model are appropriately reflected.

14.3.20 The committed development at land at End of Gateway Avenue, Baldwin's Gate, Newcastle-under-Lyme (reference: 13/00426/OUT) is not included in TEMPro and has consequently been added into the growth forecasts for this assessment.

14.3.21 There are no known planned substantial changes to the transport network in Whitmore Heath to Madeley area.

Construction (2023)

14.3.22 Construction of the Proposed Scheme is expected to commence in 2020 with construction activity continuing to 2027 (although activity in 2027 will be limited to testing and commissioning). Construction activities have been assessed against 2023 baseline traffic flows, irrespective of when they occur during the construction period. The year 2023 has been adopted as a common base year and the impact of individual or overlapping activities are considered against this single year. The year 2023 broadly represents the likely peak period during construction of the Proposed Scheme and is therefore considered to be reasonably representative.

14.3.23 Future baseline traffic volumes in the peak hours are forecast to grow by an average of 7% by 2023 compared to the baseline year of 2016.

Operation (2027 and 2041)

14.3.24 Future baseline traffic volumes in the peak hours are forecast to grow by an average of 10% by 2027 compared to the baseline year of 2016.

14.3.25 Future baseline traffic volumes in the peak hours are forecast to grow by an average of 18% by 2041 compared to the baseline year of 2016.

14.4 Effects arising during construction

Avoidance and mitigation measures

14.4.1 The following measures are proposed to avoid or reduce effects on transport users:

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

- insofar as reasonably practicable, site haul routes will be created adjacent to the route of the Proposed Scheme to transport construction materials and equipment to reduce heavy goods vehicle (HGV) movements on public roads with access taken via the main road network;
- HGVs will be routed, insofar as reasonably practicable, along the strategic and/or primary road network;
- insofar as reasonably practicable, the use of the local road network will be limited to use for site set-up, access for surveys and on-going servicing (including refuse collection and general deliveries to compounds) during construction;
- a temporary railhead will be provided near to Stone in the Stone and Swynnerton area (CA3) to allow construction materials, including excavated materials, and equipment to be transported by the existing rail network. The temporary railhead will include direct access to and from the M6, which will reduce HGV movements on the local road network;
- the reuse of excavated material, insofar as reasonably practicable, along the route of the Proposed Scheme;
- borrow pits in the Fradley to Colton area (CA1), Whitmore Heath to Madeley area; and South Cheshire area (CA5) will limit the volume of construction traffic on the road network;
- highway measures including junction improvements, passing places and carriageway widening will be provided, as required, to manage the safe passing of construction vehicles on construction HGV routes. These are considered in this assessment and Volume 4: Off-route effects;
- The draft Code of Construction Practice[201] (CoCP) includes the requirement to develop local traffic management plans which will consider the local traffic management strategy including consideration of sensitive receptors, such that the effect on safety and accidents is not significant; and
- on-site welfare facilities will be provided to reduce daily travel by site workers.

14.4.2 Section 14 of the draft CoCP includes measures whose purpose is to reduce the impacts and effects of deliveries of construction materials and equipment, including where appropriate timing of site operations and timing of traffic movements.

14.4.3 The number of private car trips to and from the construction compounds (both workforce and visitors) will be reduced by encouraging alternative sustainable modes of transport or vehicle sharing. This will be supported by an overarching framework travel plan that will require construction workforce travel plans[202] to be produced that

[201] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.
[202] Construction and operational travel plans will promote the use of sustainable transport modes as appropriate to the location and types of trip. They will include measures such as: provision of information on and promotion of public transport services; provision of good cycle and pedestrian facilities; liaison with public transport operators;; promotion of car sharing; and the appointment of a travel plan coordinator to ensure suitable measures are in place and are effective.

will include a range of potential measures to mitigate the impacts of traffic and transport movements associated with construction of the Proposed Scheme.

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

14.4.5 Site staff and workers will generally arrive before the morning peak hour and depart after the evening peak hour. Whilst tunnelling and directly associated activities will be carried out on a 24-hour, seven days a week basis, workers will mostly arrive and depart outside of the peak traffic hours.

14.4.6 Disruption to rail passengers and freight movements on the conventional railway will be reduced insofar as reasonably practicable through the use of measures such as:

- programming the construction works to coincide with the possessions that are required and planned by Network Rail for the general maintenance of their railway;
- planning the required construction works so that they can be undertaken in short overnight stages and that passenger services are not disrupted; and
- programming longer closures at the weekend and on bank holidays to reduce, insofar as reasonably practicable, the number of passengers affected.

Assessment of impacts and effects

Temporary effects

14.4.7 The following section considers the impacts on traffic and transport and the likely consequential significant effects resulting from construction of the Proposed Scheme.

Key construction transport issues

14.4.8 The traffic and transport impacts during the construction period within the Whitmore Heath to Madeley area will include:

- road closures and associated realignments and diversions;
- alternative routes for PRoW; and
- construction vehicle movements to and from the various worksites.

14.4.9 The construction assessment has also considered any impacts in the Whitmore Heath to Madeley area that arise from construction of the Proposed Scheme in the adjoining community areas.

14.4.10 Construction vehicle movements required to construct the Proposed Scheme will include the delivery of plant and materials, movement of excavated materials and site worker trips. Works will include utilities diversions, tunnelling, earthworks, underpass, viaduct, bridge and highway construction.

14.4.11 Details of construction compounds are provided in Section 2.3. The locations of the compounds and the associated access routes are shown in the TR-08 Map Series (Volume 5: Traffic and transport Map Book). Table 29 provides a summary of this along with the transport activity at each compound. For each compound the peak month of activity is the month within which HGV traffic is at its highest for that compound. The busy period is the period during which HGV traffic serving that compound will be greater than 50% of the HGV traffic in the peak month. The average daily combined two-way vehicle trips for the busy period is the lower end of the range shown in the table below. The average daily combined two-way vehicle trips for the peak month is the upper end of the range shown in the table below.

Table 29: Typical vehicle trip generation for construction sites in the Whitmore Heath to Madeley area

Compound type	Location	Access to / from compound to main road network	Indicative start/set up date	Estimated duration of use (years)	Estimated duration of busy period (months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
Satellite	Stableford North embankment satellite compound	Bent Lane (North) from the south for site set-up and servicing, followed by site haul route and after that to the A53 Newcastle Road	October 2020	4 years and 6 months	2	48-66	139-139
Satellite	Whitmore Heath tunnel satellite compound	A53 Newcastle Road from the east	October 2020	4 years and 6months	2	160-220	162-167
Satellite	Whitmore Heath tunnel south portal satellite compound	A53 Newcastle Road from the east	January 2025	1 year	8	16-22	up to 10
Transfer node	Transfer node associated with Whitmore Heath tunnel satellite compound	A53 Newcastle Road	October 2020	4 years and 6 months	3	N/A	497-551
Satellite	Whitmore Heath tunnel north portal satellite compound	Snape Hall Road/ site haul route	January 2025	1 year and 6 months	17	52-84	22-22
Satellite	Whitmore North cutting satellite compound	Initially from Snape Hall south for site set-up and servicing, followed by via site haul route to the east from Whitmore Heath Tunnel satellite	October 2020	4 years and 6 months	5	56-77	83-92

Compound type	Location	Access to / from compound to main road network	Indicative start/set up date	Estimated duration of use (years)	Estimated duration of busy period (months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
		compound and on to A53 Newcastle Road					
Satellite	Whitmore north auto-transformer station satellite compound	Snape Hall Road/site haul route	July 2024	1 year and 3 months	10	57-84	up to 10
Satellite	River Lea viaduct satellite compound	Initially from Manor Road for site set up and limited access. Main access will be via site haul route from A53 Newcastle Road using temporary crossing of the WCML	October 2020	4 years and 6months	4	80-110	114-176
Satellite	Madeley cutting satellite compound	A525 Bar Hill Road	October 2020	4 years and 6 months	1	24-33	93-93
Transfer node	Transfer node associated with Madeley cutting satellite compound	A525 Bar Hill Road	October 2020	4 years and 6 months	3	N/A	262-343
Satellite	Madeley tunnel (south) satellite compound	A525 Bar Hill Road and then via the site haul route constructed to the north of the route of the Proposed Scheme	October 2020	Civil engineering 4 years and 3 months	14	168-231	64-81
			July 2025	Railway Systems - 9 months	8	16-22	up to 10
Satellite	Madeley tunnel (north) satellite compound	A525 Bar Hill Road and via the site haul route constructed to access the compound for HGVs	October 2020	Civil Engineering- 3 years and 6 months	34	8-11	up to 10
Satellite	Madeley tunnel north portal satellite compound	A525 Bar Hill Road and via the site haul route constructed to access the compound for HGVs	July 2024	Railway Systems - 2 years and 3 months	17	80-166	18-26

Compound type	Location	Access to / from compound to main road network	Indicative start/set up date	Estimated duration of use (years)	Estimated duration of busy period (months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
Satellite	Checkley South embankment satellite compound	Initially accessed for site set up and limited access from Checkley Lane or Madeley Bridleway 2 accommodation underbridge. Main access will be via haul route back to A525 Bar Hill Road	October 2020	4 years and 6 months	2	56-77	74-82

14.4.12 Information on the indicative construction programme is provided in Section 2.3 and the construction methodology is summarised in Volume 1 (Section 6). This illustrates how the phasing of activities at different compounds will generally be staggered and that construction activities at individual compounds may not occur over the whole duration presented in Table 29.

14.4.13 Where construction routes serve more than one construction compound, the combined vehicle movements during the busiest period for each section of each route have been assessed.

Highway network

Strategic and local road network traffic

14.4.14 Temporary road or lane closures and associated diversions will be required in a number of locations including: the A53 Newcastle Road; Snape Hall Road; Manor Road; and the A525 Bar Hill Road. In most cases, these works will be restricted to short-term overnight and/or weekend closures, and are not, therefore, considered significant. Where works are of a longer duration and/or have a significant effect, these are addressed below.

14.4.15 The A53 Newcastle Road will be locally diverted temporarily via a two-lane diversion adjacent to the existing alignment in order to facilitate the construction of the Whitmore Heath cut and cover tunnel. On completion of the cut and cover tunnel the A53 Newcastle Road will be reinstated on its existing alignment. The diversion is expected to be required for approximately one year and three months and will maintain capacity on the A53 Newcastle Road. The length of the temporary diversion and the implementation of a temporary roundabout, to facilitate construction access, will not have a significant effect on traffic flows and delays for vehicle occupants.

14.4.16 To facilitate the permanent upgrade to Snape Hall Road and Common Lane for maintenance access, temporary access will be required for nine months, although access to private properties will be retained and disruption to users will be minimised. These temporary works will not have a significant effect on traffic flows and delays for vehicle occupants.

14.4.17 At Manor Road and the A525 Bar Hill Road, localised lane diversions will be required to facilitate the construction of the Manor Road overbridge and the A525 Bar Hill overbridge. At both locations, localised diversions are expected to be required for approximately three months and traffic management will be required to facilitate the implementation of the proposed road tie-ins. The temporary diversions will not have a significant effect on traffic flows and delays for vehicle occupants.

14.4.18 Where site haul routes, created adjacent to the route of the Proposed Scheme, cross the existing road network, traffic control measures will be implemented and could include the provision of temporary signals or roundabouts, which will be removed upon completion of the works. Short-term lane restrictions will be required in some locations to implement access points for construction vehicles. These traffic control measures are not likely to have a significant effect on traffic flows and delays for vehicle occupants.

14.4.19 Construction of the Proposed Scheme is forecast to result in changes in daily traffic flows due to the movement of excavated or fill material and construction vehicles accessing construction compounds and also temporary diversions.

14.4.20 Changes in peak hour traffic flows will lead to increases in delays to vehicle users and congestion[203]at the A51 London Road/A53 Newcastle Road staggered crossroads junction. This will be a major adverse effect, which is significant. Construction traffic is not expected to result in any significant effects at any other junctions in the Whitmore Heath to Madeley area.

14.4.21 Junction assessments have been undertaken against the peak month flows and include robust assumptions on the level of construction traffic in the peak hours. The temporary effect identified above can therefore considered to be the worst case and HS2 Ltd will continue to work with the relevant highway authorities to manage the impacts at this location.

14.4.22 Construction of the Proposed Scheme will result in substantial increases in traffic flows (i.e. more than 30% for HGV or all vehicles) in some locations, which can lead to traffic-related severance[204] for non-motorised users from increases in either all traffic (including Proposed Scheme worker trips, LGV and HGV traffic) or HGV traffic. The effect reported below for each road is the most significant traffic-related severance effect for non-motorised users:

- A51 London Road between Dog Lane and Checkley Lane – major adverse effect as a result of an increase in all traffic;
- A53 Newcastle Road between the A51 London Road and the A5182 Trentham Road – major adverse effect as a result of an increase in all traffic;

[203] In assessing significant effects of traffic changes on congestion and delays, a major adverse effect occurs where traffic flows on a road link will be beyond or very close to capacity with the Proposed Scheme and the increases in traffic due to the Proposed Scheme will be such as to substantially increase queues and delays on a routine basis at peak times. A moderate adverse effect will occur when traffic flows on a road link will be approaching or at capacity with the Proposed Scheme and modest increases in traffic will increase the frequency of queues and more substantial delays. A minor adverse effect occurs when traffic flows on a road link are not generally exceeding capacity with the Proposed Scheme but the increase in flows will result in occasional queues and delays or small increases in existing delays.

[204] In the context of this Traffic and transport section, severance is used to relate to a change in ease of access for non-motorised users due to, for example, a change in travel distance or travel time or a change in traffic levels on a route that makes it harder for non-motorised users to cross. A reference to severance does not imply a route is closed to access.

- A525 Bar Hill Road between the A51 London Road and the Proposed Scheme – major adverse effect as a result of an increase in all traffic;
- A525 Bar Hill Road between the Proposed Scheme and Manor Road – minor adverse effect as a result of an increase in HGV traffic;
- Manor Road between the Proposed Scheme and the A525 Bar Hill Road – moderate adverse effect as a result of an increase in all traffic; and
- Snape Hall Road between Common Lane and the Proposed Scheme – moderate adverse effect as a result of an increase in all traffic.

14.4.23 Utilities works have been assessed in detail where they are major and where the traffic and transport impacts from the works separately, or in combination with other works, will be greater than other construction activities arising within the area. Minor utilities works are expected to result in only localised traffic and pedestrian diversions, which will be of short-term duration. No additional significant effects from these minor utilities works are expected. Similarly, other minor works will involve a low level of use of local roads. Such use is not expected to give rise to significant construction traffic impacts.

Accidents and safety

14.4.24 The effect of the Proposed Scheme on accident and safety risks will not be significant as there are no locations where there are both accident clusters and substantial increases in traffic during construction.

Public transport network

14.4.25 The temporary diversion of the A53 Newcastle Road will require the diversion of the existing bus service on the A53 Newcastle Road. The increase in journey time and distance is not expected to result in an adverse significant effect on public transport delay.

14.4.26 The temporary diversion of the A525 Bar Hill Road will require the diversion of existing bus services on the A525 Bar Hill Road. The increase in journey time and distance is not expected to result in an adverse significant effect on public transport delay.

14.4.27 It is not expected that there will be any impact on any bus stops in this area.

14.4.28 The WCML, the Stoke to Market Drayton Railway and Madeley Chord will be crossed by the route of the Proposed Scheme via the River Lea viaduct. The construction of the Proposed Scheme, in particular to allow for construction of the River Lea viaduct and Stableford South embankment, is expected to require a number of rail possessions over a period of up to three years in this area including four weekend possessions of up to 54-hours. Disruption to rail users will be reduced by limiting possessions, where reasonably practicable, to existing maintenance periods. Where necessary, rail replacement services will be provided. HS2 Ltd will work with Network Rail and the train operating companies to ensure that any need for additional possessions can be reduced with good planning and communication (including appropriate advance notice). As the possessions are likely to be short term in nature, the effect on delay to rail passengers and freight services will not be significant.

Non-motorised users

14.4.29 The construction works associated with the Proposed Scheme will require the temporary closure or diversion/realignment of PRoW and roads. In most cases, these will be of a short duration and/or distance and therefore will not have a significant severance effect on users.

14.4.30 However, there will be temporary adverse effects, which are significant, on non-motorised users during construction as a result of severance from increased travel distance and/or hindrances such as substantial changes in levels for non-motorised users due to temporary PRoW and road realignments or diversions at:

- Whitmore Footpath 4 – moderate adverse effect from increase in distance of up to 650m;
- Whitmore Footpath 5 – moderate adverse effect from increase in distance of up to 1km;
- Whitmore Footpath 6 – minor adverse effect from increase in distance of up to 200m;
- Madeley Bridleway 1 – minor adverse effect from increase in distance of up to 400m;
- Madeley Bridleway 5 – minor adverse effect from increase in distance of up to 150m;
- Madeley Footpath 7 – moderate adverse effect from increase in distance of up to 1.1km;
- Madeley Footpath 24 – moderate adverse effect from increase in distance of up to 1km; and
- A53 Newcastle Road – minor adverse effect from increase in distance of up to 150m and temporary roundabout.

14.4.31 With the exception of Whitmore Footpath 4, Whitmore Footpath 5, Madeley Footpath 7 and Madeley Footpath 24, the changes in travel distance on the PRoW and road realignments or diversion are less than 500m.

Permanent effects

14.4.32 Any permanent effects of construction have been considered in the assessment of operation for traffic and transport. This is because the impacts and effects of ongoing increases in travel demand and the wider impacts and effects of the operations phase need to be considered together.

Other mitigation measures

14.4.33 The implementation of the draft CoCP in combination with the construction workforce travel plan will mitigate the transport-related effects during construction of the Proposed Scheme.

Summary of likely residual significant effects

14.4.34 The most intensive peak periods of construction for the Proposed Scheme will cause increases in traffic that will from time to time cause significant adverse effects through additional congestion and/or increased delays for road users at the A51 London Road/A53 Newcastle Road staggered crossroads junction, which will be a major adverse effect.

14.4.35 During the construction period there will be increases in traffic which will increase traffic related severance for non-motorised users at: the A51 London Road between Dog Lane and Checkley Lane (major adverse); the A53 Newcastle Road between the A51 London Road and the A5182 Trentham Road (major adverse); the A525 Bar Hill Road between the A51 London Road and the Proposed Scheme (major adverse); the A525 Bar Hill Road between the Proposed Scheme and Manor Road (minor adverse); Manor Road between the Proposed Scheme and the A525 Bar Hill Road (moderate adverse); and Snape Hall Road between Common Lane and the Proposed Scheme (moderate adverse).

14.4.36 There will be temporary adverse significant effects due to increased travel distance and/or additional hindrances to travel during construction on non-motorised users of: Whitmore Footpath 4 (moderate adverse); Whitmore Footpath 5 (moderate adverse); Whitmore Footpath 6 (minor adverse); Madeley Bridleway 1 (minor adverse); Madeley Bridleway 5 (minor adverse); Madeley Footpath 7 (moderate adverse); Madeley Footpath 24 (moderate adverse); and the A53 Newcastle Road (minor adverse).

Cumulative effects

14.4.37 The assessment includes the cumulative effects of planned and committed development during construction by taking this into account within the background traffic growth.

14.4.38 The assessment also takes into account Proposed Scheme construction traffic and transport impacts of works to construct the Proposed Scheme being undertaken in neighbouring community areas.

14.5 Effects arising from operation

Avoidance and mitigation measures

14.5.1 The following measures have been included as part of the design of the Proposed Scheme and will avoid or reduce impacts on transport users:

- reinstatement of most roads on or close to their existing alignments; and
- replacement, diversion or realignment of PRoW.

Assessment of impacts and effects

14.5.2 The following section considers the impacts on traffic and transport and the likely consequential effects resulting from the operational phase of the Proposed Scheme.

Key operation transport issues

14.5.3 The operation and maintenance of the Proposed Scheme will generate a limited number of vehicular trips and the effect will not be significant.

14.5.4 The operational effects are therefore related to road closures and the permanent diversion and realignment of roads and PRoW.

Highway network

Strategic and local road network traffic

Operation (2027)

14.5.5 The Proposed Scheme will require the permanent widening, diversion or realignment of: Bent Lane; the A53 Newcastle Road; Common Lane; Snape Hall Road; Manor Road; the A525 Bar Hill Road; and Bower End Lane. The permanent diversions or realignments will increase travel distance for vehicle occupants. The diversions or realignments are less than 1km in length and will not result in any significant effects with regard to increased journey times for vehicle occupants.

14.5.6 A section of Snape Hall Road will be permanently stopped up between points on either side of the route of the Proposed Scheme. Snape Hall Road extends around the south-west of Whitmore Heath and then turns along the northern edge of the heath. Access will be maintained via both the retained part of Snape Hall Road, Heath Road (on the south eastern edge of Whitmore Heath and retained as the Whitmore Heath tunnel will pass underneath it) and Common Lane. The stopping-up will impact on any vehicle occupants seeking to travel from one side of the stopping-up to the other. However, due to the low number of users this would affect and an alternative route available via Heath Road, the stopping up of Snape Hall Road will not result in any significant effect with regards to increased journey times for vehicle occupants.

14.5.7 The Proposed Scheme will require the permanent diversion of Bent Lane to create Bent Lane (North) in the Whitmore Heath to Madeley area and Bent Lane (South) in the Stone and Swynnerton area (CA3). Significant effects associated with this change are reported in Volume 2: Community area 3, Stone and Swynnerton.

Operation (2041)

14.5.8 The 2041 future operational traffic impacts will not change the effects assessed in 2027 in the Whitmore Heath to Madeley area.

Accidents and safety

14.5.9 The effect on accident and safety risk is not significant as there are no locations in the Whitmore Heath to Madeley area where there are substantial forecast increases in traffic due to the operation of the Proposed Scheme.

Public transport network

14.5.10 The permanent realignment of the A525 Bar Hill Road will increase travel distances for bus passengers. However, as the realignment is less than 1km in length, there will be no significant effects on public transport within the Whitmore Heath to Madeley area.

Non-motorised users

14.5.11 Madeley Bridleway 5 will be permanently stopped-up between Madeley Footpath 28 and Madeley Bridleway 2. Users will be permanently diverted along Madeley Footpath 28 (which will be upgraded to a bridleway) to Madeley Bridleway 2 before crossing the route of the Proposed Scheme under the Madeley Bridleway 2 accommodation underbridge. The stopping up of Madeley Bridleway 5 and diversion via the upgraded Madeley Footpath 28 will reduce travel distance by up to 200m and result in a minor beneficial severance effect, which is significant, on non-motorised users.

14.5.12 There will be permanent widening, realignment, diversion or extension of 11 PRoW and seven roads in the Whitmore Heath to Madeley area that will have an impact on travel distances or introduce hindrances such as substantial changes in levels for non-motorised users.

14.5.13 There will be adverse effects, which are significant, on non-motorised users of two of these PRoW and roads as a result of severance from increased travel distance and/or hindrances. These are:

- Madeley Bridleway 2 – minor adverse effect from diversion via an underbridge; and
- Snape Hall Road – moderate adverse effect from increase in distance of up to 950m.

Other mitigation measures

14.5.14 No further mitigation measures are considered necessary during operation of the Proposed Scheme based on the outcome of this assessment.

Summary of likely residual significant effects

14.5.15 There will be a minor beneficial severance effect due to reduced travel distance for non-motorised users of Madeley Bridleway 5.

14.5.16 There will be a moderate severance adverse effect due to increased travel distance on the non-motorised users of Snape Hall Road.

14.5.17 There will be a minor adverse severance effect as a result of diversion via an underbridge on non-motorised users of Madeley Bridleway 2.

Cumulative effects

14.5.18 The assessment includes cumulative effects of planned and committed development during operation, by taking into account background traffic growth in the future baseline.

Monitoring

14.5.19 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

14.5.20 Operational and maintenance traffic will be very limited and there are no stations on the route of the Proposed Scheme. Consequently, no specific monitoring

requirements are considered necessary for this topic during operation of the Proposed Scheme.

15 Water resources and flood risk

15.1 Introduction

15.1.1 This section provides a description of the current baseline for water resources and flood risk in the Whitmore Heath to Madeley area. The likely impacts and significant effects of the Proposed Scheme's construction and operation on surface water and groundwater bodies and their associated water resources are assessed. The likely impacts and significant effects of the Proposed Scheme on flood risk and land drainage are also considered.

15.1.2 Engagement has been undertaken with the Environment Agency, Staffordshire County Council (SCC), which is the Lead Local Flood Authority (LLFA), and Severn Trent Water Limited (the local water and sewerage undertaker). The purpose of this engagement has been to obtain relevant baseline information and to discuss issues and potential effects.

15.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: CA4 Map Book.

15.1.4 Map Series WR-01, WR-02, WR-03, WR-05 and WR-06, showing details of the water features referred to in this section, are contained in the Volume 5: Water resources and flood risk assessment Map Book.

15.1.5 Detailed information on the water resources and flood risk issues specific to the Whitmore Heath to Madeley area are contained in the Volume 5 appendices. These comprise:

- Appendix WR- WR-002-004 – Water resources assessment; and
- Appendix WR- WR-003-004 – Flood risk assessment.

15.1.6 Volume 5 also includes a detailed route-wide, stand-alone Water Framework Directive (WFD) compliance assessment (Appendix WR-001-000), a draft route-wide water resources and flood risk monitoring strategy and a draft route-wide water resources and flood risk operation and maintenance manual (Appendix WR-002-000).

15.1.7 In addition, detailed hydraulic modelling reports are included in Background Information and Data (BID)[205] (BID-WR-004-008, Hydraulic modelling report, Meece Brook and BID-WR-004-009, Hydraulic modelling report - River Lea).

15.1.8 Volume 3: Route-wide effects, Water resources and flood risk (Section 16), covers the following at a route-wide level:

- the risk to water resources associated with accidents or spillages from trains during operation of the Proposed Scheme;

[205] HS2 Ltd (2017), High Speed Two (HS2) Phase 2a (West Midlands - Crewe), Background Information and Data, Available online at: www.gov.uk/hs2

- a summary of how the Proposed Scheme complies with the statutory requirements of the WFD; and
- route-wide flood risk issues related to application of the Sequential Test and Exception Test in the National Planning Policy Framework (NPPF)[206].

15.2 Scope, assumptions and limitations

15.2.1 The scope, assumptions and limitations for the water resources and flood risk assessment are set out in Volume 1 (Section 8), the Scope and Methodology Report (SMR)[207] and the SMR Addendum[208].

15.2.2 Unless indicated otherwise, the spatial scope of the assessment (the study area) is based upon the identification of surface water and groundwater features within 1km of the centre line of the route of the Proposed Scheme, as described in Section 2.2 of this report.

15.2.3 The assessment is based on desk study information, including information provided by consultees and stakeholders, as well as surveys of accessible water features.

15.2.4 Where surveys have not been undertaken due to land access constraints, a precautionary approach has been adopted in the assessments of receptor value and impact magnitude.

15.2.5 Hydraulic modelling has been undertaken of watercourses and key structures within flood risk areas. This includes modelling of the River Lea.

15.2.6 Groundwater levels have been inferred from the available Environment Agency groundwater level monitoring boreholes, historic borehole logs and topographic data, as well as from spring and watercourse locations.

15.2.7 The assessment is based on existing available water quality information provided by the Environment Agency.

15.2.8 Impacts on biological receptors, such as aquatic fauna and flora, which are referred to in the Volume 5: Appendix WR-001-000, WFD compliance assessment, are assessed in Section 8, Ecology and biodiversity.

15.3 Environmental baseline

Existing baseline - Water resources and WFD

Surface water

15.3.1 All water bodies in the study area fall within either the Staffordshire Trent Valley Catchment of the Humber river basin district (RBD) or the Weaver and Gowy Catchment of the North West RBD.

[206] DCLG (2015). National Planning Policy Framework.
[207] Volume 5: Appendix CT-001-001, Environmental Impact Assessment Scope and Methodology Report.
[208] Volume 5: Appendix CT-001-002, Environmental Impact Assessment Scope and Methodology Report Addendum.

15.3.2 The river basin management plans[209] identify the chemical[210] and ecological[211] condition of surface water bodies, and the quantitative[212] and chemical[213] status of groundwater bodies within this RBD.

15.3.3 The statutory objective of the WFD is to prevent deterioration of all water bodies at good or high status and to prevent water bodies at less than good status from deteriorating further.

15.3.4 Specialist field surveys have been undertaken, where access has been available. This has included the majority of surface water bodies within the study area. Receptor values have been adjusted to reflect the outputs from these surveys, in close consultation with the Environment Agency. In the absence of field surveys, surface water bodies, other than minor ponds and ditches, have been identified within this assessment as being of either high or very high value on a precautionary basis.

15.3.5 Summary information relating to the surface water bodies crossed by the Proposed Scheme within this study area, including their location, current overall WFD status and future overall status objectives, is provided in Table 30. Table 30 also identifies the receptor values attributed to each individual watercourse based on the methodologies set out in the SMR, the SMR Addendum and as applied in the WFD compliance assessment (Volume 5: Appendix WR-001-000).

Table 30: Key surface water bodies and their WFD status

Water body name and identification number[214]	Current WFD status[215]	WFD status objective	Watercourse classification	Crossing location (National Grid Reference)[216]	Receptor value
Meece Brook from source to Chatcull Brook GB104028053080	Poor	Good by 2027	Main river	Meece Brook (NGR SJ 80987 40093) Meece Brook (NGR SJ 80987 40093)	High
River Lea GB112068055200	Bad	Good by 2027	Main river	River Lea (NGR SJ 78000 42637)	High
	Main river tributaries:				
	Poor	Good by 2027	Minor ditch	Snape Hall Road (NGR SJ 79490 41430)	Low
	Poor	Good by 2027	Minor ditch	Whitmore Wood (NGR SJ 78972 41846)	Low

[209] Environment Agency (2015), Water for life and livelihoods Part 1: Humber river basin district: River basin management plan. Environment Agency (2015), Water for life and livelihoods Part 1: North West river basin district: River basin management plan

[210] The chemical status of surface waters reflects concentrations of priority and hazardous substances present.

[211] The ecological status of surface waters is determined based on the following elements:

- Biological elements – communities of plants and animals (for example, fish and rooted plants), assessed in the ecology and biodiversity section;
- Physico-chemical elements – reflects concentrations of pollutants such as metal or organic compounds, such as copper or zinc;
- Hydromorphological elements – reflects water flow, sediment composition and movement, continuity (in rivers) and the structure of physical habitats.

[212] The quantitative status of groundwaters reflects the presence or absence of saline or other intrusions, interactions with surface water, issues related to groundwater dependent terrestrial ecosystems (GWDTE) and overall water balance.

[213] The chemical status of a groundwater body reflects effects on drinking water protected areas, its general quality, the importance of water quality within the water body for GWDTEs and surface water interactions and whether there are intrusions of poor quality groundwater present.

[214] The Environment Agency has attributed each surface water and groundwater body a unique water body identification (ID) number.

[215] See Volume 5 WFD compliance assessment (Volume 5, WR-001-000) for definitions of WFD status.

[216] This is the location where the Proposed Scheme will cross the watercourse concerned.

Water body name and identification number[214]	Current WFD status[215]	WFD status objective	Watercourse classification	Crossing location (National Grid Reference)[216]	Receptor value
	Bad	Good by 2027	Minor ditch	Wrinehill Wood (NGR SJ 75477 45373)	Low
	Bad	Good by 2027	Minor ditch	Madeley Bridleway (NGR SJ 75210 45601)	Low

Abstractions and permitted discharges (surface water)

15.3.6 There are no licensed surface water abstractions in the study area.

15.3.7 Records of private unlicensed surface water abstractions, which comprise those for quantities less than 20m3 per day, have been obtained from Stafford Borough Council (SBC) and Newcastle-Under-Lyme Borough Council (NBC). These data indicate that there are two registered private unlicensed surface water abstractions within the study area. As there is no obligation to register private water supplies, unregistered private groundwater supplies may also be present. Private water supplies are assessed as high value receptors unless details obtained from the owner indicate otherwise.

15.3.8 There are five licensed consented discharges to surface waters within the study area. These have been assessed as being receptors of low value.

Groundwater

15.3.9 The location of abstractions, geological formations and indicative groundwater levels, where available, are shown in Map Series WR-02, in Volume 5: Water resources and flood risk Map Book.

15.3.10 The geology of the study area is described in Section 10, Land quality, and the superficial and bedrock hydrogeology is summarised in Table 31. Unless stated otherwise, the geological groups listed will all be crossed by the Proposed Scheme. Table 31 also identifies the receptor values attributed to each groundwater receptor based on the methodologies set out in the SMR, the SMR Addendum and as applied in the WFD compliance assessment (Volume 5: Appendix WR-001-000).

Table 31: Summary of geology and hydrogeology in the study area

Geology[217]	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status	WFD status objective	Receptor value
Superficial deposits						
Peat	Located near Hey Sprink and south of the route of the Proposed Scheme near Whitmore	Organic rich clay or humic deposits	Unproductive	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low

[217] In recent years, the British Geological Survey has revised the nomenclature used to describe the geological materials present in Great Britain, with the publication of a series of lithostratigraphic framework reports. Some of these reports cover an entire geological period e.g. The Carboniferous and others cover a single group e.g. the Triassic Mercia Mudstone. The nomenclature used in these reports supersede the nomenclature introduced in the 1980s, when the Group/ Formation / Member classification was adopted by the British Geological Survey, replacing the earlier classification adopted by the pioneer geological surveyors in the 19th century. While some traditional names have been retained by this process, many new names have also been generated, and many geological maps have not yet been updated. Some stratigraphic units have been renamed twice in the last 35 years. To reflect this, the previous name used for geological units (if different) is shown in brackets.

Geology[217]	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status	WFD status objective	Receptor value
	Heath and Baldwin's Gate					
Alluvium	Along the valley and tributaries of Meece Brook and Checkley Brook	Clay, silt, sand and gravel	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
River Terrace Deposits	Along the valley of Meece Brook and the Checkley Brook	Sand and gravel	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Glacial Till	A small discontinuous outcrop to the west of Whitmore Wood and near continuous cover from around Barhill Wood to the north of the study area	Gravel in a fine matrix	Unproductive	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low
Glaciofluvial Deposits (Glaciofluvial Sheet Deposits and Undifferentiated Glaciofluvial Deposits)	Outcrops at the River Lea crossing and discontinuous areas in the north of the study area. Additional outcrop at Baldwin's Gate (not crossed by the route of the Proposed Scheme)	Sand and gravel	Secondary A	Not assessed by the Environment Agency except in the north of the study area where they are part of the Weaver and Dane Quaternary Sand and Gravel Aquifers (GB41202G991700) – Poor	Good by 2027	Moderate
Bedrock						
Mercia Mudstone Group – Sidmouth Mudstone	Outcrop underlying the northern part of the study area from Grafton's Wood	Mudstone and siltstone	Secondary B	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Sherwood Sandstone Group - Wilmslow Sandstone (Wildmoor Sandstone)	Outcrop underlying approximately 2km of the southern section of the study area	Sandstone with subordinate siltstone and mudstone	Principal	The Staffordshire Trent Valley - PT Sandstone Staffordshire (GB40401G300500) – Poor	Poor by 2015	High
Sherwood Sandstone Group - Wilmslow Sandstone (Wildmoor Conglomerate)	Small outcrop to the south-west of the route within the Wilmslow Sandstone outcrop	Conglomerate of mainly sand and gravel with a matrix of fine silt and clay	Principal	The Staffordshire Trent Valley - PT Sandstone Staffordshire (GB40401G300500) – Poor	Poor by 2015	High
Sherwood Sandstone Group - Wilmslow	Outcrop to the east of the Wem fault	Sandstone with subordinate	Principal	South Cheshire and Staffordshire North Permo-Triassic Sandstone Aquifers	Good by 2015	High

Geology[217]	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status	WFD status objective	Receptor value
Sandstone (Wilmslow Sandstone)		siltstone and mudstone		(GB41201G103400) – Good		
Sherwood Sandstone Group - Chester Formation (Kidderminster Sandstone and Conglomerate Interbedded)	Outcrop in the vicinity of Whitmore Heath	Sandstone and conglomerate	Principal	The Staffordshire Trent Valley - PT Sandstone Staffordshire (GB40401G300500) – Poor	Poor by 2015	High
Sherwood Sandstone Group - Chester Formation (Kidderminster Formation – Conglomerate)	Outcrop in the vicinity of Whitmore Heath	Pebble conglomerate with a sandy matrix and pebbles	Principal	The Staffordshire Trent Valley - PT Sandstone Staffordshire (GB40401G300500) – Poor	Poor by 2015	High
Sherwood Sandstone Group - Chester Formation (Chester Pebble Beds)	Outcrop to the east of the Wem fault as far south as Barhill Wood	Sandstone (pebbly gravel sandstone)	Principal	South Cheshire and Staffordshire North PT Sandstone Aquifers (GB41201G103400) – Good	Good by 2015	High
Warwickshire Group - Salop Formation	Outcrop underlying the Proposed Scheme from the east of Whitmore Wood to the River Lea viaduct	Sandstone, siltstone and conglomerate	Secondary A	Staffordshire Trent Valley - Coal Measures Stoke (GB40402G304600) – Poor	Poor by 2015	Moderate
Warwickshire Group - Halesowen Formation	Outcrop underlying the Proposed Scheme from where it crosses the River Lea to Barhill	Mudstone, siltstone and sandstone	Secondary A	Staffordshire Trent Valley - Coal Measures Stoke (GB40402G304600) - Poor	Poor by 2015	Moderate

Superficial deposit aquifers

15.3.11 The basis of the receptor values attributed to the superficial deposit aquifers present within the study area, as shown in Table 31, is outlined briefly as follows:

- Alluvium, River Terrace Deposits and Glaciofluvial Sheet Deposits may be capable of supporting water supplies at a local rather than regional scale and may also form a source of baseflow to rivers. They have therefore been classified as moderate value receptors;
- Glacial Till deposits may supply baseflow to watercourses or store and yield limited amounts of groundwater and so have been classified as low value receptors; and
- deposits of Peat are classified as Unproductive in this area, and therefore, are low value receptors in terms of water resources.

Bedrock aquifers

15.3.12 The basis of the receptor values attributed to the bedrock aquifers present within the study area, as shown in Table 31, is briefly as follows:

- the Sherwood Sandstone Group (locally comprising sandstones of the Helsby Sandstone Formation and the Chester Formations) has been classified as a Principal aquifer by the Environment Agency and is therefore a high value receptor; and
- the Mercia Mudstone Group and the Warwickshire Group are capable of supporting water supplies at a local rather than strategic scale and in some cases form an important baseflow to rivers. These are therefore considered receptors of moderate value.

WFD status of groundwater bodies

15.3.13 A summary of locations, current overall WFD status, and future overall status objectives associated with the designated bedrock groundwater bodies within the study area is provided in Table 31. The value attributed to each of these receptors is also indicated.

15.3.14 The superficial deposits in the study area are not formally designated as WFD groundwater bodies but may be hydraulically connected to the WFD bedrock aquifers.

Abstractions and permitted discharges (groundwater)

15.3.15 There is one very high value groundwater abstraction licensed for public water supply in the study area, near Whitmore, which is protected by a source protection zone (SPZ).

15.3.16 There are two high value licensed private groundwater supplies at Netherset Hey and Manor Farm, which have a default SPZ 1 and SPZ2 zones of 50m and 250m radius respectively.

15.3.17 Information obtained from the local authorities indicates that there are three unlicensed private abstractions registered within the study area. All three abstractions are from boreholes and are high value receptors. Unregistered private groundwater supplies may also be present. Private water supplies have been assessed as high value receptors unless details obtained from the owner indicate otherwise.

15.3.18 There is one consented discharge to groundwater within the study area. This discharge has been assessed as a low value receptor.

Groundwater-surface water interactions

15.3.19 Desk-based assessment using Ordnance Survey maps identified 14 features within the study area that had potential to be springs. Access was possible to inspect five of these features. One feature was confirmed to be a spring (a high value receptor) and the other four features inspected were confirmed to be land drainage features of low value. The remaining nine potential spring features are assumed to be high value receptors, pending site inspection.

15.3.20 There are 37 ponds within the land required for the Proposed Scheme. The nature and relative value of these features, the magnitude of the impacts that the Proposed Scheme will have on them, and the mitigation proposed, are outlined in Chapter 8, Ecology and biodiversity.

Existing baseline - flood risk and land drainage

15.3.21 The Environment Agency's Flood map for planning (rivers and sea)[218] has been used to scope the baseline flood risk for flooding from main rivers and ordinary watercourses. These plans define Flood Zone 2 (land assessed as having between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability of river flooding) and Flood Zone 3 (land assessed as having a 1 in 100 (1%) or greater annual probability of river flooding).

15.3.22 The updated Flood map for surface water[219] has been used to scope surface water flood risks. Infrastructure failure flood risks have been scoped using the Environment Agency Risks of flooding from reservoirs national dataset[220]. The British Geological Survey (BGS) national dataset, Areas susceptible to groundwater flooding[221], has been used to assess the future risk of groundwater flooding. The following reports were also used to help determine the baseline flood risk within the study area:

- Staffordshire Preliminary Flood Risk Assessment (PFRA) (2011)[222]; and
- Stoke-on-Trent City Council and NBC Strategic Flood Risk Assessments (SFRA) (2007)[223],[224].

15.3.23 River and surface water flood zones are shown in WR-01 Map Series in Volume 5: Water resources and flood risk Map Book.

River flooding

15.3.24 The study area includes substantial areas of floodplain (Flood Zone 2 and 3) associated with Meece Brook, to the south of Whitmore; the Upper River Lea, to the west of Hey Sprink and the Lower River Lea and Checkley Brook, to the west of Wrinehill. Table 32 shows the watercourses within the study area and the receptors that would potentially be affected by any changes in flood magnitude. The value of these receptors, based on Table 52 in the SMR, is also indicated.

Table 32: River flood risk sources and receptors

Source	Location (NGR)	Receptor potentially affected	Receptor value
Meece Brook	SJ 80852 40637	Cricket pitch	Low
	SJ 80932 40947	Residential properties at Whitmore	High

[218] Environment Agency, Flood map for planning (rivers and sea). Available online at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=_e&ep=map&scale=8&x=435500&y=335500
[219] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=402498&northing=282043&address=100070518535
[220] Environment Agency, Risks of flooding from reservoirs national dataset. Available online at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=402498&northing=282043&address=100070518535
[221] British Geological Survey, Areas susceptible to groundwater flooding. Available online at: http://www.bgs.ac.uk/products/hydrogeology/groundwaterFlooding.html
[222] Staffordshire Preliminary Flood Risk Assessment (PFRA) (2011) Staffordshire County Council.
[223] Stoke-on-Trent City Council Strategic Flood Risk Assessment (SFRA) (2008) Halcrow.
[224] Newcastle-under-Lyme Borough Council Strategic Flood Risk Assessment (SFRA) (2008) Halcrow.

Source	Location (NGR)	Receptor potentially affected	Receptor value
	SJ 81613 38659	Stableford caravan park	High
	SJ 81571 38748	A51 London Road	Very High
Unnamed tributary	Various	Agricultural land	Low
River Lea	SJ 77377 44343	Residential properties at Whitmore	High
	SJ 77214 44869	Madeley Pool	Low
	Various	Agricultural land	Low
	SJ 77590 43772	Netherset Hey Industrial Estate	High

Surface water flooding

15.3.25 There are numerous areas that are susceptible to surface water flooding within the study area. These are identified in maps WR-01-106b to 107a in the Volume 5: Water resources and flood risk Map Book. The key sources and receptors with potential to be affected are shown in Table 33. The value of these receptors, based on Table 52 of the SMR, is also indicated.

Table 33: Surface water flood risk sources and receptors

Source	Location (NGR)	Receptor potentially affected	Receptor value
Surface water flow path	SJ 79258 41295	Snape Hall Farm	High
	SJ 79165 41688	Whitmore Wood	Low
	Various	Agricultural land	Low
	SJ 78874 41797	Snape Hall Road	High
	SJ 76927 44169	Residential properties along A525Bar Hill Road (Bar Hill)	High
	SJ 76729 44675	Moor Hall Cottages	High
	SJ 75366 45974	Wrinehill Mill	Moderate

Artificial water bodies

15.3.26 Flooding from artificial water bodies may occur due to the failure of an impounding structure, such as a dam or canal embankment. The flood risk assessment (WR-003-002) considers the risks associated with artificial water bodies within the study area including: the Whitmore fisheries ponds approximately 2km to the north of the route of the Proposed Scheme; Madeley pond, in the centre of Madeley; and Madeley Manor Lake, north of Madeley. There are no significant flood risk issues associated with these artificial water bodies.

Groundwater flooding

15.3.27 The formal source of public information regarding historical incidents of groundwater flooding in the Whitmore Heath to Madeley area is the Newcastle-under-Lyme SFRA[224]. The SFRA states that flooding of basements is reported to have occurred in the past in Silverdale, approximately 5.5km to the north of the study area. This is not something that would be affected by the Proposed Scheme.

15.3.28 The Environment Agency's Areas susceptible to groundwater flooding map indicates a potential risk of groundwater flooding adjacent to Baldwin's Gate, in the southern part of the study area, where there is an outcrop of the Sherwood Sandstone Group. The Proposed Scheme will not affect this source of flood risk.

Land drainage

15.3.29 Existing topography, soils and land drainage systems within the study area are described in Section 4, Agriculture, forestry and soils. The rivers and watercourses within the area are connected to an extensive network of existing open drains. Subsurface drainage systems are also likely to be present in fields used for agriculture. The land drainage function of these systems, which is important for crop productivity, is potentially sensitive to increases in water levels within the receiving watercourses.

Future baseline

Construction (2020)

15.3.30 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2020.

15.3.31 No committed developments have been identified in this area that will materially alter the baseline conditions in 2020 for water resources and flood risk receptors.

Operation (2027)

15.3.32 Volume 5: Appendix CT-004-000 provides details of the developments in the Whitmore Heath to Madeley area that are assumed to have been implemented by 2027.

15.3.33 No committed developments have been identified in this area that will materially alter the water resources and flood risk baseline conditions in 2027.

Climate change

15.3.34 Detailed analysis of the potential impacts of climate change on the Proposed Scheme has been undertaken and is reported in Volume 3: Route-wide effects (Section 4). In general, the design of the Proposed Scheme has adopted a precautionary approach to potential future increase in peak river flows and rainfall intensities, using the latest guidance issued by the Environment Agency in February 2016[225].

[225] Environment Agency (2016) Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities.

15.3.35 Although no definitive guidance is available, climate change may also affect future surface water and groundwater resources. However any such changes are unlikely to change the significance of effects identified in this assessment.

15.4 Effects arising during construction

Avoidance and mitigation measures

15.4.1 The principal strategy adopted to limit the temporary and permanent effects of the Proposed Scheme is through avoidance of sensitive receptors wherever reasonably practicable. Where receptors could not be avoided, mitigation measures have been incorporated where appropriate and reasonably practicable, to limit the potential effects. Section 16 of the draft Code of Construction Practice[226] (CoCP) includes a range of mitigation measures that aim to reduce construction impacts as far as is reasonably practicable. The avoidance and mitigation measures that are of particular relevance to water resources and flood risk during construction are described in the following sections of this report.

Water resources and WFD

15.4.2 The avoidance of sensitive receptors has reduced the risks associated with the Proposed Scheme not complying with the requirements of the WFD. Examples of this avoidance strategy include:

- avoidance of channels and floodplain areas – the route of the Proposed Scheme will avoid passing along river or stream valleys, such as that of Meece Brook and the River Lea, and their associated floodplains. Instead it will pass over the larger watercourses (rivers and streams) on viaducts spanning the floodplain, with the piers set back from the channel;
- avoidance, where reasonably practicable, of groundwater dependent terrestrial ecosystems, including natural springs that can play a key role in the hydrology and hydrogeology of such ecosystems; and
- avoidance, where reasonably practicable, of major public water supplies and smaller licensed and unlicensed abstractions of surface water and groundwater.

15.4.3 The presence of any unregistered private water supplies, their function and the means of protecting or if necessary replacing them will be discussed with any landowners potentially affected by the Proposed Scheme.

15.4.4 The temporary works shown on Map Series CT-05 in Volume 2: CA4 Map Book have been informed by a detailed consideration of the water resources constraints and have sought to avoid sensitive features wherever reasonably practicable.

15.4.5 Where watercourse diversions and/or realignments are proposed, the aim will be to design these with equivalent hydraulic capacity to the existing channels. The Proposed Scheme will also aim to ensure that field subsurface drainage systems can

[226] Volume 5: Appendix CT-003-000, Draft Code of Construction Practice.

be adapted to discharge into the new channel. Where such watercourses are natural channels, the design will aim to incorporate appropriate features to retain and, where reasonably practicable, enhance their hydromorphological condition[227].

15.4.6 For watercourses that are not in their natural condition, the design aim will be to incorporate measures, where reasonably practicable, to improve their hydromorphological condition, provided this is compatible with the watercourses' flood risk and land drainage functions.

15.4.7 The draft CoCP will includes requirements to protect water bodies and their associated water resources from the potential impacts of pollution from construction site runoff, including where appropriate:

- provision of maps showing sensitive areas and buffer zones where no pollutants are to be stored or used; and
- preparation of method statements for silt management, site drainage at compounds and satellite compounds, for the storage and control of oils and chemicals and the prevention of accidental spillages, in consultation with the Environment Agency, and if appropriate, the LLFA and other relevant authorities as part of the approvals process. These method statements will cover, where applicable:
  - the avoidance of discharges of site runoff to ditches, watercourses, drains, sewers or soakaways without the prior approval of the appropriate authority;
  - measures to prevent silt-laden runoff and other pollutants entering the water environment; and
  - restrictions or controls on excavation within watercourses to limit effects on water quality, sedimentation, fisheries and aquatic ecology.

15.4.8 Method statements will be required for all watercourse crossings and channel realignments required by site haul routes. The method statements will describe how potential changes to flood risk, water quality and channel morphology will be safeguarded during the establishment, use and decommissioning of all site haul routes.

15.4.9 Permanent culverts proposed on the smaller watercourse crossings within this study area include the Snape Hall Road drop inlet culvert, the Whitmore Wood culvert and Wrinehill Wood culvert. The detailed design of these culverts will be developed in general accordance with the Construction Industry Research and Information Association (CIRIA) and Environment Agency guidance and in consultation with Environment Agency specialists. The design has sought to mitigate the impact on the hydromorphology of the affected watercourses, as follows:

- drop inlet culverts have been avoided wherever reasonably practicable and are proposed on minor headwater channels or ditches only;

[227] "Hydromorphological condition" reflects the extent to which water flow, sediment composition and movement, continuity (in rivers) and the structure of physical habitats departs from that expected of a natural river or stream system.

- culvert lengths have been reduced as far as is reasonably practicable; and
- invert levels will be set below the firm bed of the watercourse to allow a natural substrate to develop along the bed of the culvert.

15.4.10 The wider issues associated with these culverts, and how their detailed design will aim to ensure no deterioration in the status of any of the relevant water body's WFD quality elements, are considered within the WFD compliance assessment report (WR-001-000). The impacts of ecological receptors relating to these culverts are considered in Section 8, Ecology and biodiversity.

15.4.11 Existing groundwater abstraction boreholes or monitoring points will be protected from physical damage, insofar as reasonably practicable, including appropriate decommissioning of abandoned boreholes in order to prevent pollution pathways. If boreholes are to be decommissioned and replaced with alternatives, the contractor will follow the latest good practice. This will also be applicable to springs potentially affected by construction works, although additional measures may be required to mitigate temporary construction impacts on springs that are to be relocated.

15.4.12 Measures will be introduced, as required, to mitigate the temporary and permanent effects on groundwater flows and water quality during excavation and construction of foundations, tunnels and cuttings, as far as is reasonably practicable. The types of measure likely to be adopted could include:

- installation of cut-off[228] structures around excavations;
- ensuring that cut-off structures are driven to sufficient depths to meet an underlying strata or zone of lower permeability;
- promotion of groundwater recharge, such as discharging pumped water to recharge trenches around excavations to maintain baseline groundwater and surface water conditions;
- incorporation of passive bypasses within the design, which could comprise a 'blanket' of permeable material, such as gravel, placed around temporary structures allowing groundwater to bypass the below-ground works, without a rise in groundwater levels on the upstream side; and
- the Tunnel Boring Machine (TBM) will be operated in a closed face mode when tunnelling within water bearing strata and the tunnel lining will be designed to reduce leakage rates as far as is reasonably practicable, thereby reducing the requirements for dewatering and drainage.

15.4.13 The exact requirements will be refined and method of mitigation will be designed following ground investigation.

15.4.14 One borrow pit is proposed within this study area. This assessment is based on excavation to an assumed average and maximum depth of the borrow pits, as described in Section 2.3. The borrow pit, west of Netherset Hey Farm, will be partially within the floodplain of the River Lea and will be excavated in the Glaciofluvial Sheet

[228] Impermeable barrier preventing water flow.

Deposits Secondary A aquifer. There is also a minor tributary of the River Lea within the area of the borrow pit. To reduce the potential for impacts on the River Lea, a 50m buffer strip has been incorporated into the design within which no excavation will be undertaken. The minor tributary will be temporarily diverted and the mitigation approach adopted for all temporary realignments and diversions of watercourses will apply.

15.4.15 All construction operations related to the borrow pit west of Netherset Hey Farm will be managed in accordance with the CoCP to reduce the potential for adverse impacts on the water environment.

15.4.16 Following construction, the area will be restored to its current levels and land use, and the tributary of the River Lea will be returned to its existing alignment. The reinstatement works will be designed to ensure that the land within the borrow pit area drains in a manner suitable for its continued use as agricultural land. These drainage measures will be designed to control groundwater levels and to sustain baseflows to the River Lea.

Flood risk and land drainage

15.4.17 The design of the Proposed Scheme will aim to mitigate permanent impacts on flood risk and land drainage as follows:

- the floodplain avoidance strategy outlined above will ensure that impacts on flood flows within rivers and streams, and their floodplains, will be limited to those associated with the intermediate pier structures and a section of embankment at the River Lea and the Checkley Brook crossing, where complete avoidance of the floodplain is not reasonably practicable. The Proposed Scheme includes replacement floodplain storage areas to replace losses associated with the embankment and piers;
- the temporary works shown on Map Series CT-05 in the Volume 2: CA4 Map Book have been informed by a detailed consideration of the flood risk constraints and have sought to avoid flood zones wherever reasonably practicable;
- provision has been made to pass surface water runoff and land drainage flows beneath sections of raised embankment that will cross surface water flow paths, where reasonably practicable. This will be achieved using perimeter drainage and culverts, with their inverts set below the likely level of any upstream field subsurface drainage systems;
- in locations where the route of the Proposed Scheme will cross watercourses, the design aim is for structures to accommodate flood flows up to and including the 1 in 100 (1%) annual probability storm with an allowance for climate change based on latest guidance issued by the Environment Agency[229];

[229] Environment Agency (2016) Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities

- runoff from the footprint of the infrastructure could occur more rapidly post-construction due to steeper slope angles and the permeability of the newly-created surfaces. The design of drainage systems aims to ensure that there will be no significant increases in flood risk downstream, during storms up to and including the 1 in 100 (1%) annual probability design event, with an allowance for climate change based on the latest guidance issued by the Environment Agency;
- balancing ponds for highways and railway drainage have been sized on a precautionary basis, pending more detailed information about the permeability and runoff characteristics of existing and proposed ground surfaces;
- where the Proposed Scheme will pass in cutting, drainage will be provided with the aim of preventing flow into the cutting and diverting this water into its natural catchment. Where reasonably practicable, runoff from the cuttings will also be drained to the catchments to which this water will naturally drain, avoiding transfer of water from one water body to another, which could increase flood risk or impact on land drainage systems; and
- measures will be introduced to reduce any potentially significant effects on groundwater flood risk as far as is reasonably practicable, including the incorporation of passive hydraulic bypasses at cuttings and other below ground structures. These could for example comprise a 'blanket' of permeable material such as gravel. These measures will be required in the locations where retaining walls are situated within aquifers in this study area to prevent 'damming' of groundwater.

15.4.18 The nominated undertaker will, insofar as reasonably practicable, ensure that flood risk is managed throughout the construction period and will consider flooding issues when planning sites and storing materials. If necessary, temporary provision will be made to reduce the potential for impacts on existing land drainage systems during construction. Some of the specific measures referred to in Section 16 of the draft CoCP, include:

- preparation of flood risk assessments and method statements for temporary works, including main construction and satellite compound drainage, watercourse crossings and realignments and temporary realignments in consultation with the Environment Agency, and where applicable, the LLFA and other relevant regulators;
- location of storage, machinery, equipment and temporary buildings outside flood risk areas where reasonably practicable;
- construction of outfalls during periods of low flow to reduce the risk of scour and erosion;
- design of temporary watercourse realignments with equivalent hydraulic capacity to the existing channels, ensuring that field subsurface drainage systems can be adapted to discharge into the new channel; and

- having regard to the requirement for construction activities to avoid any increases in flood risk to vulnerable receptors.

15.4.19 In accordance with Section 16 of the draft CoCP, monitoring will also be undertaken in consultation with the Environment Agency and where applicable, the LLFA, to ensure that temporary structures are installed, maintained and removed in accordance with the relevant environmental approvals and that impacts on existing land drainage systems are managed appropriately.

Assessment of impacts and effects

15.4.20 This section describes the significant effects following the implementation of the avoidance and mitigation measures. The majority of the potential temporary impacts on the water environment during construction will be avoided or mitigated by the working methods outlined in the draft CoCP. The mitigation embedded into the design has focused on reducing permanent impacts resulting from the presence of the Proposed Scheme to as low a level as is reasonably practicable.

Temporary effects – Water resources and WFD

Surface water

15.4.21 Potential temporary impacts on surface water quality, due to site runoff and increased pollution risk, are a key concern during construction and have the potential to affect abstractions and the water environment more generally. However, the practices outlined in the draft CoCP are considered adequate to mitigate any impacts, such that there are unlikely to be any significant effects.

15.4.22 The minor tributary of the River Lea that is within the area of the borrow pit is a moderate value receptor. This temporary diversion will be designed to provide a channel of equivalent capacity and hydromorphological value and as such the impacts should be minor, resulting in no significant effects.

Groundwater

Aquifers

15.4.23 The Whitmore Heath tunnel and Madeley tunnel will intersect the Sherwood Sandstone Group Principal aquifer, the Salop Formation Secondary A aquifer and the Glaciofluvial Deposits Secondary A aquifer. Any impact on groundwater levels and flow will be minor and localised and therefore also considered to be negligible in the context of the groundwater body as a whole and there will be no significant effect. Where cut and cover construction methods are used for a section of Whitmore Heath tunnel, implementation of the CoCP measures will ensure any impact on the aquifer will be negligible.

15.4.24 The cuttings in the Whitmore Heath to Madeley area will intersect the Sherwood Sandstone Principal aquifer, Halesowen Formation, Salop Formation and Glaciofluvial Deposits (Secondary A aquifers) and the Mercia Mudstone Secondary B aquifer. As with tunnels, whilst there may be minor localised impacts, the implementation of the measures in the draft CoCP means that there will be no significant effect. Where impacts of the tunnels and cuttings on the aquifers could affect additional local

receptors, which rely on the groundwater resource, e.g. springs and abstractions, the impacts on these are reported below.

15.4.25 The borrow pit west of Netherset Hey Farm will be excavated between an assumed average depth of 4.5m below ground level and a maximum depth of 18m below ground level (including topsoil and subsoil stripping). Groundwater levels are likely to be close to the surface in this area. Excavation and dewatering will result in a localised and controlled impact on groundwater flows and levels within the Glaciofluvial Deposits Secondary A aquifer. Where this could affect additional local receptors, which rely on this groundwater resource, the impacts on these are reported below.

Abstractions

15.4.26 The construction of cuttings, embankments, the Meece Brook viaduct and the A53 Newcastle Road overbridge, in the southern part of the Whitmore Heath to Madeley area, is in the vicinity of the licensed public groundwater supply abstraction near Whitmore. Given the extent of the proposed construction activity, there will be a temporary impact on this very high value receptor throughout the construction period. This would result in a major adverse effect, which would be significant.

Groundwater-surface water interactions

15.4.27 There remains the potential for baseflows in the River Lea, which is a high value receptor, to be affected while groundwater levels are lowered in the borrow pit. This has been identified as a potential moderate adverse effect, which would be significant, assuming excavation of the borrow pit to the assumed average borrow pit depth and additional mitigation may be required. There would be no new or different significant effects if the borrow pit is extracted to the maximum depth.

Temporary effects - Flood risk and land drainage

15.4.28 Construction of viaducts over Meece Brook and the River Lea and their associated floodplains will require temporary working within flood zones.

15.4.29 Construction sequencing and temporary works design will be carefully considered and assessed in terms of impacts on flood risk. These activities will be implemented in consultation with the Environment Agency. It is not anticipated that these temporary activities will result in significant effects related to flood risk and land drainage.

15.4.30 A section of embankment associated with the River Lea viaduct (Lea North embankment) will extend into the floodplain. The design has been developed in this area to include local mitigation measures, including the River Lea flood channels and River Lea flood culvert. Modelling work indicates that there is still a potential for increases in peak flood level of over 100mm to occur in a localised area of farmland downstream of the viaduct adjacent to the WCML. This comprises a major adverse impact on a moderate value receptor, which is significant.

Permanent effects – Water resources and WFD

15.4.31 Permanent effects are those initially caused by activity to construct the Proposed Scheme but which will also remain after the Proposed Scheme has been constructed and is present in the area.

Surface water

15.4.32 Implementation of the avoidance and mitigation measures described above will result in no significant permanent effects related to surface water resources and WFD.

Groundwater

Aquifers

15.4.33 Implementation of the avoidance and mitigation measures will ensure that there are no permanent significant effects related to the impact of the proposed cuttings on water levels and quality in the aquifers intercepted by the Proposed Scheme. Where the impacts of the cuttings on the aquifers could affect additional local receptors that rely on the groundwater resource, for example springs and abstractions. The impacts on these have been assessed below.

15.4.34 As part of the restoration plan for the borrow pit west of Netherset Hey Farm, drainage measures will be designed to control groundwater levels with no material loss of water to the superficial deposit aquifer system such that impacts should be minor, resulting in no significant effect.

Abstractions

15.4.35 On completion of construction, abstraction from the borehole cluster associated with the SPZ and public groundwater supply abstraction near Whitmore will be resumed. The permanent pollution risk posed by the Proposed Scheme has been assessed as negligible in a route-wide assessment in Volume 3, Route-wide effects, Water resources and flood risk (Section 16). The detailed design of, and maintenance regime for, the track and drainage measures within the SPZ associated with this supply will be developed in consultation with Severn Trent Water Limited and the Environment Agency, to ensure that the Proposed Scheme will not result in permanent significant adverse effects from operation of the Proposed Scheme.

15.4.36 An unlicensed private groundwater abstraction at Hey House Lodge will be directly overlain by the route of the Proposed Scheme. This abstraction currently supplies Hey House Lodge, which is scheduled for demolition. Therefore, although there will be permanent loss of this supply, the significance of the effect will be negligible (further detail provided in Volume 5: WR-002-004).

15.4.37 An unlicensed private groundwater supply to Hey House Farm, and an unlicensed private groundwater abstraction at Bower End Farm may be permanently affected by the Proposed Scheme. This will be discussed with the landowners concerned with a view to a permanent new supply being provided if necessary, such that there will be no significant effects.

Permanent effects - flood risk and land drainage

15.4.38 The design of all watercourse and surface water crossings within the study area, including the viaducts over the River Lea and Meece Brook, will ensure that the effects related to construction of the Proposed Scheme will not be significant in terms of flood risk and land drainage. This is reported in Volume 5: Appendix WR-003-004, Flood risk assessment.

15.4.39 The area of the borrow pit west of Netherset Hey Farm will be restored to its existing levels and land use. The reinstatement works will be designed to ensure that this land drains in a manner suitable for its continued use for agricultural production, resulting in no significant permanent effects.

Other mitigation measures

15.4.40 Mitigation options for the temporary impact on the licensed public groundwater abstraction near Whitmore, and its associated groundwater supply zone, are being discussed with the owner and the Environment Agency, with a view to ensuring a continuous, resilient water supply during the construction period. Such mitigation options may include the temporary suspension of abstraction at this location. Options to mitigate this temporary loss of water supply may include:

- increasing existing outputs of alternative potential water supplies, for example, by enhancing treatment of other supplies;
- importing water from another source unaffected by construction of the Proposed Scheme;
- provision of replacement borehole sources; and
- initiatives to reduce the quantity of water required, for example, reducing consumption in the zone.

15.4.41 Additional mitigation measures for the management of groundwater baseflow to the River Lea during the construction phase will be required. Mitigation measures will be designed in detail following ground investigation and monitoring of surface water and groundwater levels. Mitigation could take the form of:

- a wider buffer strip, or shallower batter on the excavations;
- installation of a groundwater cut-off;
- creation of a new lined channel and temporary diversion of the River Lea;
- adoption of wet working techniques that avoid the need for dewatering; or
- recirculation of treated water from the borrow pit back into the River Lea at an appropriate rate and location.

15.4.42 Any such additional measures will be designed in consultation with the Environment Agency.

15.4.43 As the hydraulic models are further developed and the detailed design refined, particular attention will be paid to the flood risk issues downstream of the River Lea viaduct. This work will be undertaken in close consultation with the Environment Agency and Network Rail. If any residual effects are identified, the affected landowners would also be consulted. The aim will be to ensure that no parties are affected by unacceptable increases in flood risk.

Summary of likely residual significant effects

15.4.44 In the absence of the other mitigation measures set out above, the Proposed Scheme has the potential to result in residual significant effects as follows:

- a major adverse temporary effect associated with impacts on the licensed public groundwater abstraction near Whitmore, which is significant; and
- a moderate adverse temporary effect on the River Lea due to impacts associated with dewatering of the borrow pit west of Netherset Hey Farm, which is significant.

15.4.45 It is currently anticipated that it should be possible to develop the means of mitigating these impacts, to ensure that there are no residual significant effects arising from construction of the Proposed Scheme. However, until a mitigation strategy is agreed with the Environment Agency in consultation with Severn Trent Water Limited, as described above, there is the potential for a significant effect related to the public water supply near Whitmore.

Cumulative effects

15.4.46 No significant cumulative temporary or permanent effects during construction with regard to water resources or flood risk are anticipated.

15.5 Effects arising from operation

Avoidance and mitigation measures

15.5.1 The principal issue of concern during operation of the Proposed Scheme is the potential for accidental spillages to occur that could result in the release of contaminants into the water environment. This issue has been assessed on a route-wide basis in Volume 3: Route-wide effects (Section 16), where the mitigation measures associated with this risk are described. A draft operation and maintenance plan for water resources and flood risk is provided in Volume 5: Appendix WR-005-000. Of specific concern in this study area is any risk posed by operation of the scheme to the public water supply abstraction near Whitmore. The detailed design of, and maintenance regime for, the track and drainage measures within the SPZ associated with the public water supply near Whitmore will be developed in close consultation with Severn Trent Water Limited and the Environment Agency to ensure that the operation of the Proposed Scheme does not result in significant effects.

15.5.2 The design takes into account the policies in the NPPF and will aim to ensure that the Proposed Scheme is safe from flooding without increasing flood risk elsewhere, as outlined in the flood risk assessment, Appendix WR-003-002. Evidence of application of the Sequential Test and Exception Tests in the NPPF is provided on a route-wide basis in Volume 3: Route-wide effects.

15.5.3 Sustainable drainage systems will be used where reasonably practicable. These will help to remove any suspended material within runoff from the Proposed Scheme through filtration, vegetative adsorption or settlement. The drainage systems proposed will aim to ensure that the quantity and quality of water draining from the Proposed Scheme during its operational phase will have a negligible impact on the water environment.

15.5.4 A route-wide WFD compliance assessment is provided in Volume 3: Route-wide effects. This describes the measures embedded into the design that are specifically

designed to ensure that the Proposed Scheme complies with the requirements of the WFD.

Assessment of impacts and effects

15.5.5 There are considered to be no significant adverse effects related to water resources and flood risk arising from operation of the Proposed Scheme.

Other mitigation measures

15.5.6 There are considered to be no further measures required to mitigate adverse effects on surface water resources, groundwater resources or flood risk.

Summary of likely residual significant effects

15.5.7 There will be no residual significant effects on surface water, groundwater or flood risk during operation of the Proposed Scheme.

Cumulative effects

15.5.8 A review of the committed developments within the study area has identified no potential for significant cumulative permanent effects in the study area.

Monitoring

15.5.9 Volume 1, Section 9 sets out the general approach to monitoring of water resources and flood risk during operation of the Proposed Scheme.

15.5.10 There are no area-specific requirements for monitoring water resources and flood risk during the operation of the Proposed Scheme.

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