

High Speed Rail (Crewe to Manchester and West Midlands to Leeds)

Working Draft Environmental Statement

Volume 2: Community Area report

LA13: Ravenfield to Clayton

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Department
for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

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A report prepared for High Speed Two (HS2) Limited:

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Preface

The working draft Environmental Statement

This report forms part of Volume 2 of the working draft Environmental Statement (ES) for Phase 2b of High Speed Two (HS2). The purpose of the working draft ES is to provide the public and other stakeholders with an opportunity to review and comment on preliminary environmental information for Phase 2b of HS2, which is based on a stage in the ongoing design development and environmental assessment process. Nothing included at this stage is intended to limit the form of the final scheme that will be presented in the hybrid Bill and formal ES in light of further scheme development and the ongoing discussions with stakeholders such as Transport for the North and Midlands Connect. Consultation on the working draft ES is being undertaken to help inform the ongoing design and environmental assessment in advance of producing a statutory formal ES. The formal ES will accompany the deposit of the hybrid Bill for Phase 2b of HS2.

Phase 2b comprises the section of the proposed HS2 rail network, from Crewe to Manchester (and a connection onto the West Coast Main Line (WCML)) (the western leg), and from the West Midlands to Leeds (and a connection onto, and part electrification of, the Midland Main Line (MML) and a connection onto the East Coast Main Line (ECML)) via the East Midlands and South Yorkshire (the eastern leg). Collectively, this is referred to in this working draft ES as the 'Proposed Scheme'. The working draft ES describes the Proposed Scheme and reports its likely significant environmental effects and the measures proposed to mitigate those effects, based on a stage in the ongoing design and environmental assessment.

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

The hybrid Bill for Phase 2a of the HS2 network, between the West Midlands and Crewe, was the subject of an ES deposited in July 2017, followed by a subsequent ES deposited with an Additional Provision to that Bill in March 2018. The Phase 2a Bill is expected to receive Royal Assent in 2019.

Consultation on the working draft Environmental Statement

The public has an opportunity to comment on this working draft ES. The period of public consultation is taking place during October 2018 – December 2018; the first day of the consultation period being the date the Secretary of State for Transport formally announces the consultation and the publication of the working draft ES documents on www.gov.uk/hs2.

Structure of the HS2 Phase 2b working draft Environmental Statement

This report forms part of Volume 2 of the working draft ES for Phase 2b of HS2. The working draft ES describes the design of the Proposed Scheme and reports the likely significant environmental effects of the construction and operation of the Proposed Scheme and proposed mitigation and monitoring measures, based on a stage in the ongoing design and environmental assessment process. The report will be updated for the formal ES to reflect further work on the design, assessment and mitigation and monitoring measures between now and when the hybrid Bill is deposited. The structure of the working draft ES is shown Figure 1.

This working draft ES has been prepared by persons who have sufficient expertise to ensure the completeness and technical quality of the statement.

The working draft ES comprises the following documents:

Non-technical summary

This provides a summary in non-technical language of the following, identified at a stage in the ongoing design and environmental assessment:

- the Proposed Scheme and the reasonable alternatives studied;
- the likely significant beneficial and adverse effects of the Proposed Scheme;
- the means to avoid 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 working draft ES.

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, based on a stage in the ongoing design;
- 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, based on a stage in the ongoing design; and

- a summary of the reasonable alternatives studied (including local alternatives studied prior to the Government's announcement of the preferred route in July 2017). Local alternatives studied post July 2017 are reported in the relevant Volume 2: Community area reports.

Volume 2: Community area reports and map books

These cover the following community areas:

- western leg: MA01 Hough to Walley's Green; MA02 Wimboldsley to Lostock Gralam; MA03 Pickmere to Agden and Hulseheath; MA04 Broomedge to Glazebrook; MA05 Risley to Bamfurlong; MA06 Hulseheath to Manchester Airport; MA07 Davenport Green to Ardwick; MA08 Manchester Piccadilly Station; and
- eastern leg: LA01 Lea Marston to Tamworth; LA02 Birchmoor to Austrey; LA03 Appleby Parva to Ashby-de-la-Zouch; LA04 Coleorton to Kegworth; LA05 Ratcliffe-on-Soar to Long Eaton; LA06 Stapleford to Nuthall; LA07 Hucknall to Selston; LA08 Pinxton to Newton and Huthwaite; LA09 Stonebroom to Clay Cross; LA10 Tibshelf to Shuttlewood; LA11 Staveley to Aston; LA12 Ulley to Bramley; LA13 Ravenfield to Clayton; LA14 South Kirkby to Sharlston Common; LA15 Warmfield to Swillington and Woodlesford; LA16 Garforth and Church Fenton; LA17 Stourton to Hunslet; and LA18 Leeds Station.

The reports provide the following information for each area, as identified at a stage in the ongoing design and environmental assessment:

- 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 considered since the Government's announcement of the preferred route in July 2017;
- a description of the environmental baseline;
- a description of the likely significant beneficial and adverse effects of the Proposed Scheme;
- the proposed means of avoiding, reducing or managing the likely significant adverse effects; and
- where possible, 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 a separate Volume 2: Community area map book. These maps include the location of the key environmental features (Map Series CT-10), key construction features (Map Series CT-05) and operation features (Map Series CT-06) of the Proposed Scheme. There are also specific maps showing proposed viewpoint and photomontage locations (Map Series LV-00, LV-02, LV-03, and LV-04, to be read in conjunction with Section 11, Landscape and visual of the Volume 2: Community area reports), operational sound contour maps (Map Series SV-01, to be read in conjunction with Section 13, Sound, noise and vibration of the Volume 2: Community area reports) and maps showing key surface water and groundwater features (Map Series WR-01 and WR-02, to be read in conjunction with Section 15, Water resources and flood risk of the Volume 2: Community area reports).

In addition to the community areas detailed above, reports are provided for community areas within which electrification of a section of the MML is proposed: MMLo1 Danesmoor to Brierley Bridge and MMLo2 Unstone Green to Sheffield Station. These reports are provided at an earlier stage of the design and environmental assessment process, following the amendment of the route of the Proposed Scheme to include the electrification of a section of the MML between Clay Cross and Sheffield Midland Station. This would enable high speed trains to connect to Chesterfield and Sheffield as part of the Proposed Scheme. They include for each area:

- an overview of the area;
- a description of the proposed works within the area, based on a stage in the ongoing design;
- an outline of potential effects; and
- an overview of stakeholder engagement and consultation to be carried out as part of the EIA process.

Mitigation measures have not been identified at this stage of the design and environmental assessment process in relation to the likely effects arising from construction and operation of the Proposed Scheme for the MMLo1 Danesmoor to Brierley Bridge and MMLo2 Unstone Green to Sheffield Station areas. Any required mitigation measures will be reported in the formal ES. In addition, any required environmental monitoring during operation of the Proposed Scheme will be reported in the formal ES.

Volume 3: Route-wide effects

This describes the effects that are likely to occur at a geographical scale greater than the community areas described in the Volume 2: Community area reports, based on a stage in the ongoing design and environmental assessment.

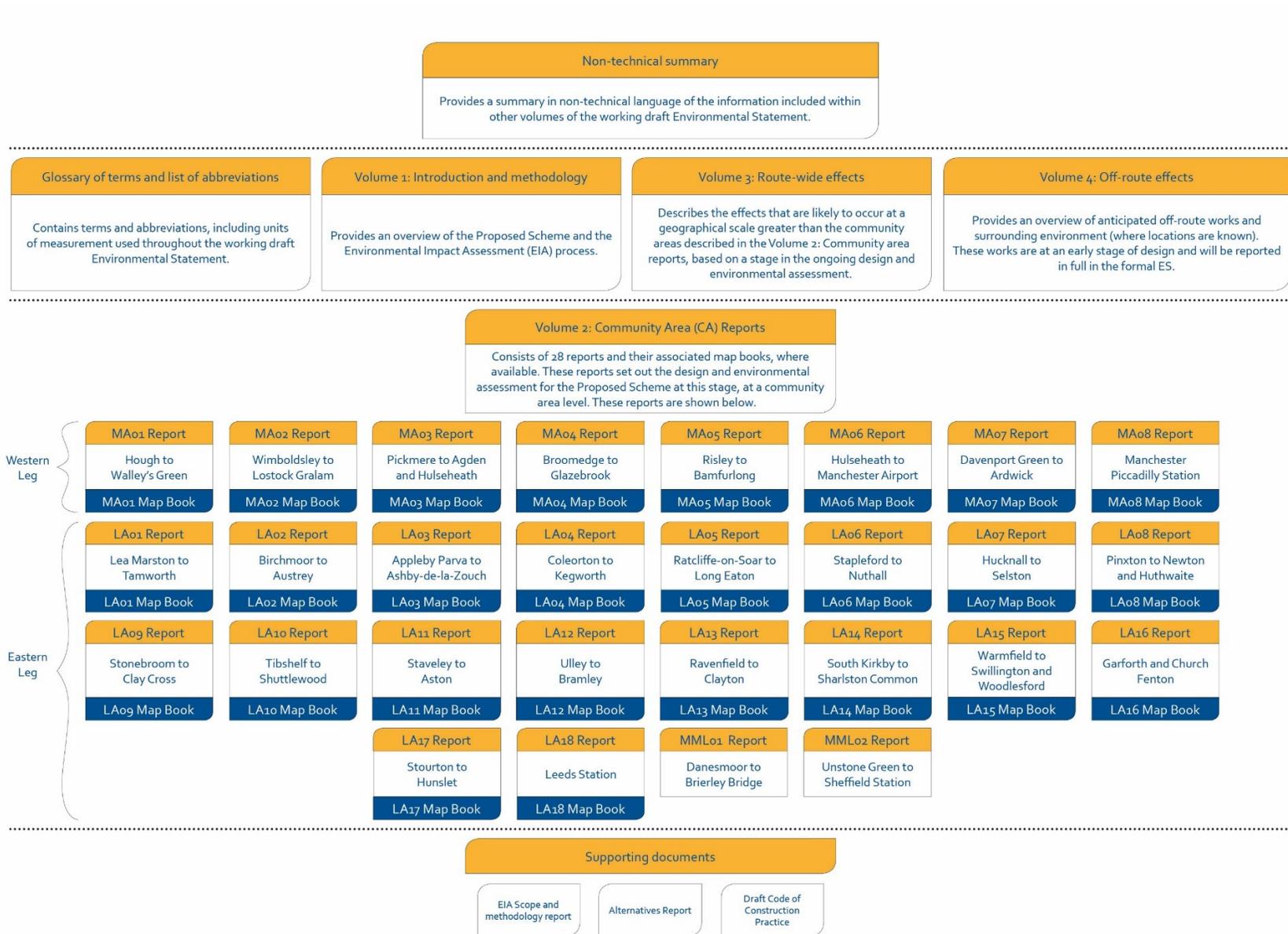
Volume 4: Off-route effects

This provides an overview of anticipated off-route works and surrounding environment (where locations are known). These works are at an early stage of design and will be reported in full in the formal ES.

Supporting documents

- EIA Scope and Methodology Report: this outlines the scope and methodology adopted for the EIA. HS2 Ltd consulted on a draft of the EIA Scope and Methodology Report (SMR) between July and September 2017. This updated version takes into consideration comments received, where appropriate, in addition to changes required as a result of updates to legislation or industry best practice guidance.
- Alternatives report: this describes the evolution of the Proposed Scheme and the reasonable alternatives considered at this stage of the design, at the strategic, route-wide, route corridor and local levels.
- Draft Code of Construction Practice (CoCP): this sets out measures and standards to provide effective planning, management and control of potential impacts on individuals, communities and the environment during construction.

Figure 1: Structure of the working draft Environmental Statement

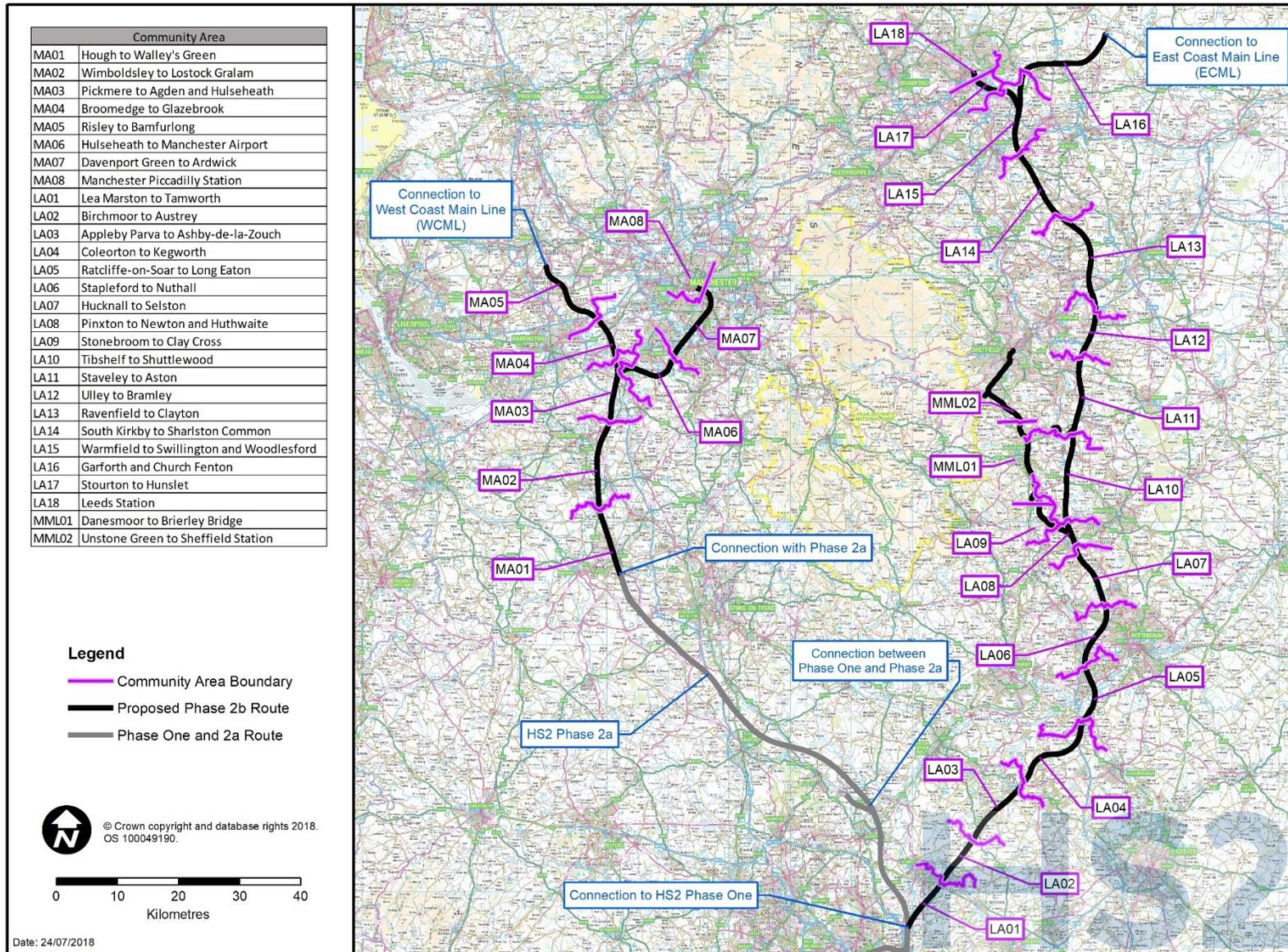


1. Introduction

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, East Midlands and South Yorkshire will be served by high speed trains running at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph)).
- 1.1.2 HS2 would be built in phases. Phase One comprises the first section of the HS2 network of approximately 230km (143 miles) between London and the West Midlands that would commence operations in 2026. It was the subject of an Environmental Statement (ES) deposited with the High Speed Rail (London - West Midlands) Bill in November 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 pre-construction work on Phase One commenced in 2017.
- 1.1.3 Phase Two of HS2 will extend the route from Phase One in the West Midlands to the north-west to Manchester (approximately 80km (50 miles) with connections to the West Coast Main Line (WCML) at Crewe and Golborne, and to the north-east to Leeds with a connection to the Erewash Valley Line and Midland Main Line (MML) south-east of Chesterfield and the East Coast Main Line (ECML) approaching York (approximately 198 km (123 miles)), completing what is known as the 'Y network'.
- 1.1.4 Phase Two of HS2 is being taken forward in two stages, referred to as Phase 2a and Phase 2b. Phase 2a of HS2 includes the section of the route between the West Midlands and Crewe. The High Speed Rail (West Midlands - Crewe) Bill, together with an ES, was prepared for the Phase 2a proposals and deposited in Parliament in July 2017. A subsequent ES was deposited with Additional Provisions to that Bill in March 2018.
- 1.1.5 Phase 2b (the Proposed Scheme), the subject of this working draft ES, comprises the route from Crewe to Manchester (and connections into the WCML) (referred to as the 'western leg'), and from the West Midlands to Leeds (and connections into the Midland Main Line (MML and the ECML)) via the East Midlands and South Yorkshire (referred to as 'the eastern leg'). The connection to and electrification of an approximately 30km (19 miles) section of the existing MML would enable high speed trains to connect to Chesterfield and Sheffield. Construction of the Proposed Scheme would commence in 2023, with operation planned to start in 2033.
- 1.1.6 For environmental assessment and community engagement purposes, the Proposed Scheme has been divided into 28 community areas (CA). These are shown in Figure 2. This CA report relates to the Ravenfield to Clayton area (CA number LA13) which is located on the eastern leg of the Proposed Scheme.

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



1.2 Purpose and status of this report

- 1.2.1 This working draft ES sets out the preliminary environmental information and the key features of a point-in-time design for the Proposed Scheme. It provides a description of the design of the Proposed Scheme, environmental baseline information, and the likely impacts (and where practicable, the significant effects) of the construction and operation of the Proposed Scheme on the environment within the Ravenfield to Clayton area. The report also describes the proposed mitigation measures that have been identified, at this stage, to avoid, reduce or manage the likely significant adverse effects of the Proposed Scheme on the environment within the area, along with proposed monitoring measures.
- 1.2.2 The design development and environmental assessment process is ongoing. Consultation on the working draft ES is being carried out to assist early engagement with those potentially affected by the Proposed Scheme and to help inform the design and assessment of the Proposed Scheme. Parliamentary Standing Orders do not require a working draft ES. Developing a working draft ES and consulting on it in advance of the formal ES means that consultees have the opportunity to comment on the Proposed Scheme earlier in the process.
- 1.2.3 As this is a working draft ES, where information is not available at this time, professional judgement and reasonable worst-case assumptions have been used to provide an indication of the likely impact to inform the consultation.
- 1.2.4 The likely significant environmental effects of the Proposed Scheme would be described in the formal ES to be deposited in accordance with the requirements of Parliamentary Standing Order 27A (SO27A)^{1,2}. It is possible that the effects and mitigation described in the formal ES may differ from those presented in this working draft ES, due to the provisional nature of the environmental and design information that is currently available and as a result of consultation on the Proposed Scheme, as appropriate.
- 1.2.5 The working draft ES has been undertaken on the assumption that the policies adopted for Phase One and Phase 2a will also apply to Phase 2b. The assessment also assumes that any general mitigation measures required as a result of those policies are implemented appropriately in the delivery and operation of the proposed Scheme. Where policies are referred to in this working draft ES it is on this basis.

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 considered;

¹ Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment), House of Commons
² House of Lords, 2005, Standing Orders of the House of Lords - Private Business, The Stationery Office

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- 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);
 - ecology and biodiversity (Section 7);
 - health (Section 8);
 - historic environment (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 (Sections 4 to 15) comprises:

- an introduction to the topic;
- a description of the existing environmental baseline within the community area;
- a description of the impacts or likely significant environmental effects identified to date arising during construction and operation of the Proposed Scheme; and
- a description of any proposed mitigation and monitoring measures that have been identified to date to address any significant adverse effects.

1.3.3 Environmental effects have been assessed in accordance with the methodology set out in Volume 1 and the EIA Scope and Methodology Report (SMR)³.

1.3.4 The maps relevant to the Ravenfield to Clayton area are provided in a separate corresponding document entitled Volume 2: LA13 Map Book, which should be read in conjunction with this report.

1.3.5 The Proposed Scheme described in this report is that shown on the Map Series CT-05 (construction) and CT-06 (operation) (Volume 2: LA13 Map Book). There is some flexibility during detailed design to alter the horizontal and vertical alignments and

³ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

other details within the limits shown on the plans and sections submitted to Parliament and as set out in the Bill, and this flexibility is included within the scope of the environmental assessment. Further explanation is provided in Volume 1, Section 1.

- 1.3.6 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.

2 Overview of the area and description of the Proposed Scheme

2.1 Overview of the area

General

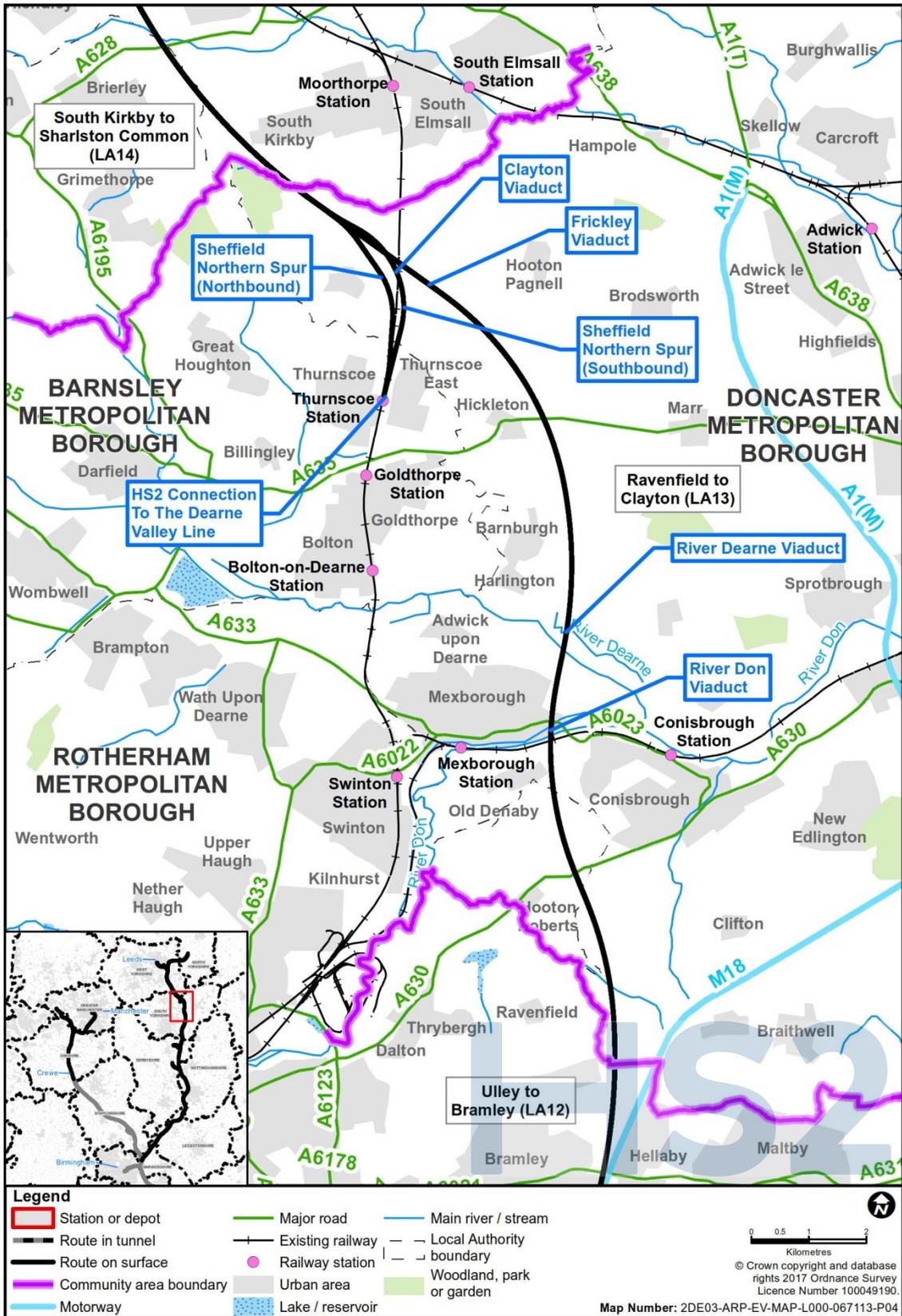
- 2.1.1 The Proposed Scheme through the Ravenfield to Clayton area (LA13) would be approximately 17.6km long, with an additional 6.7km long Sheffield Northern spur, and lies within the local authority areas of Rotherham Metropolitan Borough Council (RMBC), Doncaster Metropolitan Borough Council (DMBC) and Barnsley Metropolitan Borough Council (BMBC).
- 2.1.2 The Proposed Scheme would pass through the parishes of Braithwell, Ravenfield, Conisbrough Parks, Hooton Roberts, Denaby, Barnburgh, Hickleton, Hooton Pagnell, and Clayton with Frickley. The boundary between Ravenfield and Conisbrough Parks parish forms the southern boundary of this area, the boundary between Clayton with Frickley parish and South Kirkby and Moorthorpe parish forms the northern extent of this area.
- 2.1.3 As shown in Figure 3, the Ulley to Bramley area (LA12) lies to the south, and the South Kirkby to Sharlston Common area (LA14) lies to the north of the Ravenfield to Clayton area.

Settlement, land use and topography

- 2.1.4 The Ravenfield to Clayton area is predominantly rural in character, with agriculture being the main land use interspersed with towns, villages and farmsteads. The main residential areas are the towns of Conisbrough, Mexborough, and Thurnscoe. Within the wider rural area there are a number of villages and hamlets including, Ravenfield, Hooton Roberts, Old Denaby, Denaby Main, Harlington, High Melton, Barnburgh, Hickleton, Clayton, and Hooton Pagnell.
- 2.1.5 Land use within the Ravenfield to Clayton area is characterised by farmland, both arable and pasture, with areas of parkland and woodland, industrial estates, and historic coal mining and landfill areas.
- 2.1.6 At the southern end of this area, the route of the Proposed Scheme would pass to the east of Ravenfield, through the open countryside of Conisbrough Parks, before passing into the urban area of Mexborough, crossing the River Don. North of Mexborough, the route crosses the River Dearne valley and continues to the north-west, where the topography rises towards the settlements of Barnburgh, Hickleton and Clayton and south of South Kirkby.
- 2.1.7 The topography of the Ravenfield to Clayton area is undulating with the highest point located to the north of Hickleton (approximately 115m above Ordnance Datum (AOD)).

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Figure 3: Community area context map



Key transport infrastructure

- 2.1.1.8 The M18 and the A1(M) pass through the Ravenfield to Clayton area. The A630 Doncaster Road, the A6023 Doncaster Road, and the A635 Barnsley Road also pass through the area, providing links to the wider transport network. Local roads include Common Lane, Park Lane, Firsby Lane, Denaby Lane, Pastures Road; Grange Lane, Ludwell Hill, St Helen's Lane, Red Hill Lane, Church Field Road, and Top Lane.
- 2.1.1.9 The Ravenfield to Clayton area is crossed by the Sheffield to Doncaster Railway, and the Dearne Valley Line. Rail services are accessible at Mexborough and Thurnscoe stations. The Ravenfield to Clayton area has several bus routes.
- 2.1.1.10 There is one navigable waterway in this area, the Sheffield and South Yorkshire Navigation.
- 2.1.1.11 The route would cross several public rights of way (PRoW), including the promoted Trans Pennine Trail, Dearne Way and Wild Yorkshire Way, local access roads, bridleways and public footpaths, which provide links between scattered dwellings and surrounding villages.

Socio-economic profile

- 2.1.1.12 Within the RMBC area construction accounts for the largest proportion of businesses (14%) followed by retail (11%) and professional, scientific and technical (10%). In the DMBC area, the business administration and support services sector accounts for the largest proportion of businesses (14%) followed by construction (12%) and retail (11%)⁴.
- 2.1.1.13 The 2016 Annual Population Survey⁵ (2016) identifies the employment rate⁶ within the RMBC and DMBC was 67% (106,000 people) and 72% (134,000 people) respectively. In 2016, the unemployment rate within the RMBC and DMBC was 7% and 6% respectively.
- 2.1.1.14 According to the Annual Population Survey⁷, 25% of RMBC and DMBC residents aged 16-64 were qualified to National Vocational Qualification Level 4 and above, whilst 12% of RMBC and 8% of DMBC residents had no qualifications.

Notable community facilities

- 2.1.1.15 The Ravenfield to Clayton area is predominantly agricultural land and rural in character, with the main concentrations of regional community facilities located in Doncaster and Rotherham, and locally in the towns of Mexborough and Conisbrough.
- 2.1.1.16 Mexborough is a town with community facilities including a hospital, five primary schools, an academy school, places of worship, shops, library, post office and community centres.

⁴ Office for National Statistics, (2017), *UK Business Count-Local Units 2017*. Available online at <https://www.nomisweb.co.uk>

⁵ Office for National Statistics, (2016), *Annual Population Survey 2016*, NOMIS. Available online at <https://www.nomisweb.co.uk>.

⁶ The proportion of working age (16-64 year olds) residents that is in employment.

⁷ Office for National Statistics, (2016), *Annual Population Survey 2016*, NOMIS. Available online at <https://www.nomisweb.co.uk>.

- 2.1.17 Conisbrough is a town with community facilities including six primary schools, one academy school, places of worship, shops, health centre, and a library.
- 2.1.18 There are also a number of villages and hamlets in the area, such as Ravenfield, Hooton Roberts, Old Denaby, Denaby Main, Harlington, Barnburgh, Hickleton, Marr, Thurnscoe, Hooton Pagnell, and Clayton, which provide a smaller number of local services. Outside of the main settlements the area is characterised by clusters of dwellings within rural areas.

Recreation, leisure and open space

- 2.1.19 The Ravenfield to Clayton area is predominantly rural, with open space and agricultural land. The urban settlements of Conisbrough and Mexborough are located in the central part of the Ravenfield to Clayton area. The area is crossed by several PRoW including the promoted Dearne Way, Barnsley Boundary Walk, and Trans Pennine Trail, as well as the towpath of the Sheffield and South Yorkshire Navigation at Mexborough.
- 2.1.20 There are recreational and amenity green spaces at Ravenfield Ponds, Thryberg Reservoir, Firsby Reservoir Local Nature Reserve (LNR), Old Denaby LNR, Denaby Woods, and Howell Wood Country Park. There are a number of golf courses in the Ravenfield to Clayton area, including those at Crookhill Park Golf Course, High Melton Golf Course and Hickleton Golf Course. There are also play areas such as one off Pitman Road in Denaby Main.
- 2.1.21 Recreational and leisure facilities in Mexborough include Mexborough Castle, Dearne Valley Leisure Centre, Denaby Ings nature reserve, allotments, Avago Karting circuit, Mexborough Athletic Sports Club and Clayfield amenity green space.
- 2.1.22 Recreational and leisure facilities in Conisbrough include Conisbrough Castle, the Miners' Welfare Recreation Ground, Minney Moor Recreation Ground, Conisbrough Community Centre and North Cliff Park.
- 2.1.23 There is amenity open space at Melton Wood Country Park and Scables Wood at Barnburgh Cliff. There are fisheries located at Hickleton and Barnburgh.

Policy and planning context

Planning framework

- 2.1.24 Volume 1 provides an overview of the policy case for HS2. Relevant development plan documents and policies have been considered in relation to environmental topics, as part of considering the Proposed Scheme in the local context.
- 2.1.25 The following local policies have been considered and referred to where appropriate to the assessment:
- Barnsley Core Strategy (2011)⁸;

⁸ Barnsley Metropolitan Borough Council, (2011), *Barnsley Core Strategy*. Available online at: <https://www.barnsley.gov.uk/media/3093/core-strategy.pdf>

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- saved policies of the Barnsley Unitary Development Plan (2000)⁹;
- Barnsley, Doncaster and Rotherham Joint Waste Plan (2012)¹⁰;
- Barnsley Education Sites Development Plan Document (2009)¹¹;
- Rotherham Core Strategy (2014)¹²;
- saved policies of the Rotherham Unitary Development Plan: Written Statement and Proposals Map (1999)¹³;
- Doncaster Local Development Framework Core Strategy 2011-2028 (2012)¹⁴;
- saved policies of the Doncaster Unitary Development Plan and Proposals Map (2007)¹⁵; and
- the Sheffield City Region Transport Strategy and Implementation Plan (2011)¹⁶.

Committed development

- 2.1.26 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.
- 2.1.27 Where it is likely that committed developments would have been completed by 2023, these would be identified as 'future baseline' schemes and taken into account in the formal ES.
- 2.1.28 Where there are committed developments that are considered likely to be constructed between 2023 and 2033, i.e. at the same time as the Proposed Scheme, they would be considered as receptors for the operation of HS2, but also potentially to give rise to cumulative impacts with the Proposed Scheme during construction. Any cumulative impacts and likely significant effects will be reported in the formal ES.
- 2.1.29 Planning applications yet to be determined at the time of the formal ES 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 will not be included in the assessment in the formal ES.

⁹ Barnsley Metropolitan Borough Council, (2000), *Saved policies of the Barnsley Unitary Development Plan*. Available online at: <https://www.barnsley.gov.uk/services/planning-and-buildings/local-planning-and-development/our-current-statutory-development-plan/the-unitary-development-plan/>

¹⁰ Barnsley Metropolitan Borough Council, (2012), *Barnsley, Doncaster and Rotherham Joint Waste Plan*. Available online at: <https://www.barnsley.gov.uk/media/3096/adopted-barnsley-doncaster-and-rotherham-joint-waste-plan.pdf>

¹¹ Barnsley Metropolitan Borough Council, (2009), *Barnsley Education Sites Development Plan Document*. Available online at: <https://www.barnsley.gov.uk/media/4070/education-sites-dpd-adoption-version.pdf>

¹² Rotherham Metropolitan Borough Council, (2014), *Rotherham Core Strategy*. Available online at: http://www.rotherham.gov.uk/downloads/200074/planning_and_regeneration

¹³ Rotherham Metropolitan Borough Council, (1999), *Saved Policies of the Rotherham Unitary Development Plan*. Available online at: http://www.rotherham.gov.uk/corestrategyexamination/info/2/core_strategy_examination/6/unitary_development_plan

¹⁴ Doncaster Metropolitan Borough Council, (2012), *Doncaster Local Development Framework Core Strategy 2011-2028*. Available online at: <http://www.doncaster.gov.uk/services/planning/ldf-core-strategy-development-plan-document-dpd>

¹⁵ Doncaster Metropolitan Borough Council, (2007), *Doncaster Unitary Development Plan and Proposals Map*. Available online at: <http://www.doncaster.gov.uk/services/planning/doncaster-unitary-development-plan>

¹⁶ Sheffield City Region (2011), *Sheffield City Region Transport Strategy (2011-2026)*. Available online at: <http://www.syltp.org.uk/strategy.aspx>

Ongoing design development

- 2.1.1.30 Design development continues on this section of route as further engineering and environmental baseline is collated, including from field surveys, and as part of ongoing consultation and stakeholder engagement. Any further changes resulting from this would be reported in the formal ES. The main areas of design development being considered include:
- review of the proposed lengths and heights of viaducts and other river crossing structures and associated replacement floodplain storage area;
 - identification of temporary and permanent utility diversions;
 - refinement of the design for the Sheffield Northern spur;
 - refinement of the realignment of roads and PRow crossing the Proposed Scheme;
 - refinement of drainage features required for rail and modified highways;
 - refinement of maintenance access routes and access to balancing ponds;
 - additional environmental features required to mitigate likely significant environmental effects;
 - identification of accommodation works and crossings to provide for private means of access;
 - refinement of construction compound locations and site haul routes; and
 - refinement of auto-transformer station and mid-point auto-transformer feeder station locations.

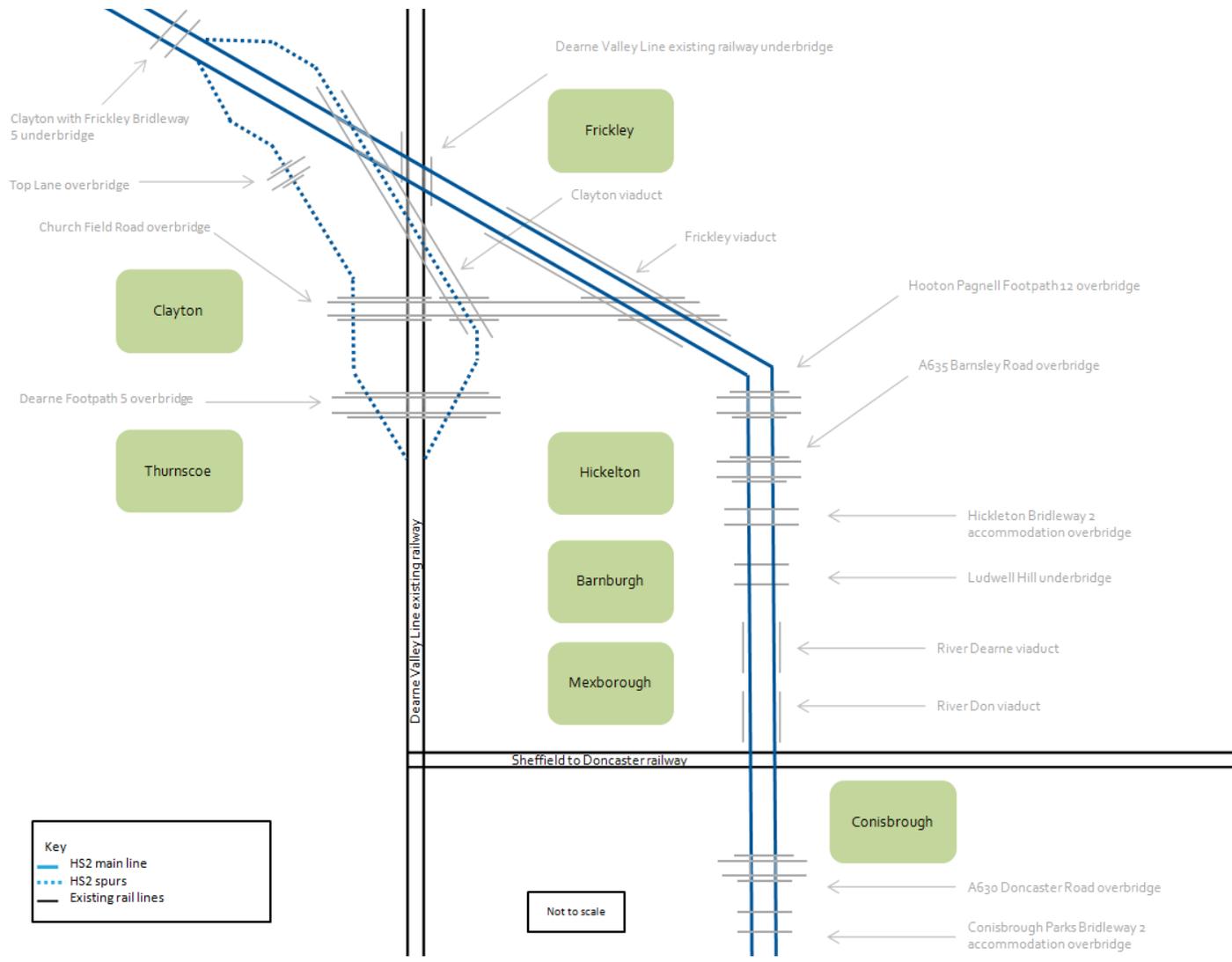
2.2 Description of the Proposed Scheme

- 2.2.1 The following section describes the main features of the Proposed Scheme in the Ravenfield to Clayton area, including the proposed environmental mitigation measures that have been identified to date. Further general information on typical permanent features is provided in Volume 1, Section 5. Similarly, a general description of the approach to mitigation is explained in Volume 1, Section 9.
- 2.2.2 Land required for operation of the Proposed Scheme is described in this section and is shown on Volume 2: Map Series CT-06. Land also required for construction is described in Section 2.3 and shown on Volume 2: Map Series CT-05.
- 2.2.3 In general, features are described from south to north along the route, and east to west for features that cross the Proposed Scheme.
- 2.2.4 All dimensions in the sections below are approximate.

Overview

- 2.2.5 The route of the Proposed Scheme through the Ravenfield to Clayton area would be approximately 17.6km in length. The route would extend from the north-east of Bramley, travels northwards past Conisbrough and Mexborough and past to the east of Hickleton to the boundary with the South Kirkby to Sharlston Common area (LA14) to the south-west of South Kirkby.
- 2.2.6 The Sheffield Northern spur would comprise an additional approximately 6.7km section, which would connect the HS2 main line to the Dearne Valley Line existing railway towards Sheffield. The spur is comprised of the northbound section (3.2km) and the southbound section (3.5km).
- 2.2.7 The Proposed Scheme within the Ravenfield to Clayton area has two main components (as illustrated on Figure 4):
- the HS2 main line (17.6km in length): the route of the Proposed Scheme, from the northern boundary of the Ulley to Bramley area (LA12) and continuing northwards towards Clayton, and the South Kirkby to Sharlston Common area (LA14); and
 - the Sheffield Northern spur (6.7km in length): a spur that would provide a link between the HS2 main line and the Dearne Valley Line existing railway.
- 2.2.8 To facilitate the connection of the Proposed Scheme to the Dearne Valley Line existing railway, modifications would be required to the existing conventional rail infrastructure in the South Yorkshire area. These modifications would include electrification and re-signalling works and would be managed from construction compounds as shown on maps CT-05-476 and CT-05-476-L1 in the Volume 2: LA13 Map Book. Further details of the modifications will be provided in the formal ES. This section of the route is illustrated on maps CT-06-476-L5 to CT-06-476-R2 in the Volume 2: LA13 Map Book.
- 2.2.9 Each of the main line components and their key features are set out in the following sections. Where key features are associated with more than one component of the Proposed Scheme, they are described within the section they are first associated with. Where reference is made to the Proposed Scheme, this includes the two components collectively. This section of route is illustrated on maps CT-06-466b to CT-06-478a in the Volume 2: LA13 Map Book.

Figure 4: Key permanent features of route of the Proposed Scheme in the Ravenfield to Clayton area



HS2 main line

2.2.10 In the Ravenfield to Clayton area, the HS2 main line would be carried on the following features:

- viaducts for a total length of 2.4km (River Don, River Dearne and Frickley viaducts);
- cuttings for a total length of 8.2km (Bramley North, Ravenfield, Hooton Roberts, Old Denaby, Mexborough, Hickleton and Clayton cuttings); and
- embankments for a total length of 7km (Ravenfield, Conisbrough Parks, Hooton Roberts, Old Denaby, Mexborough, Barnburgh, Thurnscoe, Clayton South and Clayton North, embankments).

2.2.11 The HS2 main line is described in four separate sections below.

Bramley North cutting to Hooton Roberts embankment

2.2.12 The route of the Proposed Scheme (HS2 main line) would continue from the Ulley to Bramley area (LA12) north towards the Ravenfield to Clayton area in the Bramley North cutting. It would continue northwards onto Ravenfield embankment, into Ravenfield cutting, onto Conisbrough Parks embankment, into Hooton Roberts cutting, and onto the Hooton Roberts embankment.

2.2.13 This section of route is illustrated on maps CT-06-466b to CT-06-469 in the Volume 2: LA13 Map Book.

2.2.14 Key features of this 4.5km section would include:

- a section of Bramley North cutting, 1.3km in length, up to 14m in depth and 95m in width, continuing from the Ulley to Bramley area (LA12) (see Volume 2: Map CT-06-466b, E5 to Map CT-06-467, D6);
- an area of landscape mitigation planting to the west of the section of Bramley South cutting in this area, to help integrate the Proposed Scheme into the surrounding landscape and provide visual screening for properties in Ravenfield (see Volume 2: Map CT-06-466b, E4 to G5);
- Braithwell Common drop inlet culvert¹⁷, 470m north of Common Lane, for the diversion of surface water drainage under the route of the Proposed Scheme. Access would be provided from Common Lane to the south of the Proposed Scheme (see Volume 2: Map CT-06-466b, G4 and G5);
- areas of woodland habitat creation on the western side of the Bramley North cutting to provide replacement habitat (see Volume 2: Map CT-06-466b, G4 to G5, and I4 to I5);
- Ravenfield culvert, 830m north of Common Lane, to carry an unnamed

¹⁷ A drop inlet culvert comprises a circular pipe or rectangular box culvert, usually with an inlet weir and open stepped 'cascade' on the upstream side to dissipate energy. Drop inlet culverts are used when a watercourse (or dry valley) crosses the route or road in cutting or close to existing ground level.

watercourse under the HS2 main line (see Volume 2: Map CT-06-466b, I5);

- an area of landscape mitigation planting, to the west of the Bramley North cutting, to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-467, B6 to D7);
- an ecological mitigation pond, to the east of the route of the Proposed Scheme, immediately east of the Ravenfield culvert, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-466b, I5);
- an ecological mitigation pond, to the east of the route of the Proposed Scheme, north-west of Birk Lodge Farm, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-467, D6 to D7);
- Ravenfield embankment, 538m in length and up to 18m in height, with landscape earthworks and landscape mitigation planting on both sides, to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-467, D5 to G6);
- Firsby Brook culvert, 230m south-east of Firsby Reservoir, to carry Firsby Brook under the HS2 main line (see Volume 2: Map CT-06-467, D5 to E6);
- an ecological mitigation pond, to the west of the route of the Proposed Scheme, south-east of Firsby Hall Farm, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-467, F4 to F5);
- Ravenfield cutting, 284m in length, up to 11m in depth and 77m in width, with an area of woodland habitat creation to the west to provide visual screening to Firsby Hall Farm and help integrate the Proposed Scheme with the surrounding landscape (see Volume 2: Map CT-06-467, G5 to H6);
- diversion of Conisbrough Parks Bridleway 14, 530m north of its existing alignment for 1.1km, crossing the HS2 main line via the Conisbrough Parks Bridleway 2 accommodation underbridge (see Volume 2: Map CT-06-467, G5 to I6);
- Conisbrough Parks embankment, 576m in length and up to 10m in height, with landscape earthworks and landscape mitigation planting on both sides, to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-467, H5 to Map CT-06-468, C6);
- Conisbrough Parks culvert, 400m north-east of Firsby Hall Farm, to carry an unnamed watercourse under the HS2 main line (see Volume 2: Map CT-06-467, I5 to I6);
- realignment of Conisbrough Parks Footpath 3, 80m to the south of its existing alignment for 270m, crossing the HS2 main line via the Conisbrough Parks Bridleway 2 accommodation underbridge (see Volume 2: CT-06-467, I5 to Map CT-06-468, B6);
- Conisbrough Parks Bridleway 2 accommodation underbridge, 13m in length. The underbridge would provide accommodation access for Firsby Hall Farm

across the HS2 main line (see Volume 2: Map CT-06-467, I5);

- diversion of Conisbrough Parks Bridleway 2, 900m south of its existing alignment for 1.4km, crossing the HS2 main line via the Conisbrough Parks Bridleway 2 accommodation underbridge (see Volume 2: Map CT-06-467, I2 to I6, and Map CT-06-468, B6 to F6);
- a balancing pond for railway drainage from the HS2 main line, 340m north-west of Firsby Hall Farm. Access would be provided via the diverted Conisbrough Parks Bridleway 2 from Firsby Lane (see Volume 2: Map CT-06-468, B4 to B5);
- Hooton Roberts cutting, 932m in length, up to 17m in depth and 150m in width, with areas of woodland habitat creation adjacent to the eastern and western sides, to provide replacement habitat, help integrate the Proposed Scheme into the surrounding landscape and provide visual screening for properties south of the A630 Doncaster Road/Sheffield Road (see Volume 2: Map CT-06-468, C6 to H5);
- A630 Doncaster Road overbridge, 115m in length, crossing the HS2 main line at existing ground level on the existing alignment of Doncaster Road, and 11m above track level (see Volume 2: Map CT-06-468, G5 to G6);
- Hooton Roberts embankment, 909m in length and up to 22m in height, with landscape earthworks and landscape mitigation planting on both sides to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-468, H5 to Map CT-06-469, E6);
- an area of woodland habitat creation to the west of the route of the Proposed Scheme, to provide habitat connectivity (see Volume 2: Map CT-06-468, H5 to I5);
- Crooked Lane South culvert, 480m north of A630 Doncaster Road, to carry an unnamed watercourse under the HS2 main line (see Volume 2: Map CT-06-469, B5 to B7); and
- Crooked Lane North culvert, 750m north of A630 Doncaster Road, to carry an unnamed watercourse under the HS2 main line (see Volume 2: Map CT-06-469, C5 to C7).

2.2.15 There would also be maintenance access routes and hedgerow planting throughout this section. There would also be 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 would be managed from the Bramley North cutting satellite compound and Common Lane overbridge satellite compound, both located in the Ulley to Bramley area (LA12), and Hooton Roberts cutting main compound, which are described in Section 2.3, and shown on map CT-05-468, Volume 2: LA13 Map Book.

Old Denaby cutting to Barnburgh embankment

- 2.2.17 The HS2 main line would continue from the Hooton Roberts embankment into the Old Denaby cutting. The HS2 main line would continue north on to the Old Denaby embankment before crossing the River Don on the River Don viaduct. The HS2 main line would continue through Mexborough cutting and onto Mexborough embankment before crossing the River Dearne via the River Dearne viaduct. The HS2 main line would continue on to Barnburgh embankment to the north.
- 2.2.18 This section of route is illustrated on maps CT-06-469 to CT-06-473 in the Volume 2: LA13 Map Book.
- 2.2.19 Key features of this 5.6km section would include:
- Denaby Main auto-transformer station, 49m by 24m, 880m south-east of Old Denaby on the western side of HS2 main line. Access would be provided from Denaby Lane to the north (see Volume 2: Map CT-06-469, E5);
 - an ecological mitigation pond, to the east of the route of the Proposed Scheme, south of Denaby Main, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-469, E6 to E7);
 - Old Denaby cutting, 917m in length, up to 9m in depth and 65m in width. A noise fence barrier would be located at the base of the cutting west of the route of the Proposed Scheme, 240m in length and up to 3m in height above rail, to provide acoustic screening for properties in Old Denaby (see Volume 2: Map CT-06-469, E6 to Map CT-06-470, B6);
 - an area of landscape mitigation planting, to the east of the HS2 main line, adjacent to Old Road and Hill Top Road to provide screening for properties on Old Road and Hill Top Road (see Volume 2: Map CT-06-469-R1, A4 to E5);
 - diversion of Conisbrough Footpath 3, 700m north of its existing alignment for 1.7km, crossing under the River Don viaduct via Denaby Lane and Coalpit Road, (see Volume 2: Map CT-06-469, G6 to J5 to Map CT-06-470, C5);
 - an area of woodland habitat creation to the east side of Old Denaby cutting, to provide replacement habitat (see Volume 2: Map CT-06-469, G6 to H7);
 - Denaby Wood South inverted siphon, 560m south of Denaby Lane, to carry an unnamed watercourse under the HS2 main line. Access to the inverted siphon on both sides of the HS2 main line would be provided via access roads from Denaby Lane and Eland Road via the diverted Conisbrough Footpath 3, with turning heads to facilitate vehicular access (see Volume 2: Map CT-06-469, H5 to H6);
 - Denaby Wood North inverted siphon, 300m south of Denaby Lane, to carry an unnamed watercourse under the HS2 main line. Access to the inverted siphon on both sides of the HS2 main line would be shared with that for Denaby Wood South inverted siphon (see Volume 2: Map CT-06-469, I6);
 - a replacement floodplain storage area on the western side of the HS2 main

line, adjacent to the Old Denaby cutting. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-470, B5);

- Old Denaby embankment, 59m in length, and up to 20m in height, with landscape mitigation planting on the western side to help integrate the Proposed Scheme into the surrounding landscape and provide visual screening for properties on Denaby Lane and Old Denaby. A noise fence barrier would be located west of the route of the Proposed Scheme, 60m in length and up to 3m in height above rail, to provide acoustic screening for properties in Old Denaby (see Volume 2: Map CT-06-470, B5 to C6);
- River Don viaduct, 803m in length and up to 19m in height above existing ground level, crossing over Denaby Lane, Sheffield to Doncaster Railway, the River Don, the Sheffield and South Yorkshire Navigation, the A6023 Doncaster Road and Pastures Road. A noise fence barrier would be located west of the route of the Proposed Scheme, 800m in length and up to 3m in height, and a noise fence barrier, east of the route of the Proposed Scheme, 510m in length and up to 3m in height, to provide acoustic screening for properties in Mexborough and Denaby Main (see Volume 2: Map CT-06-470, C6 to G6);
- an area of landscape mitigation planting to the east of the HS2 main line on the southern end of River Don viaduct, to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-470, C6);
- a replacement floodplain storage area on the eastern side of the HS2 main line, adjacent to the River Don viaduct. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-470, C6 to D8);
- diversion of Conisbrough Footpath 1, 30m to the south-east of its existing alignment for 290m, crossing the HS2 main line via Denaby Lane under River Don viaduct (see Volume 2: Map CT-06-470, C6 to D7);
- a balancing pond for railway drainage to the east of the HS2 main line. Access would be provided from Denaby Lane (see Volume 2: Map CT-06-470, C6 to D7);
- an area of landscape mitigation planting on River Don viaduct, north of the Sheffield and South Yorkshire Navigation, to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-470, E4 to F5);
- a replacement floodplain storage area on the eastern side of River Don viaduct, south of the Sheffield and South Yorkshire Navigation. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-470-R1, F3 to F5);
- Mexborough cutting, 538m in length, up to 7m in depth and 60m in width, with associated landscape mitigation planting on both sides, to help integrate the Proposed Scheme into the surrounding landscape and provide visual screening

for properties at Pastures Court, Clayfield Avenue, Mallory Drive, Oulton Rise, and Pastures Road. Noise fence barriers, up to 4m in height above rail, would be located at the bottom of the cutting and continue on both sides of the route of the Proposed Scheme from the River Don viaduct, to provide acoustic screening for properties in Mexborough (see Volume 2: Map CT-06-470, G6 to I6);

- Mexborough embankment, 343m in length and up to 12m in height, with associated landscape earthworks on the western side, and landscape mitigation planting on both sides to help integrate the Proposed Scheme into the surrounding landscape. Noise fence barriers, on both sides of the route of the Proposed Scheme, up to 4m in height above rail, would continue from the Mexborough cutting to provide acoustic screening for properties in Mexborough (see Volume 2: Map CT-06-471, B4 to D4);
- an area of landscape mitigation planting on the western side of Mexborough embankment, to help integrate the Proposed Scheme into the surrounding landscape and provide visual screening for properties at Mallory Drive, Oulton Rise, and Ullswater Road (see Volume 2: Map CT-06-471, C1 to B4 and Map CT-06-471-L1, C4 to C4);
- River Dearne viaduct, 933m in length and up to 14m in height crossing over the River Dearne and Trans Pennine Trail (see Volume 2: Map CT-06-471, C4 to H4);
- realignment of Mexborough Footpath 9, 20m to the west of its existing alignment for 50m, west of the HS2 main line (see Volume 2: Map CT-06-471, C4);
- a replacement floodplain storage area on the eastern side of the River Dearne viaduct, south of the River Dearne. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-471, B8 to D6);
- a balancing pond for railway drainage to the east of River Dearne viaduct, 360m south of the River Dearne. Access would be provided from Pastures Road (see Volume 2: Map CT-06-471, C5);
- realignment of an unnamed watercourse, 55m to the south-west of its existing alignment for 195m, crossing the HS2 main line under the River Dearne viaduct (see Volume 2: Map CT-06-471, E4 to E5);
- an ecological mitigation pond, to the west of the route of the Proposed Scheme, immediately west of the River Dearne viaduct to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-471, F4);
- a replacement floodplain storage area on the east side of the HS2 main line, 270m east of the River Dearne viaduct. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-471, F8 to G6);

- a balancing pond for railway drainage on to the eastern side of the HS2 main line, 25m east of the River Dearne viaduct. Access would be provided from Melton Mill Lane from the east (see Volume 2: Map CT-06-471, H4 to H5);
- Barnburgh embankment, 2km in length and up to 24m in height, with landscape earthworks on the eastern side, and landscape mitigation planting on both sides to help integrate the route of the Proposed Scheme into the surrounding landscape. A noise fence barrier would be located west of the route of the Proposed Scheme, 1.9km in length and up to 2m in height, to provide acoustic screening for properties in Harlington and Barnburgh (see Volume 2: Map CT-06-471, H4 to I4 and Map CT-06-473, C5);
- Oowler Carr culvert, 270m north-west of Barnburgh Grange, for the diversion of an unnamed watercourse under the route of the Proposed Scheme (see Volume 2: Map CT-06-471, I4 to I5);
- Ludwell Hill underbridge, 50m in length and up to 10m above existing ground level, to cross over Ludwell Hill (see Volume 2: Map CT-06-472, D7 to E4);
- St Helen's Spring culvert, 115m north of Ludwell Hill underbridge, to carry St Helen's Spring under the HS2 main line (see Volume 2: Map CT-06-472, E5 to E7);
- diversion of Barnburgh Bridleway 4 (St Helen's Lane), 570m to the south of its existing alignment for 690m at Ludwell Hill (see Volume 2: Map CT-06-472, D7 to G7);
- Harlington auto-transformer station, 49m by 24m, 420m north of Ludwell Hill on the eastern side of the Barnburgh embankment. Access would be provided via Barnburgh Bridleway 4 diversion (see Volume 2: Map CT-06-472, F6);
- an area of woodland habitat creation to the west of the HS2 main line to provide replacement habitat (see Volume 2: Map CT-06-472, F5 to I4 and Map CT-06-473, B4 to C5);
- areas of landscape mitigation planting, to the east of the HS2 main line the Barnburgh Bridleway 4 diversion, to help integrate the Proposed Scheme into the surrounding landscape and to provide visual screening for St Helen's Chapel scheduled monument (see Volume 2: Map CT-06-472, F7 to G9);
- a balancing pond for railway drainage on the east side of the HS2 main line, adjacent to the Barnburgh embankment. Access would be provided from Ludwell Hill (see Volume 2: Map CT-06-472, H7 to H8);
- realignment of Barnburgh Footpath 7, 55m to the north-east of its existing alignment for 210m (see Volume 2: Map CT-06-472, I7 to H8);
- Thunder Hole culvert, 550m north-east of Barnburgh, to carry an unnamed watercourse under the HS2 main line (see Volume 2: Map CT-06-472, I5 to I6);
- Barnburgh Footpath 3 accommodation underbridge, 8m in length. The overbridge would provide accommodation access across the HS2 main line

(see Volume 2: Map CT-06-472, I5);

- realignment of Barnburgh Footpath 3, 50m to the south of its existing alignment for 130m, crossing the route of the Proposed Scheme via the Barnburgh Footpath 3 accommodation underbridge (see Volume 2: Map CT-06-472, I5 to I6); and
- an area of landscape mitigation planting to the east of the Barnburgh embankment, to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-473, B6 to B7).

2.2.20 There would also be maintenance access routes and hedgerow planting throughout this section. There would also be 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 would be managed from the Hooton Roberts cutting main compound, Old Denaby embankment satellite compound, River Don viaduct central satellite compound, River Don viaduct satellite compound, Mexborough embankment satellite compound, River Dearne viaduct satellite compound, and Barnburgh embankment satellite compound, which are described in Section 2.3, and shown on maps CT-05-468, CT-05-470, CT-05-471, and CT-05-472, in the Volume 2: LA13 Map Book.

Hickleton cutting to Frickley viaduct

2.2.22 The HS2 main line would continue north-west into Hickleton cutting. It would continue onto Thurnscoe embankment and Frickley viaduct.

2.2.23 This section of route is illustrated on maps CT-06-473 to CT-06-476 in the Volume 2: LA13 Map Book.

2.2.24 Key features of this 5km section would include:

- Hickleton cutting, 3.7km in length, up to 32m in depth and 190m in width with associated landscape mitigation on both sides to help integrate the HS2 main line into the surrounding landscape (see Volume 2: Map CT-06-473, C5 to Map CT-06-475, G5);
- diversion of Barnburgh Bridleway 2, 550m to the south of its existing alignment, for 1.2km, crossing the HS2 main line at Barnburgh Footpath 3 accommodation underbridge (see Volume 2: Map CT-06-473, D5 to D6);
- diversion of Barnburgh Bridleway 2, 470m to the north of its existing alignment for 1.2km, crossing the HS2 main line at Hickleton Bridleway 2 accommodation overbridge (see Volume 2: Map CT-06-473, D5 to D6);
- diversion of Hickleton Bridleway 2, 530m to the north of its existing alignment, for 980m, crossing the HS2 main line at Hickleton Bridleway 2 accommodation overbridge (see Volume 2: Map CT-06-473, D6 to E4);
- realignment of Hickleton Footpath 1, 300m to the north of its existing alignment for 490m, crossing the HS2 main line at Hickleton Bridleway 2

accommodation overbridge (see Volume 2: Map CT-06-473, F5 to E6);

- Hickleton Bridleway 2 accommodation overbridge, 135m in length. To provide agricultural access across the route of the Proposed Scheme and connectivity for PRow users (see Volume 2: Map CT-06-473, F5 to F6);
- areas of landscape mitigation planting, on both sides, to the north of Hickleton Bridleway 2 accommodation overbridge, to help integrate the HS2 main line into the surrounding landscape (see Volume 2: Map CT-06-473, F5 to G6);
- Sheep Walks inverted siphon, 69m south of the A635 Barnsley Road, to carry an unnamed watercourse under the HS2 main line. Access to the inverted siphon on both sides would be via the Hickleton Bridleway 2 accommodation overbridge and access road from Hickleton Road, with turning heads to facilitate vehicular access (see Volume 2: Map CT-06-473, G5 to G6);
- Hickleton drop inlet culvert, 210m south of the A635 Barnsley Road, to carry an unnamed watercourse under the HS2 main line. Access would be provided from Hickleton Road to the west (see Volume 2: Map CT-06-473, I5);
- landscape earthworks with associated landscape mitigation planting to the west of the HS2 main line to help integrate the Proposed Scheme into the surrounding landscape and provide visual screening for Hickleton Hall (see Volume 2: Map CT-06-473, H5 to Map CT-06-474, C5);
- A635 Barnsley Road overbridge, 90m in length and up to 11m above track level (see Volume 2: Map CT-06-474, D3 to B8);
- realignment of A635 Barnsley Road, 40m to the north of its existing alignment on an embankment 130m long and up to 11m in height, crossing the HS2 main line on the A635 Barnsley Road overbridge. The existing A635 Barnsley Road would be closed where it crosses the HS2 main line, and retained as access to both sides. A turning head would be provided to facilitate vehicle access on the retained sections to the east and west of the route of the Proposed Scheme (see Volume 2: Map CT-06-474, B8 to D3);
- areas of landscape mitigation planting on both sides of Hickleton cutting, to the north of the A635 Barnsley Road overbridge, to help integrate the HS2 main line into the surrounding landscape and provide screening to properties at Hickleton (see Volume 2: Map CT-06-474, C6 to E5);
- Red Hill inverted siphon, 120m north of the A635 Barnsley Road, to carry surface water drainage under the route of the Proposed Scheme. Access to the inverted siphon on both sides of the route of the Proposed Scheme would be provided from the realigned A635 Barnsley Road, with turning heads to facilitate vehicular access (see Volume 2: CT-06-474, C5 to C6);
- a balancing pond for highway drainage from the realigned A635 Barnsley Road to the western side of the HS2 main line, with access provided via the realigned A635 Barnsley Road (see Volume 2: Map CT-06-474, D4);
- diversion of Hooton Pagnell Footpath 13, 700m to the south of its existing

alignment for 1.6km, crossing the HS2 main line at the A635 Barnsley Road (see Volume 2: Map CT-06-474, C6 to F6);

- closure of Red Hill Lane where it would cross the HS2 main line with access retained to properties on the eastern side of the route. A turning head would be provided to facilitate vehicle access on both sides of the retained section of Red Hill Lane (see Volume 2: CT-06-474, E5 to E6); an area of landscape mitigation planting west of Hickleton cutting, to help integrate the HS2 main line into the surrounding landscape and provide screening to properties at Hickleton (see Volume 2: Map CT-06-474, F5);
- Bilham retaining wall, 60m in length and up to 9m in height, to the west of the HS2 main line. The retaining wall will reduce the amount of land required in proximity to Bilham Belvedere listed building. Access would be provided via an access road from Red Hill Lane (see Volume 2: Map CT-06-474, G5 to H5); an area of landscape mitigation planting east of Hickleton cutting, to help integrate the HS2 main line into the surrounding landscape (see Volume 2: Map CT-06-474, G6 to H6);
- Bilham mid-point auto-transformer station, 49m by 24m, 250m west of Bilham House Farm on the eastern side of the HS2 main line. Access would be provided via an access road from Bilham Lane (see Volume 2: Map CT-06-474, H6 to I6);
- The Wilderness culvert, 520m north-west of Bilham House Farm, to carry an unnamed watercourse under the route of the HS2 main line (see Volume 2: Map CT-06-475, B5);
- areas of landscape mitigation planting, on both sides to help integrate the HS2 main line into the surrounding landscape and provide replacement habitat (see Volume 2: Map CT-06-475, B5 to C6);
- an ecological mitigation pond, to the south-west of Watchley Lane, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-475, C4 to D5);
- areas of woodland habitat creation, on both sides to provide replacement habitat and to help integrate the HS2 main line into the surrounding landscape (see Volume 2: Map CT-06-475, D5 to F6);
- realignment of Hooton Pagnell Footpath 12, 70m north of its existing alignment for 180m, crossing the HS2 main line at Hooton Pagnell Footpath 12 overbridge (see Volume 2: Map CT-06-475, E5 to E6);
- Hooton Pagnell Footpath 12 overbridge, 115m in length, up to 21m above track level (see Volume 2: Map CT-06-475, E5 to E6);
- Thurnscoe embankment, 746m in length and up to 25m in height with landscape earthworks and landscape mitigation planting on both sides to help integrate the HS2 main line into the surrounding landscape (see Volume 2: Map CT-06-475, G5 to Map CT-06-476, C6);

- a balancing pond for railway drainage from the Proposed Scheme to the west of the HS2 main line. Access would be provided from Church Field Road from the north (see Volume 2: Map CT-06-476, B4);
- Frickley viaduct, 660m in length and up to 27m in height, crossing over Church Field Road (see Volume 2: Map CT-06-476, B6 to F6);
- areas of landscape mitigation planting, on both sides of the HS2 main line, to provide visual screening to All Saints Church and properties on Church Field Road (see Volume 2: Map CT-06-476, C5 to D7); and
- a replacement floodplain storage area on both sides of the route HS2 main line, under Frickley viaduct. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-476, D5 to E5).

2.2.25 There would also be maintenance access routes and hedgerow planting throughout this section. There would also be 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 would be managed from the Hickleton cutting main compound and Thurnscoe embankment satellite compound, which are described in Section 2.3, and shown on maps CT-05-473, and CT-05-476, in the Volume 2: LA13 Map Book.

Clayton South embankment to Clayton North embankment

2.2.27 The route of the Proposed Scheme would continue north-west from the Clayton South embankment to the Clayton cutting, before continuing to the end of the Ravenfield to Clayton area on the Clayton North embankment.

2.2.28 This section of route is illustrated on maps CT-06-476 to CT-06-478a in the Volume 2: LA13 Map Book.

2.2.29 Key features of this 2.5km section would include:

- Clayton South embankment, 455m in length and up to 21m in height, with associated landscape mitigation planting both sides to help integrate the HS2 main line into the surrounding landscape and landscape earthworks on the south-west side (see Volume 2: Map CT-06-476, E5 to H6);
- areas of landscape mitigation planting, on both sides of Frickley viaduct, to help integrate the HS2 main line into the landscape and provide visual screening to properties at Clayton (see Volume 2: Map CT-06-476, E5 to H6);
- realignment of Clayton with Frickley Bridleway 11, 120m to the south-east of its existing alignment for 320m, which would cross the HS2 main line under Frickley viaduct (see Volume 2: Map CT-06-476, E5 to F6);
- Dearne Valley Line existing railway underbridge, 105m in length and up to 14m above Network Rail track level (see Volume 2: Map CT-06-476, G5);

- Clayton cutting, 571m in length, up to 10m in depth and 60m in width with landscape mitigation planting on both sides to help integrate the HS2 main line into the landscape and provide visual screening to properties at Clayton (see Volume 2: Map CT-06-476, H5 to Map CT-06-476, C6);
- diversion of Clayton with Frickley Footpath 1, 130m to the north-west of its existing alignment for 1.7km, which would cross the HS2 main line via Clayton with Frickley Bridleway 5 underbridge (see Volume 2: Map CT-06-476, H6 to CT-06-477, C2);
- diversion of Clayton with Frickley Footpath 2, 500m to the north-west of its existing alignment for 1.3km, via Clayton with Frickley Bridleway 5 underbridge (see Volume 2: Map CT-06-477, B7 to D5);
- areas of landscape mitigation planting, on both sides of Clayton embankment, to help integrate the HS2 main line into the landscape and provide visual screening to properties at Clayton (see Volume 2: Map CT-06-477, C5 to G6);
- a section of Clayton North embankment, 2.4km in length and 21m in height, continuing into the South Kirkby to Sharlston Common area (LA14) with landscape mitigation planting and landscape earthworks on both sides of the HS2 main line to help integrate the route into the surrounding landscape (see Volume 2: Map CT-06-477, C5 to Map CT-06-478a, C6);
- an ecological mitigation pond, to the south of Clayton with Frickley Footpath 3, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-477, D7);
- areas of woodland habitat creation on both sides of the Clayton North embankment to provide habitat connectivity and landscape integration (see Volume 2: Map CT-06-477, F3 to D10);
- diversion of Clayton with Frickley Footpath 3, 120m to the north of its existing alignment for 380m, which would cross the HS2 main line at Clayton with Frickley Bridleway 5 underbridge (see Volume 2: Map CT-06-477, D5 to E7);
- Clayton with Frickley Bridleway 5 underbridge, 8m in length (see Volume 2: Map CT-06-477, E5 to E6);
- Sheep Wash plantation culvert, located 800m north of Clayton, to carry an unnamed watercourse under the HS2 main line (see Volume 2: Map CT-06-477, E5 to E6);
- diversion of Clayton with Frickley Footpath 4, 420m to the south-east of the existing alignment for 830m, via Clayton with Frickley Bridleway 5 underbridge (see Volume 2: Map CT-06-477, F5 to G6);
- diversion of Clayton with Frickley Bridleway 5, 760m to the south-east of its existing alignment for 1.8km, which would cross the HS2 main line at Clayton with Frickley Bridleway 5 underbridge (see Volume 2: Map CT-06-477, H5 to I6);

- a balancing pond for railway drainage from the Proposed Scheme on the eastern side of the HS2 main line. Access would be provided from Broad Lane from the north (see Volume 2: Map CT-06-477, G6);
- areas of landscape mitigation planting, on both sides of Clayton embankment, to help integrate the HS2 main line into the landscape (see Volume 2: Map CT-06-477, H5 to I7 and Map CT-06-478a, B5 to B7);
- an ecological mitigation pond, to the south of Howell Wood County Park, to provide replacement habitat for great crested newts (see Volume 2: Map CT-06-478a, B2 to B3); and
- Howell Beck culvert, 150m east of Howell Wood, to carry Howell Beck under the route of the Proposed Scheme (see Volume 2: Map CT-06-478, C6).

2.2.30 There would also be maintenance access routes and hedgerow planting throughout this section. There would also be utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.31 Construction of this section would be managed from the Clayton cutting satellite compound, which is described in Section 2.3, and shown on maps CT-05-476, in the Volume 2: LA13 Map Book.

Sheffield Northern spur

2.2.32 In the Ravenfield to Clayton area, the Sheffield Northern spur would be carried on the following features:

- viaducts for a total length of 950m (Clayton viaduct);
- cuttings for a total length of 4.8km (Church Field Road and Thurnscoe cuttings); and
- embankments for a total length of 960m (Frickley and Church Field Road embankments).

2.2.33 The Sheffield Northern spur described in the sections below.

2.2.34 The Sheffield Northern spur (southbound and northbound) would diverge from the HS2 main line on either sides at Clayton North embankment, to the north of Clayton. The Sheffield Northern spur (southbound) would initially run along the eastern side of the HS2 main line and the Sheffield Northern spur (northbound) would initially run along the western side.

2.2.35 The Sheffield Northern spur (southbound), 3.2km in length, would continue from Clayton North embankment onto the Clayton viaduct, crossing the HS2 main line, the Dearne Valley Line existing railway, and Church Field Road. The Sheffield Northern spur (southbound) would then continue onto the Church Field Road embankment, Thurnscoe cutting, and then converge with the Dearne Valley Line existing railway at Thurnscoe.

- 2.2.36 The Sheffield Northern spur (northbound), 3.5km in length, would continue from Clayton North embankment into Church Field Road cutting, and converge with the Dearne Valley Line existing railway at Thurnscoe.
- 2.2.37 The Sheffield Northern spur is illustrated on maps CT-06-476, CT-06-476-L1, CT-06-476-L2, and CT-06-477.
- 2.2.38 Key features of this 6.7km section would include:
- Sheffield Northern spur (southbound) would diverge from the HS2 main line on Clayton North embankment, up to 498m in length and up to 21m in height, with landscape earthworks to help integrate the Proposed Scheme into the surrounding landscape, and run parallel to the HS2 main line for 1.3km (see Volume 2: Map CT-06-477, G6 to E6);
 - Sheffield Northern spur (southbound) would continue onto:
 - Frickley embankment, 648m in length and up to 25m in height, with landscape earthworks to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: CT-06-477, E6 to Map CT-06-476, I6);
 - Clayton North culvert, 600m north-east of Clayton, to carry an unnamed watercourse under the Sheffield Northern spur (southbound) (see Volume 2: Map CT-06-477, B6 to B7);
 - Clayton viaduct, 948m in length and up 20m in height above existing ground level, would carry the Sheffield Northern spur (southbound) over the HS2 main line, Dearne Valley Line existing railway, and Church Field Road (see Volume 2: CT-06-476, I6 to E3);
 - Church Field Road embankment, 307m in length and up to 14m in height, with landscape earthworks to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-476, E3 to CT-06-476-L1, H7);
 - Clayton South culvert, 920m south-east of Clayton, to carry an unnamed watercourse under the Sheffield Northern spur (southbound) (see Volume 2: Map CT-06-476-L1, H6 to I7);
 - Thurnscoe cutting, 1.6km in length, and up to 11m depth and 73m width (see Volume 2: Map CT-06-476-L2, I6 to J6 and Map CT-06-476-L1, A6 to H7);
 - diversion of Stotfold Road , 500m east its existing alignment for 620m to join Church Field Road. The existing Stotfold Road would be closed east of the Sheffield Northern spur, with a turning head provided to facilitate vehicle access (see Volume 2: Map CT-06-476-L1, H5 to J7);
 - diversion of Clayton with Frickley Bridleway 11, 40m to the east of its existing alignment for 130m to cross the Sheffield Northern spur and Dearne Valley Line existing railway via the Dearne Footpath 5 overbridge (see Volume 2: Map CT-06-476-L1, G7 to H7);
 - diversion of Clayton with Frickley Footpath 13, 50m to the east of its existing

alignment for 200m to cross the Sheffield Northern spur and Dearne Valley Line existing railway via the Dearne Footpath 5 overbridge (see Volume 2: Map CT-06-476-L1, F7 to G7);

- diversion of Dearne Footpath 2, 570m to the south of its existing alignment for 1.4km, to cross the Sheffield Northern spur and Dearne Valley Line existing railway via the Dearne Footpath 5 overbridge (see Volume 2: Map CT-06-476-L1, F5 to E7);
 - diversion of Dearne Bridleway 4, 70m to the east of its existing alignment for 900m, to cross the Sheffield Northern spur and Dearne Valley Line existing railway via the Dearne Footpath 5 overbridge (see Volume 2: Map CT-06-476-L1, B6 to F7);
 - realignment of Dearne Footpath 5, 40m to the north of its existing alignment for 85m, to cross the Sheffield Northern spur and Dearne Valley Line existing railway via the Dearne Footpath 5 overbridge (see Volume 2: Map CT-06-476-L1, B6 to C6); and
 - Dearne Footpath 5 overbridge, 62m in length and 8m above track level (see Volume 2: Map CT-06-476-L1, C6).
- Sheffield Northern spur (northbound) would diverge from the HS2 main line on Clayton North embankment in south-west direction, up to 498m in length and up to 21m in height, with landscape earthworks to help integrate the Proposed Scheme into the surrounding landscape, and would run parallel to the HS2 main line (see Volume 2: Map CT-06-477, G6 to D5);
 - Clayton auto-transformer station, 49m by 24m, on the western side of the route of the Sheffield Northern spur (northbound). Access would be provided via an access road from Clayton with Frickley Footpath 1 diversion (see Volume 2: Map CT-06-477, D5); and
 - Sheffield Northern spur (southbound) would continue into:
 - Church Field Road cutting, 3.2km in length, and up to 19m depth and 140m width (see Volume 2: Map CT-06-477, D5 to Map CT-06-476-16 B6);
 - Top Lane overbridge, 63m in length and 8m above track level (see Volume 2: Map CT-06-477, B4 to B5);
 - realignment of Clayton with Frickley Footpath 1, 110m to the south of its existing alignment for 440m, crossing the Sheffield Northern spur via the Top Lane overbridge (see Volume 2: Map CT-06-477, B3 to Map CT-06-476, I5);
 - realignment of Clayton with Frickley Footpath 10, 50m to the south-west of its existing alignment for 130m (see Volume 2: Map CT-06-477, B3);
 - Frickley Beck inverted siphon, 300m north-east of Clayton, to carry Frickley Beck under the route of the Sheffield Northern spur (northbound). Access to the inverted siphon on both sides of the route of the spur would be provided via access roads from Common Lane, with turning heads to facilitate vehicular access (see Volume 2: Map CT-06-476, H3);

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- Church Field Road retaining wall, 130m in length and up to 5m in height, along the eastern side of the Sheffield Northern spur (northbound). This retaining wall would reduce the land required for the Proposed Scheme in proximity to an existing pumping station on Church Field Road (see Volume 2: Map CT-06-476, F1 to F2);
- Church Field Road overbridge, 68m in length and 8m above ground level to carry Church Field Road over the Sheffield Northern spur (northbound) on its existing alignment (see Volume 2: Map CT-06-476, F1 to F2);
- a balancing pond for railway drainage on the western side of the Sheffield Northern spur (northbound), 90m west of Church Field Road cutting. Access would be provided from Stotfold Road. The pumping station for railway drainage would be located within the Church Field Road cutting (see Volume 2: Map CT-06-476-L1, H3 to I5);
- Closure of Stotfold Road where it would cross the Sheffield Northern spur (northbound) at the Church Field Road cutting. A turning head would be provided to facilitate vehicle access on the retained section of Stotfold Road on the west of the spur (see Volume 2: Map CT-06-476-L1, H5);
- Stotfold Road inverted siphon, 800m south-east of Clayton, to carry an unnamed watercourse under the Sheffield Northern spur (northbound). Access to the inverted siphon would be provided from Stotfold Road to the west (see Volume 2: Map CT-06-476-L1, C5 to C6);
- a balancing pond for railway drainage, to the west of the Sheffield Northern spur (northbound) and Dearne Valley Line existing railway, adjacent to the Church Field Road cutting. Access would be provided from School Street from the south (see Volume 2: Map CT-06-476-L1, B5 to C5);
- Thurnscoe retaining wall, 370m in length and up to 6m in height, along the western side of the Sheffield Northern spur (northbound). This retaining wall would reduce the land required for the Proposed Scheme in proximity to properties in Thurnscoe (see Volume 2: Map CT-06-476-L1, B6 to Map CT-06-476-L2, I6); and
- a pumping station for railway drainage would be located to the west of the Thurnscoe retaining wall (see Volume 2: Map CT-06-476-L2, J6).

2.2.39 To facilitate the connection of the Proposed Scheme to the existing Dearne Valley Line existing railway via the Sheffield Northern spur, modifications would be required to the existing conventional rail infrastructure in the Sheffield and South Yorkshire areas.

2.2.40 There would also be maintenance access routes and hedgerow planting throughout this section. There would also be utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.41 Construction of this section would be managed from the Clayton Junction South main compound, which is described in Section 2.3, and shown on Maps CT-05-476-L1, in the Volume 2: LA13 Map Book.

Demolitions

- 2.2.42 As set out in Volume 1, as the design develops, it is likely that not all the properties reported within the assessment would need to be demolished, for example where not all of the land is required for permanent works.
- 2.2.43 At this stage of the design development, it is anticipated that demolition of 63 existing residential properties, nine commercial/business properties (including farm outbuildings) and seven other structures would be required in the Ravenfield to Clayton area. These could be needed for construction of the permanent features or, in some cases, to enable the construction works for the Proposed Scheme. Demolitions would be managed from the same construction compounds as the permanent features with which they are associated. The identified demolitions 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 are envisaged to build the Proposed Scheme in the Ravenfield to Clayton area. The construction arrangements described in this section provide the basis for the assessment presented in this working draft ES.
- 2.3.2 Land used only for construction purposes would be restored as agreed with the owner of the land and the relevant planning authority once the construction works in that area are complete.
- 2.3.3 Land would be required permanently for the key features of the Proposed Scheme described in Section 2.2.
- 2.3.4 During the construction phase, public roads and PRoW routes would remain open for public use wherever reasonably practicable. Where such routes would cross the Proposed Scheme and require diversion, the alternative road or PRoW crossing the Proposed Scheme would be constructed prior to any closure of existing roads or PRoW wherever reasonably practicable. Where they would 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 would be provided where it is safe and reasonably practicable to do so.
- 2.3.5 Volume 1, Section 5 and Section 6 provide details of the permanent features of the Proposed Scheme and 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

- 2.3.6 All contractors will be required to comply with a Code of Construction Practice (CoCP). In addition, Local Environmental Management Plans (LEMPs) will be produced for each local authority area. The CoCP and LEMPs 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 generic control measures and standards to be implemented throughout the construction process. The LEMPs will set out how the project will adapt and deliver the required environmental and community protection measures within each area through the implementation of specific measures required to control dust and other emissions from activities in the area.

2.3.7 In addition, HS2 Ltd has produced a Community Engagement Framework¹⁸ which sets out how HS2 Ltd and its contractors, as well as their sub-contractors, would undertake community engagement during the construction of the HS2 project. The framework is being implemented on Phase One of HS2 and is applicable to all phases of HS2.

2.3.8 The objectives of the framework include:

- to set out how HS2 Ltd and its contractors would undertake community engagement during the construction of the project;
- to provide clarity and reassurance to HS2 Ltd's stakeholders about how community engagement activity would be managed; and
- to help HS2 Ltd be a good neighbour to local communities, including by providing accurate and timely information about construction works and offering opportunities to influence them, where appropriate.

2.3.9 A draft CoCP has been prepared and is published alongside this document, in Supporting document: Draft Code of Construction Practice. It will remain a draft document through the Parliamentary process and the CoCP will be finalised by Royal Assent. The CoCP sets out measures to be implemented by the appointed construction contractor.

Overview of the construction process

2.3.10 Building and preparing the Proposed Scheme for operation would comprise the following general stages:

- advance works including: site investigations further to those already undertaken; preliminary mitigation works; preliminary enabling works;
- civil engineering works including: establishment of construction compounds; haul routes, site preparation and enabling works; main earthworks and structure works; site restoration; removal of construction compounds where the compound would not be 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;
- site finalisation works; and

¹⁸ HS2 Ltd (2017) Community Engagement Framework. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/625971/hs2_community_engagement_framework.pdf

- systems testing and commissioning.

2.3.11 General information about the construction process is set out in more detail in Volume 1, Section 6, and the draft CoCP including:

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

Advance works

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

- further detailed site investigations and surveys for proposed construction compounds;
- 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;
- site establishment with temporary fence construction; along with soil stripping and vegetation removal; and
- utility diversions and new utility connections for facilities associated with the Proposed Scheme.

Engineering works

Introduction

2.3.13 Construction of the Proposed Scheme would 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 and erection of bridges and viaducts; and
- works to install, test and commission railway systems, including track, overhead line equipment, communications and signalling equipment and traction power supply.

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

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

General overview of construction compounds

2.3.16 Main compounds would be used for core project management staff (i.e. engineering, planning and construction delivery) and commercial and administrative staff. These teams would directly manage some works and coordinate the works at the satellite compounds. In general, a main compound would 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.

2.3.17 Satellite compounds would 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.

2.3.18 Three main civil engineering compounds, the Hooton Roberts cutting main compound, Hickleton cutting main compound and Clayton Junction South main compound, would be located in the Ravenfield to Clayton area and would manage eight civil engineering satellite compounds in the Ravenfield to Clayton area. A ninth satellite compound, Common Lane satellite compound, would be managed from the Springvale embankment main compound in the Ulley to Bramley area (LA12) and would be located in the Ravenfield to Clayton area (see Volume 2: Community area LA12, Ulley to Bramley).

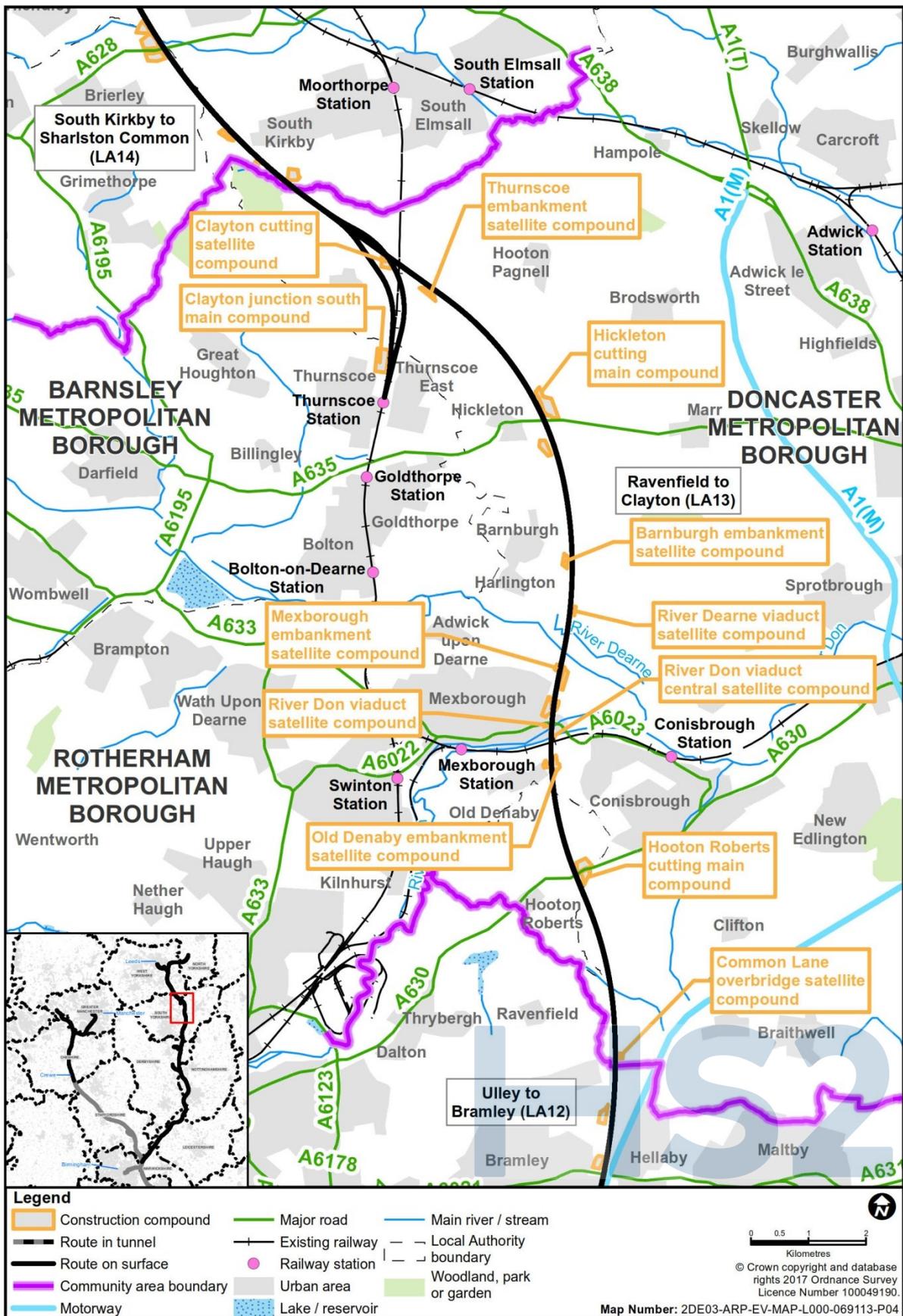
2.3.19 Following the completion of civil engineering works, six of these compounds would remain and be used for railway installation works. These compounds for railway systems installation works would be managed from the Staveley railhead main compound, in the Staveley to Aston area (LA11) (see Volume 2: Community area LA11, Staveley to Aston area).

2.3.20 The location of construction compounds in the Ravenfield to Clayton area is shown on Figure 5. Map Series CT-05 (in the Volume 2: LA13 Map Book) show in detail the locations of the construction compounds described below.

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Figure 5: Location of construction compounds in the Ravenfield to Clayton area



- 2.3.21 Figure 6 shows the management relationship for civil engineering works compounds and Figure 7 for the railway installation works. Details of the works associated with individual compounds are provided in subsequent sections of this report.
- 2.3.22 In the Ravenfield to Clayton area there would be no worker accommodation required.
- 2.3.23 Soil stripped as part of the works, prior to it being used when the land is reinstated, would be stored for the duration of construction. The location of topsoil and subsoil storage areas would generally be 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-05-466b to CT-05-478a, in the Volume 2: LA13 Map Book.
- 2.3.24 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

- 2.3.25 The movement of construction vehicles, whether to carry materials, plant, other equipment and workforce, or moving empty, would 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 working areas would be on designated haul routes within the construction site, often along the line of the route of the Proposed Scheme or running parallel to it.
- 2.3.26 The construction compounds would provide the interface between the construction works and the public road or railway network. The likely road routes to access compounds in the Ravenfield to Clayton 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 would be used as construction traffic routes but are at a distance from the route of Proposed Scheme. These minor works would be reported in the formal ES.
- 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 areas would 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 Map CT-05-468 and Map CT-05-473 in the Volume 2: LA13 Map Book.

Construction compounds

- 2.3.29 This section provides a summary of the civil engineering works to be managed from the construction compounds in the Ravenfield to Clayton area, as illustrated in Figure 6, and railway system works as illustrated in Figure 7. All dates and durations of activities and number of workers are indicative. All compounds would undertake initial site set-up works and, at the end of its use, finalisation works including site reinstatement, landscaping and planting (as necessary).

Figure 6: Construction compounds for civil engineering works

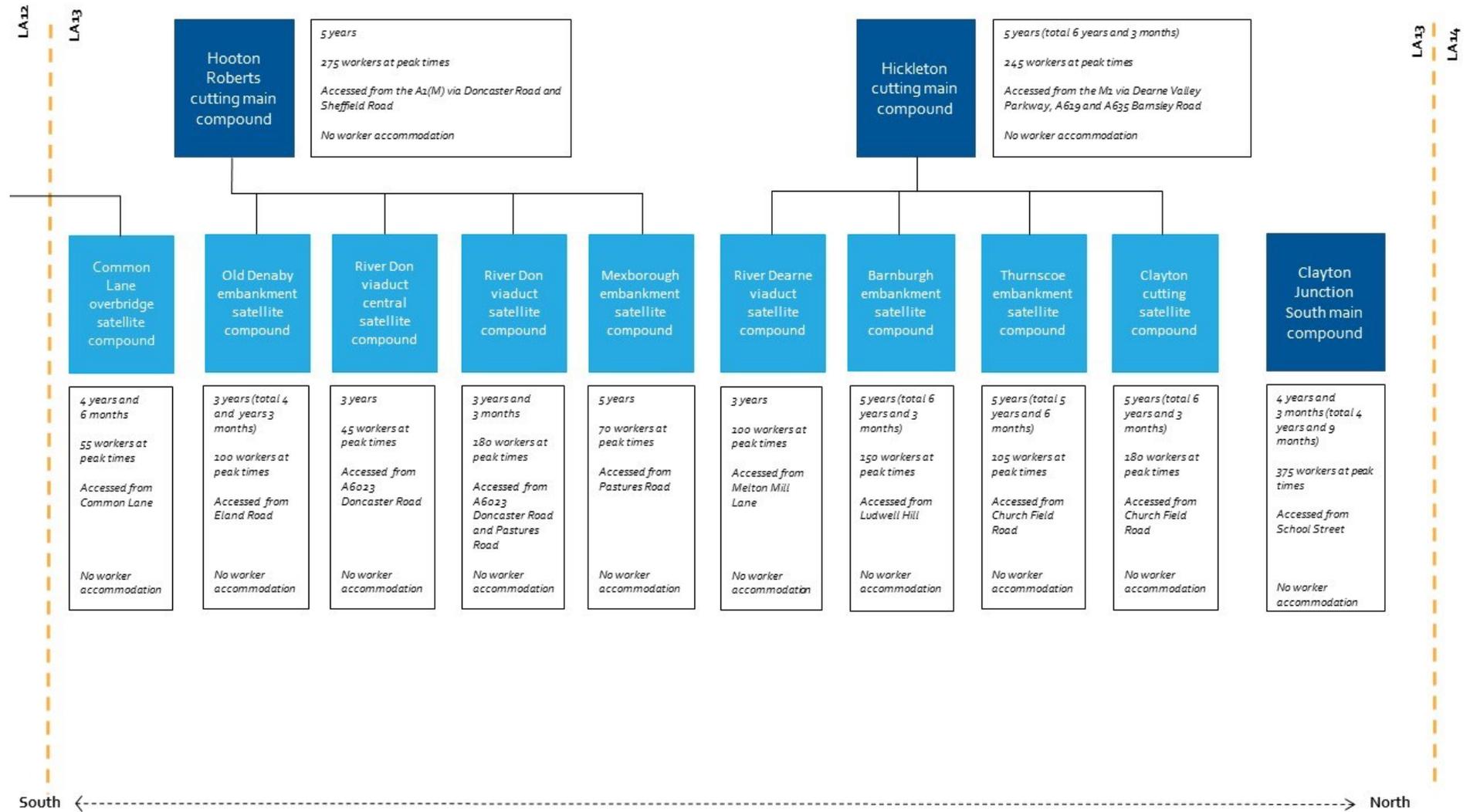
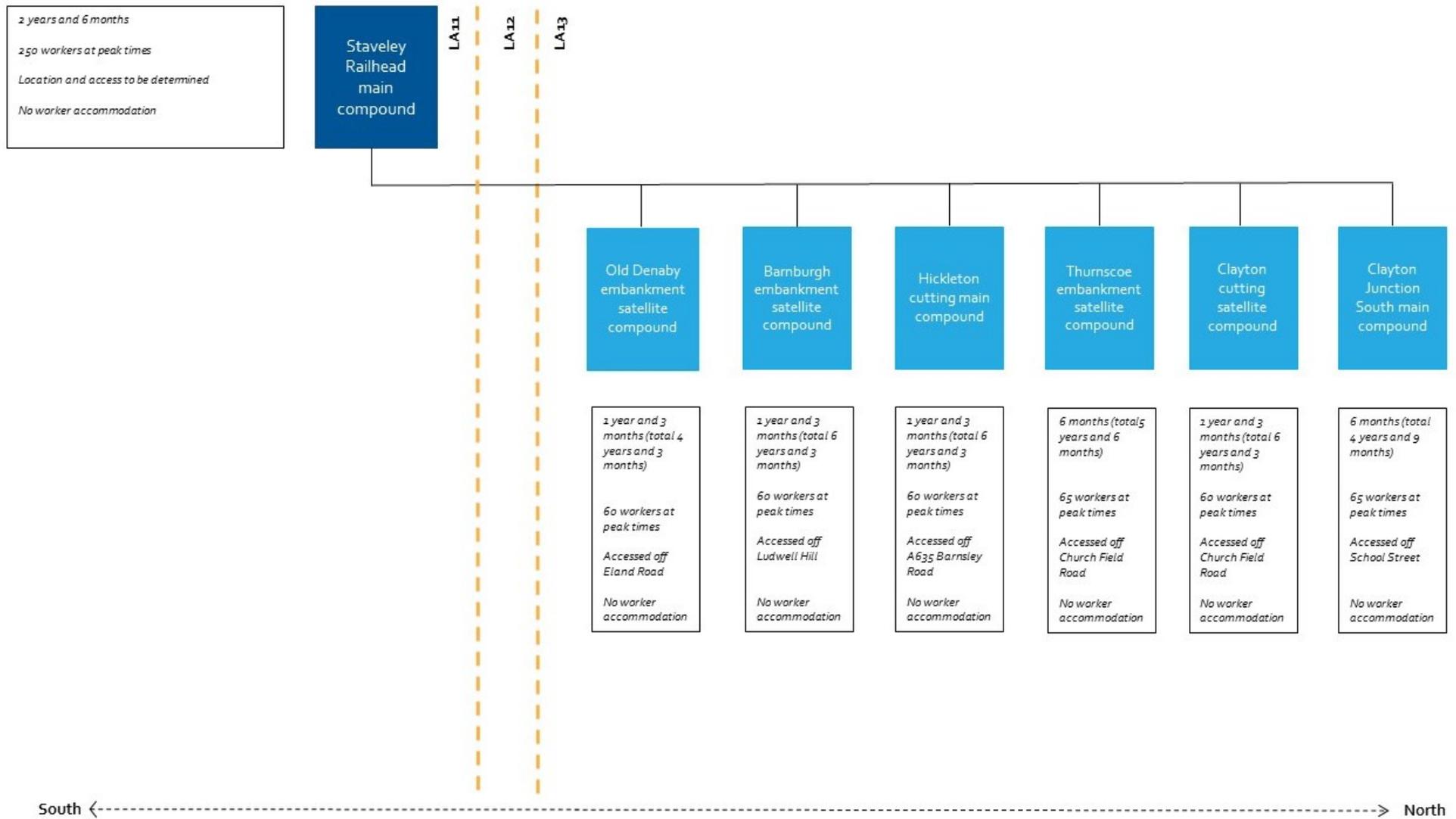


Figure 7: Construction compounds for railway systems installation works



Common Lane overbridge satellite compound

- 2.3.30 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area and Ulley to Bramley area (LA12), as illustrated in Figure 6 (see Volume 2: Map CT-05-466b, E6 to F6).
- 2.3.31 No demolitions would be required as a result of the works to be managed from this compound.
- 2.3.32 The compound would be used to manage the construction of the Common Lane overbridge, which would take approximately one year to complete.
- 2.3.33 The compound would be used to manage the construction of the Bramley North cutting, which would take approximately nine months to complete.
- 2.3.34 The following permanent diversion of watercourses would be required as a result of the works to be managed from this compound:
 - Braithwell Common drop inlet culvert to carry surface water drainage under the HS2 main line, which would take six months to complete; and
 - Ravenfield culvert to carry surface water drainage under the HS2 main line, which would take six months to complete.
- 2.3.35 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Hooton Roberts cutting main compound

- 2.3.36 This compound would be used to manage civil engineering works and provide main compound support to four civil engineering satellite compounds in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-468, F6 to H8).
- 2.3.37 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 1.

Table 1: Demolitions required as a result of the works to be managed from the Hooton Roberts cutting main compound

Description	Location	Feature resulting in the demolition
Commercial		
Farm outbuilding	Located on agricultural land south-west of Birk Lodge Farm, near Ravenfield	Bramley North cutting

- 2.3.38 The compound would be used to manage the construction of the following bridges:
 - Conisbrough Parks Bridleway 2 accommodation underbridge, which would take nine months to complete; and
 - the A630 Doncaster Road overbridge, which would take one year to complete.

- 2.3.39 The compound would be used to manage the construction of the following earthworks:
- Bramley North cutting, which would take nine months to complete;
 - Ravenfield embankment, which would take one year and three months to complete;
 - Ravenfield cutting, which would take six months to complete;
 - Conisbrough Parks embankment, which would take one year and three months to complete;
 - Hooton Roberts cutting, which would take one year and nine months to complete;
 - Hooton Roberts embankment, which would take three years to complete; and
 - Old Denaby cutting, which would take six months to complete.
- 2.3.40 This compound would manage a transfer node for the storage and loading and unloading of bulk earthworks materials, which would be moved to and from the site on public roads. The transfer node would be accessed from the A630 Doncaster Road and via site haul routes (Volume 2: Map CT-05-468, G5).
- 2.3.41 This compound would be used to manage four temporary material stockpile areas on the western and eastern sides of the HS2 main line (see Volume 2: Maps CT-05-466b, G5 to I6, CT-05-467, B6 to D6, and CT-05-468, B3 to F6).
- 2.3.42 The works to be managed from this compound would require the following works to public roads:
- temporary diversion of Firsby Lane, for a period of three years, to the west of HS2 main line, with diversions along Arbour Lane, Garden Lane, the B6093 Main Street, and the A630 Sheffield Road to cross the HS2 main line. During this time, Conisbrough Parks Bridleway 2 diversion would be constructed. Following the construction period, Firsby Lane would be permanently diverted by 1.4km to the south of its existing alignment via Conisbrough Parks Bridleway 2 diversion. Following the construction period, a section of Firsby Lane to the west of the HS2 main line would be permanently closed; and
 - temporary realignment of the A630 Doncaster Road, 50m north of its existing alignment, for a period of one year, with diversions along Kilnhurst Road and Denaby Lane and would be constructed offline¹⁹. During this time, the A630 Doncaster Road overbridge would be constructed. On completion of construction, the A630 Doncaster Road would be reinstated along its existing alignment.

¹⁹ Offline works are works which are generally constructed along or nearby existing routes, which will remain open during construction

2.3.43 The works to be managed from this compound would require the following works to PRoW:

- temporary diversion of Conisbrough Parks Bridleway 14 to the east of the land required for construction of Ravenfield cutting and Conisbrough Parks embankment for a period of three years, with users diverted to the north connecting to Conisbrough Parks Footpath 3 for the construction of the HS2 main line. On completion of construction, Conisbrough Parks Bridleway 14 would be permanently realigned via Conisbrough Parks Bridleway 2 accommodation underbridge;
- temporary diversion of Conisbrough Parks Footpath 3 to the east of the land required for construction of Ravenfield cutting and Conisbrough Parks embankment for a period of one year, with users diverted to the south connecting to Conisbrough Parks Bridleway 14 for construction of the HS2 main line. On completion of construction, Conisbrough Parks Bridleway 3 would be permanently realigned via Conisbrough Parks Bridleway 2 accommodation underbridge;
- temporary diversion of Conisbrough Parks Bridleway 2 to the west of the land required for the construction of Hooton Roberts cutting for a period of three years, with users diverted to the north, connecting to the A630 Doncaster Road for the construction of the HS2 main line. On completion of construction, Conisbrough Parks Bridleway 2 would be permanently diverted via Conisbrough Parks Bridleway 2 accommodation underbridge;
- temporary diversion of Conisbrough Footpath 3 to the west of the land required for the construction of Old Denaby cutting and Old Denaby embankment for a period of three years, with users diverted to the north connecting to Denaby Lane for the construction of the HS2 main line. On completion of construction, Conisbrough Parks Footpath 3 would be permanently realigned connecting to Denaby Lane, Coalpit Road and Eland Road; and
- permanent diversion of Conisbrough Footpath 1, to the south-east of its existing alignment, connecting to Denaby Lane for construction of the HS2 main line. The permanent diversion would be constructed before closing the existing alignment.

2.3.44 The works to be managed from this compound would require the following works to watercourses:

- realignment of Firsby Brook under the route of the Proposed Scheme will be required as a result of the works to be managed from this compound. It will be realigned via Firsby Brook culvert, which would take six months to complete;
- Conisbrough Parks culvert to carry surface water under the HS2 main line, which would take six months to complete;
- Crooked Lane South culvert to carry surface water under the HS2 main line, which would take six months to complete;

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- Crooked Lane North culvert to carry surface water under the HS2 main line, which would take six months to complete;
- Denaby Wood South inverted siphon to carry surface water under the HS2 main line, which would take six months to complete; and
- Denaby Wood North inverted siphon to carry surface water under the HS2 main line, which would take six months to complete.

2.3.45 There would also be minor utilities works managed from this compound.

Old Denaby embankment satellite compound

2.3.46 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 for a period of three years (see Volume 2: Map CT-05-470, B6 to C6, and B5 to C5). On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations works for a period of one year and three months.

2.3.47 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 2.

Table 2: Demolitions required as a result of the works to be managed from the Old Denaby embankment satellite compound

Description	Location	Feature resulting in the demolition
Commercial		
Two commercial warehouse buildings	Eland Road, Denaby Main, Doncaster	Old Denaby cutting and Old Denaby embankment
Two commercial warehouse buildings	Coalpit Road, Denaby Main, Doncaster	Old Denaby cutting and Old Denaby embankment
Other		
Electrical equipment building	Eland Road, Denaby Main, Doncaster	Old Denaby cutting and Old Denaby embankment

2.3.48 The compound would be used to manage the construction of the River Don viaduct, which would take two years to complete.

2.3.49 The compound would be used to manage the construction of the Old Denaby embankment, which would take nine months to complete.

2.3.50 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaduct beams, and facilitate the construction of the River Don viaduct would be located at this compound for a period of two years, accessed from Denaby Lane (see Volume 2: Map CT-05-470, B5 to C6).

2.3.51 The works to be managed from this compound would require temporary overnight/weekend closures of the towpath adjacent to the Sheffield and South Yorkshire Navigation during the construction of the HS2 main line.

2.3.52 There would also be minor utilities works managed from this compound.

River Don viaduct central satellite compound

- 2.3.53 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-470, E6).
- 2.3.54 No demolitions would be required as a result of the works to be managed from this compound.
- 2.3.55 The compound would be used to manage the construction of the River Don viaduct, which would take two years to complete.
- 2.3.56 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaduct beams for the River Don viaduct, would be located at this compound for a period of two years, accessed from the A6023 Doncaster Road (see Volume 2: Map CT-05-470, E6).
- 2.3.57 This compound would be used to manage one temporary material stockpile area on the eastern side of the HS2 main line (see Volume 2: Map CT-05-470-R1, F4 to G4).
- 2.3.58 There would also be minor utilities works managed from this compound.

River Don viaduct satellite compound

- 2.3.59 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-470, F4 to F5, F5 to H5, and G6 to H6).
- 2.3.60 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 3.

Table 3: Demolitions required as a result of the works to be managed from the River Don viaduct satellite compound*

Description	Location	Feature resulting in the demolition
Residential		
52 residential properties on Comelybank Drive**	Comelybank Drive, Mexborough	River Don viaduct
Seven residential properties on Doncaster Road	Doncaster Road, Mexborough	River Don viaduct
Residential property on Don View	Don View, Mexborough	River Don viaduct
Commercial		
Industrial unit	Doncaster Road, Mexborough	River Don viaduct
Industrial unit	Pastures Farm, off Pastures Road, Mexborough	River Don viaduct
Other		
Garage building	Comelybank Drive, Mexborough	River Don viaduct

*As set out in Volume 1, as the design develops, it is likely that not all the properties reported as 'demolitions' within this assessment would need to be demolished, such as where not all of the land is required for permanent works. In this context, for example, at the current point of assessment it is assumed that 26 of the properties on Comelybank Drive would need to be demolished.

** This figure includes residential properties that are assumed to be either completed or under construction (as of Summer 2018) at Comelybank Drive.

- 2.3.61 The compound would be used to manage the construction of the River Don viaduct, which would take two years to complete.
- 2.3.62 The compound would be used to manage the construction of the Mexborough cutting, which would take three months to complete.
- 2.3.63 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaduct beams and facilitate the construction of the River Don viaduct, would be located at this compound for a period of two years, accessed from the A6023 Doncaster Road (see Volume 2: Map CT-05-470, F5 to H5).
- 2.3.64 This compound would be used to manage one temporary material stockpile area on the western side of the HS2 main line (see Volume 2: Map CT-05-470, G4 to H5).
- 2.3.65 The works to be managed from this compound would require the following works to public roads:
- a number of overnight/weekend closures of the A6023 Doncaster Road during the construction of the HS2 main line, with diversions along Cadeby Road, Main Street, Boat Lane, Mill Lane, the A630 Doncaster Road and Low Road; and
 - a number of overnight/weekend closures of Pastures Road during the construction of the HS2 main line, with diversions along Cadeby Road, Main Street, Boat Lane, Mill Lane, the A630 Doncaster Road and Low Road.
- 2.3.66 The works to be managed from this compound would require the following work to PRoW:
- temporary realignment of Mexborough Footpath 9 to the west of the land required for the construction of the HS2 main line. On completion of construction, Mexborough Footpath 9 would be permanently realigned for 50m to the west of its existing alignment; and
 - a number of overnight/weekend closures of Mexborough Footpath 7 during the construction of the River Dearne viaduct. On completion of construction, Mexborough Footpath 7 would be reinstated along its existing alignment.
- 2.3.67 There would also be minor utilities works managed from this compound.
- Mexborough embankment satellite compound*
- 2.3.68 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in (see Volume 2: Map Figure 6 CT-05-471, A5 to C5, and C4 to D4).
- 2.3.69 No demolitions would be required as a result of the works to be managed from this compound.
- 2.3.70 The compound would be used to manage the construction of the River Dearne viaduct, which would take two years and three months to complete.
- 2.3.71 The compound would be used to manage the construction of the Mexborough embankment, which would take three years and three months to complete.

- 2.3.72 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaduct beams and facilitate the construction of the River Dearne viaduct, would be located at this compound for a period of two years and three months, accessed from Pastures Road and A6023 Doncaster Road (see Volume 2: Map CT-05-470, I6 to I7, and CT-05-471, B5 to C5).
- 2.3.73 This compound would be used to manage two temporary material stockpile areas on the eastern side of the HS2 main line (see Volume 2: Map CT-05-470, I7, and CT-05-471, B5 to B8).
- 2.3.74 The works to be managed from this compound would require the following works to PRoW:
- a number of overnight/weekend closures of the Trans Pennine Trail during the construction of the HS2 main line; and
 - a number of overnight/weekend closures of Barnburgh Footpath 5 during the construction of the River Dearne viaduct.

- 2.3.75 There would also be minor utilities works managed from this compound.

River Dearne viaduct satellite compound

- 2.3.76 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-471, H5 to I5).
- 2.3.77 No demolitions would be required as a result of the works to be managed from this compound.
- 2.3.78 The compound would be used to manage the construction of the River Dearne viaduct, which would take two years and three months to complete.
- 2.3.79 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaduct beams, and facilitate the construction of the River Dearne viaduct would be located at this compound for a period of two years and three months, accessed from Ludwell Hill (see Volume 2: Map CT-05-471, H5 to I5).
- 2.3.80 This compound would be used to manage one temporary material stockpile area on the eastern side of the HS2 main line (see Volume 2: Map CT-05-471, F8 to G8).
- 2.3.81 There would also be minor utilities works managed from this compound.

Barnburgh embankment satellite compound

- 2.3.82 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-472, E5 to F4), for a period of five years. On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations works for a period of one year and three months.
- 2.3.83 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 4.

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Table 4: Demolitions required as a result of the works to be managed from the Barnburgh embankment satellite compound

Description	Location	Feature resulting in the demolition
Residential		
Two residential properties on Ludwell Hill	Ludwell Hill, Barnburgh	Barnburgh embankment
Other		
Pylon	Land located south of Ludwell Hill, Barnburgh	Barnburgh embankment
Outbuilding	Land located south of Ludwell Hill, Barnburgh	Barnburgh embankment
Outbuilding	Barnburgh Lakes, Ludwell Hill, Barnburgh	Barnburgh embankment
Footbridge	Barnburgh Footpath 3, 600m east of Barnburgh, within Thunder Hole woodland	Barnburgh embankment

2.3.84 The compound would be used to manage the construction of the following bridges:

- Ludwell Hill underbridge, which would take nine months to complete; and
- Barnburgh Footpath 3 accommodation underbridge, which would take nine months to complete.

2.3.85 The compound would be used to manage the construction of the Barnburgh embankment, which would take three years and three months to complete.

2.3.86 This compound would be used to manage four temporary material stockpile areas on the eastern and western side of the HS2 main line (see Volume 2: Map CT-05-471, H3 to I3, Map CT-05-472, C4 to H7, and Map CT-05-473, B4 to C5).

2.3.87 The works to be managed from this compound would require the following works to public roads:

- temporary realignment of Ludwell Hill, 50m to the north of its existing alignment, for a period of one year. During this time, Ludwell Hill underbridge would be constructed. Following the construction period, Ludwell Hill would be reinstated along its existing alignment and would remain open; and
- permanent diversion of St Helen's Lane with users diverted to Ludwell Hill and Barnburgh Bridleway 4 for construction of the HS2 main line. The permanent diversion would be constructed before closing the existing alignment. On completion of construction, a section of St Helen's Lane would be permanently closed where it would cross the HS2 main line.

2.3.88 The works to be managed from this compound would require the following work to PRoW:

- permanent diversion of Barnburgh Bridleway 4 to the east of the Barnburgh embankment, with users diverted to Ludwell Hill for construction of the HS2 main line. The permanent diversion would be constructed before closing the

existing alignment. On completion of construction, a section of Barnburgh Bridleway 4 to the east of the Barnburgh embankment would be permanently closed where it would cross the HS2 main line;

- permanent realignment of Barnburgh Footpath 7, with users diverted to the north for construction of the HS2 main line. The permanent realignment would be constructed before closing the existing alignment;
- temporary realignment of Barnburgh Footpath 3 for a period of two years, with users diverted to the north, connecting to Barnburgh Bridleway 2 and Hickleton Bridleway 2, for construction of the HS2 main line. On completion of construction, Barnburgh Footpath 3 would be permanently extended under Barnburgh Footpath 3 accommodation underbridge and permanently connected to Barnburgh Bridleway 2 and Hickleton Bridleway 2; and
- permanent realignment of Barnburgh Bridleway 2 to the east of the land required for the construction of the Barnburgh embankment and the Hickleton cutting, with users diverted to Hickleton Bridleway 2 accommodation overbridge and Barnburgh Footpath 3 accommodation underbridge for construction of the HS2 main line. The permanent diversion would be constructed before closing the existing alignment. On completion of construction, a section of Barnburgh Bridleway 2 would be permanently closed where it would cross the HS2 main line.

2.3.89 The works to be managed from this compound would require the following works to watercourses:

- Owler Carr culvert to carry surface water under the HS2 main line, which would take six months to complete;
- St Helen's Spring culvert, for the diversion of St Helen's Spring, which would take six months to complete; and
- Thunder Hole culvert to carry surface water under the HS2 main line which would take six months to complete.

2.3.90 There would also be minor utilities works managed from this compound.

Hickleton cutting main compound

2.3.91 This compound would be used to manage civil engineering works and provide compound support to four satellite compounds in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-473, G4 to I4, and CT-05-474, B7 to F7), for a period of five years. On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations works for a period of one year and three months.

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

- 2.3.93 The compound would be used to manage the construction of the following bridges:
- Hickleton Bridleway 2 accommodation overbridge, which would take nine months to complete;
 - A635 Barnsley Road overbridge, which would take nine months to complete; and
 - Hooton Pagnell Footpath 12 overbridge, which would take six months to complete.
- 2.3.94 The compound would be used to manage the construction of Hickleton cutting, which would take three years and six months to complete.
- 2.3.95 This compound would manage a transfer node for the storage and loading and unloading of bulk earthworks materials, which would be moved to and from the site on public roads. The transfer node would be accessed from the A635 Barnsley Road (Volume 2: Map CT-05-473, C7 to H7).
- 2.3.96 This compound would be used to manage one temporary material stockpile area on the western side of the HS2 main line (see Volume 2: Map CT-05-474, F5 to I3).
- 2.3.97 The works to be managed from this compound would require the following works to public roads:
- permanent realignment of the A635 Barnsley Road, 50m to the north of its existing alignment, which would take nine months to complete and would be constructed offline. The permanent realignment would be constructed before closing the existing alignment; and
 - permanent closure of 180m of Red Hill Lane during construction, with diversions along the A635 Barnsley Road, Church Lane and the B6422 Butt Lane. On completion of construction, Red Hill Lane would remain permanently closed where it would cross the route of the Proposed Scheme.
- 2.3.98 The works to be managed from this compound would require the following works to PRoW:
- permanent diversion of Hickleton Bridleway 2 on the eastern and western sides of the land required for the construction of the Hickleton cutting and Barnburgh embankment, with users diverted to Barnburgh Footpath 3 accommodation underbridge and Hickleton Bridleway 2 accommodation overbridge for construction of the HS2 main line. The permanent diversion would be constructed before closing the existing alignment. On completion of construction, a section of Hickleton Bridleway 2 would be permanently closed where it would cross the route of the HS2 main line;
 - permanent diversion of Hickleton Footpath 1 on both sides of the land required for the construction of the Hickleton cutting, with users diverted to Hickleton Bridleway 2 accommodation overbridge and Hickleton Bridleway 2 for the construction of the HS2 main line. On completion of construction, Hickleton Footpath 1 would be permanently closed where it would cross the route of the Proposed Scheme;

- permanent diversion of Hooton Pagnell Footpath 13 on both sides of the land required for the construction of the Hickleton cutting, with users diverted to the A635 Barnsley Road overbridge for construction of the HS2 main line. The permanent diversion would be constructed before closing the existing alignment; and
- temporary realignment of Hooton Pagnell Footpath 12 on both sides of the land required for the construction of the Hickleton cutting for a period of one year, with users diverted to the north of the existing alignment for the construction of the HS2 main line. On completion of construction, the Hooton Pagnell Footpath 12 would be permanently extended over Hooton Pagnell footpath 12 overbridge.

2.3.99 The works to be managed from this compound would require the following works to watercourses:

- Sheep Walks inverted siphon to carry surface water under the HS2 main line, which would take six months to complete;
- Hickleton drop inlet culvert to carry surface water under the HS2 main line, which would take six months to complete;
- Red Hill Lane inverted siphon to carry surface water under the HS2 main line, which would take six months to complete; and
- The Wilderness culvert to carry surface water under the HS2 main line, which would take six months to complete.

2.3.100 There would also be minor utilities works managed from this compound.

Thurnscoe embankment satellite compound

2.3.101 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-476, B4 to D5), for a period of five years. On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations works for a period of six months.

2.3.102 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 5.

Table 5: Demolitions required as a result of the works to be managed from the Thurnscoe embankment satellite compound

Description	Location	Feature resulting in the demolition
Commercial		
Farm outbuildings / agricultural business	Lodge Farm, 200m south-east of Church Field Road, Hooton Pagnell,	Thurnscoe embankment

2.3.103 The compound would be used to manage the construction of Frickley viaduct, which would take two years and three months to complete.

2.3.104 The compound would be used to manage the construction of Thurnscoe embankment, which would take three years and three months to complete.

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- 2.3.105 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaduct beams, and facilitate the construction of the Frickley viaduct would be located at this compound for a period of two years and three months, accessed from the Church Field Road (see Volume 2: Map CT-05-473, G4 to I4, and Map CT-05-474, B7 to E7).
- 2.3.106 This compound would be used to manage two temporary material stockpile areas on the eastern and western side of the HS2 main line (see Volume 2: Map CT-05-475, H5 to I8, and Map CT-05-476, B7 to B8).
- 2.3.107 The works to be managed from this compound would require a number of overnight/weekend closures of Church Field Road for the construction of the Frickley viaduct. Following the construction period, Church Field Road would remain on its existing alignment.
- 2.3.108 There would also be minor utilities works managed from this compound.

Clayton cutting satellite compound

- 2.3.109 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-476, G4 to H5), for a period of five years. On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations for a period of one year and three months.
- 2.3.110 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 6.

Table 6: Demolitions required as a result of the works to be managed from the Clayton cutting satellite compound

Description	Location	Feature resulting in the demolition
Residential		
Residential property	Off Top Lane, east of Common Lane, Frickley Estate, Clayton	Clayton cutting
Commercial		
Farm outbuildings	Off Top Lane, east of Common Lane, Frickley Estate, Clayton	Clayton South embankment
Other		
Overbridge	Top Lane, over Dearne Valley Line via Clayton with Frickley bridleway 1, Clayton	Clayton South embankment

- 2.3.111 The compound would be used to manage the construction of the following bridges and viaducts:
- Dearne Valley Line underbridge, which would take one year to complete; and
 - Clayton with Frickley Bridleway 5 underbridge, which would take nine months to complete.
- 2.3.112 The compound would be used to manage the construction of the following earthworks:
- Clayton south embankment, which would take one year and six months to complete;
 - Clayton cutting, which would take three months to complete; and
 - Clayton North embankment, which would take three years and three months to complete.
- 2.3.113 This compound would be used to manage three temporary material stockpile areas on the eastern and western side of the HS2 main line (see Volume 2: Map CT-05-476, D6 to I7, and Map CT-05-477, E7 to G7).
- 2.3.114 The works to be managed from this compound would require the following works to PRoW:
- temporary diversion of Clayton with Frickley Bridleway 11 for a period of two years, to the north of the land required for construction of the HS2 main line connecting to Clayton with Frickley Footpath 1. On completion of construction, Clayton with Frickley Bridleway 11 would be permanently diverted around the foot of the Clayton South embankment;
 - temporary diversion of Clayton with Frickley Footpath 1 for a period of three years, to the north-east of the land required for construction of the HS2 main line around the perimeter of the adjacent stockpile connecting to Clayton with Frickley Footpath 2. On completion of construction, Clayton with Frickley Footpath 1 would be permanently diverted by 1.7km via the Clayton with Frickley Bridleway 5 underbridge;
 - temporary diversion of Clayton with Frickley Footpath 10 to the south-west of the land required for construction of the Sheffield Northern spur connecting to Clayton with Frickley Footpath 1. On completion of construction, Clayton with Frickley Footpath 10 would be permanently realigned by 80m connecting to Clayton with Frickley Footpath 1 diversion;
 - temporary diversion of Clayton with Frickley Footpath 2 for a period of three years, to the north-east of the land required for the construction of the Proposed Scheme around the perimeter of the adjacent stockpile to connect to Clayton with Frickley Footpath 1 in south-east direction and connecting with Clayton with Frickley Footpath 3 in north-west direction. On completion of construction, Clayton with Frickley Footpath 2 would be permanently diverted by 1.3km via the Clayton with Frickley Bridleway 5 underbridge;

- temporary diversion of Clayton with Frickley Footpath 3 on both sides of the Proposed Scheme, connecting to Clayton with Frickley Footpath 2 and Clayton with Frickley Footpath 4 around the perimeter of the adjacent stockpile on the north-eastern side, and connecting with Clayton with Frickley Footpath 4 on the south-western side. The permanent diversion would be constructed before closing the existing alignment. On completion of construction, Clayton with Frickley Footpath 3 would be permanently diverted by 380m via the Clayton with Frickley Bridleway 5 underbridge;
- temporary diversion of Clayton with Frickley Footpath 4 for a period of three years, on both sides of the land required for construction of the Proposed Scheme, connecting to Clayton with Frickley Footpath 3 and Clayton with Frickley Footpath 5. On completion of construction, Clayton with Frickley Footpath 4 would be permanently diverted by 830m under the Clayton with Frickley Bridleway 5 underbridge; and
- temporary diversion of Clayton with Frickley Bridleway 5, to the south-west of the land required for construction of the Proposed Scheme connecting to Clayton with Frickley Footpath 4. On completion of construction, Clayton with Frickley Bridleway 5 would be permanently diverted by 1.8km under the Clayton with Frickley Bridleway 5 underbridge.

2.3.115 The works to be managed from this compound would require the following works to watercourses:

- Sheepwash Plantation culvert to carry surface water under the route of the Proposed Scheme, which would take six months to complete; and
- Howell Beck culvert for the diversion of Howell Beck, which would take six months to complete.

2.3.116 There would also be minor utilities works managed from this compound.

Clayton Junction South main compound

2.3.117 This compound would be used to manage civil engineering works in the Ravenfield to Clayton area, as illustrated in Figure 6 (see Volume 2: Map CT-05-476, C6 to E4), for a period of four years and three months. On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations works for a period of six months.

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

2.3.119 The compound would be used to manage the construction of the following bridges and viaducts:

- Clayton viaduct, which would take three years and three months to complete;
- Top Lane overbridge, which would take one year to complete;
- Church Field Road overbridge, which would take one year to complete; and

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- Dearne Footpath 5 overbridge, which would take six months to complete.

2.3.120 The compound would be used to manage the construction of the following earthworks:

- Frickley embankment, which would take one year and nine months to complete;
- Church Field Road embankment, which would take one year to complete;
- Thurnscoe cutting, which would take one year and nine months to complete; and
- Church Field Road cutting, which would take one year and three months to complete.

2.3.121 A pre-cast yard and pre-cast laydown area to manufacture and store concrete elements, such as viaducts beams, to facilitate the construction of the Clayton viaduct would be located at this compound for a period of three years and three months. The yard would be accessed from site haul to Church Field Road (see Volume 2: Map CT-05-476, G4 to H5).

2.3.122 This compound would be used to manage seven temporary material stockpile areas on the eastern and western side of the route of the Proposed Scheme (see Volume 2: Map CT-05-476-L1, E6 to I3, and Map CT-05-476, E4 to H2).

2.3.123 The works to be managed from this compound would require the following works to public roads:

- temporary diversion of Church Field Road, to the south of its existing alignment along Stotfold Road diversion and Stotfold Road, for construction of the route of the Sheffield Northern spur. On completion of construction, Church Field Road would be reinstated along its existing alignment;
- temporary diversion of Top Lane, to the south for a period of three years for construction of the Sheffield Northern spur. On completion of construction, Top Lane would be permanently diverted to Top Lane overbridge 50m to the north of its existing alignment; and
- permanent closure of Stotfold Road where it would cross the Sheffield Northern spur, with users diverted to Church Field Road and access maintained to the properties.

2.3.124 The works to be managed from this compound would require the following works to PRoW:

- temporary diversion of Clayton with Frickley Bridleway 11, to the east for a period of one year. This would divert users for 550m, around the perimeter of the temporary material stockpile on the eastern side of the Sheffield Northern spur. On completion of construction, Clayton with Frickley Bridleway 11 would be diverted connecting to Stotfold Road;

- temporary diversion of Dearne Bridleway 4. This would divert users for 1km, via Deightomby Street and around the perimeter of the temporary material stockpile on the eastern side of the Sheffield Northern spur. On completion of construction, Dearne Bridleway 4 would be diverted via Dearne Footpath 5 overbridge;
- temporary diversion of Dearne Footpath 2. This would divert users for 900m, around the perimeter of the construction compound on the western side of the Sheffield Northern spur connecting to Dearne Footpath 5. On completion of construction, Dearne Footpath 2 would be diverted to the Dearne Footpath 5 overbridge via Dearne Footpath 2 diversion; and
- temporary diversion of Dearne Footpath 5. This would divert users for 900m, around the perimeter of the Clayton Junction South main compound on the western side of the Sheffield Northern spur connecting to Dearne Footpath 2. On completion of construction, Dearne Footpath 5 would be realigned to cross the Dearne Footpath 5 overbridge.

2.3.125 The works to be managed from this compound would require the following works to watercourses:

- Clayton North culvert to carry surface water under the Sheffield Northern spur, which would take six months to complete;
- Clayton South culvert to carry surface water under the Sheffield Northern spur, which would take six months to complete;
- Frickley Beck inverted siphon for the diversion of Frickley Beck, which would take six months to complete; and
- Stotfold Road inverted siphon to carry surface water under the Sheffield Northern spur, which would take six months to complete.

2.3.126 There would also be minor utilities works managed from this compound.

Construction waste and material resources

2.3.127 Excavated material (defined as excluding topsoil and subsoil) generated across the Proposed Scheme would be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, where suitable and reasonably practicable, either with or without treatment.

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

2.3.129 Local excess or shortfall of excavated material within the Ravenfield to Clayton area would be managed through the mitigation earthworks design approach adopted for the Proposed Scheme, with the aim of contributing to an overall balance of excavated material on a route-wide basis. The overall balance of excavated material would be presented in Volume 3 of the formal ES.

Commissioning of the railway

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

Construction programme

- 2.3.131 A construction programme illustrating indicative periods for each of the core construction activities described above is provided in Figure 8. Construction durations referred to in the following sections of this report are based on the indicative programme.

Monitoring during construction

- 2.3.132 The appointed contractor would be required to undertake the necessary monitoring for each environmental topic to comply with the requirements of the CoCP, the relevant LEMP and any additional consent requirements. Any actions that may be necessary for compliance would be reported to the nominated undertaker and remedial action identified.
- 2.3.133 The CoCP and the relevant LEMP would 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, would be consulted on the monitoring procedures to be implemented prior to construction commencement.

2.4 Operation of the Proposed Scheme

Introduction

- 2.4.1 This section describes the operational characteristics of the Proposed Scheme in the Ravenfield to Clayton area. Volume 1, Section 4 describes the envisaged operational characteristics of the Proposed Scheme as a whole, including Phase One, Phase 2a and Phase 2b.

HS2 services

- 2.4.2 It is anticipated that there would be up to seven trains per hour each way on the HS2 main line, south of Clayton Junction passing through the Ravenfield to Clayton area. North of Clayton Junction, it is anticipated that there would be up to 9 trains per hour each way on the HS2 main line. Services are expected to operate between 05:00 and midnight from Monday to Saturday and 08:00 and midnight on Sunday.
- 2.4.3 In this area, trains would run at speeds of up to 225mph (360kph). The trains would be either single zoom trains or two zoom trains coupled together, 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 would be undertaken using asset condition monitoring and unattended measurement systems fitted to the HS2 passenger rolling stock. Intrusive inspections would be carried out during the maintenance period. The maintenance approach would be a combination of risk based, preventative and reactive maintenance.
- 2.4.6 Provision for railway maintenance vehicles along the eastern leg of the route of the Proposed Scheme] would be made at the Staveley depot in the Staveley to Aston area (LA11). Further information on the Staveley depot can be found in Volume 2: Staveley to Aston area (LA11).

Operational waste and material resources

- 2.4.7 The assessment of the likely significant environmental effects associated with the disposal of operational waste would be undertaken for the Proposed Scheme as a whole and reported in Volume 3: Route-wide effects of the formal ES.
- 2.4.8 Forecasts of the amount of waste arising from track maintenance and ancillary infrastructure and the associated potential significant environmental effects would also be reported in the formal ES.

Monitoring during operation

- 2.4.9 The nominated undertaker would be responsible for monitoring during operation of the Proposed Scheme. Proposed indicative area-specific monitoring measures for each environmental topic area are presented in Sections 4 to 15 of this report based on the existing level of assessment.

- 2.4.10 Relevant local authorities and consenting authorities, such as the Environment Agency, would be consulted on the monitoring procedures to be implemented during operation prior to construction commencement.

2.5 Route section alternatives

Sheffield Northern spur

- 2.5.1 During the design development process since the announcement of the route in July 2017, further consideration has been given to the connection of the Dearne Valley Line to the HS2 main line via the Sheffield Northern spur at Clayton. The connection is required to allow conventional compatible trains to run from Sheffield Midland Station onto the HS2 main line towards Leeds and the North. Design options available for this connection (Clayton junction) presented opportunities to optimise the operational performance of the junction, simplify the construction methods, create smaller structure and reduce the environmental impacts.
- 2.5.2 The following four options were taken forward to a more detailed appraisal where engineering and construction feasibility, cost and environmental impacts were considered:
- Option O: a grade separated junction where the northbound spur line would pass above the HS2 main line and the existing conventional Network Rail lines. Sheffield Northern spur (southbound) would diverge from a section of the Clayton north embankment, and continue onto the Frickley embankment. The Clayton viaduct, 950m in length and up to 20m in height, would carry the Sheffield Northern spur (southbound) over the HS2 main line, Dearne Valley Line existing railway, and pass onto the Church Field Road embankment, 14m in height. The Sheffield Northern spur (southbound) would then run in the Thurnscoe cutting to connect with the Dearne Valley Line at Thurnscoe. The Sheffield Northern spur (northbound) would diverge from a section of the Clayton north embankment in south-west direction, and then pass into the Church Field Road cutting, 3.2km in length and up to 19m in depth, to connect with the Dearne Valley Line at Thurnscoe;
 - Option A: a flat junction arrangement where the northbound spur line would pass beneath the HS2 main line. Sheffield Northern spur (southbound) would diverge from a section of the Clayton north embankment and continue onto the Frickley cutting, which would carry the Sheffield Northern spur (southbound) under the HS2 main line, Dearne Valley Line existing railway, and pass under Church Field Road. The Sheffield Northern spur (southbound) would then run in the Thurnscoe cutting to connect with the Dearne Valley Line at Thurnscoe. The Sheffield Northern spur (northbound) would diverge from a section of the Clayton north embankment in south-west direction, and then pass into the Church Field Road cutting, 3.2km in length, and up to 19m in depth to connect with the Dearne Valley Line at Thurnscoe;
 - Option B (the Proposed Scheme): a grade separated junction, similar to Option O, where the Sheffield Northern spur (northbound) would pass above the HS2 main line and the conventional Network Rail lines. Sheffield Northern spur

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(southbound) would diverge from a section of the Clayton north embankment and continue onto the Frickley embankment. The Clayton viaduct, 950m in length and up to 20m in height, would carry the Sheffield Northern spur (southbound) over the HS2 main line, Dearne Valley Line existing railway, and pass onto the Church Field Road embankment, 14m in height. The Sheffield Northern spur (southbound) would then run in the Thurnscoe cutting to connect with the Dearne Valley Line at Thurnscoe. The Sheffield Northern spur (northbound) would diverge from a section of the Clayton North embankment in south-west direction, and then pass into the Church Field Road cutting, 3.2km in length and up to 19m in depth, to connect with the Dearne Valley Line at Thurnscoe; and

- Option C: a split-level option where the junction would be grade separated at the connection with the conventional Network Rail lines, and with retaining walls between the spur lines and the 40m deep cutting carrying the HS2 main lines. Sheffield Northern spur (southbound) would diverge from a section of the Clayton north embankment and continue onto the Frickley embankment. The Clayton viaduct, 950m in length and up to 20m in height, would carry the Sheffield Northern spur (southbound) over the HS2 main line, Dearne Valley Line existing railway, and pass onto the Church Field Road embankment, 14m in height. The Sheffield Northern spur (southbound) would then run in the Thurnscoe cutting to connect with the Dearne Valley Line at Thurnscoe. The Sheffield Northern spur (northbound) would diverge from a section of the Clayton north embankment in south-west direction, and then pass into the Church Field Road cutting, 3.2km in length and up to 19m in depth, to connect with the Dearne Valley Line at Thurnscoe.

2.5.3 Table 7 provides a summary of the outcomes of the preliminary appraisal of the alternative options described above.

Table 7: Consideration of local alternatives for Sheffield Northern spur

Option	Outcome of analysis	Further action/considerations
Option O	<p>Similar number of demolitions required at Robin Hill Lane compared to the Proposed Scheme.</p> <p>Less likelihood of impacts on designated heritage assets (South Kirkby Camp Scheduled Monument and Grade II listed Vissitt Manor) compared to the Proposed Scheme.</p> <p>Less visual impacts on sensitive receptors, including those associated with Howell Wood; the settlement of South Kirkby; Avenue Farm; Brierley Boarding Kennels; and businesses at the junction between Common Road and Southmoor Road, compared to the Proposed Scheme.</p> <p>Less construction and/or operational visual, noise and air quality impacts on nearby sensitive receptors compared to the Proposed Scheme.</p> <p>Similar water resources and flood risk impacts to the Proposed Scheme.</p> <p>Reduced operational performance compared to the Proposed Scheme.</p>	This option will not be subject to further consideration

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Option	Outcome of analysis	Further action/considerations
	<p>Similar technical and engineering complexities to the Proposed Scheme.</p> <p>Similar construction programme compared to the Proposed Scheme.</p> <p>Similar cost compared to the Proposed Scheme.</p>	
Option A	<p>Similar number of demolitions required at Robin Hill Lane compared to the Proposed Scheme.</p> <p>Option would require the demolition of the Grade II listed building, Vissitt Manor, similar to the Proposed Scheme.</p> <p>Similar impacts on the setting of South Kirkby Camp Scheduled Monument compared to the Proposed Scheme.</p> <p>Similar construction and/or operational, noise and air quality impacts on nearby sensitive receptors compared to the Proposed Scheme.</p> <p>Similar visual impact on sensitive receptors, including those associated with Howell Wood; the settlement of South Kirkby; Avenue Farm; Brierley Boarding Kennels; and businesses at the junction between Common Road and Southmoor Road, compared to the Proposed Scheme.</p> <p>Similar construction and/or operational visual, noise and air quality impacts on nearby sensitive receptors compared to the Proposed Scheme.</p> <p>Similar water resources and flood risk impacts to the Proposed Scheme.</p> <p>Reduced operational performance compared to the Proposed Scheme.</p> <p>Fewer technical and engineering complexities to the Proposed Scheme.</p> <p>Similar construction programme compared to the Proposed Scheme.</p> <p>Lower cost compared to the Proposed Scheme.</p>	This option will not be subject to further consideration
Option B (the Proposed Scheme)	<p>Similar number of demolitions required at Robin Hill Lane compared to alternative options.</p> <p>Option would require the demolition of the Grade II listed building, Vissitt Manor, similar to Option A and Option C. Impacts on the setting of South Kirkby Camp Scheduled Monument compared to the Option O.</p> <p>Increased visual impact on sensitive receptors, including those associated with Howell Wood; the settlement of South Kirkby; Avenue Farm; Brierley Boarding Kennels; and businesses at the junction between Common Road and Southmoor Road, compared to Option O. However, similar visual impacts to Option A and less visual impacts compared to Option C.</p> <p>Similar construction and/or operational, noise and air quality impacts on nearby sensitive receptors compared to Option A, but less than for Option C.</p>	This is the selected option taken forward into the Proposed Scheme

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Option	Outcome of analysis	Further action/considerations
	<p>Similar water resources and flood risk impacts to the alternative options.</p> <p>Better operational performance compared to alternative options.</p> <p>Similar technical and engineering complexities to Option O. Greater technical and engineering complexities compared to Option A. Less technical and engineering complexities compared to Option C.</p> <p>Similar construction programme compared to alternatives options.</p> <p>Similar cost compared to Option O. Greater cost compared to Option A. Lower cost compared to Option C.</p>	
Option C	<p>Similar number of demolitions required at Robin Hill Lane compared to the Proposed Scheme.</p> <p>Option would require the demolition of the Grade II listed building, Vissitt Manor, similar to the Proposed Scheme. Similar impacts on the setting of South Kirkby Camp Scheduled Monument compared to the Proposed Scheme.</p> <p>Greater visual impacts on sensitive receptors, including those associated with Howell Wood; the settlement of South Kirkby; Avenue Farm; Brierley Boarding Kennels; and businesses at the junction between Common Road and Southmoor Road compared to the Proposed Scheme.</p> <p>Greater construction and/or operational, noise and air quality impacts on nearby sensitive receptors compared to the Proposed Scheme.</p> <p>Similar water resources and flood risk impacts to the Proposed Scheme.</p> <p>Reduced operational performance compared to the Proposed Scheme.</p> <p>Greater technical and engineering complexities to the Proposed Scheme.</p> <p>Similar construction programme compared to the Proposed Scheme.</p> <p>Greater cost compared to the Proposed Scheme.</p>	This option will not be subject to further consideration

2.5.4 Option B was taken forward into the Proposed Scheme. Overall, Option B would have similar environmental impacts compared to the other options. It was selected as the preferred option because it would have better operational performance compared to Options O, A and C, as it is grade separated and would therefore remove conflicting crossing movements, which would increase capacity and provide improved timetable flexibility. In addition, Option B would provide improved operational performance by allowing HS2 trains to sufficiently accelerate and decelerate before joining and after leaving the Sheffield Northern Spur, which would avoid disrupting the services on the HS2 main line.

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 initial preferred route announcement in November 2016, HS2 Ltd has carried out a programme of informal stakeholder engagement and formal consultation with a broad range of stakeholders.
- 3.1.3 A variety of mechanisms have been used to enable an open and inclusive approach to engagement and consultation, reflecting the differing requirements and expectations of stakeholders.
- 3.1.4 Whilst stakeholders have informed the design and assessment of the Proposed Scheme to-date, it is important to note that this is an ongoing process. Feedback from the consultation on the working draft ES and emerging scheme design and ongoing engagement will continue to be considered as part of the ongoing design and assessment of the Proposed Scheme ultimately presented in the formal ES. There will be further consultation undertaken on the formal ES by Parliament following deposit of the hybrid Bill.

3.2 Key stages of Phase 2b engagement and consultation

- 3.2.1 The process of engagement remains ongoing. A summary of engagement undertaken or underway since the initial preferred route announcement in November 2016 is provided in Table 8.

Table 8: Mechanisms and timeline of stakeholder engagement since route announcement

Engagement and consultation activity and mechanisms	Date
Phase 2b initial preferred route announcement	15 November 2016
Phase 2b route refinement and property consultations	15 November 2016 – 9 March 2017
Phase 2b information events to support the route refinement and property consultations	January -February 2017
Confirmation of Phase 2b route announcement	17 July 2017
Start date of engagement with local communities and stakeholders on the confirmed Phase 2b route	July 2017
Consultation on the draft EIA and Equality Impact Assessment (EQIA) Scope and Methodology Report (SMR) to inform the EIA and EQIA and the proposed relocation of the Eastern Leg Rolling Stock Depot	17 July 2017 – 29 September 2017
Phase 2b information events to support SMR and Eastern Leg Rolling Stock Depot consultations	September 2017
Phase 2b information events to provide update on design development	June – July 2018

Engagement and consultation activity and mechanisms	Date
Phase 2b consultation on the working draft ES and working draft EQIA	October – December 2018

Draft EIA SMR consultation

- 3.2.2 The EIA SMR was formally consulted on between July and September 2017 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. One hundred and seven responses to the SMR were received, as a result of which changes were made to the SMR. These are set out in the SMR Consultation Summary Report published alongside this working draft ES, and will be used to inform the assessment methodologies applied for the formal ES.

Consultation on the working draft ES and ongoing engagement

- 3.2.3 As set out in Volume 1, the working draft ES is being formally consulted upon. The consultation is taking place during October 2018 to December 2018. A parallel consultation on the working draft equality impact assessment (EQIA) is also being undertaken during this period. As part of the process of consultation, stakeholders are invited to comment on the Proposed Scheme and the working draft ES and EQIA Reports which inform it.
- 3.2.4 These consultations and wider feedback from ongoing stakeholder engagement will continue to be considered as part of the ongoing design of the Proposed Scheme and the assessment and identification of mitigation opportunities for the Ravenfield to Clayton area. A consultation summary report will be published with the formal ES explaining how the responses have been taken into consideration.

3.3 Informing the Proposed Scheme

- 3.3.1 The main purpose of stakeholder engagement and consultation at this early stage is to inform the Proposed Scheme. Volume 1 details the engagement and consultation undertaken prior to initial preferred route announcement in November 2016.
- 3.3.2 The main themes to emerge from stakeholder engagement in the Ravenfield to Clayton area since the initial preferred route announcement in November 2016, and which are informing the Proposed Scheme are:
- compensation for temporary and permanent land requirements during construction and operation including the Shimmer Estate;
 - refining the location of balancing ponds and environmental mitigation to minimise the loss of agricultural land;
 - provision of access to severed agricultural land, including access under viaducts and the provision of farm access tracks including at Hooton Roberts, Barnburgh and, Hickleton;
 - retention or realignment of PRow in Doncaster including in Denaby, Barnburgh and Hickleton);

- temporary or permanent changes to road access including the A635 at Hickleton);
- congestion on A635 Barnsley Road in Hickleton during construction;
- impacts on access to local community educational/care/sporting/leisure/cultural facilities including Howell Wood, Frickley Church and Bilham Belvedere;
- range of impacts from the viaduct on communities in Mexborough, including the Shimmer Estate;
- impacts to local businesses including Denaby Main Industrial Estate and in Mexborough;
- potential severance of communities during construction and operation;
- relocation of accommodation bridges close to existing access points;
- visual impact of proposals on Barnburgh, Hickleton, and Firsby;
- potential impact on ecology and biodiversity, and opportunities for environmental mitigation, including at the River Don and River Dearne valleys, Howell Wood, and local wildlife sites such as Thunder Hole and Denaby Ings;
- consideration of mining and geotechnical factors within design development, including at Hooton Roberts;
- discussion of alternative engineering options in the area, including tunnelling; and
- the range of impacts of the Sheffield Northern spur at Clayton.

3.3.3 Stakeholder feedback will continue to be considered as part of the ongoing design of the Proposed Scheme and will be reported in the formal ES.

3.4 Engagement and consultation with stakeholder groups

Communities

3.4.1 Community stakeholders in the Ravenfield to Clayton area include a range of local interest groups, local facility and service providers, schools and educational establishments, cultural, leisure and sports stakeholders. Engagement on the Proposed Scheme has been undertaken with community walking groups, local residents groups and constituency surgeries led by Ed Miliband MP.

3.4.2 The purpose of this engagement has been to give affected communities the opportunity to raise issues in relation to the Proposed Scheme. Community stakeholders have been provided with information on the development of the Proposed Scheme, as a basis from which to identify potential impacts and opportunities for mitigation within the local area, reflecting local conditions and issues.

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- 3.4.3 Engagement has been, and will continue to be, undertaken with schools and educational establishments, in particular, with those within proximity to the Proposed Scheme and those with specialist interests or catering to the needs of vulnerable people within the community. This has informed the assessment of community and health in the working draft ES, whilst also informing the separate EQIA being undertaken in parallel to the EIA.
- 3.4.4 As part of the consultation process for this working draft ES, public events are being held in communities across the route of the Proposed Scheme. Communities have been notified of these events through a range of publicity in the community area and also through the www.gov.uk/hs2 website. Documents have been made available online and in community libraries. Members of local communities and other interested parties have been invited to engage on issues pertinent to the working draft ES and the development of the Proposed Scheme design.
- 3.4.5 Table 9 summarises key engagement undertaken with community stakeholders to date, including the focus of the engagement and how this has informed the design of the Proposed Scheme.

Table 9: Engagement to date with community stakeholders

Stakeholder	Area of focus
Ed Miliband MP	Engagement with MP for Doncaster North to brief on the Proposed Scheme. Regular contact with MP's Westminster and Doncaster offices to provide further information and advice to resolve constituent queries. Surgeries conducted to answer questions, give information, offer support, and try to resolve issues and concerns.
John Healy MP	Regular contact with MP for Wentworth and Dearne's office to provide further information on Proposed Scheme and advice to resolve constituent queries.
Caroline Flint MP Office	Engagement with MP office for Don Valley regarding resident property schemes and support available.
Mexborough First Councillors	Introductory meeting to brief the councillors on the Proposed Scheme. Regular meetings and communication to establish relationship on the Proposed Scheme and resolving constituent's queries and concerns.
Mexborough Advisory Forum	Provide advice and support to the residents and homeowners in Mexborough and on the Shimmer Estate. To assist owner-residents of the Shimmer Estate to secure a local comparable home.
Doncaster High Speed Rail College	Initial meeting to establish relationships and discuss sharing of facilities and resources.
Doncaster Chambers of Commerce	Introductory meeting on the Proposed Scheme.
Local residents	Meetings, home visits and surgeries held to discuss concerns of impacted residents about the Proposed Scheme and to resolve specific concerns and reassurances as required.
Women only walks	Accompany group to walk on local PRow routes impacted by the Proposed Scheme.
Hickleton local ramblers group	Accompany group to walk on local PRow routes impacted by the Proposed Scheme and exchange information and understand local rights of way.
Residents of The Shimmer Estate	Engagement to discuss concerns of impacted residents detailing the Proposed Scheme timeline, key milestones and information, and advice on property related matters as well as various other aspects regarding the Proposed Scheme.

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Stakeholder	Area of focus
Residents of Mallory Drive	Engagement to discuss concerns of impacted residents about the Proposed Scheme including one to one meetings and surgeries.
Residents of Oulton Rise	Engagement to discuss concerns of impacted residents about the Proposed Scheme including one to one meetings and surgeries.

Local authorities and parish councils

- 3.4.6 Direct engagement has been offered to and undertaken with borough and parish councils within the Ravenfield to Clayton area. The purpose of this engagement is to collate local baseline information and knowledge to inform the design and assessment, identify and understand local issues and concerns, provide access to wider stakeholders and communities and provide a mechanism for ongoing dialogue and discussion on the assessment and design development.
- 3.4.7 Engagement has focused on the technical areas which inform the assessment, including, landscape and visual, sound, noise and vibration and traffic and transport, amongst other topics.
- 3.4.8 Key issues identified during engagement with local authorities and parish councils include those summarised in Table 10.

Table 10: Engagement to date with local authorities and parish councils

Stakeholder	Area of focus
Sheffield City Region Combined Authority	Engagement regarding the Parkway Station strategy
Doncaster Metropolitan Borough Council	General introductory and project update meetings, including briefings to Council leaders. Discussion on needs of LA, including approach to engagement with stakeholders.
	Meetings with technical leads to collate data and discuss key assessment topics including: air quality; community and equality issues; ecology; flood risk, drainage and water; historic environment; landscape and visual issues; land quality; road diversions and realignments; sound, noise and vibration; traffic and transport; utilities; and waste and material resources.
	The Shimmer Estate and Mexborough Advisory Forum.
	Engagement regarding the Parkway Station strategy
	Seeking information related to planned and committed developments.
Barnsley Metropolitan Borough Council	General introductory and project update meetings, including briefings to the Leaders and Chief Executives. Discussion on needs of LA, including approach to engagement with stakeholders.
	Meetings with technical leads to collate data and discuss key assessment topics including: air quality; community and equality issues; health; ecology; flood risk, drainage and water; landscape and visual issues; land quality; road diversions and realignments; sound, noise and vibration; traffic and transport; utilities; and waste and material resources.
	Engagement regarding the Parkway Station strategy
	Engagement with Barnsley Metropolitan Borough Council regarding landscape and visual assessment, and geotechnical and mining constraints through South Yorkshire Mining Advisory Service.

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Stakeholder	Area of focus
Rotherham Metropolitan Borough Council	General introductory and project update meetings, including briefings to the Leaders and Chief Executives. Discussion on needs of LA, including approach to engagement with stakeholders.
	Meetings with technical leads to collate data and discuss key assessment topics including: air quality; community and equality issues; ecology; flood risk, drainage and water; landscape and visual issues; land quality; sound, noise and vibration; traffic and transport; utilities; and waste and material resources.
	Seeking information related to planned and committed developments.
	Meeting with LA to discuss the design development, key design challenges and approach to working together.
	A meeting with the Rotherham Metropolitan Borough Council Growth Board was also held to provide an update on the scheme. The potential parkway station and business opportunities were also discussed.
	Engagement regarding the Parkway Station strategy
Conisbrough Parks Parish Council	Introductory meeting to establish relationships based on producing the best design for their community, to understand local concerns, to explain the hybrid bill process and design process and to initiate a schedule for any further meetings required to focus on environmental and engineering issues.
Hooton Roberts Parish Meeting	Mitigation session to show the published design of the Proposed Scheme for comments and gather feedback.
Denaby Parish Council	Introductory meeting to establish relationships based on producing the best design for their community, to understand local concerns, to explain the hybrid bill process and design process and to initiate a schedule for any further meetings required to focus on environmental and engineering issues.
Ravenfield Parish Council	Introductory meeting to establish relationships based on producing the best design for their community, to understand local concerns, to explain the hybrid bill process and design process and to initiate a schedule for any further meetings required to focus on environmental and engineering issues.
Hickleton Parish Council	Introductory meeting to establish relationships based on producing the best design for their community, to understand local concerns, to explain the hybrid bill process and design process and to initiate a schedule for any further meetings required to focus on environmental and engineering issues.

3.4.9 Councils will continue to be engaged as part of the design development of the Proposed Scheme with ongoing dialogue on key topics such as highways, PRoW and the draft Code of Construction Practice (CoCP)²⁰.

Expert, technical and specialist groups

3.4.10 Engagement has also been undertaken with expert, technical and specialist groups to provide appropriate specialist input, as and where appropriate. Stakeholders engaged to date include:

- Animal and Plant Health Agency;

²⁰ Supporting document: Draft Code of Construction Practice

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- British Geological Survey;
- Campaign to Protect Rural England;
- Canal and River Trust;
- Coal Authority;
- Dearne Valley Landscape Partnership;
- Department for Environment, Food and Rural Affairs;
- Doncaster Clinical Commissioning Group;
- English Heritage;
- Environment Agency;
- Fera Science Ltd;
- Forestry Commission;
- Highways England;
- Historic England;
- Inland Waterways Association;
- National Farmers Union;
- National Trust;
- Natural England;
- Network Rail;
- Public Health England;
- The Ramblers;
- Royal Agricultural Society;
- Royal Society for the Protection of Birds;
- Royal Society of Wildlife Trusts/The Wildlife Trusts (i.e. Sheffield and Rotherham Wildlife Trust and Yorkshire Wildlife Trust);
- Sheffield City Region Local Enterprise Partnership;
- Sheffield and Rotherham Wildlife Trust;
- South Yorkshire Archaeology Service;
- South Yorkshire Mining Advisory Service;
- Trans Pennine Trail; and
- Woodland Trust.

- 3.4.11 A key purpose of this engagement has been to obtain detailed specialist baseline information to inform the working draft ES and the design development of the Proposed Scheme.
- 3.4.12 Further information about topic-specific engagement is provided in Sections 4 to 15, where relevant.

Utilities

- 3.4.13 Engagement is also ongoing with utility companies and statutory stakeholders such as National Grid Transmission, Northern Powergrid, Yorkshire Water Services Limited, Cadent Gas, CLH Pipeline System, BT Openreach, Virgin Media, Instalcom and Zayo to establish what infrastructure exists in the Ravenfield to Clayton area and how it may need to be modified as part of the Proposed Scheme.

Directly affected individuals, major asset owners and businesses

- 3.4.14 This group includes those with property potentially affected by the Proposed Scheme, including individuals, major asset owners and businesses within the Ravenfield to Clayton area.
- 3.4.15 Engagement is ongoing with farmers and growers whose land or property would be directly affected by the Proposed Scheme whether permanently or temporarily. The purpose of this engagement has been to obtain baseline information and provide them with the opportunity to raise issues and discuss mitigation in relation to the Proposed Scheme. For example, the location of environmental mitigation will seek to reduce the loss of agricultural land and the location of accommodation overbridges across the route will be considered to better reflect the needs of farmers.
- 3.4.16 Information gathered from seven farm visits have informed the assessment presented in this working draft ES. Farm visits are ongoing and engagement will continue as the design and assessment develops.
- 3.4.17 Engagement is also continuing with key representatives for the farmers and growers industry, in particular with the National Farmers Union and Country Land and Business Association.
- 3.4.18 A route-wide programme of engagement is ongoing, in parallel to the working draft ES process. This engagement provides affected individuals, major asset owners and businesses the opportunity to raise issues and opportunities in relation to the Proposed Scheme and to gain an understanding of compensation and assistance available for property owners. Within the Ravenfield to Clayton area, an information event was held at Mexborough Business Centre on 19 June 2018. Facilities were available at the event for affected individuals, major asset owners and businesses to have private meetings with HS2 staff.
- 3.4.19 Engagement has been undertaken with the Guinness Partnership and Strata Homes Limited associated with the impacts of the Proposed Scheme on the Shimmer Estate.
- 3.4.20 HS2 Ltd is continuing to engage with directly affected individuals and major asset owners as the design and assessment develops.

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 Ravenfield to Clayton 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 commenced and is ongoing. 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 within a Phase 2b Farmers and Growers Guide²¹.
- 4.1.3 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: LA13 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, Introduction and Methodology (Section 8) and the Scope and Methodology Report (SMR)²².
- 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)²³ system, which classifies agricultural land into 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

²¹ To be prepared for Phase 2b in due course, as per previous Phases found here: <https://www.gov.uk/government/publications/hs2-guide-for-farmers-and-growers>

²² Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

²³ 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*.

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 commercial land use feature providing resources such as timber or fuel. The impacts on this feature have been calculated quantitatively in terms of the physical extent of commercial forestry land required. The qualitative effects on forestry land and woodland are addressed principally in Section 7, Ecology and biodiversity and Section 11, Landscape and visual.
- 4.2.5 The primary functions provided by soils other than for food and biomass production, such as flood water attenuation, carbon storage or the support of ecological habitats, are identified in this section and the ability of the soils to fulfil their primary functions after construction of the Proposed Scheme is assessed. 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, Ecology and biodiversity; Section 9, Historic environment; Section 11, Landscape and visual; and Section 15, Water resources and flood risk.
- 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. Where any part of a farm or rural holding is required for the construction and operation of the Proposed Scheme, the whole land holding is considered to be part of the study area for impacts on this receptor.
- 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 buildings and other farm infrastructure on the land holding will not be replaced as this would ultimately be at the discretion of the landowner. For this reason, financial compensation is not a consideration in the assessment of effects on farm holdings, as set out under Impacts on holdings below. 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 Ravenfield to Clayton 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 Ravenfield to Clayton area is provided in Section 10, Land quality and Section 15, Water resources and flood risk. The underlying geology of the study area is mapped by the British Geological Survey

(BGS)²⁴. Superficial deposits of alluvium are mapped between Conisbrough and Mexborough and continue around the northern periphery of Mexborough in association with the Rivers Don and Dearne. Alluvial deposits mostly include consolidated silty clay but may also contain silt, sand, peat and gravel. Alluvium is also associated with Frickley Beck and Howell Beck in the north of the study area.

- 4.3.3 Superficial glaciofluvial deposits are mapped to the north and north-east of Hooton Roberts and primarily include sand and gravel.
- 4.3.4 The bedrock geology is of Carboniferous-age, of the Pennine Coal Measures Group. The Pennine Coal Measures Group, of which the Pennine Upper and Middle Coal Measures are components, includes interbedded grey mudstones, siltstones and pale grey sandstones. Coal seams are common.
- 4.3.5 The Pennine Upper Coal Measures Formation forms a band aligned north to south and is mapped from Bramley to west of Conisbrough, and from east of Harlington to the north of the study area. The Pennine Middle Coal Measures Formation is mapped between Conisbrough and Harlington.
- 4.3.6 The Pennine Upper Coal Measures Formation is intersected by narrower bands of fine- to medium-grained yellowish-brown sandstone, including Ravenfield, Wickersley and Ackworth Rock. The Pennine Middle Coal Measures Formation is intersected by Mexborough Rock, which comprises distinctive red-purple sandstone.
- 4.3.7 An outcrop of the Cadeby Formation extends south-west from Conisbrough. The formation includes dolostone (carbonate rock) with subordinate mudstone, siltstone and sandstone.

Topography and drainage

- 4.3.8 Topography in this study area is characterised by a series of outcrops and valleys, including the wide valleys of the Rivers Don and Dearne at Mexborough. Valley sides are largely irregular, with complex slopes, and are of variable steepness. Gradients range from shallow, less than seven degrees, to steeper slopes at some areas east of Ravenfield, at Old Denaby, to the north-east of Barnburgh and to the north of Clayton, where gradients exceed 7 degrees and may in some cases approach 18 degrees. Gradients steeper than 7 degrees preclude land from BMV quality.
- 4.3.9 The highest altitudes in the study area are at Ravenfield and north-east of Barnburgh/Hickleton at around 115m above Ordnance Datum (AOD).
- 4.3.10 At Denaby Main, the land falls from around 50m to 30m AOD, to the valley of the River Don. Barnburgh Cliff forms a steep south-west facing escarpment falling from 105m to around 85m AOD, from where moderate, irregular slopes continue to fall to the south-west toward Barnburgh and the River Dearne beyond. North of Clayton, the highest ground is at around 85m AOD and falls to around 40m AOD in the valley of Howell Beck.

²⁴ British Geological Survey (2018). Geology of Britain viewer. Available online at: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

- 4.3.11 The floodplains of the River Dearne and the River Don at Mexborough lie at around 15 to 20m AOD, and the valley footslopes are shallow. The rivers are fed by a series of brooks and channels, including the Firsby and Hooton Brooks to the north of Ravenfield and the Ludwell Spring to the south-east of Barnburgh. Frickley Beck between Hooton Pagnell and Clayton, and Howell Beck drain land in the northern part of the study area.
- 4.3.12 The Environment Agency's Flood Map for Planning (rivers and sea)²⁵ has been used to scope the baseline flood risk for flooding from main rivers and ordinary watercourses. Land at risk of flooding is confined to the channels and floodplains of the River Don, River Dearne and Frickley Beck, in which the land is predominantly classed as Flood Zone 3²⁶ or, with large flood storage areas²⁷ also associated with the rivers. Further details are provided in Section 15, Water resources and flood risk.

Description and distribution of soil types

- 4.3.13 The broad characteristics of the soils likely to be present in the study area are described by the Soil Survey of England and Wales²⁸ and their general distribution is shown on the National Soil Map²⁹. Soils possessing similar characteristics are amalgamated into associations.
- 4.3.14 There are three known groups of soil associations in this study area. The presence of each group has been confirmed in parts of the study area by detailed soil survey data obtained from published soil survey data.
- 4.3.15 The most prevalent group of associations includes the Bardsey, Dale and Brickfield 3 associations. Bardsey soils are the most extensive in the study area, mapped east of Ravenfield, between Hooton Roberts and Denaby Main, to the east of Barnburgh and between Clayton and South Kirkby. Profiles are characterised by stoneless clay loam or sandy clay loam topsoils overlying grey clay or silty clay subsoils. Brickfield 3 soils are typically of clay loam throughout. Profiles of the Dale association are characterised by stoneless clay or clay loam topsoil over grey clay subsoil. Profiles of the Bardsey and Brickfield 3 associations may be imperfectly or poorly drained, of Wetness Class³⁰ (WC) III or IV, whilst Dale soils are of WC IV, or potentially V.
- 4.3.16 This group of soils has been identified in surveys undertaken to the south-west of Conisbrough³¹ and north-east of Mexborough³². Topsoil comprising medium or heavy clay loam or silty clay loam overlies slowly permeable clay or heavy clay loam subsoils. Most of the soils are of WC IV, with others of WC III.

²⁵ Environment Agency (2018). Flood Map for Planning. Available online at: <https://flood-map-for-planning.service.gov.uk/>

²⁶ The Environment Agency defines Flood Zone 3 as land having a 1 in 100 or greater annual probability of river flooding, or where water has to flow or be stored in times of flood. Flood Zone 2 is defined as land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding.

²⁷ Flood storage areas recognised by the Environment Agency generally lie within the [floodplain](#), but are isolated by purpose-built walls or embankments

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 bands

³¹ ADAS (1994). Statement of Physical Characteristics and Agricultural Land Classification Validation Report – Conisbrough OCCS & Landfill Site, South Yorkshire. Job no: 152/94

³² MAFF (1991). Agricultural Land Classification, Pastures Road, Mexborough. Project no: 020/91

- 4.3.17 The next most prevalent group of associations includes soil of the Rivington 1 and Aberford associations, which are well drained (WC I). The Rivington 1 association is mapped from the east of Ravenfield to Hooton Roberts, and also to the north of Mexborough, and comprises sandy loam or sandy silt loam topsoil overlying sandstone or extremely stony sandy loam.
- 4.3.18 The Aberford association is mapped within a small area between Hooton Roberts and Conisbrough, and a wider area from north-east of Barnburgh to north of Hickleton, and comprises calcareous clay loam throughout.
- 4.3.19 Soil surveys undertaken at Conisbrough and Mexborough identify this group of associations to include profiles comprising medium clay loam, silty clay loam or sandy loam topsoils over sandy loam subsoil developed from sandstone bedrock.
- 4.3.20 The least prevalent soil association mapped is the Conway association, which is present within the river channels around Mexborough. Soil profiles in this association consist of stoneless silty clay loam throughout. Drainage of these soils is poor and the profiles typically of WC IV.

Soil and land use interactions

Agricultural land quality

- 4.3.21 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, topography and drainage.
- 4.3.22 The main soil properties that affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility.
- 4.3.23 Climate within this area does not in itself place any limitation on agricultural land quality. However, the interactions of climate with soil characteristics are important in determining the wetness and droughtiness³³ limitations of the land.
- 4.3.24 The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point dataset³⁴ for five points within the study area. These data show climate in the area to be moderately cool and dry. The number of Field Capacity Days³⁵ (FCDs), when the moisture deficit³⁶ is zero, ranges from 128 to 135 days per annum. This is lower than average for lowland England (where the average is 150 days) and generally favourable for providing opportunities for agricultural cultivations and soil handling. Moisture deficits, which give an indication of the liability of soils to droughtiness in summer, are moderate to moderately large.

³³ 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

³⁴ Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*

³⁵ Field Capacity Days (FCD) is a meteorological parameter which estimates the duration of the period when the soil moisture deficit is zero. Soils usually return to field capacity (zero deficit) during the autumn or early winter and the field capacity period, measured in days, ends in the spring when evapotranspiration exceeds rainfall and a moisture deficit begins to accumulate.

³⁶ 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

- 4.3.25 Site factors include gradient and microrelief³⁷, which are limiting to agricultural land quality in some places throughout this study area, in particular to the east of Ravenfield, at Denaby Main, to the north-east of Barnburgh and to the north of Clayton. Where slopes are between 7 and 11 degrees the limitation of ALC is to Subgrade 3b, whilst slopes between 11 and 18 degrees are limited more severely to Grade 4. Flood risk is also likely to affect agricultural land quality within valleys of the River Don and the River Dearne, and in the area of the Frickley Beck, limiting agricultural land quality to Subgrade 3b. Further details are provided in Section 15, Water resources and flood risk.
- 4.3.26 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 WC 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 moisture retention of different soil textures and thicknesses of each soil horizon, soil structures, stone content and moisture deficits.
- 4.3.27 The most prevalent soil types, comprising imperfectly or poorly drained profiles of the Bardsey, Dale and Brickfield 3 associations, are most affected by soil wetness and workability. As confirmed by survey data at Conisbrough, under the climatic conditions of the study area, poorly drained Bardsey and Brickfield 3 association soils of WC IV with clay loam or sandy clay loam topsoils are limited to Subgrade 3b, as are better drained (WC III) profiles with heavy clay loam topsoils. Profiles of WC III with medium loamy topsoils are less severely limited, to Subgrade 3a. Poorly drained Dale association soils of WC IV with clay loam or clay topsoil are similarly limited to Subgrade 3b, and those of WC V are limited to ALC Grade 4.
- 4.3.28 The second most prevalent soils, comprising well drained profiles of WC I of the Rivington 1 and Aberford associations are most affected by droughtiness, the severity of which will be determined by such factors as topsoil textures, stone contents and depth to the sandstone bedrock. As moisture deficits are moderate to moderately large, droughtiness limitations are likely to be slight to moderate, to Grade 2 or Subgrade 3a, with small areas of Subgrade 3b.
- 4.3.29 The surveys at Conisbrough and Mexborough also identified this soil group. Profiles including sandy loam, medium clay loam or sandy clay loam topsoil over predominantly sandy loam subsoil and sandstone are classified as Grade 2, limited slightly by droughtiness. At Mexborough, across high ground, moderately stony medium sandy loam profiles over sandstone are more severely limited to Subgrade 3b, due to a reduced capacity for water storage in freely drained profiles of relatively limited depth.
- 4.3.30 The alluvial Conway soils, comprising silty clay loam throughout, are most affected by wetness and workability. The survey data at Mexborough identified alluvial soils consisting of heavy clay loam throughout. The profiles are mostly of WC III (as they

³⁷ Microrelief is the complex change of slope angle and direction over short distances, or the presence of boulders or rock outcrops, which can severely limit the use of agricultural machinery

are subject to fewer than 130 FCDs), though a confined area is assessed as WC V due to its position within an area enclosed by ditches and in the floodplain of the River Don. The profiles are limited to Subgrade 3b and Grade 4 respectively.

4.3.31 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 Environment, Food and Rural Affairs (Defra) predictive mapping³⁸ shows that there is a moderate likelihood of encountering BMV agricultural land in the locality, which makes such land a resource of medium sensitivity in this study area.

4.3.32 The preceding assessment of agricultural land quality attributed to the soil associations is based on interpretation of publicly available data and will be confirmed by detailed soil survey, as will be the detailed distribution of soil types and land in the various grades of the ALC. The results will be reported in the formal ES.

Other soil interactions

4.3.33 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 England³⁹ and the Government's White Paper, *The Natural Choice: securing the value of nature*⁴⁰, 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.

4.3.34 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 7, Ecology and biodiversity and Section 11, Landscape and visual.

4.3.35 The floodplains of the River Don, River Dearne, and the numerous becks and brooks within the study area 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.

³⁸ Defra (2005), *Likelihood of Best and Most Versatile Agricultural Land*

³⁹ Defra (2009), *Soil Strategy for England*

⁴⁰ HM Government (2011), *The Natural Choice: securing the value of nature*

Land use

Land use description

- 4.3.36 Arable agriculture is the predominant rural land use in the study area, with nearly all the land used to grow arable crops in medium to large regularly-shaped fields. Land in pasture is generally found in the four areas: near Bramley, Barnburgh, Hickleton and Clayton.
- 4.3.37 Woodland is found throughout the study area, with the largest block being the ancient woodland at Howell Wood on the northern boundary of the study area. Smaller areas of ancient woodlands include Hooton Cliff, Denaby Wood, Stables Wood, Watchley Crag, Hickleton Spring and Unnamed Wood west of Barnburgh Cliff. Other woodland in the study area comprises Summer House Plantation, The Wilderness, Little Watchley, Church Plantation, Mushroom Plantation and Sheepwash Plantation. Howell Wood, Church Plantation, Mushroom Plantation and Sheepwash Plantation are all managed commercially, with regular selective thinning and felling of timber.
- 4.3.38 A number of environmental designations influence land use within the study area. The whole area is classified as a nitrate vulnerable zone, where statutory land management measures apply limiting the average amount of nitrogen from manufactured fertiliser and organic manures that can be applied to agricultural land in the area, in order to reduce nitrogen losses from agricultural sources to the natural water environment.
- 4.3.39 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 has been the main agri-environment scheme in England since 2015. The CSS incorporates elements of Environmental Stewardship, the England Woodland Grant scheme and Catchment Sensitive Farming grants.
- 4.3.40 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 over the coming years. The higher tier and mid-tier options in the CSS are 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. However, four new simpler non-competitive offers have been introduced in 2018 to complement the higher tier and mid-tier options and open up the scheme to more farmers and land managers. Holdings that have land entered into an agri-environment scheme are identified in Table 11.

Number, type and size of holdings

- 4.3.41 Table 11 sets out the current understanding of main farm holdings within this study area. The details of holdings have been obtained from face-to-face interviews with farm owners and occupiers. Publicly available sources have been used to obtain information about other farm holdings where it has not yet been possible to arrange interviews and this information will be validated as survey work continues. Other farm

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holdings may be identified as survey work continues and the design develops. Effects on these farm holdings will be reported in the formal ES.

4.3.42 Table 11 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.

Table 11: Summary of characteristics of holdings

Holding name	Holding type	Holding size (ha)	Diversification	Agri-environment scheme	Sensitivity to change
Birk Lodge Farm*	Arable and beef cattle	120	Not known	None	Medium
Manor Farm (Beal)*	Arable	1,467	Not known	Not known	Medium
Hill Top Farm*	Arable	94	Not known	Not known	Medium
Newlands Farm*	Arable	41	Not known	Not known	Medium
Land east of Hooton Cliff*	Arable	20	Not known	Not known	Medium
Manor Farm (Hooton Roberts)/Grange Farm	Arable and beef cattle	227	None	HLS	Medium
Holly Farm*	Arable	92	Not known	Not known	Medium
Ivy House Farm*	Equestrian (non-commercial)	4	Caravan storage	Not known	Low
Pastures Farm	Arable, beef cattle, pigs, sheep, chickens and equestrian	170	Broiler hatching business, residential and commercial lets, butchery, caravan park, fishing lake	None	Medium
Land North of River Don*	Rough grassland	18	Not known	Not known	Medium
Hall Farm*	Arable	224	Not known	Not known	Medium
Barnburgh Grange	Arable and potatoes	113	Contract farming	None	Medium
Land South of Ludwell Hill*	Equestrian (non-commercial)	1	Not known	Not known	Low

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Holding name	Holding type	Holding size (ha)	Diversification	Agri-environment scheme	Sensitivity to change
Dovecote Farm	Dairy (accommodation land) and arable	155	Cattery	None	Medium
Land farmed by Marshall Bros*	Arable	18	Not known	Not known	Medium
Manor Farm (Harlington)*	Arable	44	Not known	Not known	Medium
Hill Farm*	Arable	139	Not known	Not known	Medium
Crown Inn Farm*	Arable	64	Not known	Not known	Medium
Lodge Farm	Arable and potatoes	415	Grain drying/storage, agricultural contracting, residential let, fishing ponds and fertilizer mixing	None	Medium
Brodsworth Estate*	Arable	1,230	Not known	ELS + HLS	Medium
Hooton Pagnell Estate	Arable, potatoes and sheep	265	Wedding venue, residential lets	HLS	Medium
Frickley Estate	Arable and equestrian (international eventing course)	1,060	Equestrian, forestry, fishing ponds, 4x4 centre	ELS	High
Land north of Thurnscoe*	Arable	32	Not known	None	Medium

* It has not yet been possible to arrange farm impact assessment interviews with these holdings. Publicly available sources have been used to obtain the information presented.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 In addition to design features that would be included in the Proposed Scheme to mitigate the impacts on farm holdings, 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 would be stripped and stored. This would enable agricultural land that is required temporarily for construction to be returned to agricultural use. It would also enable soils to be returned to other uses, such as to support landscape planting and biodiversity, and to a suitable condition whereby they would be able to fulfil the identified function.

4.4.2

Compliance with the Code of Construction Practice (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 CoCP⁴¹ 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 of the draft CoCP);
- the provision of a method statement within the farm pack 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 would include any remediation measures necessary following the completion of works. Where they occur, there will be special provisions for handling peat and peaty soils (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).

⁴¹ Supporting document: Draft Code of Construction Practice

4.4.3 As part of the ongoing development of the design, the following measures have been incorporated at this stage to avoid or mitigate adverse impacts on agriculture, forestry or soils:

- Conisbrough Parks Bridleway 2 accommodation underbridge to mitigate severance of agricultural land at Newlands Farm (CT-06-467);
- Hickleton Bridleway 2 accommodation overbridge to mitigate severance of agricultural land at Lodge Farm (CT-06-473); and
- Top Lane overbridge to mitigate severance of agricultural land at Frickley Estate (CT-06-473).

4.4.4 The effect of severance of agricultural land for Hall Farm, Pastures Farm, Barnburgh Grange, Lodge Farm and Frickley Estate is also reduced by the ability of agricultural machinery to pass under the River Dearne viaduct and the Frickley viaduct.

4.4.5 As the design develops it will be necessary to continue to assess the requirement for access to severed parcels of agricultural land.

4.4.6 Upon completion of construction, it is currently anticipated that soils replaced for agricultural, forestry or landscape uses would 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 land. Some poorly or very poorly drained land, or land with heavier textured soils, such as the Bardsey, Dale, Brickfield 3 and Conway 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 would 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 and forestry 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 residual parcels of land no longer effective for agricultural use due to their size and/or shape as part of environmental mitigation works, such as ecological habitat creation.

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

- part of the operational railway or associated infrastructure 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 Interpretation of publicly available data shows that the Proposed Scheme is likely to require approximately 560ha of agricultural land within the Ravenfield to Clayton area during the construction phase, of which approximately 290ha (52%) are likely to be classified as BMV land (Grades 2 and 3a). This would be a medium magnitude of impact on BMV land.
- 4.4.11 As BMV land in this local area is a receptor of medium sensitivity, it is currently anticipated that the likely effect of the Proposed Scheme on BMV land during the construction phase would be moderate adverse, which would be significant.
- 4.4.12 Following completion of construction, temporary facilities would 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.

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 FCDs, as set out in the SMR. In areas with the highest number of FCDs, 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 with the fewest number of FCDs 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 Soils⁴². These principles would be followed throughout the construction period.
- 4.4.15 Clayey and seasonally waterlogged soils (including Bardsey, Dale, Brickfield 3 and Conway 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.
- 4.4.16 Implementation of the measures set out in the draft CoCP would reduce the magnitude of impact on soil. The detailed soil survey data will define the sensitivity of

⁴² Defra (2009), *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*

soil, and the assessment of the effects on soils to be disturbed will be reported in the formal ES.

Impacts on holdings

- 4.4.17 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 would occur simultaneously at the start of the construction period and it is the combined effect of both that would have the most impact on the holding. During the construction period, some agricultural land would be restored and the impact on individual holdings would reduce.
- 4.4.18 The effects of the Proposed Scheme on individual agricultural and related interests during the construction period will be reported in the formal ES. The formal ES will present the total area of land required on a particular holding during the construction period in absolute terms and as a percentage of the total area farmed. It will also show the area of land that would be returned to the holding following the construction period. The disruptive effects, principally of construction noise and dust, will be reported in the formal ES and assessed according to their effects on land uses and enterprises.
- 4.4.19 The potential temporary effects from the construction of the Proposed Scheme on individual agricultural and related interests are summarised in Table 12 for those holdings currently identified. The scale of the impact of land required to construct the Proposed Scheme is based on the likely proportion of land required from the holding during construction. The effects of severance will be judged on the ease and availability of access to severed land. With the implementation of the measures set out in the draft CoCP, these would generally be the same during and post construction.
- 4.4.20 The potential scale of effect is determined by combining the highest impact on the farm holding with the sensitivity of that holding, as set out in the SMR.

Table 12: Summary of temporary effects on holdings from construction

Holding name/ Sensitivity to change	Land potentially required	Potential severance impact	Potential scale of effect
Birk Lodge Farm Medium sensitivity	High	High	Major/moderate adverse
Manor Farm (Beal) Medium sensitivity	Negligible	Negligible	Negligible
Hill Top Farm Medium sensitivity	Medium	Negligible	Moderate adverse
Newlands Farm Medium sensitivity	High	High	Major/moderate adverse
Land east of Hooton Cliff Medium sensitivity	High	High	Major/moderate adverse

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Holding name/ Sensitivity to change	Land potentially required	Potential severance impact	Potential scale of effect
Manor Farm (Hooton Roberts)/Grange Farm Medium sensitivity	Low	Medium	Moderate adverse
Holly Farm Medium sensitivity	High	High	Major/moderate adverse
Ivy House Farm Low sensitivity	High	Negligible	Moderate adverse
Pastures Farm Medium sensitivity	Low	High	Major/moderate adverse
Land North of River Don Low sensitivity	High	Negligible	Moderate adverse
Hall Farm Medium sensitivity	Medium	High	Major/moderate adverse
Barnburgh Grange Medium sensitivity	High	Medium	Major/moderate adverse
Land South of Ludwell Hill Low sensitivity	High	Negligible	Moderate adverse
Dovecote Farm Medium sensitivity	Medium	Negligible	Moderate adverse
Land farmed by Marshall Bros Medium sensitivity	Negligible	Negligible	Negligible
Manor Farm (Harlington) Medium sensitivity	Negligible	High	Major/moderate adverse
Hill Farm Medium sensitivity	Low	Negligible	Minor adverse
Crown Inn Farm Medium sensitivity	High	Negligible	Major/moderate adverse
Lodge Farm Medium sensitivity	High	Medium	Major/moderate adverse
Brodsworth Estate Medium sensitivity	Negligible	High	Major/moderate adverse
Hooton Pagnell Estate Medium sensitivity	Low	Negligible	Minor adverse

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Holding name/ Sensitivity to change	Land potentially required	Potential severance impact	Potential scale of effect
Frickley Estate High sensitivity	Medium	High	Major adverse
Land north of Thurnscoe Medium sensitivity	High	Negligible	Major/moderate adverse

- 4.4.21 Overall, the construction of the Proposed Scheme could potentially affect 23 holdings in the Ravenfield to Clayton area temporarily. On the basis of information currently available, 19 holdings would potentially experience moderate, major/moderate or major adverse temporary effects from construction, which would be significant for each holding.
- 4.4.22 One holding at the Frickley Estate is currently anticipated to experience a major adverse temporary effect from construction. This holding includes a high sensitivity international equestrian eventing course which would experience a high temporary impact from construction. Furthermore, there would be high severance impacts across the wider estate.
- 4.4.23 It is anticipated that 12 farm holdings would experience major/moderate adverse temporary effects from construction, all of which are medium sensitivity arable or mixed arable and livestock holdings. Of these, Birk Lodge Farm, Newlands Farm, Land east of Hooton Cliff and Holly Farm would experience a high severance impact, and a high impact associated with the proportion of the holding required.
- 4.4.24 Six holdings would experience moderate adverse temporary effects from construction. The majority of these are medium sensitivity receptors which would experience medium impacts, but also include three low sensitivity holdings at Ivy House Farm, land north of the River Don and land south of Ludwell Hill which would experience a high impact.
- 4.4.25 Although financial compensation would be available under existing statutory arrangements to offset these impacts, it is not a consideration in the assessment of effects on farm holdings.

Permanent effects of construction

Impacts on agricultural land

- 4.4.26 Interpretation of publicly available data shows that the Proposed Scheme is likely to require approximately 320ha of agricultural land permanently within the Ravenfield to Clayton area, of which approximately 140ha (44%) are likely to be classified as BMV land (Grades 2 and 3a). This is a medium magnitude of impact on BMV land.
- 4.4.27 As BMV land in this local area is a receptor of medium sensitivity, it is currently anticipated that the likely effect of the Proposed Scheme on BMV land following construction would be moderate adverse, which would be significant.

Impacts on forestry land

- 4.4.28 It is currently anticipated that an area of approximately 3ha of commercial forestry land at Mushroom Plantation and Sheepwash Plantation would be required for the Proposed Scheme. These woodlands are managed mostly as commercial forestry and the impacts on these resources would primarily relate to reduced timber revenues. The effects on forestry land will be reported in the formal ES. The qualitative assessment of loss of woodland is presented in Section 7, Ecology and biodiversity.

Impacts on holdings

- 4.4.29 The potential permanent effects from the construction of the Proposed Scheme on individual agricultural and related interests are summarised in Table 13 for those holdings currently identified. The scale of the impact of land required to operate the Proposed Scheme is based on the likely proportion of land required from the holding. The potential 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 potential loss of or damage to farm capital, such as property, buildings and structures, and the consequential effects on land uses and enterprises.
- 4.4.30 The potential scale of effect is determined by combining the highest impact on the farm holding with the sensitivity of that holding, as set out in the SMR.

Table 13: Summary of permanent effects on holdings from construction

Holding name/ Sensitivity to change	Land potentially required	Potential severance impact	Potential impact on farm infrastructure	Potential scale of effect
Birk Lodge Farm Medium sensitivity	Medium	High	High	Major/moderate adverse
Manor Farm (Beal) Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Hill Top Farm Medium sensitivity	Low	Negligible	Negligible	Minor adverse
Newlands Farm Medium sensitivity	High	Low	Negligible	Major/moderate adverse
Land east of Hooton Cliff Medium sensitivity	High	High	Negligible	Major/moderate adverse
Manor Farm (Hooton Roberts)/Grange Farm Medium sensitivity	Negligible	Medium	Negligible	Moderate adverse
Holly Farm Medium sensitivity	High	High	Negligible	Major/moderate adverse
Ivy House Farm Low sensitivity	High	Low	Negligible	Moderate adverse

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Holding name/ Sensitivity to change	Land potentially required	Potential severance impact	Potential impact on farm infrastructure	Potential scale of effect
Pastures Farm Medium sensitivity	Negligible	High	High	Major/moderate adverse
Land North of River Don Low sensitivity	Negligible	Negligible	Negligible	Negligible
Hall Farm Medium sensitivity	Low	Negligible	Negligible	Minor adverse
Barnburgh Grange Medium sensitivity	Medium	Negligible	Negligible	Moderate adverse
Land South of Ludwell Hill Low sensitivity	High	Negligible	High	Moderate adverse
Dovecote Farm Medium sensitivity	Medium	Negligible	Negligible	Moderate adverse
Land farmed by Marshall Bros Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Manor Farm (Harlington) Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Hill Farm Medium sensitivity	Low	Negligible	Negligible	Minor adverse
Crown Inn Farm Medium sensitivity	High	Negligible	Negligible	Major/moderate adverse
Lodge Farm Medium sensitivity	Medium	Medium	High	Major/moderate adverse
Brodsworth Estate Medium sensitivity	Negligible	Medium	Negligible	Moderate adverse
Hooton Pagnell Estate Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Frickley Estate High sensitivity	Low	High	High	Major adverse
Land north of Thurnscoe Medium sensitivity	Low	Negligible	Negligible	Minor adverse

- 4.4.31 Overall, the construction of the Proposed Scheme could potentially affect 21 holdings in the Ravenfield to Clayton area permanently. On the basis of information currently available, 14 holdings could experience moderate, major/moderate or major adverse permanent effects from construction, which would be significant for each holding. Two holdings: those at Manor Farm (Beal) and land farmed by Marshall Bros, would not experience any permanent effects from construction.
- 4.4.32 It is currently anticipated that one holding, at the Frickley Estate, would potentially experience a major adverse permanent effect from construction. This would be due to the demolition of buildings at the farm and on part of the equestrian eventing course, and the high impact of severance.
- 4.4.33 Seven medium sensitivity arable or mixed use holdings would potentially experience major/moderate adverse permanent effects. All of the farm buildings at the arable unit at Lodge Farm would be demolished as a result of the Proposed Scheme, and buildings at Birk Lodge Farm and Pastures Farm would also require demolition. A high proportion of the holding at Pastures Farm and land east of Hooton Cliff would be required, with these holdings experiencing a high severance impact.
- 4.4.34 Six holdings would experience a moderate adverse permanent effect, including the low sensitivity holding at land south of Ludwell Hill which would have stables demolished.
- 4.4.35 Although financial compensation will be available under existing statutory arrangements, there can be no certainty that this would 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

- 4.4.36 Soils and their associated seed banks from the ancient woodlands would be stored separately and utilised in species translocation.
- 4.4.37 Other mitigation would 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.
- 4.4.38 A farm pack within the Phase 2b Farmers and Growers Guide would be provided to all farmers and landowners, setting out baseline conditions on the farm and the assurances and obligations that HS2 Ltd would accept upon entering the land. This would 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

- 4.4.39 Although the extent of land required permanently by ALC grade is not yet known in the Ravenfield to Clayton area, current indications based on publicly available

information are that the effect on BMV agricultural land would be moderate adverse temporarily during construction, which would be significant, and moderate adverse permanently from construction, which would be significant. The amount of land required by ALC grade will be assessed and reported in the formal ES.

4.4.40 Nineteen of the 23 farm holdings identified are anticipated to experience moderate, major/moderate or major adverse temporary effects during construction; with fourteen anticipated to experience moderate, major/moderate or major adverse permanent effects of construction, which would be significant for each holding.

4.4.41 Effects on forestry land and soils to be disturbed will reported in the formal ES.

4.5 Effects arising from operation

Avoidance and mitigation measures

4.5.1 No measures are currently anticipated to be 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 would include:

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

4.5.3 One set of farm buildings at The Croft, and the international eventing course at Frickley Estate lie within approximately 100m of the route of the Proposed Scheme. The potential for significant effects on sensitive livestock receptors from noise will be assessed and reported in the formal ES.

4.5.4 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.

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

Other mitigation measures

4.5.6 No other mitigation measures have been identified at this stage.

Summary of likely residual significant effects

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

Monitoring

- 4.5.8 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 4.5.9 There are no area-specific requirements identified for monitoring agriculture, forestry and soil during the operation of the Proposed Scheme in the Ravenfield to Clayton 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 identified to date arising from the construction and operation of the Proposed Scheme within the Ravenfield to Clayton area. Oxides of nitrogen (NO_x) including nitrogen dioxide (NO₂), fine particulate matter⁴³ (PM₁₀, PM_{2.5}) 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 and the use of site haul routes. Emissions would also arise from road traffic during construction and operation of the Proposed Scheme.
- 5.1.2 Engagement with Barnsley Metropolitan Borough Council (BMBC), Doncaster Metropolitan Borough Council (DMBC) and Rotherham Metropolitan Borough Council (RMBC) has commenced and is ongoing. The purpose of this engagement has been to obtain relevant baseline information, which includes monitoring data in this area.
- 5.1.3 Maps showing the location of the key environmental features and the key construction and operational features of the Proposed Scheme can be found in the Volume 2: LA13 Map Book.

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, Introduction and Methodology (Section 8) and the Scope and Methodology Report (SMR)⁴⁴.
- 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 occur⁴⁵:
- from construction activities;
 - 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; or
 - from the operation of combustion plant at buildings.
- 5.2.3 The assessment of construction traffic will be reported in the formal ES. The assessment will incorporate HS2 Ltd's policies on vehicle emissions. 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.

⁴³ PM_{2.5} 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.

⁴⁴ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

⁴⁵ 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 traffic emissions will be undertaken where sensitive receptors are located up to a distance of 200m from roads screened in for further assessment.

- 5.2.4 The assessment of construction traffic impacts will use traffic data based on an estimate of the average daily flows in the peak year during the construction period (2023-2032). The assessment would assume vehicle emission rates and background pollutant concentrations from year 2023. As both pollutant emissions from vehicle exhausts and background pollutant concentrations are anticipated to reduce year by year as a result of vehicle emission controls, the year 2023 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 Ravenfield to Clayton area are emissions from road vehicles and agricultural activities. The main roads within the area are the M18, the A1(M), the A630 Doncaster Road/Sheffield Road/High Road, the A6023 Low Road/Doncaster Road, the A635 Barnsley Road, the A6195 Dearne Valley Parkway/Rotherham Road, the B6273 Rotherham Road and the B6411 Houghton Road.
- 5.3.2 There are no industrial installations (regulated by the Environment Agency) with permits for emissions to air within the Ravenfield to Clayton area.
- 5.3.3 Estimates of background air quality have been obtained from the Department for Environment, Food and Rural Affairs (Defra)⁴⁶ for the baseline year of 2017. These data are estimated for 1km grid squares for NO_x, NO₂, PM₁₀ and PM_{2.5}. Background concentrations are within the air quality standards for all pollutants within the Ravenfield to Clayton area.

Local monitoring data

- 5.3.4 There are currently seven local authority diffusion tube sites located within the Ravenfield to Clayton area for monitoring NO₂ concentrations. These are located along the A6023 Doncaster Road in Mexborough and along the A635 Barnsley Road in Hickleton. Measured concentrations in 2016 were within the air quality standard with the exception of three sites, in Hickleton⁴⁷. Measured annual mean NO₂ concentrations at these three sites in Hickleton are also consistently above 60µg/m³, suggesting exceedance of the 1-hour mean NO₂ standard.

Air quality management areas

- 5.3.5 There is one air quality management area (AQMA) within the Ravenfield to Clayton area, the Doncaster Council AQMA No 7. This AQMA covers residential properties along the A635 Barnsley Road in Hickleton and was declared in August 2014 for exceedances of the annual mean and 1-hour mean NO₂ standards.

⁴⁶ Department for Environment, Food and Rural Affairs (Defra), Defra Background Pollutant Concentration Maps. Available online at: <https://uk-air.defra.gov.uk/data/lagm-background-maps?year=2015>

⁴⁷ At the time of assessment, measurements for 2016 were the latest published annual monitoring baseline data

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.
- 5.3.7 Most of the sensitive receptors that may be affected by the Proposed Scheme are residential properties in the communities of Conisbrough, Mexborough, Barnburgh, Hickleton, Thurnscoe and Clayton. Other receptors include Strafford House Voyage Care, Flower Park and Hickleton Hall (residential care homes), and numerous primary schools.
- 5.3.8 There is one statutory designated ecological site identified within the Ravenfield to Clayton area, namely Denaby Ings Site of Special Scientific Interest (SSSI). Other non-statutory sensitive ecological sites identified close to the route of the Proposed Scheme include 15 local wildlife sites, two local nature reserves and five ancient woodlands. Further details of the ecological receptors are set out in Section 7, Ecology and biodiversity.

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 (CoCP). The draft CoCP⁴⁸ 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

⁴⁸ Supporting documents: Draft Code of Construction Practice

sensitive receptors;

- 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.

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.

Assessment of impacts and effects

Temporary effects

5.4.4 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 PM_{2.5} concentrations.

Construction dust effects

5.4.5 The risks of demolition of existing buildings, earthworks, construction of new structures and trackout⁴⁹, have been assessed for their effect on dust soiling, human health⁵⁰ and ecological sites. There are residential and ecological receptors located within the Ravenfield to Clayton area.

5.4.6 It has been identified that for demolition activities, the risk of dust and human health would range from low to high within this area, depending on the location of sensitive receptors and the magnitude of the activities. For earthworks and construction, the risk of dust effects would range from low to high within this area, depending on the location of sensitive receptors and the magnitude of the activities. There would also be a low to medium risk of human health effects for both activities. For trackout, there would be a medium to high risk of dust effects and a low to medium risk of human health effects. There would also be a low to medium risk of ecological effects from all dust generating activities.

5.4.7 With the application of the established national best practice mitigation measures contained in the draft CoCP, no significant effects are anticipated from dust generating activities.

Construction traffic effects

5.4.8 Construction activity could also 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.

5.4.9 The M18, the A1(M), the A630 Doncaster Road/Sheffield Road/High Road, the A6023 Low Road/Doncaster Road, the A635 Barnsley Road, the A6195 Dearne Valley Parkway/Rotherham Road, the B6273 Rotherham Road, the B6411 Houghton Road,

⁴⁹ 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

⁵⁰ Human health effects relate mainly to short-term exposure to particles of size between 2.5µm to 10µm, measured as PM₁₀

Denaby Lane, Coalpit Road, Eland Road, Comelybank Drive, Pastures Road, Ludwell Hill, Hangman Stone Road, Blacksmiths Lane, Red Hill Lane, Middlecliff Lane/Billingley Lane, and Clayton Lane/Church Field Road, would likely provide the primary access for construction vehicles in this area. An increase in traffic flows as a result of construction traffic, temporary closures or diversions is anticipated on these roads. A detailed assessment of air quality impacts from traffic emissions in the area will be undertaken and reported in the formal ES.

- 5.4.10 Direct and indirect effects from changes in air quality, such as those arising from increased levels of construction traffic, would be considered for all sensitive receptors within 200m of construction routes. These would include human receptors and those ecological habitats considered to be sensitive to changes in air quality. These effects would be reported in the formal ES.

Permanent effects

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

Other mitigation measures

- 5.4.12 No other mitigation measures are proposed at this stage in relation to air quality during construction of the Proposed Scheme in this area.

Summary of likely residual significant effects

- 5.4.13 The methods outlined within the draft CoCP are considered effective at reducing dust emissions and therefore no significant residual effects would be anticipated. Any significant residual effects from construction traffic emissions will be reported in the formal ES.

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 would arise from changes in the volume, composition and/or speed of road traffic and changes in road alignment.
- 5.5.3 There would be no direct atmospheric emissions from the operation of trains that would cause an impact on air quality, and therefore no assessment is required. Indirect emissions from sources such as rail wear and brakes have been assumed to be negligible.

Operational traffic effects

- 5.5.4 Direct and indirect effects from changes in air quality, such as those arising from increased levels of traffic, will be considered for all receptors within 200m of affected roads. These will include human receptors and those ecological habitats considered to be sensitive to changes in air quality. Any effects will be reported in the formal ES.

Other mitigation measures

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

Summary of likely residual significant effects

- 5.5.6 Any significant residual effects for air quality from the operation of the Proposed Scheme will be reported in the formal ES.

Monitoring

- 5.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 5.5.8 Any area specific requirements for monitoring air quality effects during operation of the Proposed Scheme in this area will be reported in the formal ES.

6 Community

6.1 Introduction

- 6.1.1 This section of the report describes the impacts and likely significant effects identified to date on local communities resulting from the construction and operation of the Proposed Scheme in the Ravenfield to Clayton area.
- 6.1.2 The assessment draws on information gathered from engagement with the users and operators of community facilities including Doncaster Metropolitan Borough Council (DMBC), Rotherham Metropolitan Borough Council (RMBC), Barnsley Metropolitan Borough Council (BMBC), Hooton Roberts parish, community walking groups, local residents and Mexborough Advisory Forum (residents and homeowners in Mexborough and on the Shimmer Estate). The purpose of this engagement has been to understand how the facilities are used and to obtain relevant baseline information to inform the design development and assessment of the Proposed Scheme. Engagement will continue with these and other stakeholders to inform the formal ES.
- 6.1.3 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: LA13 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)⁵¹.
- 6.2.2 The assessment of in-combination effects will draw upon the findings of other technical disciplines (e.g. air quality, sound, noise and vibration, landscape and visual and traffic and transport). Likely significant in-combination effects on community facilities and resources will be reported in the formal ES.
- 6.2.3 Effects relating to the severance of public rights of way (PRoW) (public footpaths and bridleways) and highways and pedestrian diversions, are assessed under the Traffic and transport topic. However, where PRoW and other routes are a “promoted” destination in their own right as a recreation resource, they will be considered within the community assessment. Where impacts on open space and PRoW are considered, these have been informed by open space and PRoW condition surveys, where it has been possible to undertake such surveys.
- 6.2.4 Where reasonably practicable, public footpaths and routes would be reinstated, or convenient alternatives provided. HS2 Ltd will seek to provide a temporary or permanent alternative route in advance of a closure of a road or PRoW. No significant effects on these routes are likely once the mitigation measures have been implemented. Alternative temporary routes have not been defined in all cases due to

⁵¹ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

the relatively early stage of design of the Proposed Scheme. Where this is the case they will be reported in the formal ES.

- 6.2.5 If a temporary or permanent alternative route cannot be provided in advance of any road or PRow closure then this will be discussed with the relevant local authority and local groups and reported in the formal ES.
- 6.2.6 The assessment in the working draft ES is based on the design information, including demolitions as set out in Section 2, available at the time of the assessment. This is subject to change as a result of design changes confirmed in advance of the submission of the hybrid Bill.
- 6.2.7 The construction of the Proposed Scheme could lead to isolation effects in one or more communities in this area. These will be assessed in the formal ES.
- 6.2.8 Overall, the study area is taken as the area of land that encompasses the likely significant effects of the Proposed Scheme. The study area includes the area of land required both temporarily and permanently for the construction and operation of the Proposed Scheme. It also includes a wider corridor within which receptors or resources could be affected by a combination of significant residual effects arising from, for example, noise, vibration, poor air quality, HGV traffic and visual intrusion. These in-combination effects will be identified in the formal ES. 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.
- 6.2.9 For the working draft ES, the full details of the construction traffic routes and geographical scope of likely in-combination (amenity) effects are yet to be determined. In the formal ES, the study area and associated baseline of community resources will be updated to take account of these.
- 6.2.10 At this stage it has not been possible to complete surveys of public open spaces in this area; therefore, for the working draft ES an assumption has been made about the level of sensitivity on a case by case basis. This would be adjusted, as appropriate, on the basis of survey results to inform the formal ES.

6.3 Environmental baseline

- 6.3.1 The Proposed Scheme through the Ravenfield to Clayton area would be approximately 17.6km² 4.3km in length, with an additional 6.7km long Sheffield Northern Spur and lie within the RMBC, DMBC and BMBC areas. It would extend from the east of Rotherham, passing close to the settlements of Ravenfield, Hooton Roberts, Old Denaby, Denaby Main, Conisbrough, Mexborough, High Melton, Harlington, Barnburgh, Hickleton, Hooton Pagnell, Frickley and Clayton.
- 6.3.2 The Ravenfield to Clayton area is predominantly rural in nature with a section of the route of the Proposed Scheme running through a more urban area between Denaby Main, Conisbrough and Mexborough. In general, the majority of community facilities are located in the larger settlements of Conisbrough and Mexborough. The area is also characterised by clusters of dwellings and individual dwellings within rural areas close to the Proposed Scheme.

Ravenfield, Hooton Roberts, Old Denaby and Denaby Main

- 6.3.3 This area covers the villages of Ravenfield, Hooton Roberts, Old Denaby and Denaby Main. Together they comprise approximately 710 residential properties.
- 6.3.4 Ravenfield is located approximately 800m north of Bramley, and north-west of junction 1 on the M18. The village comprises approximately 85 residential properties. The nearest residential properties would be located approximately 700m west of the route of the Proposed Scheme. Community resources within the village of Ravenfield comprise of Saint James' Church and recreational open spaces on the outskirts of the village. Approximately 800m north-east of the village, Ravenfield Ponds is a fishery for coarse fishing, open to all club members with an annual membership. However, the site is open to members of the general public, free of charge, and is part of the wider Ravenfield Park. A site map is located at the entrance. Located approximately 250m east of Ravenfield Ponds, Firsby reservoir is open to the general public and designated as a Local Nature Reserve (LNR) with a footpath around the reservoir. The reservoir and LNR are maintained by RMBC.
- 6.3.5 Hooton Roberts is located approximately 7km north-east of Rotherham, and north of junction 1 on the M18. The village comprises approximately 34 residential properties. The nearest residential properties would be located approximately 800m west of the route of the Proposed Scheme. Community resources within the village comprise of Strafford House Voyage Care, assisted living facility, and the Earl of Stafford public house.
- 6.3.6 Old Denaby is located approximately 6km north-east of Rotherham, and north of junction 1 on the M18. The village comprises approximately 90 residential properties. The nearest residential properties would be located approximately 160m west of the route of the Proposed Scheme. Community resources comprise of Ferryboard Farm Fisheries and The Manor restaurant, an informal play area, Pitman Road woodland and Old Denaby wetland LNR. There are areas of recreational open space; Denaby Wood, with an approximate area of 2ha, accessible off The Green residential housing estate and a promoted PRow, Heron Way, runs south of Denaby Wood.
- 6.3.7 Pitman Road play area is located on Pitman Road, at the junction of Pitman Road and Denaby Lane in Old Denaby. The play area is identified as an informal space and is owned by Doncaster Council. It is approximately 0.5ha in area. Pitman Road woodland is located adjacent to Pitman Road play area, off Denaby Lane, Old Denaby. The woodland is approximately 1ha in area and is owned by DMBC. This resource is accessible by a public footpath, however the footpath is not accessible for wheelchair users.
- 6.3.8 Old Denaby Wetland LNR is approximately 19 ha in area and located off Denaby Lane. This resource is accessible via public footpaths, however the footpaths are not accessible for wheelchair users.
- 6.3.9 Denaby Main is located approximately 7.7km north-east of Rotherham and west of junction 36 on the A1(M). The village comprises approximately 500 residential properties. The nearest residential properties would be located approximately 500m east of the route of the Proposed Scheme. The village is located between

Mexborough and Conisbrough and schools in this area comprise of St Alban's Catholic Primary School, Balby Street Primary School and Denaby Main Primary and Nursery School. Other community resources include Dearne Valley leisure centre, Denaby Lane and Wadworth Street allotments, Flower Park care home and an Asda supermarket.

Conisbrough and Mexborough

- 6.3.10 Conisbrough is situated alongside the southern banks of the River Don and located directly east of Denaby Main. The town comprises approximately 4,950 residential properties. Conisbrough's high street, Church Street, is surrounded by housing estates located on both sides of Old Road, A6023 Low Road and A630 Sheffield Road. The nearest residential properties would be approximately 500m east of the route of the Proposed Scheme.
- 6.3.11 There are six primary schools within Conisbrough; Castle Academy, Rowena Nursey and infant School, Rowena Academy, Morley Place Junior School, Ivanhoe Primary Academy and Pennine View School. In addition, Conisbrough has one secondary school, De Warrene Academy secondary school. There are four churches; Conisbrough Baptist Church, St Peter's Church, The Parish Church of All Saints and St Alban's Church. Other community facilities include shops, a post office, a library, a community centre, a general practice, a youth hub, two dental practices, four public houses and three residential care homes.
- 6.3.12 Mexborough is located to the north of the River Don, along the A6023 Doncaster Road. The town has approximately 5,200 residential properties. Some residential properties would be on the route of the Proposed Scheme, including housing recently constructed on Comelybank Drive (known as the 'Shimmer Estate') and properties at the southern end of Doncaster Road.
- 6.3.13 There are five primary schools within Mexborough; New Pastures Primary School, Windhill Primary School, Montagu Primary Academy, Mexborough St John the Baptist Church of England Primary School and Mexborough Highwoods Primary School. There is a junior school, Mexborough Doncaster Junior School as well as a secondary school, Mexborough Academy. There are six churches; St John the Baptist Church, Mexborough Baptist Church, Mexborough New Life Church, Bank Street Methodist Church, Brunswick Methodist Church and Blessed English Martyrs Roman Catholic Church. Other community facilities include shops, two post offices, a library, a hospital, a community centre, a youth centre, two residential care homes and Denaby Ings nature reserve and Site of Special Scientific Interest. There is a recently built residential housing estate located on Comelybank Drive, north-west of Denaby Main, otherwise known as the 'Shimmer estate'.
- 6.3.14 Clayfield is an informal amenity green space located near to Clayfield View within Mexborough. It is approximately 6ha in area and the residential properties along Clayfield Avenue, Clayfield View, The Pastures and Pastures Court back onto this amenity green space. Pedestrian access is available from Clayfield View and Pastures Court.

- 6.3.15 There are eight promoted PRoW within the community study area:
- Conisborough Parks Bridleway 13, Conisborough Parks Footpath 3 and Conisborough Park Footpath 4 make up South Yorkshire Way Central;
 - Conisborough Parks Bridleway 13 and Conisborough Parks Footpath 3 make up Heron Way;
 - Conisborough Parks Bridleway 13 and Ravenfield Footpath 10 make up Rotherham Ring Route;
 - Mexborough Footpath 7 makes up St Bernard's Way;
 - Mexborough Footpath 7 makes up the Dearne Way;
 - Mexborough Footpath 7 makes up the Trans Pennine Trail;
 - Mexborough Footpath 7 makes up Wild Yorkshire Way; and
 - Dearne Footpath 2 makes up Barnsley Boundary Walk.

High Melton to Hickleton

- 6.3.16 The area covers the settlements of High Melton, Harlington, Barnburgh and Hickleton. Together they comprise approximately 780 residential properties.
- 6.3.17 High Melton is located approximately 6.5km west of Doncaster and north-west of junction 36 on the A1(M). The village comprises approximately 50 residential properties. The nearest residential properties that fall within the community study area would be approximately 700m east of the route of the Proposed Scheme. The remaining community receptors of High Melton lie further east of the route of the Proposed Scheme and are outside the 1km study area.
- 6.3.18 Harlington and Barnburgh are two adjoining villages located approximately 9km west of Doncaster and north-east of the River Dearne. The villages comprise approximately 300 residential properties. The nearest residential properties would be approximately 250m west of the route of the Proposed Scheme. Community resources within the village of Harlington comprise of Harlington Inn public house, Village Store newsagents and Furlong Road allotments. Community resources within Barnburgh comprise of St Peter's church, Barnburgh and Harlington village hall, Barnburgh primary school, Barnburgh Lane allotment, Barnburgh working men's club and institute.
- 6.3.19 Barnburgh Lakes, located on Ludwell Hill, provides three fishing lakes and a bait shop. There are regular fishing matches three days a week throughout the year with Sunday matches between the months of October and April. There is also an on-site café, which is open to the general public and has an outdoor seating area overlooking the lakes. The Crown Inn public house is located close to Barnburgh Lakes.
- 6.3.20 Hickleton is a village located 9km north-west of Doncaster, comprising approximately 80 residential properties. The nearest residential properties would be located approximately 250m west of the route of the Proposed Scheme. A church and Hickleton Hall, a Sue Ryder nursing home are located in the village.

- 6.3.21 Hickleton Golf Club is located off Lidget Lane and Red Hill Lane. The club has an 18-hole golf course with membership of over 500 members comprising of men, ladies, seniors and junior sections. In addition, it is open to societies, groups and casual visitors. The clubhouse has facilities that can cater for private functions including weddings, christenings and parties. The club restaurant is open to the public on Sundays.
- 6.3.22 Bilham Park is approximately 36 ha and includes three plantations; Summer House, Bilham and Fishpond, Bilham Belvedere summer house and formal water garden. It is publicly accessible from Bilham Lane.

Thurnscoe and the surrounds

- 6.3.23 This area covers the villages of Hooton Pagnell, Frickley and Clayton. Thurnscoe is the larger of the settlements and together, they comprise approximately 3,200 residential properties.
- 6.3.24 Thurnscoe is located approximately 11.4km north-west of Doncaster and west of junction 37 on the A1(M). The nearest residential property would be located approximately 100m west of the route of the Proposed Scheme. Community resources within Thurnscoe comprise a library, Hill Primary Academy, Gooseacre Primary Academy, Robert Odgen School, Embankment Children's Centre, doctors surgery, post office, two working men's clubs, Thurnscoe care centre, three allotments, a reservoir, a supermarket and a variety of food and drink establishments. Places of worship include St Helen's Church and St Hilda's Church.
- 6.3.25 Frickley is located 12km east of Barnsley and west of junction 38 on the A1(M). The village comprises a private estate including a Grade II Listed Hall which is not publicly accessible. There are seven residential cottages on the estate, which would be located approximately 370m east of the route of the Proposed Scheme. All Saints Church Frickley is located off Church Field Road, approximately 2.4km from Frickley.
- 6.3.26 Frickley Park, within the estate, is an affiliated venue for the national governing body for equestrian eventing (dressage, cross country jumping and show jumping), and is home to the national under-18 eventing championships. Clayton is located approximately 10.6km east of Barnsley, 6.8km west of junction 30 on the A1(M) and 5.7km north of the River Dearne. The nearest residential properties would be located approximately 120m west of the route of the Proposed Scheme. Community resources within the village comprise the Village Shop convenience store and Millennium Green park which is an open space with trails for the public. The area surrounding Clayton includes open space area such as Howell Wood located off Burnt Wood Lane. An area of 47ha in the north of the wood is designated as a country park by DMBC and is open to the public all year round. There is one promoted PRoW in the area; the Barnsley Boundary Walk.

6.4 Effects arising during construction

Avoidance and mitigation measures

6.4.1 The draft Code of Construction Practice (CoCP)⁵² 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 of the draft CoCP);
- 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, which may affect community resources during construction (Section 16);
- specific measures in relation to air quality and noise will also serve to reduce impacts for the neighbouring communities including discretionary noise insulation for sensitive community resources and, in special circumstances, temporary rehousing (Sections 7 and 13); and
- where practicable, the avoidance of HGVs operating adjacent to schools during drop off and pick up periods (Section 14).

Assessment of impacts and effects

Temporary effects

Residential properties

6.4.2 It would be necessary to carry out works associated with the construction of the Proposed Scheme on land that falls within the boundary of one residential property on Firsby Lane, south of the A630 Doncaster Road. The Hooton Roberts cutting main compound would require the garden located west of the driveway of this property. The approximate duration of the Hooton Roberts cutting main compound would be five years. The temporary loss of outside space would not impact on the ability of the residents to use their property and access would be maintained throughout construction. This is not considered to have a significant community effect.

6.4.3 It would be necessary to carry out works associated with the construction of the Proposed Scheme on land that comprise part of the driveway of one residential property on Church Field Road. The approximate duration of the Thurnscoe embankment satellite compound is five years and six months. The temporary loss of this area would not impact on the ability of the residents to use their property and

⁵² Supporting document: Draft Code of Construction Practice

access would be maintained throughout construction. This is not considered to have a significant community effect.

Community facilities

- 6.4.4 No temporary effects on community facilities have been identified as a result of the land required for construction of the Proposed Scheme.

Recreational facilities

- 6.4.5 No temporary effects on recreational facilities have been identified as a result of the land required for construction of the Proposed Scheme.

Open space and recreational PRow

- 6.4.6 Pitman Road play area on Denaby Lane would be required temporarily for the construction of the River Don viaduct. There are no paths, no bins, no benches, no children's play area, or other associated facilities. The grassed areas are overgrown. Access to this area would be closed for two years. The temporary loss of this play area would result in a minor effect which would not be significant.
- 6.4.7 Access to Pitman Road woodland, on Denaby Lane would be closed for approximately two years for the construction of the River Don viaduct. There is a publicly accessible woodland in Denaby Wood, approximately 500m south-west of Pitman Road woodland which will also be permanently affected by the operational purposes. The temporary loss of this woodland would result in a moderate adverse effect which would be significant.
- 6.4.8 The construction of River Don viaduct satellite compound and stockpiling of material would require the entire area of Clayfield amenity green space. During the construction period, the space would be inaccessible for two years. The temporary loss of this informal amenity green space would result in a moderate adverse effect which would be significant.
- 6.4.9 The construction of Hickleton cutting would require approximately 5% of Hickleton Golf Course. The land required for construction of the Proposed Scheme would encroach onto the eastern corner of Hickleton golf course, including the 13th hole. This space would be inaccessible for three years and six months. During this time, Hickleton golf course would be unable to fully function in its current layout. The temporary loss of this golf course would result in a moderate adverse effect which would be significant.
- 6.4.10 The construction of Hickleton cutting and associated works to the north of Red Hill Lane would require approximately 2.7ha of Bilham Park. During the construction period, the space would be inaccessible for three years and six months. Proposed mitigation and an assessment of the likely effects will be reported in the formal ES.
- 6.4.11 Land required for construction of the Proposed Scheme would result in temporary severance of the same PRow in four different promoted PRow; Mexborough Footpath 7 which makes up the Dearne Way, St Bernard's Way, the Trans Pennine Trail and Wild Yorkshire Way. Proposed mitigation and an assessment of the likely effects would be reported in the formal ES.

Permanent effects

Residential properties

- 6.4.12 The construction of the River Don viaduct would require the demolition of residential properties located on Comelybank Drive, north-west of Denaby Main (known as the Shimmer estate). Fifty-two residential properties and a garage building associated with residential properties would be permanently lost. This would result in a major adverse effect which would be significant.
- 6.4.13 The construction of the River Don viaduct would require the demolition of eight residential properties located on Doncaster Road, east of Mexborough. This would result in a major adverse effect which would be significant.
- 6.4.14 The construction of the Barnburgh embankment would require the demolition of two residential properties located on Ludwell Hill, Barnburgh. These properties would be permanently lost.
- 6.4.15 The construction of the Church Field Road cutting would require the demolition of one residential property located off Top Lane, Clayton. This property would be permanently lost.

Community facilities

- 6.4.16 No permanent effects on community facilities have been identified as a result of the land required for construction of the Proposed Scheme.

Recreational facilities

- 6.4.17 The construction of Barnburgh embankment would result in the permanent loss of approximately 60% of Barnburgh Lakes located on Ludwell Hill. Barnburgh Lakes is an 80 peg fishery spread over three lakes. This would result in the loss of two out of the three fishing lakes and a total of 48 of the 80 pegs onsite. The permanent loss of land from Barnburgh Lakes would result in a major adverse effect which would be significant.

Open space and recreational PRow

- 6.4.18 The construction of Ravenfield embankment and the proposed landscape planting on both sides, including a temporary site haul route would result in approximately 3% of Firsby Reservoir LNR being affected. Throughout the construction period, access to the facility would be maintained as the temporary haul route would be outside the eastern boundary of the LNR. This partial loss of open space would result in a negligible effect which would not be significant.
- 6.4.19 The construction of Old Denaby cutting would result in the permanent loss of approximately 41% of Denaby Wood. Access to the remaining wood on the western half would be maintained throughout construction. There is a publically accessible wood nearby identified as Denaby Thicks located approximately 500m south-east of Denaby Wood. The permanent loss of part of Denaby Wood would result in a major adverse effect, which would be significant.
- 6.4.20 The construction of the River Don viaduct would result in the permanent loss of approximately 18% of Old Denaby Wetlands LNR on Denaby Lane. Access to the

remaining western half of the LNR would be maintained throughout construction and the facility could remain in use. The permanent loss of this LNR would result in a major adverse effect which would be significant.

- 6.4.21 The construction of Mexborough cutting and associated works would result in the permanent loss of approximately 25% of Clayfield amenity green space, off Clayfield View, Mexborough. The nearest open space is a formal open space located south-west of Clayfield on the other side of Clayfield View called Pitt Street Park. This formal space, approximately 4ha in area, offers toddler and junior play areas, multi-use games area, playing fields and sports pitches. The permanent loss of land from Clayfield amenity green space would result in a moderate adverse effect which would be significant.
- 6.4.22 The construction of Hickleton cutting to the north of Red Hill Lane would permanently require approximately 2% of Hickleton golf course. The eastern corner of Hickleton golf course where boundary planting is situated would be lost. There would be no loss of land from the greenways of the golf course and it would still be able to function. This would result in a minor adverse effect which would not be significant.
- 6.4.23 The construction of Hickleton cutting to the north of Red Hill Lane would require approximately 0.1ha of Bilham Park. Proposed mitigation and an assessment of the likely effects will be reported in the formal ES.
- 6.4.24 Land required for the operation of the Proposed Scheme would result in severance of two promoted PRoW; Conisborough Parks Footpath 3 that makes up Heron Way and Dearne Footpath 2 that makes up Barnsley Boundary Walk. These footpaths are considered to provide a recreational resource. Proposed mitigation and an assessment of the likely effects would be reported in the formal ES.

Other mitigation measures

- 6.4.25 HS2 Ltd will continue to engage with owners/operators to identify reasonably practicable measures to help mitigate potential significant effects identified in this assessment.
- 6.4.26 Any other mitigation measures will be described in the formal ES.

Summary of likely residual significant effects

- 6.4.27 Land required for construction of the Proposed Scheme is likely to result in temporary residual significant effects on the following community resources:
- Pitman Road woodland in Old Denaby;
 - Clayfield amenity green space in Mexborough; and
 - Hickleton Golf Course in Hickleton.
- 6.4.28 Land required for the construction of the Proposed Scheme is likely to result in permanent residual significant adverse effects:
- Denaby Wood in Old Denaby;
 - Old Denaby Wetlands LNR in Old Denaby;

- Residential properties in Shimmer housing estate on Comelybank Drive in Mexborough;
- Residential properties on Doncaster Road in Mexborough;
- Clayfield amenity green space in Mexborough; and
- Barnburgh Lakes on Ludwell Hill in Barnburgh.

Cumulative effects

- 6.4.29 Community wide effects occur where a number of individual impacts on resources come together within a location and have a wider impact on the community, such that they change the experience of a considerable proportion of people within that community.
- 6.4.30 No cumulative effects have been identified at this time. Any combined effects on a community during construction of the Proposed Scheme, which would result in cumulative community effects, will be reported in the formal ES.

6.5 Effects arising from operation

Avoidance and mitigation measures

- 6.5.1 Avoidance and mitigation measures will be reported in the formal ES.

Assessment of impacts and effects

- 6.5.2 Operation of the Proposed Scheme could lead to in-combination effects on the community in this area which will be reported in the formal ES.

Other mitigation measures

- 6.5.3 Any other mitigation measures will be described in the formal ES.

Summary of likely residual significant effects

- 6.5.4 A summary of the likely residual significant effects would be reported in the formal ES.

Cumulative effects

- 6.5.5 Community wide effects occur where a number of individual impacts on resources come together within a location and have a wider impact on the community, such that they change the experience of a considerable proportion of people within that community.
- 6.5.6 No cumulative effects have been identified at this time. Any combined effects on a community during operation of the Proposed Scheme, which would result in cumulative community effects, will be reported in the formal ES.

Monitoring

- 6.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 6.5.8 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 would contribute to the in-combination assessments, will be described in the relevant topic sections of the formal ES.

7 Ecology and biodiversity

7.1 Introduction

- 7.1.1 This section of the report identifies the predicted impacts and likely significant effects on species and habitats identified to date in the Ravenfield to Clayton area as a consequence of the construction and operation of the Proposed Scheme. This includes effects on sites recognised or designated on the basis of their importance for nature conservation.
- 7.1.2 Engagement with stakeholders including, Natural England, Forestry Commission, Sheffield and Rotherham Wildlife Trust, Yorkshire Wildlife Trust, Rotherham Metropolitan Borough Council (RMBC), Doncaster Metropolitan Borough Council (DMBC) and Barnsley Metropolitan Borough Council (BMBC) has commenced and is ongoing. The purpose of this engagement has been to discuss the Proposed Scheme and potential effects, obtain relevant baseline information and consider alternative locations for environmental mitigation. Engagement with these stakeholders and other local groups will continue as part of the development of the Proposed Scheme and inform the formal ES.
- 7.1.3 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 are provided in the Volume 2: LA13 Map Book.
- 7.1.4 All distances and area measurements in this section are approximate.

7.2 Scope, assumptions and limitations

- 7.2.1 The scope, assumptions and limitations for the ecological assessment are set out in Volume 1, Introduction and Methodology (Section 8) and the Scope and Methodology Report (SMR)⁵³.
- 7.2.2 In the absence of field surveys and fully developed mitigation, the assessment has been undertaken on a realistic precautionary approach.
- 7.2.3 Field surveys are ongoing, but are limited to locations where landowner permission has been obtained and to areas accessible to the public. The surveys include (but are not limited to) broad habitat and detailed plant surveys, great crested newt surveys, wintering and breeding bird surveys, bat surveys, otter and water vole surveys. The findings from these ongoing surveys will be taken into account in the formal ES.

7.3 Environmental baseline

Existing baseline

Introduction

- 7.3.1 This section describes the ecological baseline relevant to the assessment: the habitats and species recorded in this area as known at this time.

⁵³ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

7.3.2 The land required for the construction of and adjacent to the Proposed Scheme, in the Ravenfield to Clayton area, supports a range of habitats characterised by farmland, both arable and pasture, with areas of parkland and woodland, industrial estates, and historic coal mining and landfill areas. At the southern end of this area, the route of the Proposed Scheme would pass to the east of Ravenfield, through the open countryside of Conisbrough Parks, before passing into the urban area of Mexborough, crossing the River Don. North of Mexborough, the route crosses the River Dearne valley and continues to the north-west, where the topography rises towards the settlements of Barnburgh, Hickleton and Clayton and south of South Kirkby. The topography of the Ravenfield to Clayton area is undulating with the highest point located to the north of Hickleton.

7.3.3 Statutory and non-statutory designated sites are shown on Map Series CT-10, Volume 2: LA13 Map Book.

Designated sites

7.3.4 There are no statutory designated sites of international importance that are relevant to the Proposed Scheme in the Ravenfield to Clayton area.

7.3.1 There is one nationally important Site of Special Scientific Interest (SSSI) that is relevant to the assessment in the Ravenfield to Clayton area: Denaby Ings SSSI. The land required for the Proposed Scheme lies within the Impact Risk Zone relevant to railway infrastructure as identified by Natural England. The Denaby Ings SSSI covers an area of 24.5ha, comprising a mosaic of open water, reed swamp and neutral grassland. It is one of the most diverse wetlands in the county, notable for its breeding bird community and invertebrates and supports an exceptionally rich fauna of the carabid beetle genus *Agonum*. The site has two parts, separated by Pastures Road, the closest of which is located 177m north-east of the land required for the Proposed Scheme.

7.3.2 There are two local nature reserves (LNR) of potential relevance to the assessment in the Ravenfield to Clayton area, each of which is classed as of county/metropolitan value. Citations provided by relevant organisations have been used in the descriptions below, and where citations are outstanding, publically available sources of information have been used. Details of site interest features and reasons for designation will be updated in the formal ES. The LNRs are:

- Firsby Reservoir LNR, covers an area of 6.7ha. It comprises two ponds with several important vegetation communities. The herb-rich, unimproved grassland provides a mosaic of both acidic and neutral areas, areas of regenerating scrub and species rich hedgerows. The open water habitat present is subject to large seasonal fluctuations. The site is located partially within the land required for the Proposed Scheme; and
- Old Denaby Wetland LNR, covers an area of 18ha. It comprises two floodplain wetland sites, both of biodiversity value. The site is located partially within the land required for the Proposed Scheme.

7.3.3 There are 27 local wildlife sites (LWS) of potential relevance to the assessment in the Ravenfield to Clayton area, each of which is of county/metropolitan value. Citations

provided by relevant organisations have been used in the descriptions below, and where citations are outstanding, publically available sources of information have been used. Details of site interest features and reasons for designation will be updated in the formal ES. The LWS are:

- Ravenfield Park and Firsby Reservoirs LWS, covering an area of 34.3ha comprising large ponds surrounded by semi-natural broadleaved woodland, semi-improved neutral grassland and marshy grassland. Many of the ponds are used for commercial fishing. It is located partly within the land required for the Proposed Scheme, east of Arbour Lane;
- Conisbrough Parks Hedgerows LWS, covering an area of 1.3ha, is designated for its important hedgerow features. It is in three separate sections and lies partly within the land required for the Proposed Scheme;
- Back Lane LWS, covering an area of 0.4ha this hedgerow is designated for its important hedgerow features and located 440m south-east of the land required for the Proposed Scheme;
- Hooton Cliff LWS, covering an area of 7.8ha the site comprises of a linear belt of mature semi-natural woodland (much of which is ancient woodland) stretching from Firsby Lane in the east to the A630 Doncaster Road to the north. The site is located partially within the land required for the Proposed Scheme;
- Conisbrough North Cliff LWS, covers an area of 39.9ha and is designated for its broadleaved semi-natural woodland, scattered scrub and unimproved calcareous grassland. Notable species recorded include stag beetle, white letter hairstreak, snake's head fritillary, wild service tree and large-leaved lime. The site is located immediately adjacent to the land required for the Proposed Scheme;
- Denaby Wood LWS, is a 11.5ha site which is designated for its broadleaved semi-natural woodland dominated by pedunculate oak, silver birch, wych elm and field maple (some of which is ancient woodland). The shrub component is patchy and scattered, and comprises holly, occasional elder and hawthorn. The site is located partially within the land required for the Proposed Scheme;
- Old Denaby Area LWS, a 24ha site designated for its tall ruderal vegetation, marshy grassland, unimproved neutral grassland, scrub, standing water, broadleaved woodland habitats and ground flora. A number of waterbird species, including lapwing, are known to use the site, which is located partially within the land required for the Proposed Scheme;
- Denaby Ings Area LWS, a 4.5ha site comprising wet broadleaved woodland adjacent to the River Dearne. The southern section is dominated by crack willow and goat willow, and the northern section contains abundant sycamore, with a dominant shrub component of elder, hawthorn and blackthorn. The site is located 80m south-east of the land required for the Proposed Scheme;

- Melton Warren LWS, a 13.4ha site designated for its diverse woodland, well-developed understorey and grassy rides. Notable species include bluebell. The site is 303m east of the land required for the Proposed Scheme;
- Hangmanstone Wood LWS, a 3.2ha site comprising a strip of scrub and scattered trees on a steep escarpment. The main area of interest is a grassy headland at the bottom of the slope where grassland species including cowslip, greater knapweed, agrimony, glaucous sedge, bird's foot trefoil, greater burnet saxifrage, marjoram, mignonette, meadow vetchling and several woodland species are present. The site is 457m east of the land required for the Proposed Scheme;
- Thunderhole LWS, a 10.4 site comprising a series of springs, streams and ponds and pockets of carr woodland, damp grassland, fen and tall herb. Several spring-fed streams pass through the carr woodland. The site is located partially within the land required for the Proposed Scheme;
- Barnburgh Cliff LWS, a 7.4ha site comprising a mosaic of woodland (some of which is ancient), scrub, cliff, and grassland including limestone grassland, and is located partially within the land required for the Proposed Scheme;
- Stables Holt LWS, a 2.8ha broadleaved woodland (which is ancient woodland) dominated by sycamore and ash with locally-frequent wych elm and scattered pedunculate oak. The site is 281m east of the land required for the Proposed Scheme;
- Barnburgh Park Quarry Wood LWS, a 4.1ha broadleaved woodland dominated by sycamore and ash with a diverse understorey. This site is located 115m south-west of the land required for the Proposed Scheme;
- Hickleton Park LWS, a 93.7ha site comprising extensive areas of parkland/wood pasture, mixed deciduous woodland plantations and more formal ornamental gardens and trees. Notable species found on the site include white letter hairstreak butterfly. The site is located partially within the land required for the Proposed Scheme;
- Hickleton Golf Course LWS, a 49.6ha site comprising a golf course formed over an extensive area of land consisting of original ridge and furrow, species-rich hedgerows and remnant parts of broadleaved woodland with the old meadow areas and hedgerows maintaining a very mixed ground flora. Notable species include white letter hairstreak, grass snake, tufted sedge and great horsetail. The site is located partially within the land required for the Proposed Scheme;
- Castle Hill, Hickleton LWS, a 1.3ha broadleaved plantation dominated by sycamore with wych elm occasionally present. Willow tit has been recorded. The site is located 235m north-west of the land required for the Proposed Scheme;

- Shrog's Plantation LWS, a 0.6ha broadleaved woodland dominated by sycamore with pedunculate oak, ash, wych elm, field maple and occasional silver birch and alder. The herb layer includes dog's mercury and yellow archangel. The site is located 195m west of the land required for the Proposed Scheme;
- Hickleton Spring LWS, a 3.1ha site broadleaved plantation woodland dominated by sycamore and beech, with dead standing and fallen timber. The site is located immediately adjacent to the land required for the Proposed Scheme;
- Bilham Park and Summer House Plantation LWS, a 6.0ha deciduous plantation woodland comprising sycamore, beech, ash, wych elm and horse chestnut, with dead standing and fallen timber. The site is noted for its floristic diversity and veteran trees and is located partly within the land required for the Proposed Scheme;
- The Wilderness LWS, a 1.6ha broadleaved plantation woodland dominated by sycamore with locally frequent beech and ash. The herb layer includes bluebell and dog's mercury and dead fallen and standing timber is present. The site is located partly within the land required for the Proposed Scheme;
- Bilham Park Fish Pond Plantation LWS, comprises 7.3ha mixed deciduous plantation with artificially created ponds and linear water features. An open water aquatic plant assemblage is present which includes white water lily and submerged starworts. The site is located 284m north-east of the land required for the Proposed Scheme;
- First, Second and Third Plantations LWS, a 7.9ha site comprising dominant sycamore and occasional to frequent ash. The canopy is constant throughout, with dog's mercury often dominant in the herb layer. Part of the site is ancient woodland. The site is located partly within the land required for the Proposed Scheme;
- Mapple Yard Plantation LWS, a 6.6ha site comprising semi-natural broadleaved woodland dominated by sycamore with frequent ash and dog's mercury constant in the ground flora. The site is located 482m north-east of the land required for the Proposed Scheme;
- Frickley Park (including Whin Covert) LWS, a site comprises 41.6ha mosaic of plantation woodland, dense scrub, semi-improved neutral grazing pasture, ornamental parkland and exotic planted woodland. The site is located 144m north-east of the land required for the Proposed Scheme;
- Challenger Wood (with Spring Wood) LWS, a 15.7ha site of primarily deciduous plantation with areas of coniferous and mixed plantations. The herb layer includes bluebell and yellow archangel. Damp ground near stream courses within the LWS include the locally frequent remote sedge. The site is located 54m south-west of the land required for the Proposed Scheme; and
- Howell Wood LWS, a 75.6ha site comprises a mosaic of semi-natural woodland habitats (part of which is ancient) with localised stands of beech, birch and

European larch. There is a relatively small linear area of unimproved acidic grassland, open water and running water with associated localised marshland habitat. The site is located immediately adjacent to the land required for the Proposed Scheme.

7.3.4 There are 10 Ancient Woodland Inventory Sites (AWIS) of potential relevance to the assessment in the Ravenfield to Clayton area, each of which is of county/ metropolitan value. They are:

- Hooton Cliff AWIS covers an area of 6.9ha. This area of ancient woodland is within Hooton Cliff LWS. It is located partly within the land required for the Proposed Scheme;
- Denaby Wood AWIS covers an area of 2.7ha. This area of ancient woodland forms part of Denaby Wood LWS. It is located 87m south-west of the land required for the Proposed Scheme;
- Unnamed Wood west of Barnburgh Cliff AWIS covers an area of 2.0ha. This area of ancient woodland forms part of Barnburgh Cliff LWS. It is located partly within the land required for the Proposed Scheme;
- Barnburgh Cliff AWIS covers a total area of 2.9ha. This area of ancient woodland forms part of Barnburgh Cliff LWS. It is located 235m north-east of the land required for the Proposed Scheme;
- Stables Holt AWIS covers an area of 3.0ha. This area of ancient woodland also comprises Stables Holt LWS. It is located 277m north-east of the land required for the Proposed Scheme;
- Hickleton Spring AWIS is a Plantation on Ancient Woodland Site (PAWS) and covers an area of 3.1ha. This area of ancient woodland forms part of Hickleton Spring LWS. It is located immediately adjacent to the land required for the Proposed Scheme;
- Watchley Crag Wood AWIS covers an area of 3.5ha. This area of ancient woodland forms part of First, Second and Third Plantations LWS. It is located partly within the land required for the Proposed Scheme;
- Mapple Yard Plantation AWIS covers an area of 4.0ha. This area of ancient woodland forms part of Mapple Yard Plantation LWS. It is located 492m north-east of the land required for the Proposed Scheme;
- Challenger Wood AWIS is a PAWS which covers a total area of 14.8ha, and is located 54m south-west of the land required for the Proposed Scheme. This area of ancient woodland is contained within Challenger Wood (with Spring Wood) LWS; and
- Howell Wood AWIS, the majority of which is a PAWS, forms part of Howell Wood LWS. It covers an area of 71.7ha and is located immediately adjacent to the land required for the Proposed Scheme.

- 7.3.5 A review is being undertaken to identify any additional woodlands that are not currently listed on the Ancient Woodland Inventory (AWI) but that may nevertheless be ancient. These will be identified and assessed in the formal ES.

Habitats

- 7.3.6 The following habitat types which occur in this area are relevant to the assessment.

Woodland

- 7.3.7 In addition to the aforementioned woodlands, there are three areas of lowland deciduous woodlands (likely to qualify as habitats of principal importance and local Biodiversity Action Plan (BAP) habitats), which are within or partly within the land required for the Proposed Scheme. These woodland areas are near:

- Ravenfield;
- Denaby Main; and
- Frickley.

- 7.3.8 On a precautionary basis, pending the findings of field surveys, these woodlands are considered to be of up to county/metropolitan value.

Grassland

- 7.3.9 There are grassland habitats present within the land required for the Proposed Scheme. Floodplain grazing marsh is located west of the River Dearne viaduct, covering an area of 0.9ha. Some of these may qualify as a habitat of principal importance and local BAP habitat. On a precautionary basis, pending the findings of field surveys (which may identify these as unimproved grasslands) these grasslands are considered to be of up to district/borough value.

Hedgerows

- 7.3.10 Many of the hedgerows in the study area are likely to qualify as a habitat of principal importance and a local BAP habitat. Some may also meet the wildlife and landscape criteria to be 'important' hedgerows as defined in the Hedgerows Regulations 1997⁵⁴. In addition, they could also provide commuting corridors for wildlife and nesting and feeding habitat. On a precautionary basis, pending the findings of field surveys, the hedgerow network is considered to be of up to district/borough value.

Watercourses

- 7.3.11 The River Don, River Dearne (main and former channels), and 17 smaller watercourses, would be crossed by the route of the Proposed Scheme. The River Don and River Dearne may qualify as habitats of principal importance and local BAP habitats. On a precautionary basis, pending the findings of field surveys, these watercourses are considered to be of up to county/metropolitan value. The smaller watercourses are considered to be of up to district/borough value.

⁵⁴ *The Hedgerow Regulations 1997 (No. 1160)*. Her Majesty's Stationery Office, London

Water bodies

- 7.3.12 There are five ponds that would be located within, or partly within, the land required for the Proposed Scheme. Some may qualify as habitats of principal importance⁵⁵, or local BAP⁵⁶ habitats (e.g. if they support fauna species of high conservation importance such as great crested newts). On a precautionary basis, pending the findings of field surveys, these ponds have been assumed to be of up to county/metropolitan value.

Ancient and veteran trees

- 7.3.13 Pending the results of the field surveys, it is possible that ancient and veteran trees would be present within the land required for the Proposed Scheme. On a precautionary basis, pending the findings of field surveys, any such ancient and veteran trees are considered to be of up to county/metropolitan value.

Reedbed

- 7.3.14 There are four areas of reedbed totalling 10.5ha within or partly within the land required for construction of the Proposed Scheme in the Ravenfield to Clayton area. Some may qualify as a habitat of principal importance and local BAP habitat. These are located close together, on either side of the River Dearne (main channel), north of Mexborough. On a precautionary basis, pending the findings of field surveys, these areas of reedbed are considered to be of up to district/borough value.

Protected and notable species

- 7.3.15 A summary of the likely value of fauna species of relevance to the assessment (excluding any features of species interest for which the sites described above are designated) is provided in Table 14.

Table 14: Species potentially relevant to the assessment within the Ravenfield to Clayton area

Resource/feature	Value	Rationale
Bats	Up to regional	<p>Ground-based bat surveys have identified one confirmed roost (species not determined) along the route of the Proposed Scheme in this area.</p> <p>Desk study indicates up to nine species of bat have been recorded in the area. These are: Daubenton's bat; Brandt's bat; whiskered bat; Natterer's bat; common pipistrelle bat; soprano pipistrelle bat; noctule bat; Leisler's bat; and brown long-eared bat.</p> <p>There is suitable habitat for both roosting and foraging bats along the route of the Proposed Scheme in this area. The woodland, hedgerows and arable fields are likely to be used by a range of bat species for foraging and commuting. Trees and buildings have been identified with potential to support roosting at numerous locations within 100m of the land required for the Proposed Scheme.</p>
Otter	Up to county/metropolitan	Otter is present in the River Don and River Dearne catchments, and habitat suitable for otter is also present along smaller watercourses and drainage ditches in the area.

⁵⁵ *Natural Environment and Rural Communities Act 2006*. Available online at: <http://www.legislation.gov.uk/ukpga/2006/16/section/41>

⁵⁶ Rotherham Biodiversity Action Plan BAP, Doncaster BAP, Barnsley BAP

High Speed Rail (Crewe to Manchester and West Midlands to Leeds)
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Resource/feature	Value	Rationale
Water vole	Up to county/metropolitan	There are no desk-based records of water vole within the Ravenfield to Clayton area. Habitat suitable for water vole is present along the River Don and River Dearne, as well as some smaller watercourses and drainage ditches.
Great crested newt	Up to county/metropolitan	There are no desk-based records of great crested newt within the Ravenfield to Clayton area. Field surveys undertaken to date have not established the presence of great crested newt in the Ravenfield to Clayton area. One pond near Barnburgh (28m from the land required for the Proposed Scheme) returned inconclusive eDNA ⁵⁷ survey results for great crested newt.
Birds	County/metropolitan	Ongoing surveys recorded evidence of barn owl near Hilltop Farm and wintering bird assemblages typical of the habitats surveyed (farmland, woodland, gardens). Kingfisher was recorded in suitable breeding habitat on the River Dearne, 350m east of the land required for the Proposed Scheme at the crossing point of the River Dearne. A probable nest of the Schedule 1 species hobby has been recorded within the Hickleton area. Schedule 1 species little egret and avocet have been recorded within 250m and 350m of the land required for the Proposed Scheme, respectively. Bittern, also a Schedule 1 species, has been recorded within 100m of the land required for the Proposed Scheme. The farmland and woodland is suitable for breeding and wintering birds. Species associated with these habitats include lapwing, barn owl, skylark, tree sparrow, yellow wagtail, linnets and yellowhammer which breed in low numbers in farmland habitats, and a range of typical common woodland breeding and wintering birds. Conservation work for the regionally uncommon willow tit is ongoing in the Dearne Valley, and in particular at Howell Wood.
White-clawed crayfish	Up to county/metropolitan	No records of white-clawed crayfish are available. Suitable habitat for white-clawed crayfish is likely to be present in watercourses including the River Don and River Dearne, as well as smaller watercourses.
Aquatic invertebrates	Up to district/borough	Suitable habitat for aquatic invertebrates is likely to be present in watercourses including the River Don and River Dearne, smaller watercourses, and in water bodies in the area.
Terrestrial invertebrates	Up to district/borough	Suitable habitat for terrestrial invertebrates is present in the area, and sites likely to support notable invertebrates have been identified through desk study as near Old Denaby, Barnburgh, Hickleton, Conisbrough, and areas of ancient woodland.
Fish	Up to district/borough	Both the River Dearne and River Don support diverse coarse fish communities. The lower Dearne catchment has records of European eel. Brown trout and grayling are present in the River Don.
Reptiles	Up to district/borough	There are records of grass snake in the Hickleton area within 1km of the land required for the Proposed Scheme. Suitable habitat is likely to be present for common reptiles, including grass snake in the River Don and River Dearne valleys, for example at Ravenfield Park and Firsby Reservoirs, in the Hooton Roberts area, and Old Denaby wetland.

⁵⁷ Biggs J, Ewald N, Valentini A, Gaboriaud C, Griffiths RA, Foster J, Wilkinson J, Arnett A, Williams P and Dunn F. 2014. Analytical and methodological development for improved surveillance of the great crested newt Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (*Triturus cristatus*) environmental DNA. Freshwater Habitats Trust, Oxford

7.4 Effects arising during construction

Avoidance and mitigation measures

- 7.4.1 The following measures have been included as part of the design of the Proposed Scheme (in addition to the landscape planting shown in the Volume 2: LA13 Map Book, Map Series CT-o6, along the rail corridor, which would be largely a mixture of woodland/scrub and grassland), and would contribute towards mitigating the losses of habitat and effects on species:
- construction of viaducts over the River Don and the River Dearne would avoid direct effects to these watercourses and allow free passage for wildlife beneath them including along the rivers and their banks;
 - construction of a viaduct at Frickley, over Church Field Road and the floodplain, would maintain the existing ecological connectivity under the route of the Proposed Scheme to adjacent habitats by minimising fragmentation;
 - new landscape mitigation planting and woodland habitat creation would contribute towards replacing the losses of woodland (e.g. Firsby Brook, south of the A630 Doncaster Road and Watchley Lane), and towards enhancing connectivity between remaining woodlands;
 - ponds lost that do not support great crested newt would be replaced on a 1:1 ratio basis; and
 - provision of species-rich hedgerow habitat creation, using appropriate native species to help maintain connectivity of the ecological network in the surrounding areas, for example at Old Denaby Area LWS, and Barnburgh Cliff.
- 7.4.2 The assessment assumes implementation of the measures set out within the draft Code of Construction Practice (CoCP)⁵⁸, which includes translocation of protected species where appropriate.
- 7.4.3 Section 9 of the draft CoCP requires contractors to implement a range of measures to protect ecological receptors including the following:
- 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;

⁵⁸ Supporting Document: Draft Code of Construction Practice.

- 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 licensing requirements, including those for protected and invasive species and designated sites.

Assessment of impacts and effects

7.4.4 The following section considers the impacts and effects on ecological features as a consequence of construction of the Proposed Scheme. All assessments have been undertaken on a precautionary basis, in the absence of survey information, and take account of the baseline value as presented in Section 7.3.

7.4.5 Further details of the baseline, impacts and mitigation in relation to water resources within this area are provided in Section 15, Water resources and flood risk.

Designated sites

7.4.6 Construction of the Proposed Scheme would not result in the permanent or temporary loss of Denaby Ings SSSI. No water-dependent effects on the site are predicted from hydrological assessment (Section 15, Water resources and flood risk). The site is assessed as low risk from dust impacts (Section 4, Air quality). In the absence of construction traffic data and taking a precautionary approach, an adverse effect from impacts on air quality is identified that would be significant at the national level.

7.4.7 Construction of the Proposed Scheme would result in the permanent loss of 0.1ha, 3%, of Firsby Reservoir LNR, which is designated for its unimproved grassland mosaic, and species-rich hedgerows with maturing trees. Habitat loss of woodland and grassland would result in a permanent adverse effect on site integrity that would be significant at the county/metropolitan level.

7.4.8 Construction of the Proposed Scheme would result in the permanent loss of 3.3ha, 18%, of Old Denaby Wetland LNR, which are floodplain wetland sites with typical river, oxbow and wetland wildlife. Hydrological assessment within Section 15, Water resources and flood risk states that the permanent dewatering associated with Hickleton cutting and installation of viaduct piers for the River Don viaduct may also change the dynamics of groundwater flow and reduce baseflow to the LNR. Habitat loss and hydrological impacts would result in a permanent adverse effect on site integrity that would be significant at the county/metropolitan level.

7.4.9 Construction of the Proposed Scheme would result in adverse effects to the 14 LWS sites listed below. The effects on sites are:

- construction of the Ravenfield embankment would result in the permanent loss of 0.1ha (1%) of the Ravenfield Park and Firsby Reservoirs LWS. This would be a permanent adverse effect on site integrity, which would be significant at the district/borough level;

- construction of the Conisbrough Parks embankment would result in the permanent loss of 0.4ha (31%) of Conisbrough Parks Hedgerows LWS. Given the extent of habitat that would be lost this would be a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Hooton Roberts cutting and A630 Doncaster Road overbridge would result in the permanent loss of 0.6ha (8%) of Hooton Cliff LWS. Given the extent of habitat that would be lost this would be a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Old Denaby cutting would result in the permanent loss of 4.7ha (41%) of Denaby Wood LWS. Given the extent of habitat that would be lost this would be a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the River Don viaduct would result in the permanent loss of 3.1ha (13%) of Old Denaby Area LWS. Given the extent of habitat that would be lost, this would be a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Barnburgh embankment and provision of a temporary material stockpile would result in the permanent loss of 7.3ha (70%) of Thunderhole LWS. In addition dewatering associated with the Hickleton cutting may lead to a temporary lowering of groundwater flows to the LWS. Given the extent of habitat that would be lost, this would be a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Hickleton cutting would result in the permanent loss of 0.6ha (8%) of Barnburgh Cliff LWS. Given the extent of habitat that would be lost, this would be a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Hickleton Footpath 1 realignment would result in the permanent loss of 0.2ha (1%) of Hickleton Park LWS. This would result in a permanent adverse effect, which would be significant at the district/borough level;
- construction of the A635 Barnsley Road overbridge would result in the permanent loss of 0.5ha (1%) of Hickleton Golf Course LWS. This would result in a permanent adverse effect, which would be significant at the district/borough level;
- provision of a temporary material stockpile adjacent to Hickleton Spring LWS could result in indirect effects from construction on habitat and species using it. It is anticipated that these effects would be reduced to a level that is not significant through implementation of measures in the draft CoCP. However, on a precautionary basis, in the absence of detailed assessment, there would be a temporary adverse effect, which would be significant at up to the district/borough level;

- construction of the Hickleton cutting and Bilham retaining wall would result in the permanent loss of 1.4ha (24%) of Bilham Park and Summer House Plantation LWS. Given the extent of habitat that would be lost, this would result in a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Hickleton cutting and Bilham retaining wall would result in the permanent loss of 0.4ha (24%) of The Wilderness LWS. Given the extent of habitat that would be lost, this would result in a permanent adverse effect, which would be significant at the county/metropolitan level;
- construction of the Hickleton cutting would result in the permanent loss of 0.6ha (8%) of First, Second and Third Plantations LWS. Given the extent of habitat that would be lost, this would result in a permanent adverse effect, which would be significant at the county/metropolitan level; and
- construction of Clayton embankment and Howell Wood overbridge in the South Kirkby to Sharlston Common area (LA14) would result in indirect construction impacts on habitat and species in the adjacent Howell Wood LWS. It is anticipated that these effects would be reduced to a level that is not significant through implementation of measures in the draft CoCP. However, on a precautionary basis, in the absence of detailed assessment, there would be a temporary adverse effect, which would be significant at up to the county/metropolitan level.

7.4.10 The following three AWIS are located partly within the land required for the Proposed Scheme and would be subject to direct impacts through habitat loss:

- construction of the Hooton Roberts cutting and A630 Doncaster Road overbridge would result in the permanent loss of 0.1ha (1%) of the Hooton Cliff AWIS. Aerial photographs appear to show that this part of the site is hardstanding. However, this has not yet been confirmed and on a precautionary basis, the impact has been assessed as habitat loss. This loss would result in a permanent adverse effect on site integrity, which would be significant at the county/metropolitan level;
- construction of Hickleton cutting would result in the permanent loss of 0.4ha (22%) of AWIS known as 'Unnamed Wood west of Barnburgh Cliff AWIS'. The impact of this habitat loss would result in a permanent adverse effect on site integrity, which would be significant at the county/metropolitan level; and
- construction of the Hickleton cutting would result in the permanent loss of 0.1ha (2%) of the Watchley Crag Wood AWIS. The impact of this habitat loss would result in a permanent adverse effect on site integrity, which would be significant at the county/metropolitan level.

Habitats

Woodland

7.4.11 Construction of the Proposed Scheme would result in the loss of 3.6ha of broadleaved woodland outside designated sites within this area. The extent of permanent loss of

these woodlands would result in an effect that would be significant at up to the county/metropolitan level. However woodland habitat creation incorporated into the Proposed Scheme will reduce these effects to a level that is not significant. If the ongoing review identifies the presence of additional ancient woodland the effects would be significant up to the county/metropolitan level.

Grassland

- 7.4.12 Construction of the Proposed Scheme would result in the loss of grassland, outside of designated sites, including 0.9ha of floodplain grazing marsh west of the River Dearne viaduct. In the absence of further survey information, it has been assumed that none of the grassland lost would be unimproved, and hence the loss would be significant at up to the district/borough level.

Hedgerows

- 7.4.13 The Proposed Scheme would result in the permanent loss of hedgerows, and would result in severance of the network in many places, adversely affecting connectivity with the surrounding area. The effects of these losses will be fully assessed in the formal ES. The Proposed Scheme includes new hedgerow planting which would help offset losses. Further hedgerow planting would be proposed as part of the design development. In the absence of this additional mitigation, the loss of these hedgerows would result in a permanent adverse effect on the conservation status of the hedgerow network that would be significant at up to the district/borough level.

Watercourses

- 7.4.14 The Proposed Scheme would cross River Don and River Dearne on viaducts. These watercourses would not be directly affected, and indirect effects would not be significant as they would be controlled through the implementation of measures in the draft CoCP. However, construction of the Proposed Scheme would result in the loss of sections of other smaller watercourses, and severance of river corridors due to the installation of culverts. These impacts would result in a permanent adverse effect, which would be significant at up to the district/borough level.

Water bodies

- 7.4.15 Five ponds would be lost as a result of construction of the Proposed Scheme. The loss of these ponds could result in an impact that would be significant up to county/metropolitan level, however these ponds would be replaced reducing the effect to a level that is not significant.

Ancient and veteran trees

- 7.4.16 Subject to survey, it is assumed that ancient and veteran trees within the land required for the Proposed Scheme in Ravenfield to Clayton area would be permanently lost. Ancient and veteran trees are an irreplaceable resource and their potential loss would result in a permanent adverse effect, which is significant at county/metropolitan level in each case.

Reedbed

- 7.4.17 Outside of designated sites, construction of the Proposed Scheme will result in the loss of 10.5ha of reedbed habitat in the Ravenfield to Clayton area. In the absence of

further survey information, it has been assumed that the loss would be significant at up to the district/borough level.

Species

Bats

- 7.4.18 The permanent removal of vegetation within the area would have impacts on bats. Habitat loss would reduce the availability of foraging resource, and potentially result in the loss of roosts and fragmentation of commuting routes. This could particularly affect breeding populations of bat species within the area. Bats may also be affected by the lighting associated with construction works, although it is anticipated that this would be controlled through measures in the draft CoCP. In the absence of further survey information, it has been assumed, on a precautionary basis, that impacts would result in a permanent adverse effect on the conservation status of the bat populations, which would be significant at up to the regional level.

Otter

- 7.4.19 The River Don and River Dearne provide suitable habitat for otter, and the species has been recorded in both catchments. The proposed viaducts over the River Don and River Dearne would avoid loss of habitat along the river corridor. Indirect effects from construction activities may result in disturbance to the species during the construction period, and prevent them from moving along watercourses. However, it is anticipated that these indirect effects would be controlled through measures outlined in the draft CoCP. Habitat loss would result at several smaller watercourses that would be crossed by the Proposed Scheme. In the absence of further survey information, it has been assumed, on a precautionary basis, that impacts to otters would result in an adverse effect on the conservation status of these species, which would be significant up to the county/metropolitan level.

Water vole

- 7.4.20 The proposed viaducts over the River Don and River Dearne would avoid loss of water vole habitat along the river corridor. Indirect effects from construction activities such as increased light and noise may result in disturbance to the species during the construction period, and prevent them from moving along watercourses. However, it is anticipated that these indirect effects would be controlled through measures outlined in the draft CoCP. Habitat loss would result at several smaller watercourses crossed by the Proposed Scheme. In the absence of further survey information, it has been assumed, on a precautionary basis, that impacts to water voles would result in an adverse effect on the conservation status of these species, which would be significant up to the county/metropolitan level.

Great crested newt

- 7.4.21 It has been assumed that all five ponds and (surrounding terrestrial habitat) within the land required for the Proposed Scheme support great crested newts, and would be lost during construction. The loss of ponds supporting great crested newts would result in the loss of habitat, and isolation and severance of breeding populations of the species across this area. Where great crested newt is shown to be present by survey, two new ecological mitigation ponds would be created for every pond lost to the land

permanently required for the Proposed Scheme. The implementation of this mitigation would reduce the effect of loss of breeding habitat to not significant. Suitable terrestrial habitat would be required around new ponds with links to encourage dispersal (e.g. by incorporating existing habitat or creating new habitat). In the absence of the full mitigation, the impact of the loss of the ponds and surrounding land, would result in a permanent adverse effect on the conservation status of great crested newts, which would be significant at up to the county/metropolitan level.

Birds

- 7.4.22 The land required for the Proposed Scheme would result in the loss of nesting and foraging habitat for a range of breeding and wintering birds, predominantly farmland and woodland species. These are likely to include the Schedule 1 species barn owl, kingfisher, avocet, little egret, hobby and bittern, which have all been recorded to date within the Ravenfield to Clayton area. On a precautionary basis, in the absence of further survey information, it has been assumed that construction of the Proposed Scheme would result in a permanent adverse effect that would be significant at up to the county/metropolitan level.

White-clawed crayfish

- 7.4.23 Suitable habitat for white-clawed crayfish is likely to be present in watercourses including the River Don and River Dearne, as well as smaller local watercourses in the area. The Proposed Scheme would pass over the two watercourses on viaducts, and indirect impacts to the watercourses would be controlled through measures outlined in the draft CoCP. Habitat loss would occur at several smaller watercourses which would be crossed by the Proposed Scheme. In the absence of further survey information, it has been assumed, on a precautionary basis, that impacts to white-clawed crayfish, would result in an adverse effect on the conservation status of these species, which would be significant up to the county/metropolitan level.

Aquatic invertebrates

- 7.4.24 The land required for the Proposed Scheme would result in loss of habitat suitable for aquatic invertebrates, including species of principal importance. In the absence of further survey information, it has been assumed, on a precautionary basis, that construction of the Proposed Scheme, would result in permanent adverse effect, which would be significant at up to the district/borough level.

Terrestrial invertebrates

- 7.4.25 The land required for the Proposed Scheme would result in loss of habitat suitable for terrestrial invertebrates, including species of principal importance, likely to be present in Old Denaby, Barnburgh, Hickleton, Conisbrough and areas of ancient woodland. In the absence of further survey information, it has been assumed, on a precautionary basis, that construction of the Proposed Scheme, would result in permanent adverse effect, which would be significant at up to the district/borough level.

Fish

- 7.4.26 There are records from the main watercourses, the River Don and River Dearne, of a wide range of coarse fish species typical of large lowland riverine environments as well as European eel, trout and grayling. Both watercourses, along with smaller watercourses and water bodies, are likely to have suitable habitat for notable fish species. The Proposed Scheme would pass over these watercourses on viaducts, and indirect impacts to the watercourses would be controlled through measures outlined in the draft CoCP. However, other smaller watercourses would still be affected and may require assessment under the Water Framework Directive (WFD)⁵⁹. In the absence of further survey information, it has been assumed, on a precautionary basis, that construction of the Proposed Scheme would result in permanent adverse effect, which would be significant at up to the district/borough level.

Reptiles

- 7.4.27 There are records of grass snake within 1km of the land required for the Proposed Scheme in the Hickleton area. Suitable habitat is also likely to be present for common reptiles, including grass snake in the River Don and River Dearne valleys. In the absence of further survey information, it has been assumed that the land required for the Proposed Scheme would have an impact that would result in permanent adverse effect, which would be significant at up to the district/borough level.
- 7.4.28 Effects on other habitats and species that would be significant at the local/parish level during construction will be reported in the formal ES.
- 7.4.29 Indirect effects from changes in air quality, such as that arising from increased levels of construction traffic, will be considered where appropriate. These effects will be reported in the formal ES.

Other mitigation measures

- 7.4.30 Further measures currently being considered, but which are not yet part of the design and will be informed by the findings of the ongoing field surveys and engagement with relevant stakeholders, include:
- options to mitigate the partial loss of the LNRs;
 - options to mitigate the partial loss of the LWS;
 - identify suitable mitigation to maintain downstream water supply to Old Denaby Wetland LNR and Thunderhole LWS;
 - options to help integrate mitigation of wetland losses within the Dearne valley into wider strategic initiatives associated with wetland creation and public enjoyment of nature;
 - provision of additional broadleaved woodland (non-ancient) to replace those lost, and/or enhancement of remaining woodlands;
 - provision of additional hedgerows which would mitigate the losses and

⁵⁹ EU Water Framework Directive. Available online at: http://ec.europa.eu/environment/water/water-framework/index_en.html

maintain the connectivity of the network;

- options to create new species rich grasslands (including translocation where appropriate) to compensate for grassland losses such as those in the Dearne valley, and losses of floodplain grazing marsh;
- options to expose limestone faces in cuttings and use spoil in-situ to enhance limestone grassland features;
- provision of additional measures to facilitate connectivity where significant foraging or commuting routes of fauna species would be affected;
- use of temporary fencing or retention of existing habitat links to reduce the risk of disturbance to otters during construction; design of watercourse culverts and underpasses to allow the free passage of wildlife;
- provision of alternative roosting/nesting habitat (nest boxes etc.) for barn owl;
- provision of alternative roosting habitat for bats;
- structures to reduce severance effects on bats; and
- provision of additional ponds (on a two to one basis where existing ponds supporting great crested newts are lost), outside the area required for the permanent works but within the land required for construction of the Proposed Scheme, and suitable terrestrial habitat around these ponds with habitat links to allow dispersal.

7.4.31 Some of the above may also be achieved through strategic mitigation, which is currently being discussed with relevant stakeholders.

7.4.32 Ancient woodland is an irreplaceable resource and this loss is considered to be a permanent adverse residual effect. The loss of ancient woodland would be partly compensated through a package of measures bespoke to the woodland affected. Ancient woodland soil with its associated seed bank would be salvaged and translocated to receptor sites that have, wherever possible, been chosen because they link to and/or are adjacent to ancient woodland fragments. This would seek to increase the connectivity of fragmented ancient woodland parcels. Other measures such as planting native tree and shrub species of local provenance, enhancement of retained woodland, and translocation of coppice stools and dead wood, would be undertaken as appropriate.

Summary of likely residual significant effects

7.4.33 Taking into account mitigation proposed in the design of the Proposed Scheme set out above, the anticipated significant residual ecological effects during construction are described in Table 15.

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Table 15: Residual significant effects on ecological resources/features during construction

Resource/feature	Residual effect	Level at which the effect would be significant
Denaby Ings SSSI	In the absence of construction traffic data and taking a precautionary approach, an adverse effect is identified from impacts arising from construction traffic.	Up to national level
Firsby Reservoir LNR	Permanent adverse effect on site integrity due to a loss of 0.1ha (3%) of the site. Habitats include acidic and neutral unimproved grassland, species-rich hedgerows and open water.	Up to county/metropolitan
Old Denaby Wetland LNR	Permanent adverse effect on site integrity due to a loss of 3.3ha (18%) of the site which comprises two floodplain wetland areas.	Up to county/metropolitan
Ravenfield Park and Firsby Reservoirs LWS	Permanent adverse effect on site integrity due to a loss of 0.1ha (1%) of the site. Habitats include woodland, semi-improved neutral grassland, marshy grassland and ponds.	Up to district/borough
Conisbrough Parks Hedgerows LWS	Permanent adverse effect on site integrity due to a loss of 0.4ha (31%) of the site designated for its hedgerows of interest.	Up to county/metropolitan
Hooton Cliff LWS	Permanent adverse effect on site integrity due to a loss of 0.6ha (8%) of the site. The site is designated for its mature semi-natural woodland.	Up to county/metropolitan
Denaby Wood LWS	Permanent adverse effect on site integrity due to a loss of 4.7ha (41%) of the site's broadleaved semi-natural woodland and shrub.	Up to county/metropolitan
Old Denaby Area LWS	Permanent adverse effect on site integrity due to a loss of 3.1ha (13%) of the site, and hydrological changes. The LWS comprises tall ruderal vegetation, marshy grassland, unimproved neutral grassland, scrub and broadleaved woodland.	Up to county/metropolitan
Thunderhole LWS	Permanent adverse effect on site integrity due to a loss of 7.3ha (70%) of the site and temporary lowering of groundwater flows. The site comprises springs, streams, pockets of carr woodland, damp grassland, fen and tall herb.	Up to county/metropolitan
Barnburgh Cliff LWS	Permanent adverse effect on site integrity due to a loss of 0.6ha (8%)	Up to county/metropolitan

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Resource/feature	Residual effect	Level at which the effect would be significant
	of the site. Habitats lost include woodland and scrub.	
Hickleton Park LWS	Permanent adverse effect on site integrity due to a loss of 0.2ha (1%) of the site. Habitats lost include woodland and field margins.	Up to district/borough
Hickleton Golf Course LWS	Permanent adverse effect on site integrity due to a loss of 0.5ha (1%) of the site. Habitats lost include the golf course and pockets of broadleaved woodland and hedgerow.	Up to district/borough
Hickleton Spring LWS	Temporary and indirect effects from noise and dust emissions on woodland, habitats and species that use them.	Up to district/borough
Bilham Park and Summer House Plantation LWS	Permanent adverse effect on site integrity due to a loss of 1.4ha (24%) of the site's deciduous plantation woodland.	Up to county/metropolitan
The Wilderness LWS	Permanent adverse effect on site integrity due to a loss of 0.4ha (24%) of the site's broadleaved plantation woodland.	Up to county/metropolitan
First, Second and Third Plantations LWS	Permanent adverse effect on site integrity due to a loss of 0.6ha (8%) of the site's broadleaved woodland.	Up to county/metropolitan
Howell Wood LWS	Temporary and indirect effects from construction on woodland, grassland, open and running water habitats and species that use them.	Up to county/metropolitan
Hooton Cliff AWIS	Permanent adverse effect on site integrity due to a loss of 0.1ha (1%) of the site, which appears from aerial imagery to be hardstanding.	Up to county/metropolitan
Unnamed Wood west of Barnburgh Cliff AWIS	Permanent adverse effect on site integrity due to a loss of 0.4ha (22%) of the site's woodland.	Up to county/metropolitan
Watchley Crag Wood AWIS	Permanent adverse effect on site integrity due to a loss of 0.1ha (2%) of the site's woodland.	Up to county/metropolitan
Woodland	The woodland habitat creation incorporated into the Proposed Scheme is anticipated to reduce effects to a level that is not significant. If the ongoing review identifies the presence of additional ancient woodland the effects would be significant up to the county/metropolitan level.	Up to county/metropolitan

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Resource/feature	Residual effect	Level at which the effect would be significant
Grassland	Loss of floodplain grazing marsh.	Up to district/borough
Hedgerows	Permanent loss of hedgerows.	Up to district/borough
Watercourses	Loss of sections of small watercourse and severance of smaller unnamed watercourses.	Up to district/borough
Ancient and veteran trees	Permanent loss of individual trees.	Up to county/metropolitan
Reedbed	Loss of 10.5ha of reedbed habitat.	Up to district/borough
Bats	Potential permanent adverse effect on conservation status due to loss of roosts, foraging habitat and fragmentation.	Up to regional
Otter	Habitat loss and construction effects would affect several smaller watercourses and water bodies crossed by the Proposed Scheme.	Up to county/metropolitan
Water vole	Habitat loss and construction effects would affect several smaller watercourses and water bodies crossed by the Proposed Scheme.	Up to county/metropolitan
Great crested newts	Potential loss of five breeding ponds and surrounding terrestrial habitat, which may support great crested newt.	Up to county/metropolitan
Birds	Permanent adverse effects through the loss of foraging and nesting opportunities for a range of woodland, wetland and grassland bird species.	Up to county/metropolitan.
White-clawed crayfish	Potential for permanent adverse effect on conservation status due to loss of suitable habitat for this species.	Up to county/metropolitan.
Aquatic invertebrates	Potential for permanent adverse effects through loss of habitat for aquatic invertebrates.	Up to district/borough.
Terrestrial invertebrates	Potential for permanent adverse effects through loss of habitat for terrestrial invertebrates.	Up to district/borough.
Fish	Potential for permanent adverse effects through loss of habitat for fish.	Up to district/borough.

Resource/feature	Residual effect	Level at which the effect would be significant
Reptiles	Potential for permanent adverse effects through loss of habitat for reptiles.	Up to district/borough.

7.5 Effects arising during operation

Avoidance and mitigation measures

7.5.1 There are no specific measures currently identified to avoid or mitigate ecological effects during operation of the Proposed Scheme within this section of the route.

Assessment of impacts and effects

7.5.2 This section considers the impacts and effects on ecological features during operation of the Proposed Scheme. All assessments are based on a precautionary basis, in the absence of survey information.

7.5.3 Bats are at risk of being struck by trains or possibly harmed by turbulence, particularly at frequently used commuting/foraging routes that cross the Proposed Scheme. This represents a potential permanent adverse effect on conservation status of the bat species concerned that would be significant at up to the county/metropolitan level.

7.5.4 Barn owls are at risk of colliding with trains, where there is suitable grassland foraging habitat. The grassland vegetation that would grow along the embankments of the Proposed Scheme may encourage barn owls to forage close to trains, with the risk that they may be killed. Mortality, even if infrequent, could affect the conservation status of this Schedule 1 species and the ongoing reduction in numbers would result in a permanent adverse effect that would also be significant at up to county/metropolitan level. Effects on all other habitats and species would likely be significant at the local/parish level during operation. These effects will be assessed and reported in the formal ES.

Other mitigation measures

7.5.5 Additional mitigation measures currently being considered include:

- updating the HS2 barn owl mitigation plan⁶⁰ which has been developed to provide measures that will be implemented to reduce the effects of the Proposed Scheme to a level that is not significant. This is likely to include seeking opportunities to provide barn owl nest boxes and where feasible habitat enhancement opportunities at least 3km from the Proposed Scheme in consultation with local landowners; and
- structures to reduce mortality to bats.

⁶⁰ Currently in development for Phase 1 of HS2

Summary of likely residual significant effects

- 7.5.6 Taking into account mitigation included as part of the Proposed Scheme design, the anticipated significant residual ecological effects during operation are detailed in Table 16.

Table 16: Residual significant effects on ecological resources/features during operation

Resource/feature	Residual effect	Level at which the effect would be significant
Bats	Potential permanent adverse effect on conservation status due to collision with trains.	Up to county/metropolitan
Barn owl	Potential permanent adverse effect on conservation status due to collision with trains.	Up to county/metropolitan

Monitoring

- 7.5.7 Volume 1, Introduction and Methodology, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 7.5.8 There are no area-specific requirements for monitoring ecology and biodiversity effects or mitigation during the operation of the Proposed Scheme in the Ravenfield to Clayton area.

8 Health

8.1 Introduction

- 8.1.1 This section identifies the communities within the Ravenfield to Clayton area that would be subject to impacts associated with the Proposed Scheme and describes the 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.
- 8.1.2 Engagement with key public health bodies is underway, including Public Health England, relevant directors of Public Health and Health and Wellbeing Boards, and relevant Clinical Commissioning Groups. The purpose of the engagement has been to understand health issues in the Ravenfield to Clayton area that may not be identified solely through a review of publicly available data. Engagement with key public health bodies will continue as part of the development of the Proposed Scheme.
- 8.1.3 This section deals specifically with impacts and effects at a local level within the Ravenfield to Clayton area. Health effects across the Proposed Scheme as a whole are assessed in the route-wide health assessment contained in Volume 3: Route-wide effects.
- 8.1.4 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 are provided in the Volume 2: LA13 Map Book.

8.2 Scope, assumptions and limitations

- 8.2.1 The scope, assumptions and limitations for the health assessment are set out in Volume 1 and the Scope and Methodology Report (SMR)⁶¹.
- 8.2.2 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'. 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.
- 8.2.3 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.

⁶¹ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

- 8.2.4 The health determinants of relevance within the Ravenfield to Clayton area are:
- for impacts during construction (temporary and permanent):
 - neighbourhood quality;
 - access to services, health and social care;
 - access to green space, recreation and physical activity; and
 - social capital.
 - for impacts during operation (permanent):
 - neighbourhood quality; and
 - access to green space, recreation and physical activity.
- 8.2.5 The geographic extent of the health assessment covers those areas where impacts on health determinants are predicted to occur.
- 8.2.6 The health assessment is based on a review of evidence linking changes in health determinants to potential health outcomes. This information will be presented in a concise review of the key literature and included in the formal ES. 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.
- 8.2.7 There is no established or widely accepted framework for assessing the significant health effects of 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. This does not, however, provide a clear basis for drawing conclusions as to whether a health effect is likely to be 'significant'.
- 8.2.8 Potential health effects have been identified based on information that is available at this stage of the assessment. A full assessment of health effects, applying the assessment criteria set out in the SMR, will be provided in the formal ES.

8.3 Environmental baseline

Existing baseline

Description of communities in the Ravenfield to Clayton area

- 8.3.1 The Ravenfield to Clayton area is characterised by towns, villages and individual properties set within a rural area. As reported in Section 14, Traffic and transport,

there are a number of public rights of way (PRoW) within the vicinity of the Proposed Scheme, which provide access to the countryside, and are considered important to health and wellbeing.

- 8.3.2 For the purposes of the health assessment, the study area is divided into the communities described below. A description of community facilities is provided in Section 6, Community.

Ravenfield, Hooton Roberts, Old Denaby, Denaby Main and surrounds

- 8.3.3 Ravenfield, Hooton Roberts and Old Denaby are all villages located to the west of the route of the Proposed Scheme. Ravenfield comprises approximately 85 residential properties, nearest of which would be approximately 700m from the route. Hooton Roberts comprises approximately 34 residential properties, the nearest of which would be approximately 800m from the route. Old Denaby comprises approximately 90 residential properties, the nearest of which would be approximately 160m from the route.
- 8.3.4 Denaby Main is village located to the east of the route of the Proposed Scheme, which comprises approximately 500 residential properties. The nearest residential properties within Denaby Main would be approximately 500m from the route.
- 8.3.5 Community facilities within these settlements are largely focused in Ravenfield and Denaby Main and include allotments, a church, care homes, a public house, a nursery and primary schools. In addition, a leisure centre, Ravenfield Ponds, Firsby reservoir Local Natural Reserve (LNR) and Local Wildlife Site (LWS), Old Denaby Wetlands LNR, Pitman Road informal play area, Pitman Road woodland, Denaby Wood and Old Denaby Wetlands provide a number of recreational opportunities for the general public.

Conisbrough and Mexborough

- 8.3.6 Conisbrough is a town situated alongside the southern banks of the River Don, to the east of the route of the Proposed Scheme. Conisbrough comprises approximately 4,950 residential properties, the nearest of which would be approximately 500m from the route. Community facilities within Conisbrough include primary schools, a secondary school, a post office, a GP surgery, churches, a community centre, a youth hub, public houses and care homes.
- 8.3.7 Mexborough is a town located to the north of the River Don. The town comprises approximately 5,200 residential properties. Some residential properties would be on the route of the Proposed Scheme. Community facilities within Mexborough include primary schools, a junior school, a secondary school, post offices, a library, churches, a hospital, a community centre, a youth centre and care homes. In addition, Clayfield amenity green space, located off Clayfield View in Mexborough is an informal space that provides recreational opportunities for the general public.

High Melton, Harlington, Barnburgh, Hickleton and surrounds

- 8.3.8 High Melton is a village to the east of the route of the Proposed Scheme, which comprises approximately 50 residential properties. The nearest residential properties would be approximately 700m from the route.

- 8.3.9 Harlington and Barnburgh are two adjoining villages located west of the route of the Proposed Scheme. Together, the villages comprise approximately 300 residential properties. The nearest residential properties would be approximately 250m from the route. Community facilities within Harlington include allotments. Community facilities within Barnburgh include allotments, a public house, a primary school, a church and a village hall. In addition, Barnburgh Lakes Fishery provides recreational opportunities for the general public.
- 8.3.10 Hickleton is a village located to the west of the route of the Proposed Scheme, which comprises approximately 80 residential properties. The nearest residential properties would be approximately 250m from the route. Community resources within Hickleton include a church and a former hall (Hickleton Hall), which has been converted to a Sue Ryder nursing home. In addition, Hickleton Golf Course and the Summer House Plantation woodland (located in the wider setting of Bilham Park) provide recreational opportunities for the general public.

Thurnscoe, Hooten Pagnell, Frickley, Clayton and surrounds

- 8.3.11 This area covers the settlements of Thurnscoe, Hooten Pagnell, Frickley and Clayton. Thurnscoe is the largest settlement. Together, they comprise approximately 3,200 residential properties.
- 8.3.12 Thurnscoe is a village located to the west of the route of the Proposed Scheme, where the nearest residential properties would be approximately 100m from the route. Community facilities include primary schools, Robert Odgen School (which is a specialist school for those diagnosed with autism), a children's centre, a post office, a care centre, allotments, a reservoir and churches.
- 8.3.13 Frickley is a village located to the east of the route of the Proposed Scheme where the nearest properties would be approximately 370m from the route. The village is not publicly accessible as it comprises a private estate made up of seven residential cottages. Community facilities include Frickley Park, which is located within the estate, and All Saints Church Frickley which is located off Church Field Road, approximately 2.4km from the village of Frickley.
- 8.3.14 Clayton is a village located to the west of the route of the Proposed Scheme, where the nearest residential properties would be approximately 120m from the route. Millennium Green park and Howell Wood provide recreational opportunities for the general public.

Demographic and health profile of the Ravenfield to Clayton area

- 8.3.15 The local communities in the Ravenfield to Clayton area have a relatively low population density, commensurate with the rural nature of the area.
- 8.3.16 Data provided by the Office for National Statistics⁶² for the local authority areas of Rotherham Metropolitan Borough Council (RMBC) and Doncaster Metropolitan

⁶² The Office for National Statistics (ONS) 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 available by Lower Super Output area.

Borough Council (DMBC), shows that this population has a broadly similar health status compared with the national (England) averages.

- 8.3.17 The population has similar levels of deprivation to the national average, with regard to the combined indices of multiple deprivation⁶³, and the health domain (a sub-set of the indices of multiple deprivation).
- 8.3.18 The available data provides detail down to local authority level, and enables a demographic and health profile to be made of the population within the Ravenfield to Clayton area. The description of the whole population, and the populations within local authority, does not exclude the possibility that there will be some individuals or small groups of people who do not conform to the overall profile.

8.4 Effects arising during construction

Avoidance and mitigation measures

- 8.4.1 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. Insofar as reasonably practicable, mitigation measures have been incorporated into the design of the Proposed Scheme with the aim of avoiding or reducing adverse health effects. Examples of the mitigation measures incorporated into the design of the Proposed Scheme include the following:
- reducing the loss of property and community assets, insofar as reasonably practicable;
 - reducing visual intrusion and noise, insofar as reasonably practicable;
 - incorporating landscape design and screening into the design; and
 - permanent realignment and diversion of a number of PRoW and roads to maintain access (see Section 14, Traffic and transport for further detail).
- 8.4.2 In addition, the locations of construction compounds and site haul routes have been selected to reduce exposure to construction impacts insofar as reasonably practicable.
- 8.4.3 HS2 Ltd would require its contractors to comply with the environmental management regime for the Proposed Scheme, which would include the measures set out in the draft Code of Construction Practice (CoCP)⁶⁴, which provides a general basis for route-wide construction environmental management. Contractors would also be required to comply with the measures in Local Environmental Management Plans (LEMP), which apply the environmental management strategies at a local level.
- 8.4.4 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.

⁶³ Department for Communities and Local Government (2015) English Indices of Deprivation 2015. Available online at: <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015>

⁶⁴ Supporting document: Draft Code of Construction Practice

- 8.4.5 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; provide appropriate information; and to be the first point of contact to resolve community issues. The nominated undertaker would be required to take reasonable steps to engage with the community, 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).
- 8.4.6 In the event of any loss of a community facility, the options for mitigating significant community effects to be explored by HS2 Ltd would include:
- improving or altering the remaining portion of the community facility;
 - improving other existing community facilities in the area that could reduce the effect;
 - improving accessibility to other community facilities; and/or
 - identifying land owned by the relevant local authority that could be brought into use as a community facility with its agreement.

Assessment of impacts and effects

Neighbourhood quality

- 8.4.7 The term 'neighbourhood quality' is used in this assessment to describe the combination of environmental factors that influence people's experience of, and feelings about, their local environment. When these factors are altered people's levels of satisfaction with their living environment may change. In turn, this could affect mental wellbeing or behaviours such as the use of outside space.
- 8.4.8 The construction of the Proposed Scheme would affect neighbourhood quality through impacts such as noise, air emissions, visual impacts and additional traffic, including heavy goods vehicles (HGV). These will be assessed in the relevant sections of the formal ES, with a focus on those receptors, or groups of receptors, that are most affected. The Community section of the formal ES will provide a combined assessment, which will identify locations that are subject to significant environmental effects on two or more topics (e.g. noise and visual).
- 8.4.9 In contrast, a qualitative approach is taken to assessing impacts on neighbourhood quality. The assessment looks at changes in character, tranquillity and amenity across the neighbourhood as a whole, including streets and other public and private outdoor areas. This is judged on a case-by-case basis, taking into account the characteristics of each neighbourhood. It will be informed by the findings from other assessments, but does not rely on the same significance thresholds, as it is not focused on individual receptors. The assessment of health and wellbeing effects considers issues such as people's feelings of attachment to, and pride in, their neighbourhood and enjoyment of outside space, and how these may change.

- 8.4.10 The sections most relevant to the neighbourhood quality assessment are: Section 5, Air quality; Section 11, Landscape and visual; Section 13, Sound, noise and vibration; and Section 14, Traffic and transport.
- 8.4.11 Dust emissions from construction activities are considered in Section 5, Air quality, which identifies no adverse effects with respect to the effects of construction activities on dust soiling and human health within the Ravenfield to Clayton area, taking account of mitigation measures contained in the CoCP. Therefore, it is not expected that dust emissions around construction sites would contribute to adverse impacts on neighbourhood quality.
- 8.4.12 The construction of the Proposed Scheme would have temporary and permanent impacts on neighbourhood quality in areas close to construction sites. 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.
- 8.4.13 Construction activities would have the potential to generate a noticeable change in noise at outdoor areas and at neighbourhoods in proximity to the route of the Proposed Scheme, as reported in Section 13, Sound, noise and vibration. It is currently expected that the construction of the Proposed Scheme may be visible from nearby neighbourhoods, as reported in Section 11, Landscape and visual. This has the potential to contribute to impacts on neighbourhood quality and will be assessed in the formal ES.
- 8.4.14 Traffic and transport impacts in the Ravenfield to Clayton area would include:
- construction vehicle movements to and from the various construction compounds and sites;
 - temporary and permanent road closures and associated diversions; and
 - temporary and permanent alternative routes for PRoW.
- 8.4.15 Construction traffic, including HGV, would be present on a number of roads in this area, as reported in Section 14, Traffic and transport.
- 8.4.16 The link between health and the aesthetic value of the public realm is not well understood, but there is moderate evidence to suggest that an attractive environment can improve people's enjoyment and sense of wellbeing. Conversely, poor quality environments have been shown to have negative effects on people's health. There is moderate evidence that people have a preference for views of natural environments over man-made environments, and that exposure to views of natural environments is associated with increased wellbeing.
- 8.4.17 Overall, it is considered that the construction of the Proposed Scheme has the potential to affect wellbeing through changes to neighbourhood quality. This will be assessed in the formal ES.

Access to services, health and social care

- 8.4.18 There is strong evidence linking access to healthcare facilities with health outcomes, and there is also weak to moderate evidence to suggest that transport problems are a key barrier to people's ability to access these services. There is moderate evidence to suggest that access to shops and other local services can affect health. This is based on a range of factors affecting quality of life, and includes issues such as reducing feelings of isolation and enabling participation in society, as well as accessing basic needs such as food shopping.
- 8.4.19 The Ravenfield to Clayton area is predominantly rural in character. Typically, there is a reliance on a limited range of shops and services in nearby settlements within the area. To access alternative services and facilities it is necessary to travel longer distances. There is potential for communities to experience increased difficulty in accessing shops and community services (such as post offices, banks, libraries) as a result of increased journey times during construction. This will be assessed and reported in the formal ES.

Access to green space, recreation and physical activity

- 8.4.20 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.
- 8.4.21 Construction of the Proposed Scheme may impact on levels of access to green space and physical activity, including:
- impacts on PRoW, including temporary closures, diversions and loss of amenity, which may deter the use of these routes by walkers, cyclists and equestrians;
 - any loss of green space or facility used for physical activity; and
 - the presence of construction traffic, including HGV, on the local road network, which may deter their use by walkers, cyclists and equestrians.
- 8.4.22 There would be direct impacts on access to green space, recreation and physical activity at a number of locations in the Ravenfield to Clayton area, where publicly accessible open space is either temporarily or permanently lost, community facilities are permanently lost, or where the usability of land is compromised. This includes the following:
- the temporary closure of access to Pitman Road woodland on Denaby Lane in Old Denaby for approximately two years due to the construction of the River Don viaduct;
 - requirement of approximately 5% of land at Hickleton Golf Course for approximately three years and six months due to the construction of Hickleton cutting. The land required would encroach upon hole number 13, making the space inaccessible and losing the ability to fully function as an 18-hole golf course;

- requirement of approximately 40% of Summer House Plantation and approximately 25% of Bilham Park due to the construction of the Hickleton cutting and associated works to the north of Red Hill Lane. While access to the remaining northern half of Summer House Plantation and the northern half of Bilham Park would be maintained throughout construction, the functionality would be partly impaired. In addition, there would be permanent loss of approximately 24% of Summer House Plantation and Bilham Park;
- permanent loss of approximately 60% of Barnburgh Lakes Fishery due to construction of the Barnburgh embankment. This would result in the loss of two out of the three fishing lakes and a total of 48 of the pegs onsite; given the scale of the reduction in available pegs it is unlikely it could continue to function;
- permanent loss of approximately 41% of Denaby Wood due to the construction of the Old Denaby cutting. Access to the remaining wood on the western half would be maintained throughout construction however the functionality of the resource would be partly impaired;
- permanent loss of approximately 18% of Old Denaby Wetlands LNR on Denaby Lane due to the construction of the River Don viaduct. However, access to the remaining western half of the LNR would be maintained throughout construction so that the facility could remain in use; and
- permanent loss of approximately 25% of Clayfield amenity green space, off Clayfield View in Mexborough due to the construction of the Mexborough cutting. During the construction period, the resource would be completely closed and unusable for two years and two months.

8.4.23 As reported in Section 14, Traffic and transport, the route of the Proposed Scheme would intersect a number of PRow in the Ravenfield to Clayton area. The impacts on amenity and recreational value of these footpath networks, and therefore levels of physical activity and associated health and wellbeing effects, will be assessed in the formal ES.

8.4.24 Construction traffic would mainly use the site haul routes along the route of the Proposed Scheme. Some construction traffic, however, including HGV, would be present on local roads. This could obstruct or deter pedestrians, cyclists and equestrians from using these routes. Health effects associated with these impacts, including consideration of levels of use and available alternative routes for active travel and recreation, will be assessed in the formal ES.

Social capital

8.4.25 The connections between 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 trust⁶⁵.

- 8.4.26 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, social participation, reciprocity and trust. 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.
- 8.4.27 The settlements along the route support small, well-established communities. The size of the temporary construction workforce may be substantial relative to the size of these local communities. During the day, the workforce would be present on construction sites and compounds throughout the area, including main compounds and satellite compounds in the vicinity of the settlements of Conisbrough, Old Denaby, Denaby Main, Mexborough, Barnburgh, Harlington, Hickleton, Thurnscoe, Clayton and Frickley. The duration of the works at each area ranges from approximately three years to six years and three months. The presence of construction workers is likely to be noticeable, with construction vehicles using local roads to access compounds and workers using facilities such as shops, restaurants and public houses within settlements.
- 8.4.28 The introduction of a temporary construction workforce into communities could have the potential to alter people's perceptions and interactions within their communities, modifying behaviour and the value they place on social capital. Such a reduction in social capital has the potential to adversely affect wellbeing, and may influence behaviours that are beneficial to wellbeing such as the use of community facilities.
- 8.4.29 The draft CoCP 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.
- 8.4.30 The Community section of the ES will include an assessment of impacts resulting from the loss of residential properties. The loss of five properties is identified as the threshold for a significant Community effect. In some cases, the Community assessment may identify significant impacts below this threshold, for example where the demolitions make up a significant proportion of a small community.
- 8.4.31 The health assessment considers changes to the social environment and loss of social networks experienced by the remaining community following the loss of residential

⁶⁵ Office for National Statistics- Measuring Social Capital. Available online at:
http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171766_371693.pdf

properties. For this to have an adverse impact on overall levels of social capital, the loss of homes would need to make up a sizeable proportion of the local community, with the potential to result in the direct loss of contacts in the local area and/or a noticeable reduction in the number of people using local facilities. This will be judged on a case-by-case basis, taking account of the size of the community and its characteristics. Therefore, not all of the significant effects identified in the Community section will result in adverse health and wellbeing effects.

8.4.32 In the Ravenfield to Clayton area, there is a potential for such impacts to occur, where it is currently anticipated that 63 residential properties would be demolished as a result of the Proposed Scheme. The erosion of social networks resulting from these demolitions would have the potential to reduce social capital, reducing the beneficial health effects that are gained through social contact and support.

8.4.33 Road closures and diversions required for the construction of the Proposed Scheme would have the potential to reduce community connectivity by increasing journey times between communities.

Other mitigation measures

8.4.34 Any other mitigation identified to reduce adverse impacts on health determinants during the construction of the Proposed Scheme will be described in the formal ES.

8.4.35 HS2 Ltd will engage with local authorities and community representatives to identify measures aimed at fostering positive relationships between local communities and the temporary construction workforce. Any measures identified will be included within the Community Engagement Framework.

8.4.36 HS2 Ltd will continue to engage with owners/operators to identify reasonably practicable measures to help mitigate potential adverse effects identified in this assessment. Any other mitigation measures will be described in the formal ES.

8.5 Effects arising from operation

Avoidance and mitigation measures

8.5.1 Adverse impacts on health determinants would be 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 Ravenfield to Clayton area will be reported in the formal ES.

Assessment of impacts and effects

Neighbourhood quality

8.5.2 Operational noise would have the potential to generate a noticeable change in noise at outdoor areas and at neighbourhoods in proximity to the route of the Proposed Scheme, as reported in Section 13, Sound, noise and vibration. The permanent features of the Proposed Scheme may be visible from nearby neighbourhoods as reported in Section 11, Landscape and visual. This has the potential to contribute to impacts on neighbourhood quality and will be assessed in the formal ES.

Access to green space, recreation and physical activity

- 8.5.3 The potential impact on neighbourhood quality during operation, described above, could have the potential to change behaviours, such as reducing the use of outdoor spaces. The effects arising from the operation of the Proposed Scheme will be assessed in the formal ES.

Other mitigation measures

- 8.5.4 If a need is identified for mitigation to reduce adverse impacts on health determinants during the operation of the Proposed Scheme in this area, the mitigation will be described in the formal ES.

Monitoring

- 8.5.5 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 8.5.6 No area-specific monitoring of health effects during the operation of the Proposed Scheme have been identified at this stage.

9 Historic environment

9.1 Introduction

- 9.1.1 This section of the report provides a description of the current baseline for heritage assets and the likely impacts and significant effects identified to date resulting from the construction and operation of the Proposed Scheme within the Ravenfield to Clayton area. Consideration is given to the extent and value (significance) of heritage assets including archaeological and palaeo-environmental remains, historic buildings, the built environment and historic landscape.
- 9.1.2 Engagement has been undertaken with Historic England, Doncaster Metropolitan Borough Council, Rotherham Metropolitan Borough Council (RMBC), Barnsley Metropolitan Borough Council (BMBC) and South Yorkshire Archaeology Service. The purpose of this engagement has been to discuss the assessment approach, to obtain relevant baseline information and to inform the design development and assessment of the Proposed Scheme. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.
- 9.1.3 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: LA13 Map Book. Only designated heritage assets within the Ravenfield to Clayton area are shown on maps CT-10-106b to CT-10-111a. Non-designated heritage assets have also been assessed as part of this work, although they are not illustrated on these maps.
- 9.1.4 A gazetteer of designated and non-designated heritage assets with accompanying maps will be included in the formal ES. The formal ES will also include a Historic Landscape Characterisation Report, which will identify historic landscape character areas potentially affected by the Proposed Scheme.
- 9.1.5 Assets have been identified in this section of the report using their National Heritage List for England (NHLE) or Historic Environment Record (HER) name and number (numbers prefixed SYHER). If no record number is known (e.g. an asset identified from historic mapping), then the asset is referred to by name. Project-specific asset identification numbers will be used for the formal ES.

9.2 Scope, assumptions and limitations

- 9.2.1 The scope, key assumptions and limitations for the historic environment assessment are set out in full in Volume 1, Section 8 and the Scope and Methodology Report (SMR)⁶⁶, including the method for determining the value of a heritage asset and magnitude of impact (Tables 19 and 20 in the SMR, respectively)
- 9.2.2 The assessment focuses on the extent to which the Proposed Scheme would affect designated and non-designated heritage assets. Impacts on assets as a result of the

⁶⁶ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

Proposed Scheme would occur largely through the physical removal and alteration of heritage assets and changes to their setting.

- 9.2.3 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 in rural areas. This is referred to in the remainder of this assessment as the 500m study area.
- 9.2.4 The setting of all designated heritage assets within a study area of up to 2km from the land required for the Proposed Scheme has been considered. This is referred to in the remainder of this assessment as the 2km study area.
- 9.2.5 The historic environment methodology includes the consideration of the relevant intra-project effects. These interactions will be included in the assessment of impacts and effects in the formal ES.
- 9.2.6 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.
- 9.2.7 The baseline studies informing this assessment have been drawn from a wide and comprehensive range of information sources. These will be supported by a programme of non-intrusive survey, including geophysical survey, the results of which will be reported in the formal ES.
- 9.2.8 At this stage of the design development, heritage assets within the land required to construct the Proposed Scheme are assumed to require complete removal and the assessment has, in the main, been undertaken on that basis. However, an exception to this is the Grade II listed Bilham Belvedere Summer House (NHLE 1151628) which, although within the land required for the construction of the Proposed Scheme, would not be physically impacted. Also, in relation to the following assets, although the asset is within the land required for the construction of the Proposed Scheme and may be affected, any effect is unlikely to be significant:
- cropmark complex to the west of Barnburgh Grange (NMP 1431500);
 - Hickleton Hall Grade II registered park and garden (NHLE 1001151);
 - Hickleton Conservation Area; and
 - Clayton Conservation Area.
- 9.2.9 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.
- 9.2.10 Common features of the historic landscape such as marl pits, field boundaries and former areas of ridge and furrow are not individually considered but have been included in the baseline, as part of the historic landscape character and will be

considered as part of the overall assessment of impacts on historic landscape reported in the formal ES.

- 9.2.11 In undertaking the assessment, the following limitations were identified and assumptions made:
- field surveys are ongoing, and are subject to land access and site conditions. The result of field surveys will be reported within the formal ES;
 - desk-based assessment is ongoing and data on non-designated heritage assets will be described in the formal ES and accompanying technical appendices; and
 - intra-project topic assessments are ongoing and will be considered as part of the assessment of historic environment effects within the formal ES.

9.3 Environmental baseline

Existing baseline

- 9.3.1 Baseline data was collated from a variety of sources, including:
- the NHLE (Historic England register of designated heritage assets);
 - South Yorkshire Historic Environment Record (SYHER);
 - conservation area appraisals; and
 - historic maps and aerial photography.

- 9.3.2 In addition to collating documentary baseline data, site visits have been undertaken.

Designated assets

- 9.3.3 The following designated heritage assets are located partially or wholly within the land required for the Proposed Scheme:

- Bilham Belvedere Summer House (NHLE 1151628), a Grade II listed building of moderate value;
- two conservation areas of moderate value: Hickleton Conservation Area and Clayton Conservation Area; and
- Hickleton Hall (NHLE 1001151), a Grade II registered park and garden of moderate value.

- 9.3.4 The following designated heritage assets (listed from south to north) are located partially or wholly within 2km of the land required, temporarily or permanently, for the construction and operation of the Proposed Scheme:

- 14 scheduled monuments of high value: Roman Ridge: section 520yds (480m) E of Dyson's Cottage to Long Plantation (NHLE 1004814); Swinton Pottery (The Rockingham Works), 310m and 120m north-west of Keeper's Cottage (NHLE 1020067); Conisbrough Castle (NHLE 1010828; also a Grade I listed building); Castle Hills motte and bailey castle, Mexborough (NHLE 1013650);

Roman Ridge: section 150yds (140m) long W of Bow Brown Wood (in Swinton, NHLE 1004812); Wildthorpe medieval settlement, 680m south of Leylands Farm (NHLE 1020579); Icehouse 720m south-east of Bath House Farm (NHLE 1020715); Heavy Anti-aircraft gunsite 330m south-east of Lowfield Farm (in Bolton upon Dearne, NHLE 1019872); Site of St Helen's Chapel (in Barnburgh, NHLE 1004799); Dovecote at Barnburgh Hall (NHLE 1004800; also a Grade II* listed building); Medieval standing cross and early 20th century memorial cross (in Hickleton, NHLE 1012155; also a Grade II listed building); Cross in the churchyard of All Saints' Church (in Hooton Pagnell, NHLE 1012936); Market cross (in Hooton Pagnell, NHLE 1012937); and Frickley Old Hall moated site (NHLE 1017606);

- seven Grade I listed buildings of high value: Conisbrough Castle (NHLE 1192747; also a scheduled monument); Church of St Peter (in Conisbrough, NHLE 1192787); Church of St John the Baptist (in Mexborough, NHLE 1151642); Church of St Andrew (in Bolton upon Dearne, NHLE 1191492); Church of St Peter (in Barnburgh, NHLE 1151675); Church of St Wilfrid (in Hickleton, NHLE 1314784); and Church of All Saints (in Hooton Pagnell, NHLE 1314808);
- nine Grade II* listed buildings of high value: Church of St John the Baptist (in Hooton Roberts, NHLE 1286668); Church of St John (in Adwick upon Dearne, NHLE 1151670); Church of St James (in High Melton, NHLE 1192208); Barnburgh Hall dovecote (NHLE 1314757; also a scheduled monument); Hickleton Hall with attached quadrant walls and walls extended to enclose entrance⁶⁷ front garden having associated gate piers and two statues, also linking wall to gate pier at south-east corner (NHLE 1286810); The Brewhouse (NHLE 1286781); The Stable and Stable Cottage to Hickleton Hall (NHLE 1151659); Hooton Pagnell Hall including Archway Flat Numbers 1 and 2 Hall Cottages, Ground Floor Flat, First Floor Flat and Pump End (NHLE 1192355); and Church of All Saints (in Clayton with Frickley, NHLE 1151647);
- 149 Grade II listed buildings of moderate value, including six within Conisbrough Conservation Area, seven within Swinton Conservation Area, seven within High Melton Conservation Area, 12 within Barnburgh Conservation Area, 23 within Hickleton Conservation Area, two within Brodsworth Conservation Area, 27 within Hooton Pagnell Conservation Area, and three within Clayton Conservation Area; three decorative garden structures not contained within a conservation area, including the Garden wall with pedestrian entrance archway fronting onto bridle path on east side of Firsby Hall Farm (NHLE 1151535); and a number of dispersed farmhouses and farm buildings, including a Barn fronting onto bridle path on east side of Firsby Hall farmyard (NHLE 1192930);
- nine conservation areas of moderate value: Clifton Conservation Area, Conisbrough Conservation Area, Swinton Conservation Area, Mexborough

⁶⁷ The incorrect spelling of the word entrance is contained within the official title of the asset

Conservation Area, High Melton Conservation Area, Barnburgh Conservation Area, Marr Conservation Area, Brodsworth Conservation Area and Hooton Pagnell Conservation Area; and

- a Grade II* registered park and garden of high value: Brodsworth Hall (NHLE 1001250).

Non-designated assets

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

- a large, rectangular ditched enclosure⁶⁸ of probable Iron Age or Roman date visible as cropmarks on aerial photographs⁶⁹ to the south of Hilltop Farm, Conisbrough Parks (South Yorkshire Historic Environment Record monument number (SYHER) 6943);
- a complex of Iron Age or Romano-British ditched enclosures, trackways, field boundaries and pits visible as cropmarks on aerial photographs to the west of Pastures Road, Mexborough and to the south of the River Dearne (National Mapping Programme (NMP) monument record number 1025539; SYHER 5206 and 3722);
- a complex of Iron Age or Romano-British field boundaries, trackways, ditches and a ditched enclosure visible as cropmarks on aerial photographs to the west of Barnburgh Grange (NMP 1431500);
- a complex of Iron Age or Romano-British ditched enclosures, trackways and field boundaries, a round house and pits, pit clusters and pit alignments, visible as cropmarks on aerial photographs at Barnburgh Cliff (NMP 1025537; SYHER 5848, 3592, 12059 and 3583);
- three Iron Age or Romano-British ditched enclosures and an associated trackway, field boundaries, ditches and a pit visible as cropmarks on aerial photographs to the east of Hickleton Golf Course (NMP 1025510; SYHER 5571);
- a complex of seven Iron Age or Romano-British ditched enclosures, trackway, field boundaries, ditches and pits, visible as cropmarks on aerial photographs south of Watchley Lane, Hooton Pagnell (NMP 620743; SYHER 3580 and 13356); and
- two Iron Age or Romano-British enclosures and some field boundaries visible as cropmarks on aerial photographs south-east of Lodge Farm, Frickley with Clayton (NMP 1025512; SYHER 5569).

⁶⁸ An area of land which is bounded and defined by a ditch and is typically smaller than a paddock or field. Enclosures were typically used to contain livestock or human settlements

⁶⁹ The presence of buried walls and/or infilled ditches/pits can cause crops to grow and ripen at different rates. When viewed from above in the right conditions, this effect can reveal the presence of buried archaeological sites

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

- a fragment of ditch of uncertain date or function visible as a cropmark on aerial photographs to the north of Firsby Hall Farm (NMP 1435779);
- a possible Romanized settlement and manufacturing site within Denaby Wood, as indicated by numerous finds of Romano-British pottery, coins and iron slag (SYHER 12207);
- post-medieval bell pits for coal extraction⁷⁰ visible as cropmarks on aerial photographs at Hooton Roberts and Denaby (NMP 1435801; SYHER 12349);
- a WWII air raid shelter formerly visible as a structure on aerial photographs between the River Don and the Sheffield and South Yorkshire Navigation (NMP 1435975); and
- historic farm buildings at Wink House, Clayton.

9.3.7 Non-designated heritage assets located partially or wholly within the 500m study area include one asset of high value and five assets of moderate value comprising evidence for Iron Age or Roman activity, and one asset of moderate value comprising evidence for medieval or post medieval activity

Historic environment overview

9.3.8 To the south of Barnburgh Cliff, the bedrock geology of the land required for the Proposed Scheme comprises the mudstones, siltstones and sandstones of the Middle and Upper formations of the Pennine Coal Measures. These have typically given rise to seasonally waterlogged soils more suitable to pastoral than arable farming and are relatively uncondusive to the formation of cropmarks, which are one of the principle means of identifying past human activity. Between Barnburgh Cliff and Bilham, the geology is principally of Cadeby Formation Dolostone (also known as Magnesian Limestone). This gives rise to light, well drained soils favourable to arable as well as pastoral farming, which are very conducive to cropmark formation. Beyond Bilham, the bedrock geology is, once again, the Middle and Upper formations of the Pennine Coal Measures. Superficial deposits occur only in the low lying valleys of the Rivers Don and Dearne. These principally comprise clays and silts, although there are some deposits of sand and gravel immediately outside the land required. Such river terrace deposits also give rise to light and well drained soils. Consequently, they provided favoured locations for settlement and agriculture before the medieval period but rarely during or after it. Such soils are also very conducive to cropmark formation.

9.3.9 Activity within the Ravenfield to Clayton area during the Palaeolithic, Mesolithic, Neolithic and Bronze Age was concentrated within river valleys and the higher ground overlooking river confluences⁷¹. Early prehistoric activity is typically evidenced by the discovery of stone and flint tools. Seven stone tools of Palaeolithic date have been

⁷⁰ A bell pit was a simple shaft mine which was expanded at the bottom to maximize the area available for extracting a particular layer of material, in this instance coal

⁷¹ For the early prehistoric period, this section draws heavily upon Cockrell, T, 2017, *Remembered Places, Forgotten Pasts: the Don Drainage Basin in Prehistory*, Oxford, Archaeopress

found at Hooton Roberts (SYHER 11301), whilst a single Palaeolithic item has been recovered close to St Helen's Chapel in Barnburgh (SYHER 13185).

- 9.3.10 Several hundred Early Mesolithic stone artefacts have been found at Hooton Roberts (SYHER 11301); the size of the assemblage suggests repeated use by itinerant bands of hunter-gatherers. In addition, collections of Early Mesolithic stone artefacts have been recovered from excavations on Pastures Road, Mexborough (SYHER 10193, 12803, 10194, and 10191), and Cadeby Cliff.
- 9.3.11 Monuments and evidence for settlement become increasingly common in the Neolithic and Bronze Age periods. Three possible Neolithic long barrows⁷² were constructed on high ground to the north of the Don Valley at High Melton (SYHER 5171, 5185 and 4449), all within the 2km study area. A collection of artefacts including four Neolithic stone axes and axe fragments and three late Neolithic arrowheads from Cadeby Cliff⁷³ suggest that a henge-like⁷⁴ natural feature at that location was used as a Late Neolithic or Early Bronze Age ceremonial monument. Geophysical survey and trial trenching at St Helen's Chapel in Barnburgh, a building situated in a natural theatre-like bowl focused on the Don and Dearne Valleys, has revealed a henge-like geophysical anomaly associated with finds including a Neolithic stone axe and an Early Bronze Age arrowhead⁷⁵.
- 9.3.12 Three Bronze Age round barrows⁷⁶ are recorded as having existed on Barnburgh Common; these were destroyed without investigation in 1819. The 1841 edition Ordnance Survey 1 inch to the mile map depicts 'tumuli' on Barnburgh Cliff, near to where undated human remains were recorded during the 19th or earlier 20th century⁷⁷. The former remains of Bronze Age round barrows have also been recorded at High Melton, Melton Warren, Marr and Hooton Pagnell.
- 9.3.13 Extensive Iron Age or Romano-British occupation throughout the Ravenfield to Clayton area has been revealed by the study of cropmarks on aerial photographs. To the south of the River Don, individual ditched enclosures predominate. Some are likely to have contained domestic structures, but these are rarely visible from cropmarks. A concentric ditched enclosure to the south of Firsby Hall Farm has been identified as a possible Iron Age or Romano-British shrine⁷⁸.
- 9.3.14 To the north of the River Don, cropmarks are much more numerous and are typically grouped into extensive complexes of enclosures and larger fields. Such complexes are known at Pastures Lane, Barnburgh Common, Barnburgh Cliff, between Hickleton and Brodsworth, Bilham, and along Watchley Lane to the south-west of Hooton Pagnell.

⁷² Long barrows are rectangular or trapezoidal mounds made of earth or stone rubble that contain one or more burial chambers, which typically contain the skeletal remains of a group of people

⁷³ Cockrell, T, 2017, *Remembered Places, Forgotten Pasts, the Don Drainage Basin in Prehistory*, Oxford, Archaeopress, 130.

⁷⁴ Henges are ceremonial enclosures that are approximately circular in plan, are defined by an external bank and an internal ditch and have between one and four entrances

⁷⁵ Cockrell, T, Cumberpatch, C, Rylatt, J, Merrony, C and Fenwick, H, 2014, *Fieldwork undertaken at St Helen's Chapel, Barnburgh, South Yorkshire August 2011*, unpublished report on behalf of the Brodsworth Community Archaeology Group

⁷⁶ A hemispherical mound of soil or rock, often with an outer ditch, heaped over a central burial

⁷⁷ Large, J S, 1952;1999, *A History of Barnburgh, with additional notes and illustrations*, Barnburgh, 19

⁷⁸ Roberts, I, Deegan, A, and Berg, D, 2010, *Understanding the Cropmark Landscapes of the Magnesian Limestone*, Morley, Archaeological Services WYAS, 35

- 9.3.15 The River Don is thought to have marked the border between the Iron Age and Romano-British Corieltauvi tribe and the Brigantes. A pair of linear earthworks known as the 'Roman Ridge' flanked the River Don on its northern side. One section ran from Bridgehouses in Sheffield to Mexborough, whilst the other ran from Kimberworth in Rotherham to Swinton Common. Two surviving lengths, both a scheduled monument, lie within the 2km study area (NHLE 1004814 and NHLE 1004812). Despite its name, the Roman Ridge was almost certainly not of Roman origin, more likely having been built to defend the southern border of the Brigantes or the early medieval kingdom of Elmet. A track or road of possible Iron Age origin ran north on high ground through the Ravenfield to Clayton area, crossing the River Don at Strafford Sands. It continued in use, as Ricknield Street, throughout the Roman, early medieval and medieval periods⁷⁹.
- 9.3.16 The River Don is also thought to have marked the northern frontier of Roman Britain until AD70. The population in the rural parts of South Yorkshire such as the Ravenfield to Clayton area was slow to adopt Roman lifestyles and Iron Age forms of settlement may have continued in use throughout the Roman period. At Thurnscoe, ditched enclosures and trackways (SYHER 5890) such as those described above continued in use into the 4th century. Nevertheless, a Roman villa with a bathhouse has been identified at Clifton, Conisbrough Parks (SYHER 5888), a short distance to the south of the Roman road that ran from Brough to Doncaster (followed today by the A630).
- 9.3.17 After the collapse of Roman authority in the early 5th century, the Ravenfield to Clayton area north of the River Don probably lay within Elmet until 617, when it was annexed by King Edwin of Northumbria. By the 8th century, much of the Ravenfield to Clayton area south of the River Don was probably part of a vast royal estate centred on Conisbrough. The town's Church of St Peter (NHLE 1192787) contains contemporary stonework and was probably a minster church⁸⁰ that provided pastoral services to the whole estate. There was much Danish settlement in and around the area in the later 9th century, with Firsby, Denaby and Barnburgh all containing Danish place-name elements.
- 9.3.18 The Norman lordships of Conisbrough and Tickhill maintained castles at Conisbrough (NHLE 1010828) and Mexborough (NHLE 1013650) respectively. These were sited in part to police traffic moving along Ricknield Street and across the River Don at Strafford Sands. Conisbrough Castle was rebuilt as a cylindrical stone keep and curtain wall in the 12th century and gained an extensive deer park (SYHER 5809) to its south at about the same time. There was also another Norman castle located within 1.5km of Ricknield Street, at Hickleton (SYHER 4401).
- 9.3.19 The present day settlement pattern within the Ravenfield to Clayton area was formed in the years either side of the Norman Conquest of 1066. These settlements were surrounded by communally farmed open fields divided into strips. All the parish churches within the 2km study area either have their origins in, or were extended or

⁷⁹ Hey, D, 2003, *Medieval South Yorkshire*, Ashbourne, Landmark, 15-17

⁸⁰ Minsters churches were typically founded between approximately AD 650 and 850 and served the spiritual needs of the occupants of the extensive royal and aristocratic estates that typified landholding at that time. They were usually served by a community of priests. Minsters were gradually replaced by churches served by single priests on the newly forming manors from the 10th century AD.

rebuilt during the medieval period. St Helen's Chapel at Barnburgh (NHLE 1004799) was rebuilt in the 12th century, but its origins as a place of Christian worship may date to the 8th century AD or earlier. Nostell Priory maintained a monastic grange (an outlying demesne farm) on Barnburgh Common (SYHER 4111).

- 9.3.20 The Black Death epidemic of 1348/1349 and subsequent endemic plague, coupled with the agricultural depression which followed, caused the desertion of the village of Wildthorpe (NHLE 1020579), which lay within the parish of High Melton, and weakened the villages of Bilham, Frickley and Stotfold, which were finally deserted during the 17th century. Although economic activity in the Ravenfield to Clayton area was almost exclusively driven by agricultural production, there were other industries. An example is the pottery manufacturing industry which operated from the site of Firsby Hall Farm (SYHER 4125) between the 13th and 17th centuries.
- 9.3.21 The post-medieval period witnessed several major episodes of landscape change. Initially, the medieval open fields were progressively enclosed to be farmed individually. The enclosure of fields and consolidation of landholdings, coupled with the aesthetic potential of the rolling Magnesian Limestone plateau, facilitated the growth during the 18th and 19th centuries of a number of country house estates (High Melton, Hickleton, Brodsworth, Bilham, Hooton Pagnell and Frickley), each with its grand house and ornamental landscape. Only Hooton Pagnell Hall and Frickley Hall remain as gentry seats.
- 9.3.22 During the late 19th and 20th centuries, the South Yorkshire landscape was transformed again, this time by heavy industry and industrial housing. Denaby Main Colliery (and Denaby Pottery Works) stood within the 500m study area, whilst there were other collieries (and the Providence Glassworks) within the 2km study area. Denaby Main colliery village grew rapidly to contain 1,500 houses, while the population of Mexborough grew from 417 in 1801 to 10,430 in 1901⁸¹. Denaby Main Colliery closed in 1968.

9.4 Effects arising during construction

Avoidance and mitigation measures

- 9.4.1 The design of the Proposed Scheme has sought to avoid impacts on heritage assets within the area insofar as reasonably practicable.
- 9.4.2 Section 8 of the draft Code of Construction Practice (CoCP)⁸² 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

⁸¹ Jones, M, 1999, 'Denaby Main: the Development of a South Yorkshire Mining Village' in Elliott, B, *Aspects of Doncaster*, 123-142; Taylor, W, 2001, *South Yorkshire Pits*, Barnsley, Wharnccliffe

⁸² Supporting document: Draft Code of Construction Practice

- 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

Temporary effects

- 9.4.3 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 would occur to assets both within the land required for the Proposed Scheme and to assets in the wider study area as a result of changes to their settings.
- 9.4.4 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.
- 9.4.5 Garden wall with pedestrian entrance archway fronting onto bridle path on east side of Firsby Hall Farm (NHLE 1151535⁸³) and Barn fronting onto bridle path on east side of Firsby Hall farmyard (NHLE 1192930) are Grade II listed buildings of moderate value located approximately 160m and 130m respectively south of the land required for the Proposed Scheme. They comprise a decorative, gabled ashlar entrance archway, built in about 1700, and adjacent sandstone barn, built in the early to mid-18th century. As well as being of aesthetic value (being beautiful by design), they have historical value as component parts of one of several contemporary gentry farmsteads engaging in socially competitive display within the Doncaster district⁸⁴. The wider agricultural setting of these assets makes a specific contribution to their historical value, as agriculture, made possible when the adjacent Conisbrough Deer Park was broken up in the 17th century, facilitated the post-medieval gentrification of this former pottery manufacturing centre.
- 9.4.6 Works associated with construction of the Conisbrough Parks embankment, the adjacent balancing pond, temporary stockpile and the Firsby Lane diversion would introduce noise and movement into the setting of these assets. This would diminish the ability to experience the aesthetic value of the assets and the degree to which the assets' historical relationship with the agricultural landscape could be understood. This would constitute a medium magnitude of impact and a moderate adverse effect.
- 9.4.7 Site of St Helen's Chapel (NHLE 1004799) is a scheduled monument of high value located approximately 35m to the east of the land required for the Proposed Scheme. It is a rare example of an early medieval church that was associated with a holy well (St Helen's Well), was built within a small circular enclosure, and probably predated the parish church. Along with the Dovecote at Barnburgh Hall, it was rebuilt in the medieval period in part as an act of social competition in a township of divided lordship. The asset has a dramatic theatre-like setting beneath the curve of Barnburgh

⁸³ The bridle path is Conisbrough Parks Bridleway 2

⁸⁴ Klemperer, M., 2010, *Style and Social Competition in the Large Scale Ornamental Landscapes of the Doncaster District of South Yorkshire, c. 1680-1840*, Oxford, Archaeopress

Edge, and was built on a projecting spur of ground, which enhances views to the confluence of St Helen's Spring with the River Dearne, and the Dearne and Don valleys more generally⁸⁵. During the medieval period, the chapel had close links to Barnburgh Hall, the Dovecote at Barnburgh Hall and the Church of St Peter.

- 9.4.8 Works associated with construction of Barnburgh embankment would introduce noise and visual disturbance into the setting of the asset and would interrupt key views to the confluence of St Helen's Spring and the River Dearne and to the site of Barnburgh Hall, the Dovecote at Barnburgh Hall and the Church of St Peter. This would constitute a medium magnitude of impact and a major adverse effect.
- 9.4.9 Dovecote at Barnburgh Hall (NHLE 1004800 and NHLE 1314757 as Barnburgh Hall Dovecote) is a scheduled monument and Grade II* listed building of high value located approximately 300m to the west of the land required for the Proposed Scheme. It comprises an octagonal limestone Tudor dovecote, commonly regarded as the finest dovecote in the Doncaster district⁸⁶. As well as being of aesthetic value (being beautiful by design), the dovecote is of historical value too as, alongside St Helen's Chapel, it was built, in part, as an act of social competition within the medieval township of Barnburgh.
- 9.4.10 Works associated with the construction of Barnburgh embankment would introduce noise and visual disturbance into the dovecote's setting, thereby compromising an appreciation of the beauty of its design and execution. Construction works would also be interposed between the dovecote and the Site of St Helen's Chapel, obscuring the historical function of the asset and its relationship with the chapel. This would constitute a low magnitude of impact and a moderate adverse effect.
- 9.4.11 Hickleton Hall with attached quadrant walls and walls extended to enclose entrance⁸⁷ front garden having associated gate piers and two statues, also linking wall to gate pier at south east corner (NHLE 1286810) is a Grade II* listed building of high value located approximately 460m to the west of the land required for the Proposed Scheme. It is a well-preserved Georgian country house that derives its value from the beauty of its architecture and its ornamental landscape setting, and from its history as one of several country houses in the Doncaster district that were developed as an act of social competition⁸⁸. Works associated with the construction of Hickleton cutting and of the mitigation earthwork that would screen it from permanent view from the hall, which would be undertaken approximately 460m from the asset, would introduce visual disturbance into the setting of Hickleton Hall and into the designed view east from the hall into the rural landscape beyond. This would constitute a low magnitude of impact and a moderate adverse effect.
- 9.4.12 Hickleton Hall (NHLE 1001151) is a Grade II registered park and garden of moderate value located almost entirely adjacent to the land required for the Proposed Scheme

⁸⁵ Cockrell, T, Cumberpatch, C, Rylatt, J, Merrony, C and Fenwick, H, 2014

⁸⁶ Hey, D, 2015, *A History of the South Yorkshire Countryside*, Barnsley, Pen and Sword Local, 185-186; Elliott, B, 1997, 'A Field Guide to Dovecotes of the Doncaster Area', in Elliott, B. (ed) *Aspects of Doncaster*, Barnsley, Wharnccliffe, 157-176

⁸⁷ The incorrect spelling of the word entrance is contained within the official title of the asset

⁸⁸ Klemperer, M., 2010

although in small part within it where the asset abuts the A635 Barnsley Road. The asset is a well-preserved example of the kind of ornamental landscape designed to provide a grand and tasteful setting for an elite residence, in part as an act of social competition, as well as to provide a range of beautiful and pleasurable experiences⁸⁹. A designed view east from the asset across the rural landscape beyond was created in the early 20th century at a time of, and as a counterbalance to, the increasing industrialisation of the South Yorkshire landscape.

- 9.4.13 Works associated with the construction of Hickleton cutting and the mitigation earthwork designed to screen the Proposed Scheme from view from the hall, and the construction and operation of Hickleton cutting main compound, would introduce noise and visual disturbance into the setting of the asset and into the designed view across the rural landscape beyond. Given the proximity of construction works and sensitivity of the designed view to this kind of impact, this would constitute a medium magnitude of impact and a moderate adverse effect.
- 9.4.14 Church of All Saints (NHLE 1151647) in Clayton with Frickley is a Grade II* listed building of high value located approximately 20m from the land required for the Proposed Scheme and approximately 200m from the proposed Frickley viaduct. As the sole surviving building on the site of the deserted settlement of Frickley and, furthermore, a building that was heavily restored in the Victorian period, the principal value of the asset is commonly regarded as its capacity to illustrate the wider phenomenon of late- and post-medieval settlement desertion in South Yorkshire and beyond⁹⁰. Consequently, the isolation and peacefulness of its setting, free from the bustle of village life, and views to and from the asset across agricultural fields make a major contribution to its value. Works associated with the construction of the Frickley viaduct would introduce noise and visual disturbance into the setting of the asset changing the character of the landscape in the view from one of agricultural fields to one of a construction site. Given the sensitivity of this asset to such impacts and changes, that the key views across fields are to the west and south-west of the church, and that the views to and from other directions would be blocked by or filtered through mature trees and vegetation around the perimeter of the churchyard, this would constitute a medium magnitude of impact and a major adverse effect.

Permanent effects

- 9.4.15 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.
- 9.4.16 The following significant effects are currently expected to occur as a result of permanent physical impacts on heritage assets within the land required for the construction and operation of the Proposed Scheme:
- 9.4.17 A number of assets, visible as cropmarks on aerial photographs and likely to date to the Iron Age or the Roman period, are non-designated heritage assets of potentially

⁸⁹ Klemperer, M., 2010

⁹⁰ Hey, D, 2003, *Medieval South Yorkshire*, Ashbourne, Landmark, 156; Ryder, n.d., *Saxon Churches in South Yorkshire*, Sheffield, South Yorkshire County Council, 91

moderate value. Associated below-ground archaeological remains may hold evidence of past human activity. Their removal during construction of the Proposed Scheme would constitute a high magnitude of impact and a major adverse effect. The sites comprise:

- a large rectangular double-ditched enclosure to the south of Hilltop Farm, Conisbrough Parks (SYHER 6943);
- a cropmark complex to the west of Pastures Road and to the south of the River Dearne, Mexborough (NMP 1025539; SYHER 5206 and 3722);
- three enclosures, a trackway, field ditches and a pit to the south of Bilham Belvedere Summer House (NMP 1025510; SYHER 5571);
- a complex of enclosures, trackways, field boundaries and pits at Barnburgh Cliff (NMP 1025537; SYHER 5848, 3592, 12059 and 3583);
- a complex of enclosures, trackway, field boundaries and pits south of Watchley Lane, Hooton Pagnell (NMP 620743; SYHER 3580 and 13356);
- two enclosures and field boundaries south-east of Lodge Farm, Frickley with Clayton (NMP 1025512; SYHER 5569).

9.4.18 Wink House, Clayton, an early 19th century farmstead comprising a farmhouse and traditional farm buildings arranged around two farmyards, an asset of low value, would be demolished for the construction of the Sheffield Northern Spur (northbound). This would constitute a high magnitude of impact and a moderate adverse effect.

9.4.19 The following significant effects are currently expected to occur as a result of permanent impact on the setting of designated or non-designated heritage assets.

9.4.20 The setting of the Site of St Helen's Chapel (NHLE 1004799, a scheduled monument of high value located approximately 35m to the east of the land required for the Proposed Scheme, discussed in paragraph 9.4.7, above) would be affected by the presence of Barnburgh embankment, which would alter the character of its setting and obscure or block key views south to the confluence of St Helen's Spring with the River Dearne and west to contemporary, related assets in Barnburgh village. This would adversely affect the ability to understand and appreciate the value of the asset and would constitute a medium magnitude of impact and a major adverse effect.

9.4.21 The setting of the Dovecote at Barnburgh Hall (NHLE 1004800, NHLE 1314757 as Barnburgh Hall Dovecote, a scheduled monument and a Grade II* listed building of high value located approximately 300m to the west of the land required for the Proposed Scheme, discussed in paragraph 9.4.9, above) would be affected by the presence of the Barnburgh embankment and associated mitigation planting. Designed to screen the Proposed Scheme from view from Barnburgh village, the mitigation planting would substantially preserve the ability to appreciate the aesthetic value of the asset when viewed from Hall Street but would adversely affect or remove that ability when viewed from the much more distant St Helen's Lane. It would also partially obscure the view to the site St Helen's Chapel, thereby reducing one's ability

to appreciate the dovecote's historic link with that asset. This would constitute a low magnitude of impact and a moderate adverse effect.

- 9.4.22 Bilham Belvedere Summer House (NHLE 1151628) is a Grade II listed building of moderate value within the land required for the Proposed Scheme. It is a ruinous mid-18th century summer house which was augmented in the early 19th century. It was set within the former ornamental landscape associated with Bilham House. Neither the house nor ornamental landscape survive but parts of the latter remain as discrete historic landscape elements, namely the remains of an elaborate water garden called the 'fishponds', several plantations, fragments of avenues, and other parkland planting. The summer house was linked to these surviving elements by a 'pleasure circuit' which ran in part along the spine of Summerhouse Plantation⁹¹. The circuit would be interrupted by Hickleton cutting, which would prevent an experience of the asset as designed. This would constitute a medium magnitude of impact and a moderate adverse effect.
- 9.4.23 The setting of the Church of All Saints (NHLE 1151647, in Clayton with Frickley, a Grade II* listed building of high value located approximately 20m from the land required for the Proposed Scheme and approximately 200m from the proposed Frickley viaduct, discussed in paragraph 9.4.14, above) would be affected by the presence of Frickley viaduct and the mitigation planting to the immediate west of the churchyard. The viaduct and mitigation planting would substantially or entirely obstruct the key view of the asset north-east across fields from Church Field Road west of the access track to the church, while the mitigation planting would block views west and south-west from the asset across agricultural fields, even though it would have the positive effect of removing the Frickley viaduct from view of the church-using community. Views of and from the church across agricultural fields in all other directions, which may have compensated for the loss of views to the west and south-west, are seasonally blocked by or filtered through mature trees and other vegetation around the northern, eastern and southern sides of the churchyard. Given that views across agricultural fields make a major contribution to the historical value of this asset, this would constitute a medium magnitude of impact and a major adverse effect.

Other mitigation measures

- 9.4.24 No additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified at this stage, however potential opportunities for further mitigation measures will continue to be considered through detailed design. These may 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.

⁹¹ Klemperer, M., 2010, 332-335

Summary of likely residual significant effects

- 9.4.25 The temporary effects of construction activity on the setting of heritage assets have been considered. However, they are largely reversible in nature and would be restricted to the duration of the construction works.
- 9.4.26 As no specific mitigation measures have yet been identified in relation to heritage assets described above, it is currently anticipated that the residual effects would be the same as those reported under permanent effects. Over time, the effect on the setting of some heritage assets could change as planting matures and the Proposed Scheme assimilates into the landscape.

9.5 Effects arising from operation

Avoidance and mitigation measures

- 9.5.1 The following measures have been incorporated into the design of the Proposed Scheme, which would reduce the impacts and effects on heritage assets as shown on the CT-06 Map Series within the Volume 2: LA13 Map Book:
- noise mitigation measures have been included within the Proposed Scheme that could reduce potential impacts on some heritage assets; and
 - landscape planting could increasingly reduce impacts on the setting of the designated assets within the study area as it matures.

Assessment of impacts and effects

- 9.5.2 The assessment considers the Proposed Scheme once operational and all effects are considered to be permanent.
- 9.5.3 During the operation of the Proposed Scheme no further ground works are anticipated, and as such there would be no further physical impacts on heritage assets arising from the operation of the Proposed Scheme.
- 9.5.4 Impacts on heritage assets due to changes in their settings arising from the presence of the Proposed Scheme are reported as permanent construction effects and are not repeated in detail here, although they would continue throughout the operation of the Proposed Scheme.
- 9.5.5 Further effects could occur in relation to heritage assets during the operation of the Proposed Scheme where additional, permanent, changes to the asset's settings have an additional detrimental effect on the way that the asset is understood or appreciated, for example as a result of increased noise or the movement of the trains in combination with the effect of the presence of the Proposed Scheme.

9.5.6 It is currently anticipated that in relation to the following heritage assets there would be no significant effects as a result of the operation of the Proposed Scheme and that therefore the significance of effect would remain as described for the permanent construction phase effect:

- Site of St Helen's Chapel in Barnburgh (NHLE 1004799);
- Dovecote at Barnburgh Hall (NHLE 1004800, NHLE 1314757 as Barnburgh Hall Dovecote);
- Bilham Belvedere Summer House (NHLE 1151628); and
- Church of All Saints (NHLE 1151647) in Clayton with Frickley.

Other mitigation measures

9.5.7 The Proposed Scheme includes a number of design measures to address potential impacts and significant effects. At this time, no additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified. Potential opportunities for further mitigation have not been identified, and will be considered as part of the detailed design process.

Summary of likely residual significant effects

9.5.8 As no specific mitigation measures have yet been identified in relation to the heritage assets described above, it is currently anticipated that the residual effects would be the same as those reported in the assessment of effects during operation.

Monitoring

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

9.5.10 No area-specific heritage monitoring requirements during operation of the Proposed Scheme have been identified at this stage.

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 Ravenfield to Clayton area (LA13) in relation to land quality, and reports the likely impacts and significant effects identified to date 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, either from a scientific, historical, mineral exploitation or mineral resources point of view including geological sites of special scientific interest (SSSI) and local geological sites (LGS), areas of historical mining activity in the context of land quality and areas of designated mineral resources. Consideration is also given to petroleum (including gas) prospects and licensing.
- 10.1.2 Engagement has been undertaken with stakeholders including Rotherham Metropolitan Borough Council (RMBC), Doncaster Metropolitan Borough Council (DMBC) and Barnsley Metropolitan Borough Council (BMBC), British Geological Survey (BGS), the Environment Agency, Coal Authority, Fera Science Ltd⁹² and the Animal and Plant Health Agency (APHA). The purpose of this engagement is to discuss the Proposed Scheme and potential effects, and obtain relevant baseline information. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.
- 10.1.3 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: LA13 Map Book.
- 10.1.4 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 and the Scope and Methodology Report (SMR)⁹³.
- 10.2.2 In accordance with the SMR, a risk based approach was 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 construction of the Proposed Scheme plus a 250m buffer. In the case of groundwater abstractions, this buffer is increased up to 1km.
- 10.2.3 The majority of new and diverted utilities would be laid in the boundaries of existing highways within normal road construction layers and natural soils below. These have

⁹² Formerly known as the Food and Environment Research Agency

⁹³ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

been considered in the context of the conceptual site model (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 mineral resources⁹⁴ identified on published minerals plans and existing planning or licensed areas. Any inference of minerals provided by geological maps/reports is excluded (except where these are covered by the Minerals Plan).
- 10.2.8 The geo-conservation assessment is based upon publicly available local geological trust records.

10.3 Environmental baseline

Existing baseline

- 10.3.1 Baseline data have been collected from a range of sources including RMBC, DMBC and BMBC, Ordnance Survey mapping, the BGS, Coal Authority, Public Health England, the Environment Agency, Natural England, Fera Science Ltd and APHA records, as well as from local geological trusts.

Geology

- 10.3.2 This section describes the underlying ground conditions within the Ravenfield to Clayton area. Recent changes in lithostratigraphic classifications by the BGS have been incorporated where appropriate⁹⁵.

⁹⁴ Defined in the SMR as 'mineral body including aggregates, salt, coal and other hydrocarbons, Petroleum Extraction Development Licences (PEDLs), Shale Prospective Areas (SPAs)'

⁹⁵ BGS, (2014), *Lithostratigraphy of the Sherwood Sandstone. Research Report RR/14/01*. Available online at: <http://www.bgs.ac.uk/downloads/start.cfm?id=2904>

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10.3.3 Table 17 provides a summary of the geology (made ground, superficial and bedrock units) underlying the study area.

Table 17: Summary of the geology underlying the land quality study area

Geology	Distribution	Formation description	Aquifer classification
Made ground			
Made ground	Significant deposits along the route of the Proposed Scheme, particularly within the Denaby and Mexborough area	Artificial ground comprising variable deposits of reworked natural and man-made materials	Not applicable
Superficial			
Alluvium	Along the River Dearne, River Don and Frickley Beck including tributaries.	Clays, organic clays, peat, silts, sands and gravels	Secondary A
Head	An isolated deposit located east of Ravenfield	Gravelly clay	Secondary (undifferentiated)
River terrace deposits	An isolated deposit located west of High Melton	Sands, sand and gravel	Secondary A
Glaciofluvial deposits	Situated to the north and north-east of Hooton Roberts	Sand and gravel	Secondary A
Bedrock			
Cadeby Formation	Isolated outcrop along the A630 Doncaster Road, south of Denaby Main. Extended outcrops around Hickleton	Oolitic compact and granular well bedded dolomitic limestone. Mudstone interbeds present at the base of the unit	Principal
Basal Permian Sand	Limited outcrops underlying the Cadeby Formation, north of Hickleton	Yellow to brown evenly graded fine to medium false-bedded loosely cemented sand and sandstone	Principal
Pennine Upper Coal Measures	Layered formation along the majority of the Ravenfield to Clayton area, outcropping in both the southern and northern extents	Interbedded mudstone/siltstone/sandstone. Dominantly sandstone, with rare poor quality coal seams Outcrops of named sandstone deposits include Ravenfield Rock, Wickersley Rock, Brierley Rock, Dalton Rock and Ackworth Rock	Secondary A
Pennine Middle Coal Measures	Layered formation located along a 3km section of the route of the Proposed Scheme between the area south of the River Don and Harlington	Interbedded mudstone/ siltstone/ sandstone with coal seams. Formation includes the major sandstone unit the Mexborough Rock	Secondary A

Made ground

10.3.4 Made ground is a term used to denote man-made deposits such as landfill, colliery 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 or shallow mineral excavations have been backfilled. There is evidence of historical and authorised landfilling within the area, as well as colliery spoil tips, which are likely to comprise increased deposits of made ground.

10.3.5 Other deposits of made ground are likely to be associated with historical and current industrial and commercial land use within the study area. Localised made ground is also anticipated associated with existing road construction, infilled features such as mine shafts, dismantled railways and agricultural land use.

10.3.6 No known farm burial or pyre sites associated with the 2001 outbreak of foot and mouth disease are known to be present within the Ravenfield to Clayton study area. However, older unrecorded sites may be present from the 1967 outbreak. Similarly, anthrax-infected cattle burials may be present, generally relating to burials 50 to 100 years ago. However, no records have been found of any such burials. 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 Alluvial deposits comprising clay and silt cross the route of the Proposed Scheme at multiple locations. These deposits are largely associated with the Firsby Brook, River Don, River Dearne and the Frickley Beck.

10.3.8 River terrace deposits comprising sands, and sand and gravel, are present in one location to the west of High Melton. Whilst this deposit is present within the study area, it is not within the area required for the construction of the Proposed Scheme.

10.3.9 Head deposits commonly comprise poorly sorted gravelly clay. There is only one limited outcrop of head deposit located east of Ravenfield.

10.3.10 Isolated glaciofluvial deposits comprising sand and gravel are present to the north and north-east of Hooton Roberts.

Bedrock geology

10.3.11 The bedrock geology in this area comprises predominately Pennine Upper Coal Measures consisting of interbedded mudstones, siltstones and sandstones with occasional interbedded coal seams. The Pennine Upper Coal Measures are absent in the centre of the study area between Denaby Main and east of High Melton where Pennine Middle Coal Measures dominate. The Cadeby Formation overlies the Pennine Upper Coal Measures east of Hooton Roberts, and to the south and north of Hickleton. Basal Permian Sand also overlies the Pennine Upper Coal Measures north of Hickleton.

10.3.12 The Coal Measures strata have been heavily folded and faulted. Fault lines intersect the route of the Proposed Scheme throughout the study area, predominately orientated south-west to north-east. A series of geological faults to the south of Mexborough and the River Don, the 'Don faults', mark the boundary between the Pennine Upper and Pennine Middle Coal Measures. Faults in the study area also mark the transition to the Cadeby Formation and bound the isolated outcrops to the south of Denaby and around Hickleton.

- 10.3.13 Sandstone dominates the Pennine Upper Coal Measures. The named sandstone outcrops that underlie the study area are the Ravenfield Rock, Wickersley Rock, Brierley Rock, Dalton Rock, and Ackworth Rock.
- 10.3.14 The underlying geology transitions into the Pennine Middle Coal Measures between Denaby Wood and the River Dearne. The Mexborough Rock, of approximately 10m thickness, outcrops as part of the Pennine Middle Coal Measures adjacent to Denaby Industrial Estate. In addition, an unnamed sandstone of around 15m thickness outcrops between the River Don and River Dearne.
- 10.3.15 Coal seams outcrop in Denaby Main, east of Old Denaby, in the north of Mexborough, south-east of Barnburgh, and to the south and north of Church Field Road. The named seams are Shafton Coal, Elmsall Coal and Upton Coal.
- 10.3.16 The Cadeby Formation underlies the route of the Proposed Scheme east of Hooton Roberts at a thickness of approximately 30m, and further north around Hickleton at a thickness of approximately 10m. North of Hickleton, the Cadeby Formation outcrops alongside the Basal Permian Sand, which marks the unconformity to the underlying Pennine Upper Coal Measures.

Radon

- 10.3.17 Radon is a radioactive gas formed by the radioactive decay of naturally occurring uranium in rocks and soils. The occurrence of radon gas is shown in the BGS Radon Potential Database maps⁹⁶.
- 10.3.18 The study area lies within the following radon affected areas:
- much of the route of the Proposed Scheme lies within the lowest band of radon potential, defined as an area in which less than 1 % of homes are estimated to have radon levels at or above the action level of 200 becquerels per cubic metre of air (Bq/m³) for residential properties;
 - areas to the east and north of Hooton Roberts, to the south, east, north-east and north of Mexborough, and within Thurnscoe are estimated to have a radon potential of between 1 to 3% for residential properties;
 - areas to the west of Conisbrough and to the south-east of Hickleton are estimated to have a radon potential of between 3 to 5% for residential properties; and
 - areas to the east and north of Hickleton are estimated to have a radon potential of between 5 to 10% for residential properties.
- 10.3.19 The formal ES will include an assessment of areas where 5% and over of homes are estimated to have radon levels at or above the action level of 200 Bq/m³.

⁹⁶ British Geological Survey, Radon data: radon potential dataset. Available online at: <https://www.bgs.ac.uk/radon/hpa-bgs.html>

Groundwater

- 10.3.20 Three categories of aquifer have been identified within the study area, as defined by the Environment Agency:
- The Cadeby Formation and Basal Permian Sand Formation are designated as Principal aquifers;
 - The alluvium, river terrace deposits, glaciofluvial deposits, Pennine Upper and Pennine Middle Coal Measures are designated as Secondary A aquifers; and
 - The head deposits are designated as a Secondary (undifferentiated) aquifer.
- 10.3.21 There are no groundwater source protection zones (SPZ)⁹⁷ identified within 250m of the route of the Proposed Scheme within the Ravenfield to Clayton area.
- 10.3.22 There are no Drinking Water Safeguarding Zones for groundwater within 250m of the route of the Proposed Scheme within the Ravenfield to Clayton area.
- 10.3.23 The following licensed and unlicensed groundwater abstractions are located within 1km of the route of the Proposed Scheme. Three privately licenced abstractions from boreholes in Barnburgh, Hickleton and Frickley, and an unlicensed private water abstraction at Frickley Hall. As there is no obligation to register private water supplies, unregistered private groundwater supplies may also be present.
- 10.3.24 Details of licenced abstractions are provided in Section 15, Water resources and flood risk. It should be noted that all abstractions that are used directly or indirectly for human consumption are by default designated as 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.
- 10.3.25 Further information on the groundwater in the Ravenfield to Clayton area is provided in Section 15, Water resources and flood risk.

Surface water

- 10.3.26 The Proposed Scheme would intersect or run adjacent to the following watercourses, from south to north. The WFD designation of each watercourse is shown in brackets.
- Firsby Brook (ordinary watercourse);
 - The River Don (main river);
 - The Sheffield and South Yorkshire Navigation (canal);
 - River Dearne (main river);
 - Ludwell Spring (ordinary watercourse);
 - Barnburgh Lakes Fishery (static water body);

⁹⁷ 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 source.

- St. Helen’s Spring (ordinary watercourse);
- Frickley Beck (ordinary watercourse); and
- Howell Beck (ordinary watercourse).

- 10.3.27 In addition to the above there are also a number of other ponds and lakes, as well as additional unnamed streams, tributaries, drains, and culverts located within 250m of the route of the Proposed Scheme.
- 10.3.28 There are two licenced surface water abstractions within the study area.
- 10.3.29 Records of private unlicensed surface water abstractions, which comprise those for quantities less than 20m³ per day, have been obtained from the local authorities. These data indicate that there are no registered private unlicensed surface water abstractions within the study area. As there is no obligation to register private water supplies, unregistered private surface water supplies may be present.
- 10.3.30 There are no Drinking Water Safeguarding Zones for surface water within 250m of the route of the Proposed Scheme within the Ravenfield to Clayton area.
- 10.3.31 Further information on surface water bodies in the Ravenfield to Clayton area is provided in Section 15, Water resources and flood risk.

Current and historical land use

- 10.3.32 Current potentially contaminative land uses within the study area include three sewage works, an industrial estate, two chemical processing and chemical distribution facilities, a petrol filling station and a garage workshop.
- 10.3.33 Historical land uses identified within the study area with the potential to have caused contamination include nine landfill sites, a number of former quarries and mining areas, pit heads, mine shafts and spoil mounds, a sewage works, a former power station, a former explosive works, dismantled railways and a former bus depot. Infilled pits and ponds may have been infilled with a variety of waste materials, but have not been licensed.
- 10.3.34 Table 18, Table 19 and Table 20 provide information on key potentially contaminated sites in the study area.

Table 18: Current and historical landfill sites located in the study area

Name and Area Reference ⁹⁸	Location	Description
Historical Hellaby Landfill (LA13-484).	Located south-east of Ravenfield along a dismantled railway.	Environment Agency records state that this historical landfill was authorised to accept industrial, commercial, household waste and liquid/ sludge between December 1973 and December 1979. Located outside the land required for the construction of the Proposed Scheme.

⁹⁸ Each potentially contaminated site is allocated a unique reference number.

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Name and Area Reference ⁹⁸	Location	Description
Former refuse pit (LA13-460)	Located within Denaby Main Industrial Estate approximately 50m west of Hill Top Road.	Identified from historical maps. No details are available regarding the type of waste, volumes and input dates.
Historical Mexborough Power Station Landfill (LA13-479).	Located to the north of Denaby Lane and South of Mexborough.	Environment Agency records state that this historical landfill was permitted to accept industrial waste from December 1945. The date of the last input of waste is not provided. Located outside the land required for the construction of the Proposed Scheme.
Historical Denaby Lane Landfill (LA13-478).	Located to the north of Denaby Lane and South of Mexborough.	No information is available regarding the type and volume of waste permitted for disposal and input dates.
Historical Mexborough and Brickworks Quarry Landfills (LA13-1).	Located to the east of Mexborough and north of Pastures Road.	Environment Agency records state that Mexborough Landfill was authorised to accept household, commercial and industrial waste. The status of this licence is listed as modified. Environment Agency records state that the historic Brickworks Quarry landfill was authorised to accept inert and industrial waste between November 1977 and May 1981. Located along the route of the Proposed Scheme.
Historical landfill – National Coal Board (NCB) Land south of Pastures Road (LA13-485).	Located to the east of Mexborough and south of Pastures Road.	Environment Agency records state that this historical landfill was permitted to accept commercial waste and liquid/ sludge. The first input of waste is not provided. The last input of waste was in March 1971.
Historical landfills - Off Pastures Road/ part of OS field 5663 and part field no's 5855 and 6968 north of Pastures Road (LA13-486).	Located to the east of Mexborough and north of Pastures Road.	Environment Agency records state that the historic landfill off Pastures Road was permitted to accept inert, industrial, commercial, household and special waste between June 1978 and December 1980. Environment Agency records state that the landfill north of Pastures Road was permitted to accept commercial, household and liquids/ sludge. The first input of waste was in March 1971. The date of the last input of waste is not provided.
Historical Hickleton landfill (LA13-431).	Located south-east of Hickleton.	Environment Agency records state that this landfill was permitted to accept inert and commercial waste between November 1980 and August 1984.
Historical landfill - Former railway cutting LA13-1349 and 1350.	North of Thurnscoe.	Environment Agency records state that this landfill was permitted to accept inert, industrial, commercial, household, special and liquids/ sludge waste between July 1978 and July 1982.

Table 19: Current and historical mining and mineral sites and colliery spoil sites located in the study area

Name and Area Reference	Location	Description
Historical spoil heaps (LA13-482 and 483).	Located between Denaby Lane and the Sheffield to Doncaster Railway.	Located within the land required for the construction of the Proposed Scheme. Recorded on the 1971 historical map.
Historical Spoil Heap (LA13-1338).	Located north of the Sheffield to Doncaster Railway.	Located within the land required for the construction of the Proposed Scheme.

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Name and Area Reference	Location	Description
Historical opencast mining (LA13-498, 499, 500, 501, 503, 505 and 514).	Mexborough and west of Conisbrough.	Areas of opencast coal mining are where coal has been recorded as being worked in the past, generally pre 1994, by opencast. A number of identified sites are located within the land required for the construction of the Proposed Scheme.
Historical surface, shallow (up to 30m) depth probable workings (various).	Mexborough and west of Conisbrough.	Areas of probable shallow coal mining are recorded by the Coal Authority within the study area. A number of identified sites are located within the land required for the construction of the Proposed Scheme.
Historical surface, moderate (between 30 and 100m) depth probable workings (various).	Mexborough and west of Conisbrough.	Areas of probable moderate depth coal mining are recorded by the Coal Authority within the study area. A number of identified sites are located within the land required for the construction of the Proposed Scheme.
Eighteen historical mine entries (LA13-6, 10, 24, 25, 26, 525, 526, 528, 529, 530, 531, 532, 533, 923, 926, 927, 928 and 929).	Various locations throughout the study area with the majority located to the east of Conisbrough and within Mexborough.	Historical mine entries comprising both shafts and adits. The mine entries were identified from historical Ordnance Survey maps and information obtained from the Coal Authority.

Table 20: Current and historical industrial sites located in the study area

Name and Area Reference	Location	Description
Historical power station (LA13-463).	Located between the River Don and the Sheffield and South Yorkshire Navigation.	A former coal powered fire station, now demolished. Located within the land required for the construction of the Proposed Scheme.
Existing Denaby Main Industrial Estate (LA13-490) including current chemical works (LA13-21 and 488).	Located west of Denaby Main.	The eastern section of the industrial estate is located within the land required for the construction of the Proposed Scheme. There are two chemical works located in proximity to the route of the Proposed Scheme. One chemical works is located adjacent to the land required for the construction of the Proposed Scheme with the other approximately 100m from the land required for the construction of the Proposed Scheme.
Historical Denaby explosive works (LA13-23).	Located west of Denaby Main on the site of the current Denaby Main Industrial Estate.	The explosive works operated between the late 1800's and the 1960's. The majority of the former site is located outside the land required for the construction of the Proposed Scheme. Historical maps indicate that the south-western area of the former explosive works site will fall within the land required for the construction of the Proposed Scheme.

- 10.3.35 Contaminants commonly associated with sites in Table 18 could include metals, semi-metals, asbestos, organic and inorganic compounds and radionuclides. Infilled pits and landfills could give rise to landfill gases such as methane or carbon dioxide and mobile contaminants within leachates.
- 10.3.36 Contaminants commonly associated with sites in Table 19 could include metals, semi-metals, asbestos, organic and inorganic compounds, acid mine drainage with low pH values and mine gases such as methane, carbon dioxide and hydrogen sulphide.

Contamination could originate from oxidised colliery spoils, metalliferous materials or unknown waste materials deposited in voids. Contamination could be associated within ancillary or pit head activities such as electrical transformation, railway infrastructure, workshops or fuel storage.

- 10.3.37 Contaminants commonly associated with industrial sites in Table 20 could include metals, semi-metals, organic and inorganic contaminants. Pathogens may be present in soils associated with sewage works and explosive residues with the historical explosive works. Asbestos material may be present in soils from previously demolished structures.

Other regulatory data

- 10.3.38 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 and integrated pollution prevention and control licences).
- 10.3.39 There are two Control of Major Accident Hazards (COMAH) sites within the study area. These relate to the two chemical processing and chemical distribution facilities located within the Denaby Main Industrial Estate (site references LA13-21 and LA13-488). Both are reported to be Lower Tier⁹⁹ COMAH facilities.
- 10.3.40 There was one major (Category 1), five significant (Category 2) and nine minor (Category 3) pollution incidents reported over an eight-year period between 1990 and 1998. The major pollution incident occurred in 1991 to the south of the A6023 Doncaster Road and involved the release of an unknown miscellaneous pollutant. The five significant pollution incidents, occurred between 1990 and 1998 and involved the release of oils to the north of Mushroom Plantation and north of Denaby Lane, mining water discharge south of the dismantled railway near North Ings, industrial effluent discharge to the north of Pastures Road and sewage discharge to the north of Pastures Road.
- 10.3.41 There are 26 discharge consents recorded within the study area.
- 10.3.42 There is one nationally significant ecological designation located within the study area, Denaby Ings SSSI.

Mining/mineral resources

- 10.3.43 There are a range of mining and mineral resources located within the study area that have the potential to be affected by the Proposed Scheme. These include sand, gravel, clay, stone and coal, which can be protected via local or county level minerals plans and by the Coal Authority, as well as other forms of petroleum hydrocarbons such as shale gas and oil, which are regulated by the Oil and Gas Authority (OGA) via the issue of Petroleum Exploration Development Licences (PEDLs).

⁹⁹ There are two types (tiers) of establishment which are subject to COMAH Regulations, known as 'Upper Tier' and 'Lower Tier' depending on the quantity of dangerous substances they hold. Upper Tier establishments will hold greater quantities of dangerous substances meaning that additional requirements are placed on them by the Regulations.

Minerals plans

- 10.3.44 RMBC, DMBC and BMBC are responsible for the overall mineral and waste local plans within the study area.
- 10.3.45 DMBC and RMBC have developed a joint approach to minerals planning for their combined authority areas, with the most recent Local Aggregates Assessment being published in 2017¹⁰⁰. This document identifies the Proposed Scheme as an infrastructure project that may contribute to local demand for minerals.
- 10.3.46 DMBC is working toward the production of a Local Plan updating existing planning policies and replacing the Core Strategy and Unitary Development Plan saved policies. The plan will identify mineral sites, areas of search and safeguarding areas. Timescales for the Local Plan publication were spring 2018 but were delayed on announcement of the route of the Proposed Scheme.
- 10.3.47 BMBC published its Draft Local Plan in 2016¹⁰¹ which is intended to provide local policy until 2033 and includes policies on mineral resources and safeguarding. The plan has been submitted to the Secretary of State and was scheduled for adoption in spring 2018.
- 10.3.48 The Ravenfield to Clayton area is underlain by the following mineral resources as identified by the BGS:
- fireclay: carboniferous coal measures (coincident with shallow coal);
 - secondary open cast coal;
 - buried coal resources overlain by up to 50m overburden;
 - brick clay: carboniferous, coal measures mudstones (coincident with shallow coal);
 - dolomite and dolomitic limestone: Permian, Cadeby and Brotherton Formations (Magnesian Limestone);
 - sandstone: carboniferous, millstone grit and coal measures;
 - Sub-alluvial River Terrace Deposits (superficial sand and gravel);
 - glaciofluvial deposits (superficial sand and gravel); and
 - river terrace deposits (superficial sand and gravel).
- 10.3.49 No active quarries have been identified within the study area.

¹⁰⁰ Rotherham Metropolitan Borough Council and Doncaster Council (2017), *Doncaster and Rotherham Local Aggregate Assessment 2017*. Available online at: http://www.rotherham.gov.uk/corestrategyexamination/download/downloads/id/452/leb40a_draft_local_aggregate_assessment_september_2017_revised.pdf

¹⁰¹ Barnsley Metropolitan Borough Council (2016) *Local Plan Publication Draft 2016*. Available online at: <http://consult.barnsley.gov.uk/portal/development/planning/lppd2016/lppd2016?pointId=s1466625849988>

Sand, gravel and clay deposits

- 10.3.50 The Rotherham Local Plan Core Strategy 2013-2028 (Adopted September 2014)¹⁰² notes that Mineral Safeguarding Areas will be defined around all deposits of aggregate limestone and brick clay that are considered to be of current or future economic importance.
- 10.3.51 Maps published by DMBC in conjunction with their Core Strategy 2011-2028 (Adopted May 2012)¹⁰³ specify an MSA for sharp sand and gravel from the superficial deposits located within the River Don valley between Mexborough and Denaby. DMBC is working towards the production of a Local Plan to replace the Core Strategy.
- 10.3.52 The BMBC Local Plan states that reserves of fireclay and brick clay underlie virtually all the borough and that these minerals will be protected from sterilisation.

Coal Mining

- 10.3.53 Available records from the Coal Authority show that the route of the Proposed Scheme would pass through areas of recorded historical coal mining activities, with historical mining operations having taken place along the majority of the route of the Proposed Scheme. Coal was extracted from open cast sites and underground workings of varying depths. There are numerous mine entries throughout the study area, comprising both shaft and adit entries.
- 10.3.54 Coal seams outcrop east of Conisbrough, in Denaby Main, east of Old Denaby, in the north of Mexborough, south-east of Barnburgh and to the south and north of Church Field Road. The named seams are Shafton Coal, Elmsall Coal and Upton Coal.

Open cast coal mining

- 10.3.55 Records indicate that the outcrops east of Conisbrough, in Denaby Main, east of Old Denaby and north of Mexborough are likely to have been subject to historical open cast and shallow coal workings (defined as less than 30m below ground level). There are no records to indicate that the outcrops south-east of Barnburgh and to the south and north of Church Field Road have been subject to workings.
- 10.3.56 The Rotherham Local Plan Core Strategy 2013-2028 (Adopted September 2014) notes that Mineral Safeguarding Areas will be defined around all deposits of coal that are considered to be of current or future economic importance.
- 10.3.57 Maps published by DMBC in conjunction with their Core Strategy 2011-2028 (Adopted May 2012)¹⁰⁴ specifies an MSA for shallow coal located between Old Denaby and Hickleton. DMBC is working towards the production of a Local Plan to replace the Core Strategy.

¹⁰² Rotherham Local Plan Core Strategy 2013-2028 (Adopted September 2014). Available online at: http://www.rotherham.gov.uk/downloads/file/1571/adopted_rotherham_core_strategy

¹⁰³ Doncaster Metropolitan Borough Council Core Strategy (Adopted May 2012). Available online at: http://doncaster.opus3.co.uk/ldf/documents/Core_Strategy

¹⁰⁴ Doncaster Metropolitan Borough Council Core Strategy (Adopted May 2012). Available online at: http://doncaster.opus3.co.uk/ldf/documents/Core_Strategy

10.3.58 The BMBC Local Plan states that shallow coal reserves underlie virtually all the borough and that these minerals will be protected from sterilisation.

Deep coal mining

10.3.59 Recorded areas of historical underground coal mining are present throughout much of the study area.

10.3.60 No licences for future coal mining have been identified within the study area.

Petroleum Exploration Development Licences /hydrocarbons

10.3.61 The Ravenfield to Clayton area is within PEDL areas 11, 43, 276 and 305 and the Bowland Shale Prospective Area¹⁰⁵. It is also within land parcels offered within the 14th Onshore Oil and Gas Licensing Round in 2014. As such, it is considered that the study area is within an area where hydrocarbon resources could be identified and extracted in the future.

Geo-conservation resources

10.3.62 No geological SSSIs have been identified within the study area. There are five LGSs within the study area identified by the BGS. With the exception of the Doncaster Road outcrop, all are located partially within the land required for the construction of the Proposed Scheme:

- Denaby Woods/ Mexborough Oxbow Lake - a site of geomorphological interest;
- Denaby Lane outcrop - a road cutting that provides rare exposure of Mexborough Rock;
- Doncaster Road outcrop – this outcrop provides rare exposure of Mexborough Rock;
- Barnburgh Cliffs - the cliffs expose the Wetherby Member of the Cadeby Formation and provide the best opportunity to observe the Carboniferous-Permian boundary in Doncaster; and
- Watchley Crag - the crags are one of a very limited number of locations to observe the Basal Permeable Sands and their relationship to the Wetherby Member.

Receptors

10.3.63 The sensitive receptors that have been identified within the study area are summarised in Table 21. A definition of receptor sensitivity is given in the SMR.

¹⁰⁵ BGS/DECC, (2013), *The Carboniferous Bowland Shale Gas Study: Geology and Resource Estimation*

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Table 21: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land quality	People	Residents at existing properties, occupants and users of nurseries, schools, study centres, play areas, parks and public open space	High
		Employees and visitors at commercial areas, retail parks areas and hotels	Moderate
		Users of industrial areas	Low
	Groundwater	Principal aquifers associated with the Cadeby Formation and Basal Permian Sand Formation	High
		Secondary A aquifers associated with alluvial Deposits, river terrace deposits, glaciofluvial deposits, Pennine Upper and Pennine Middle Coal Measures	Moderate
		Secondary undifferentiated aquifer associated with head deposits	Low
	Surface waters	Firsby Brook (WFD: Good)	Low to high
		River Don (WFD: Moderate)	
		Sheffield and South Yorkshire Navigation (WFD: Moderate)	
		River Dearne (WFD: Moderate)	
Ludwell Spring (WFD: Moderate)			
Built environment	Barnburgh Lakes Fishery (WFD: Moderate)	Low	
	St Helen's Spring (WFD: Moderate)		
	Frickley Beck (WFD: Moderate)		
	Howell Beck (WFD: Moderate)		
	Ponds and lakes		
	Unnamed streams, tributaries, drains and culverts		
	Underground structures and buried services		
Natural environment	Denaby Ings SSSI	High	
	Firsby Reservoir LNR	Moderate	
	Old Denaby Wetland LNR		
Impacts on mining/ mineral and petroleum (gas) sites (severance and sterilisation)	Mining/ mineral sites	Fireclay, brick clay and shallow minerals PEDL areas 11, 43, 276 and 305 and the Bowland Shale Prospective Area	High

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 (CoCP)¹⁰⁶. The draft CoCP sets out the measures and standards of work that would 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 would 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, 11, 13, 14 and 15);
 - methods to control spillage and prevent contamination of adjacent areas (Sections 5, 11 and 16);
 - the management of human exposure for both construction workers and people living and working nearby (Sections 5, 7, 11, 13 and 14);
 - methods for the storage and handling of excavated materials (both contaminated and uncontaminated) (Sections 6, 7, 11 and 15);
 - management of any unexpected contamination found during construction (Sections 11 and 15);
 - a post-remediation permit to work system (Section 11);
 - storage requirements for hazardous substances such as oil (Sections 5, 11 and 16);
 - traffic management to ensure that there is a network of designated haul routes to reduce compaction/degradation of soils (Sections 5, 6 and 14);
 - methods to monitor and manage flood risk and other extreme weather events which may affect land quality during construction (Sections 5 and 16); and
 - methods to manage discovery of unknown animal burial pits (Section 6).
- 10.4.3 The draft CoCP would require 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

¹⁰⁶ Supporting document: Draft Code of Construction Practice

assessment of potentially contaminated sites would be undertaken in accordance with Environment Agency CLR11¹⁰⁷ and British Standards BS10175^{108,109} and BS8576¹¹⁰.

- 10.4.4 Where significant contamination is encountered, a remedial options appraisal would be undertaken to define the most appropriate remediation techniques. Where appropriate, this appraisal would 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 UK¹¹¹. The preferred option would then be developed into a remediation strategy.
- 10.4.5 Contaminated soils excavated within the site, where practicable, would be treated to remove or render contamination inactive and reused within the Proposed Scheme where needed and suitable for use. Treatment techniques are likely to include stabilisation, soil washing and bio-remediation. Contaminated soil removed off-site would be taken to a soil treatment facility, another construction site (for treatment and reuse) or to an appropriately permitted landfill.

Assessment of impacts and effects

- 10.4.6 Construction of the Proposed Scheme in this area would require earthworks, utility diversions, deep foundations, grouting and ground stabilisation 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 the Volume 2: LA13 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 contaminative risks for the Proposed Scheme. Sites that present a low risk have not been taken further in the assessment. Any moderate to higher 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, industrial, commercial and mining sites.
- 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 or Secondary A) or nearby watercourses; and

¹⁰⁷ Environment Agency, (2004), *CLR11 Model Procedures for the Management of Land Contamination*

¹⁰⁸ British Standard, (2011), *BS10175+A1:2013 Investigation of Potentially Contaminated Sites*

¹⁰⁹ British Standard, (2011) *BS10175+A2:2017 Investigation of Potentially Contaminated Sites*

¹¹⁰ British Standard, (2013) *BS8576 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*

¹¹¹ Sustainable Remediation Forum UK, (2010), *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation*

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- 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 22. The potential impacts and baseline risks quoted 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 22: Summary of baseline CSM for sites which may pose a contaminative risk for the Proposed Scheme

Area reference ¹¹²	Area name	Human health risk	Groundwater risk	Surface water risk	Ecosystem risk	Buildings risk
On site ¹¹³						
LA13-1	Mexborough and Brickworks Quarry landfill (historical)	Low to moderate	Low	Low	Low	Very low to moderate
LA13-478, 486, 1349	Denaby Lane landfill (historical), Off Pastures Road and North Pastures Road landfills (historical), Former railway cutting landfill north of Thurnscoe (historical)	Low to moderate	Low	Low	Low	Very low to moderate
LA13-16,31, 441, 468, 496	Current (441 and 496) and historical (16, 31 and 468) railways	Very low to moderate/low	Low	Very low	Low	Very low to moderate/low
LA13-23	Former explosive works (historical)	Low to moderate	Low	Low	N/A	Low to moderate/low
LA13-482 and 483	Spoil heaps	Low to moderate/low	Moderate/low	Moderate/low	N/A	Very low to moderate
LA13-463	Former power station (historical)	Low to moderate/low	Low	Low	N/A	Low to moderate/low
LA13-464	Garage and former bus depot	Low to moderate/low	Low	Low	N/A	Low to moderate/low

¹¹² Each potentially contaminated site is allocated a unique reference number

¹¹³ 'On site' is within the area of land required for construction of the Proposed Scheme

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Area reference ¹¹²	Area name	Human health risk	Groundwater risk	Surface water risk	Ecosystem risk	Buildings risk
LA13-490	Denaby Main Industrial Estate	Low to moderate/low	Moderate/low	Low	N/A	Low to moderate/low
LA13-503, 505 and 514	Former opencast mining areas	Low to moderate/low	Low	Low	Low	Low to moderate/low
LA13-10, 24, 25, 529, 532, 533	Former shallow mining areas and mine entries	Low to moderate/low	Low	Low	Low	Low to moderate/low
Off site ¹¹⁴						
LA13-4, 8, 15, 28, 450	Farms	Very low to moderate/low	Low	Very low	N/A	Very low to moderate/low
LA13-11, 19, 440, 470 and 516	Sewage works/sewage pumping station (19, 440, 516 are current and 11 and 470 are historical)	Very low to low	Very low	Very low	N/A	Low
LA13-21 and 488	Chemical works	Low to moderate	Low	Low	N/A	Low to moderate
LA13-431, 479, 484, 485, 1358	Hickleton Landfill (historical), Mexborough Power Station landfill (historical), Hellaby and dismantled railway landfill (historical), NCB land landfill (historical), Former refuse pit located within Denaby Main Industrial Estate (historical)	Low to moderate	Low	Low	N/A	Low to moderate
LA13-474, 475, 1359,	Petrol filling station/ garage workshops/former haulage depot	Low to moderate/low	Low	Low	N/A	Low to moderate/low
LA13-476	Historical railway sidings	Very low to moderate	Low	Low	N/A	Very low to moderate/low
LA13-498, 499, 500 and 501	Former opencast mining areas	Low to moderate/low	Low	Low	Low	Low to moderate/low

¹¹⁴ 'Off site' is beyond the land required for construction of the Proposed Scheme but within 250m of it

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Area reference ¹¹²	Area name	Human health risk	Groundwater risk	Surface water risk	Ecosystem risk	Buildings risk
LA13-6, 26, 525, 526, 528, 530, 531, 923, 926, 927, 928, 929	Former shallow mining areas and mine entries	Low to moderate/low	Low	Low	Low	Low to moderate/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 would 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 would result in a negative effect, and conversely, an improvement would result in a positive effect. The assessment assumes that contamination would be controlled through the general measures in the draft CoCP. Once updated this will include mining related contamination.
- 10.4.14 All of the sites set out in Table 23 have been assessed for the change in impact associated with the construction stage of the work. Table 23 presents the summary of the resulting construction effects that have been found to be significant. All other sites referenced in Table 22 were found to have non-significant effects.

Table 23: Summary of construction CSM effects.

Name and area ref ¹¹⁵	Receptor	Main baseline risk	Main construction risk	Temporary effect
Opencast, probable shallow coal workings and mine entries (various locations)	Human health (inhalation of ground gasses on site)	Moderate/low	High	Moderate adverse effect (significant)
	Human health (inhalation of ground gasses off site)	Moderate/low	High	Moderate adverse effect (significant)
	Controlled waters (groundwater)	Low	Moderate	Moderate adverse effect (significant)
	Controlled waters (surface water)	Low	Moderate	Moderate adverse effect (significant)

¹¹⁵ Each potentially contaminated site is allocated a unique reference number.

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Name and area ref ¹²⁵	Receptor	Main baseline risk	Main construction risk	Temporary effect
	Property (exposure to vapours)	Moderate/low	High	Moderate adverse effect (significant)

10.4.15 In the event that unexpected contamination is encountered during the construction of the route in this area, this would be remediated as described in the draft CoCP resulting in an overall beneficial effect.

10.4.16 The extent to which mine water and mine gas is controlled is subject to ongoing investigation. For mining sites, potential for significant adverse effects has been identified associated with mine gas and mine water in historical workings. Any mitigation measures required will be identified, in consultation with authoritative consultees, including measures to be set out in the draft CoCP, to mitigate any significant effects

10.4.17 The assessment has considered the engineering design together with the specific nature of the potential current and historical contamination sources and receptors identified. Four landfills located within the area required for the construction of the Proposed Scheme have been identified as a key issue which the draft CoCP would address. These include Mexborough and Brickworks Quarry landfill which is located along the route of the Proposed Scheme. Consideration would be given to the potential adverse effects on nearby receptors arising from excavation into historic waste material. This would particularly apply in areas of cutting, excavation and piling.

Permanent effects

10.4.18 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.

10.4.19 The magnitude of the permanent effects and their significance have been determined by assessing the change in risk between the main baseline risk and the main post-construction risk. Therefore, where there is no change between the main baseline risk and the main post-construction risk, the permanent effect significance is deemed to be negligible even if the risk is assessed to remain as high. This would 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 construction boundary. As noted above, a worsening would result in negative effects and an improvement would result in positive effects.

10.4.20 All of the sites set out in Table 22 have been assessed for the change in impact associated with the permanent post-construction stage. All sites were found to have non-significant (neutral or minor beneficial) effects.

10.4.21 In relation to the potential significant effects associated with mining sites at construction stage, there will be a greater level of knowledge and understanding of the mine workings ground model and the best means to mitigate the potential effects on a permanent basis.

- 10.4.22 Additional site-specific permanent remediation measures, that could focus on source removal, pathway breakage or receptor protection, would be developed during the detailed design stage if required. These measures would ensure that risks to people and property from gas and vapours in the ground, the principal risk in this area, will be controlled to an acceptable level.

Mining/mineral resources

- 10.4.23 Construction of the Proposed Scheme has the potential to affect existing mineral resources and proposed areas of mineral exploitation. This could occur by sterilisation of the resource through direct excavation during construction of the Proposed Scheme or through temporary and/or permanent severance¹¹⁶ or isolation that may occur during the construction phase of the Proposed Scheme, possibly continuing through to its operation.

Temporary effects

- 10.4.24 Temporary adverse effects may occur where construction compounds are proposed within a MSA. In such cases, there would be a temporary sterilisation of the resource during construction works, but this is not considered to represent a significant effect and the resource would not be lost permanently.

Permanent effects

- 10.4.25 The majority of effects on mining and mineral sites would be permanent.

Sand, gravel and clay deposits

- 10.4.26 The effects of construction of the Proposed Scheme on the sand and gravel MSA would be permanent where underlain by the footprint of the permanent works, with a strip of mineral becoming sterilised. However, as a proportion of the total MSA, the effect is considered to be minor and therefore not significant. Mitigation measures (if any) would be discussed in advance of the works with the Mineral Planning Authority, relevant borough councils and the mineral owner.

Coal Mining – open cast and shallow

- 10.4.27 The effect of construction of the Proposed Scheme on future open cast and shallow coal mine areas would be permanent where they are present beneath the footprint of the permanent works, with a strip of mineral becoming sterilised. Mitigation measures (if any) would be discussed in advance of construction with the Mineral Planning Authority, the Coal Authority and the mineral owner.

Coal Mining – deep

- 10.4.28 The permanent effect of the Proposed Scheme on the identified deep coal resource is considered to be negligible and therefore not significant. Deep reserves are not currently worked beneath the Ravenfield to Clayton area and whilst future application to resume deep extraction cannot be fully excluded, given the narrow strip of

¹¹⁶ 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

permanent works and likely depth of coal workings, significant effects associated with construction of the Proposed Scheme are unlikely.

Petroleum Development Exploration Licences

- 10.4.29 The permanent effect of the Proposed Scheme on the identified PEDLs is considered to be negligible.
- 10.4.30 The route of the Proposed Scheme would cross an area underlain by four PEDLs of the Bowland Shale Prospective area. The PEDLs identify the deep areas of hydrocarbons resources, specifically, potential sources of shale gas. Operation of the Proposed Scheme is unlikely to place a constraint on future exploitation of potential sources of shale gas.
- 10.4.31 Table 24 reports the assessment of permanent effects from construction on the mining and mineral resources identified.

Table 24: Summary of effects for mining and mineral resources

Site name	Status	Description	Sensitivity/ value	Magnitude of impact	Effect and significance (Y/N)
Sand and gravel	MSA	MSA for sand and gravel extraction defined by local borough councils	Medium	Minor	Negligible (N)
Shallow coal	MSA	MSA for shallow coal extraction defined by local borough councils	Medium	Minor	Negligible (N)
PEDL _{11, 43, 276, 305} of the Bowland Shale Prospective Area	Licensed by UK Oil and Gas Authority	PEDL _{11, 43, 276, 305} and potential future shale gas reserves	Medium	Minor	Negligible (N)

- 10.4.32 There will be negligible effects on mining, mineral and shale gas resources in the Ravenfield to Clayton area, which are not significant.

Geo-conservation sites

- 10.4.33 It is possible that the construction and operation of the Proposed Scheme would have a minor impact on four of the LGSs, since Denaby Woods/ Mexborough Oxbow Lake, Denaby Lane outcrop, Barnburgh Cliffs and Watchley Crag are partially located within the land required for the construction of the Proposed Scheme. Doncaster Road outcrop is located outside the land required for the construction of the Proposed Scheme and as such the impact would be negligible.

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Table 25: Summary of effects for mining and mineral resources

Site name	Status	Sensitivity/ value	Magnitude of impact	Effect and significance (Y/N)
Denaby Woods/ Mexborough Oxbow Lake	LGS	Medium	Minor	Negligible (N)
Denaby Lane outcrop	LGS	Medium	Minor	Negligible (N)
Doncaster Road outcrop	LGS	Medium	Negligible	Negligible (N)
Barnburgh Cliffs	LGS	Medium	Minor	Negligible (N)
Watchley Craggs	LGS	Medium	Minor	Negligible (N)

Other mitigation measures

- 10.4.34 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 at the detailed design stage if required. These measures would ensure that risks to people, the environment and property from contaminants in the ground will be controlled such that they would not be significant. For example, measures might include excavation and treatment of contaminated soils or controls to manage movement of landfill gas and leachate.
- 10.4.35 Mitigation of the effects on mineral resources within the proposed MSA could include extraction of the resource in landscaping areas within the route of the Proposed Scheme adjacent to, rather than beneath the structural footprint of the Proposed Scheme. A plan would be discussed in advance of the construction works with the landowner, the mineral planning department at RMBC, DMBC and BMBC and any other relevant parties to assist in achieving an effective management of minerals within the affected location of the MSA.

Summary of likely residual significant effects

- 10.4.36 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.

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 would be in accordance with environmental legislation and good practice. Spillage and pollution response procedures similar to those to be outlined in the draft CoCP would be established for all high risk activities and employees would be trained in responding to such incidents.

Assessment of impacts and effects

- 10.5.3 The Proposed Scheme within this area would include three auto-transformer stations and a mid-point auto-transformer station. Auto-transformer stations and sub-stations can, in principle, be a source of contamination through accidental discharge or leaks of coolant. However, in common with other modern sub-stations, 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, 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.

Monitoring

- 10.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme. Requirements for monitoring would 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 bulk and trace 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 identified to date within the Ravenfield to Clayton 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 any associated lighting but also the presence of the new permanent infrastructure associated with the Proposed Scheme.
- 11.1.3 Engagement with Doncaster Metropolitan Borough Council (DMBC), Barnsley Metropolitan Borough Council (BMBC), Rotherham Metropolitan Borough Council (RMBC), and the Dearne Valley Landscape Partnership has commenced. The purpose of this engagement has been to discuss the assessment methodology, extent of the landscape and visual study area, and the locations of visual assessment and verifiable photomontage viewpoints. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.
- 11.1.4 The Volume 2: LA13 Map Book shows the locations of key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and operational (Map Series CT-06) features of the Proposed Scheme. It also shows the locations of landscape and visual impact measures (Map Series CT-06) and viewpoints that would potentially be significantly affected at the construction (Map Series LV-03) and operation (Map Series LV-04) phases and Landscape Character Areas (LCA) that would potentially be significantly affected at the construction and operation phases (Map Series LV-02).
- 11.1.5 A separate, but related, assessment of effects on the setting of heritage assets is reported in Section 9, Historic environment.

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 and the Scope and Methodology Report (SMR)¹¹⁷.
- 11.2.2 Summer surveys for the landscape and visual assessment were undertaken from July to September 2017 and winter surveys from November to March 2017-2018 to inform the assessment. Further surveys will be undertaken to inform the assessment and will be reported in the formal ES.
- 11.2.3 At this stage, it has not been possible to complete surveys of all publicly accessible land in this area; therefore, for the working draft ES an assumption has been made

¹¹⁷ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

about the level of sensitivity and magnitude of change on a case by case basis. This will be adjusted, as appropriate, on the basis of survey results to inform the formal ES.

- 11.2.4 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 and are an indication of the theoretical visibility of the Proposed Scheme. In some locations, extensive vegetation cover would mean the actual extent of visibility is substantially less than that shown in the ZTVs, and professional judgement will be used to further refine the study area to focus on likely significant effects.
- 11.2.5 Tall construction plant (for example cranes and piling rigs) is excluded from the ZTVs 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 ZTVs to give a better indication of the possible spread of significant effects to aid the assessment.
- 11.2.6 Landscape and visual receptors within approximately 1.5km of the route of the Proposed Scheme have been assessed as part of the study area. Long distance views of up to 2.5km have been considered at settlement edges across the study area and includes the settlements of Conisbrough, Mexborough, Thurnscoe, South Kirkby and South Elmsall as well as a number of villages and hamlets.
- 11.2.7 This assessment is based on preliminary design information and makes reasonable worst case assumptions on the nature of potentially significant effects where these can be substantiated. It is based on information known at present. The assessment of visual effects during construction covers the situation in winter of year 1. The assessment of operational visual effects covers the situation in winter and summer of year 1 and summer of year 15. The assessment of landscape effects is undertaken for the construction phase and for the operational phase at both year 1 and year 15. The landscape assessment does not consider seasonal variations e.g. winter/summer, since these do not affect character. Likely significant landscape and visual effects for year 30 will be reported in the formal ES.
- 11.2.8 Professional judgements on landscape value are summarised in the baseline descriptions and judgements on landscape susceptibility and sensitivity are summarised as part of the assessment of effects on each significantly affected LCA. Full judgements on value, susceptibility and sensitivity will be provided in the formal ES.
- 11.2.9 The assessment has been carried out on the basis that design of structures would, insofar as reasonably practicable, integrate with existing skyline features and would make use of a simple, clean and coherent palette of materials to help structures fit in the landscape.

11.3 Environmental baseline

Existing baseline

Landscape baseline

- 11.3.1 The study area extends from Ravenfield in the south to Clayton in the north. Much of the farmland through which the Proposed Scheme would pass is identified as an Area of Special Landscape Value (ASLV) by RMBC and DMBC. ASLVs are a local landscape designation that are currently afforded the highest level of protection by the councils.
- 11.3.2 The varied landscape of the study area is a reflection of the underlying geology. To the west, sandstones within the coal measures have given rise to relatively poor soils that support a mix of pasture and intensively farmed arable crops. Until the late 20th century, there was extensive coal extraction, which has left a legacy of former mines and spoil heaps (mostly now restored), power lines, settlements, industry and transport routes. To the east, the land rises through a distinct but undramatic escarpment, to an elevated, gently rolling limestone plateau supporting large-scale arable farmland with fields bounded by clipped hedgerows and trees mainly confined to blocks of woodland. Well-wooded historic estates with veteran parkland trees, such as Melton Park, Hickleton Park and Brodsworth Park have a strong influence of the character of the local landscape.
- 11.3.3 The gently curving and converging valleys of the rivers Don and Dearne that flow either side of Mexborough are fed by a series of brooks and channels, including the Firsby and Hooton Brooks to the north of Ravenfield and the Ludwell Spring to the south-east of Barnburgh. The Frickley Beck between Hooton Pagnell and Clayton, and the Howell Beck drain land in the northern part of the study area. The Sheffield and South Yorkshire Navigation is a large artificial watercourse to the south-east of Mexborough. The river valleys display a high concentration of rough grassland and immature scrub woodland, which characterise the reclamation of the spoil tips along the Don and Dearne river valleys and are an important ecological and recreational resource, with nature reserves, footpaths and cycleways.
- 11.3.4 Woodland is found throughout the study area and is often associated with the parklands. The largest block is the ancient woodland at Howell Wood on the northern boundary of the study area. Smaller blocks of ancient woodland include Bella Wood and Watchley Crag Ancient Woodland, which are both found on the limestone escarpment. Commercially managed woodlands include Howell Wood, Church Plantation, Mushroom Plantation and Sheepwash Plantation.
- 11.3.5 Settlement comprises historic nucleated villages and industrial brick built 19th and 20th century mining towns and villages such as Conisbrough, Denaby Main, Mexborough and Thurnscoe. Farmsteads are scattered throughout the area, but the limestone plateau is typically more sparsely settled than the coal measures. Stone is an integral and distinctive part of the built landscape. While some villages comprise almost exclusively limestone or sandstone, those villages, which are located on the junction of the limestone and the coal measures, including Hooton Pagnell, Hickleton and Barnburgh, display buildings constructed of both types of stone. Some of the

villages, including Hickleton, Hooton Pagnell and High Melton have a distinctly 'estate village' character and are associated with country houses and historic estates.

- 11.3.6 Archaeological evidence reflects the longstanding importance of the area for occupation, farming and transport. A prehistoric ridgeway known as Ricknield Street, which remained in use from the Iron Age to the late medieval period ran north along the coal measure sandstone crossing the River Don at Strafford Sands before tracking north along the top of the limestone escarpment and plateau.
- 11.3.7 Linear transport corridors include the M18 to the far south-east of the area, A630 Doncaster/Sheffield Road, A6023 Doncaster Road and the A635 Barnsley Road.
- 11.3.8 Other notable linear features are the many disused railway lines associated with the former coal mines, such as Frickley Colliery, Manvers Main, Hickleton Main and Denaby Main. Many of these are now important wildlife corridors, supporting a variety of habitats including woodland and scrub. Overhead power lines and pylons are also present within the study area.
- 11.3.9 Much of the landscape is scenic and rural in character and provides an important recreational resource with a public rights of way (PRoW) network that includes the Trans Pennine Trail, Barnsley Boundary Walk and Dearne Way. There are also a number of recreational areas such as Howell Wood Country Park, High Melton Golf Club and Hickleton Golf Club
- 11.3.10 The LCAs have been determined as part of an integrated process of environmental characterisation, informed by a review of historic landscape mapping and the outcome from other topics including ecological assessments. These LCAs will be refined upon completion of the historic landscape characterisation exercise and these final LCA will be included in the formal ES. Use has been made of published landscape character assessments and a wide range of supporting GIS data, aerial photography and Ordnance survey mapping, plus desk study and fieldwork. Landscape character assessments reviewed include the relevant National Landscape Character Areas¹¹⁸, BMBC Landscape Character Assessment¹¹⁹, DMBC Landscape Character Assessment and Capacity Study¹²⁰, RMBC Landscape Character Assessment and Landscape Capacity Study, Landscape Character Assessment of Wakefield District¹²¹ and the Dearne Valley Landscape Partnership Landscape Character Assessment¹²².
- 11.3.11 These published LCAs have been adapted for this assessment to provide LCAs of an appropriate and consistent scale. Minor amendments have also been made to some published LCA boundaries to reflect existing conditions.

¹¹⁸ 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>

¹¹⁹ Barnsley Metropolitan Borough Council (2002), *Barnsley Borough Landscape Character Assessment*. Available online at: <https://www.barnsley.gov.uk/media/4585/eb86-barnsley-landscape-character-assessment.pdf>

¹²⁰ Doncaster Metropolitan Borough Council (2007), *Landscape Character and Capacity Assessment of Doncaster Borough*. Available online at: <http://www.doncaster.gov.uk/services/planning/doncaster-landscape-character-assessment-and-capacity-study>

¹²¹ Wakefield Metropolitan District Council (2004), *Landscape Character Assessment of Wakefield Council*. Online at: <http://www.wakefield.gov.uk/Documents/planning/planning-policy/information-monitoring/ldf-landscape-assessment.pdf>

¹²² Dearne Valley Landscape Partnership (2012), *Dearne Valley Landscape Character Assessment*. Available online at: <http://discoverdearne.org.uk/story-of-the-dearne/nature/landscape-character/>

- 11.3.12 For the purposes of this assessment, the Ravenfield to Clayton study area has been subdivided into 23 LCAs. These LCAs are draft and subject to review in consultation with local planning authorities. Full descriptions of all LCAs will be provided in Volume 5 of the formal ES. Thirteen of the 23 LCAs would not be significantly affected by the Proposed Scheme as there would be no physical changes to landscape characteristics and/or the LCAs would be at a distance from the Proposed Scheme. The Bramley Fringe LCA would be significantly affected by the Proposed Scheme and is included in Volume 2: Community area report LA12 Ulley to Bramley as it is located for the most part within the Ulley to Bramley area. A summary of the remaining 10 LCAs that would be significantly affected within the Ravenfield to Clayton area is provided in Table 26.

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Table 26: Summary of significantly affected LCAs

Micklebring Farmland

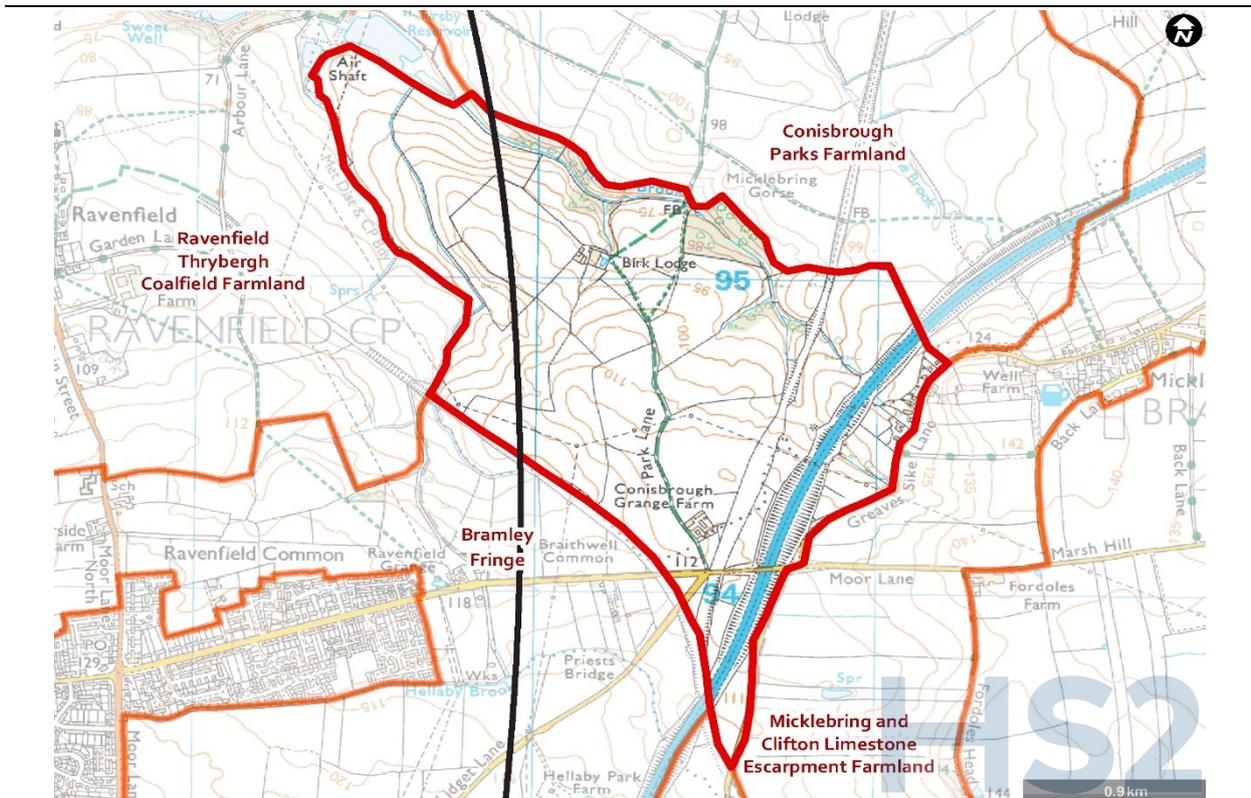


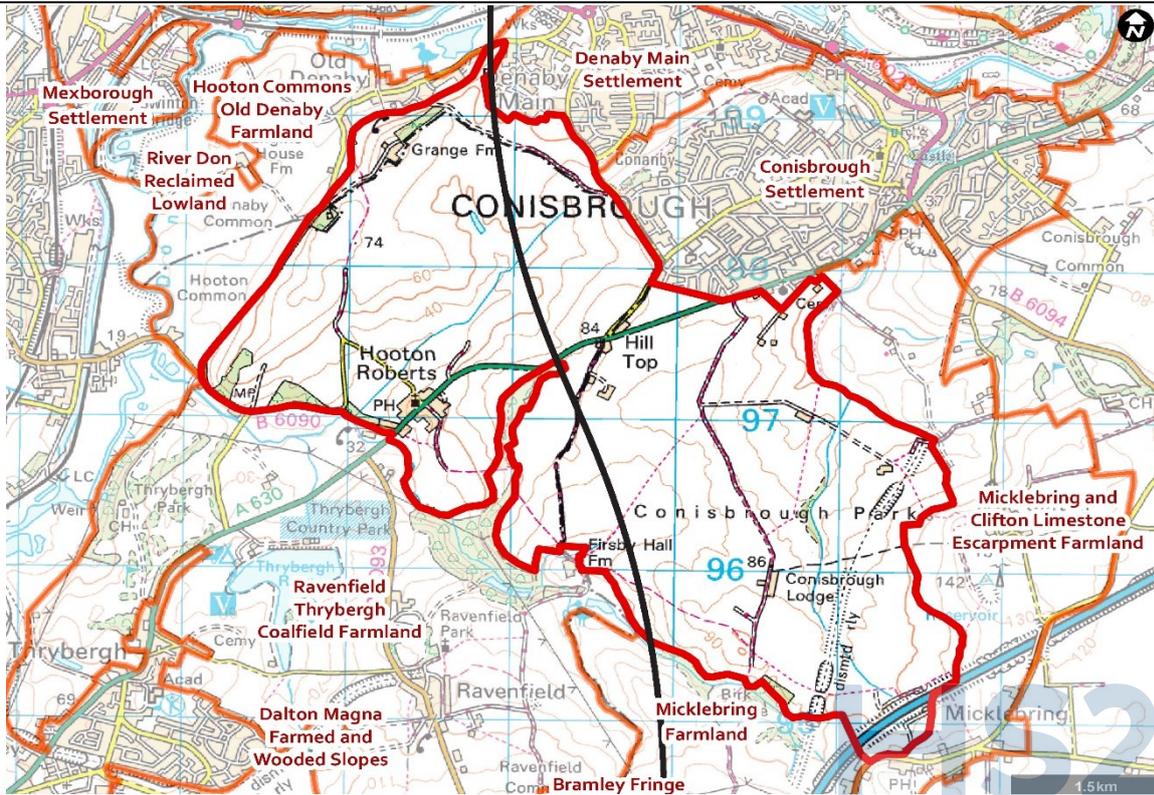
Image showing the characteristic rolling farmland and wooded stream valleys. Tall pylons on the skyline are a feature of this LCA.



The Micklebring Farmland LCA which is designated as an ASLV extends to west of the limestone escarpment and the village of Micklebring, which is in the adjoining LCA. The landscape comprises rolling and sloping farmland with small to medium sized irregular pastures and arable fields bounded by hedgerows with occasional hedgerow trees. Linear woodlands are found along the stream valleys, two dismantled railway lines and the M18 which cuts across the south-east corner of the LCA. There are no settlements, only two farmsteads and few opportunities for public access within the area. The M18 is in cutting and is not a prominent landscape feature, although traffic noise from the motorway detracts from the tranquillity typically experienced throughout the remainder of the LCA. Pylons are a more prominent visual detractor and impinge on the long views across the farmland. There has been some field enlargement and loss of hedgerows due to intensive farming practices, but the irregular historic field pattern is still discernible.

The value of this LCA is medium-high due to its high proportion of linear woodlands, rural character and contrast it provides with the surrounding larger-scale intensive arable farmland in adjoining LCAs

Conisbrough Parks Farmland



The first image shows the undulating farmland and hedged fields north of Hooton Roberts. The second image shows the more open larger-scale character of the landscape south of Howdike Lane.

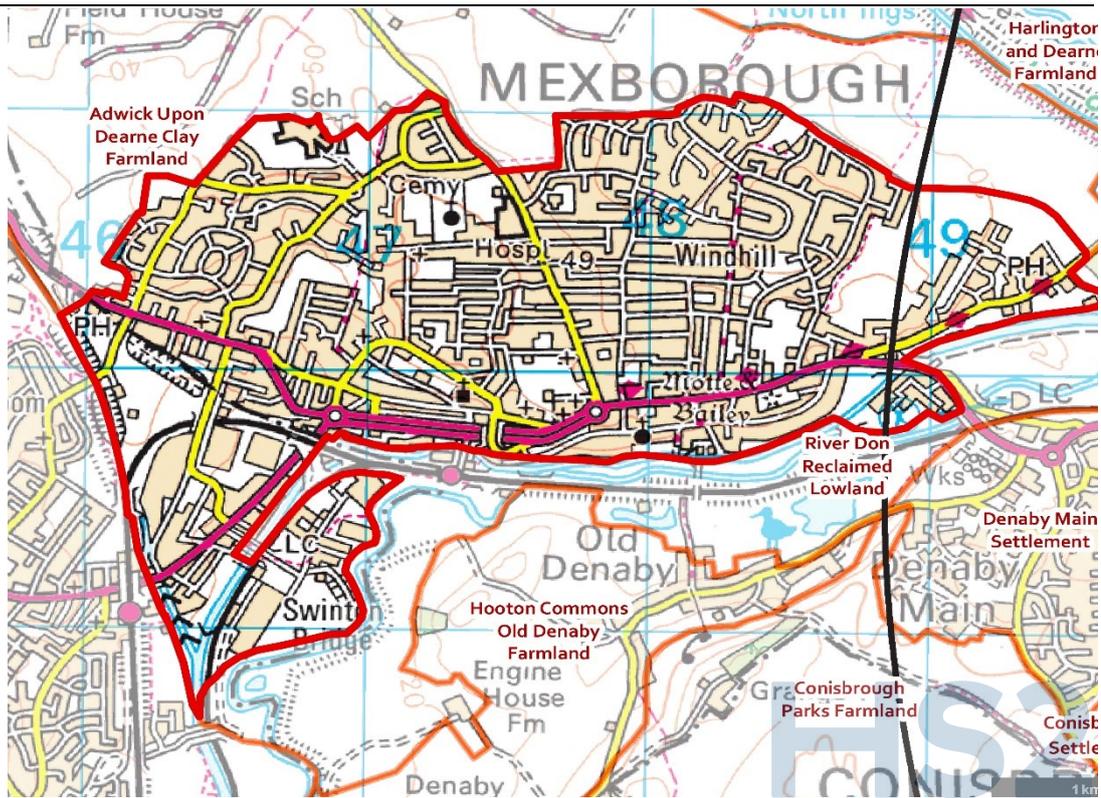


The Conisbrough Parks Farmland LCA is a large and slightly elevated LCA, which was formerly a medieval royal deer park. The complex undulating landform today supports a patchwork of medium and large-scale irregular arable fields with some pasture. Immediately east of Hooton Roberts there are also some slightly sinuous elongated rectangular fields of likely 17th and 18th century origin. Fields are bounded by robust mixed species hedgerows with occasional dressed stone walls, although in places there has been some hedgerow loss due to agricultural intensification. Hedgerow trees are prevalent particularly east of Crooked Lane. The few woodlands are mostly located west of Hooton Roberts and include ancient woodland on the escarpment at Denaby Wood. Elsewhere linear tree belts follow the farm tracks, a dismantled railway line and the small watercourses. Settlement comprises the historic village of Hooton Roberts, the hamlet of Hill Top and occasional dispersed red brick farmsteads and residential properties. There is little public access other than the main A630 Doncaster/Sheffield Road. Much of the LCA has a distinctive, and in places historic, rural character and is mostly designated as an ASLV. Along the eastern edge of the LCA traffic noise from the M18 and views of pylons and the communications masts at Beacon Hill are visual detractors and interrupt the otherwise strong visual relationship with the limestone escarpment to the east.

The value of this LCA is medium as although much of the landscape is rural in character and designated as an ASLV, the farmland has been subject to agricultural intensification resulting in loss of traditional field patterns, field amalgamation and hedgerow loss.

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Mexborough Settlement



The first image is of the Victorian/Edwardian buildings in Mexborough's conservation area. The second image is from the east of the LCA, showing the new housing estate (under construction) off Pastures Lane.

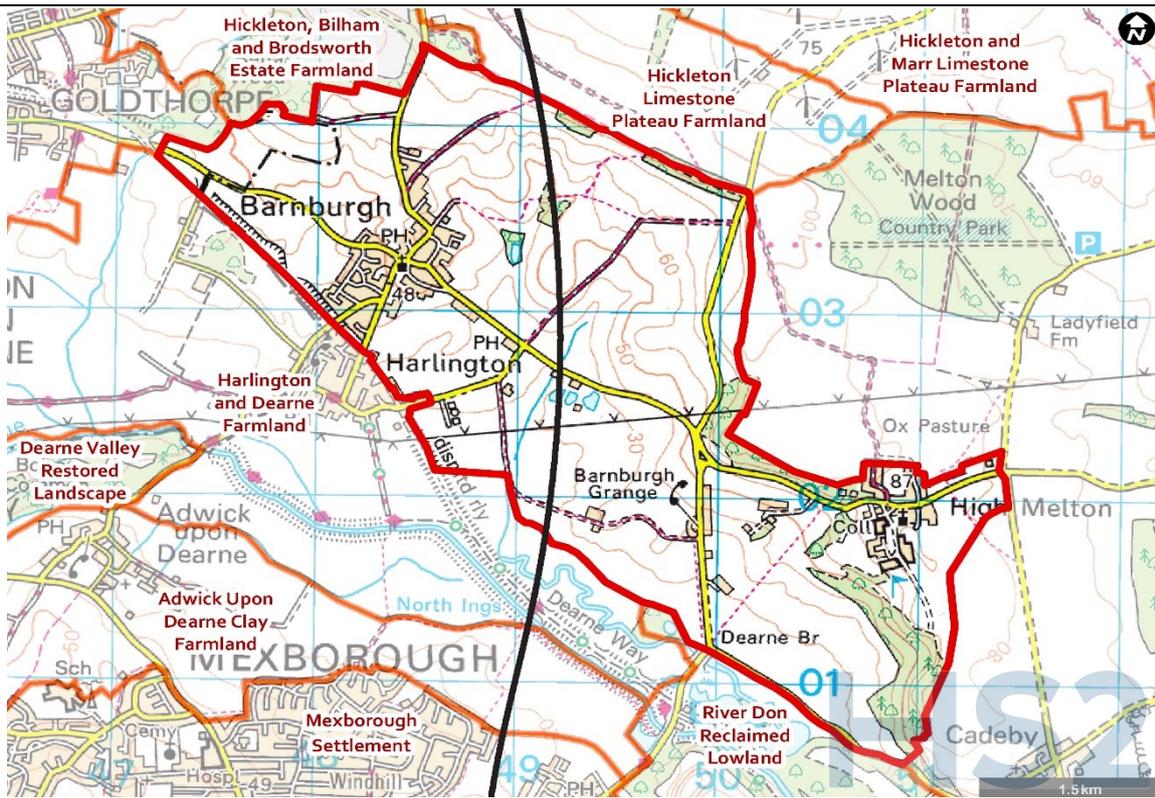


The Mexborough Settlement LCA is situated on a ridgeline from where it affords long northerly views out across the Don valley. Mexborough is a historic town with the remnants of a motte and bailey castle (now a scheduled monument) at Castle Hill. The medieval centre of Mexborough lies to the west of the 12th century Grade I Listed Church of St John the Baptist. The conservation area comprises a cohesive group of social, civic and commercial Victorian/ Edwardian buildings built in a mix of sandstone and brick. Expansion of the coal industry in the late 19th and early 20th century transformed the town and by the 1930s it was heavily industrial and affected by landfill, chemical works and colliery spoil heaps. Since the decline of industry in the 1980s Mexborough has undergone a process of economic, environmental and social regeneration, with new roads and housing extending the eastern boundary of the town towards the river.

The value of this LCA is medium as although there are historic parts to the town, much of it was affected by the former coal industry and is not of high scenic quality.

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High Melton and Barnburgh Scarp Slope Farmland



The first and second images shows the use of Magnesian limestone as a building material within the historic villages of Barnburgh and High Melton. The third shows the low wooded limestone escarpment that defines the eastern edge of the LCA.

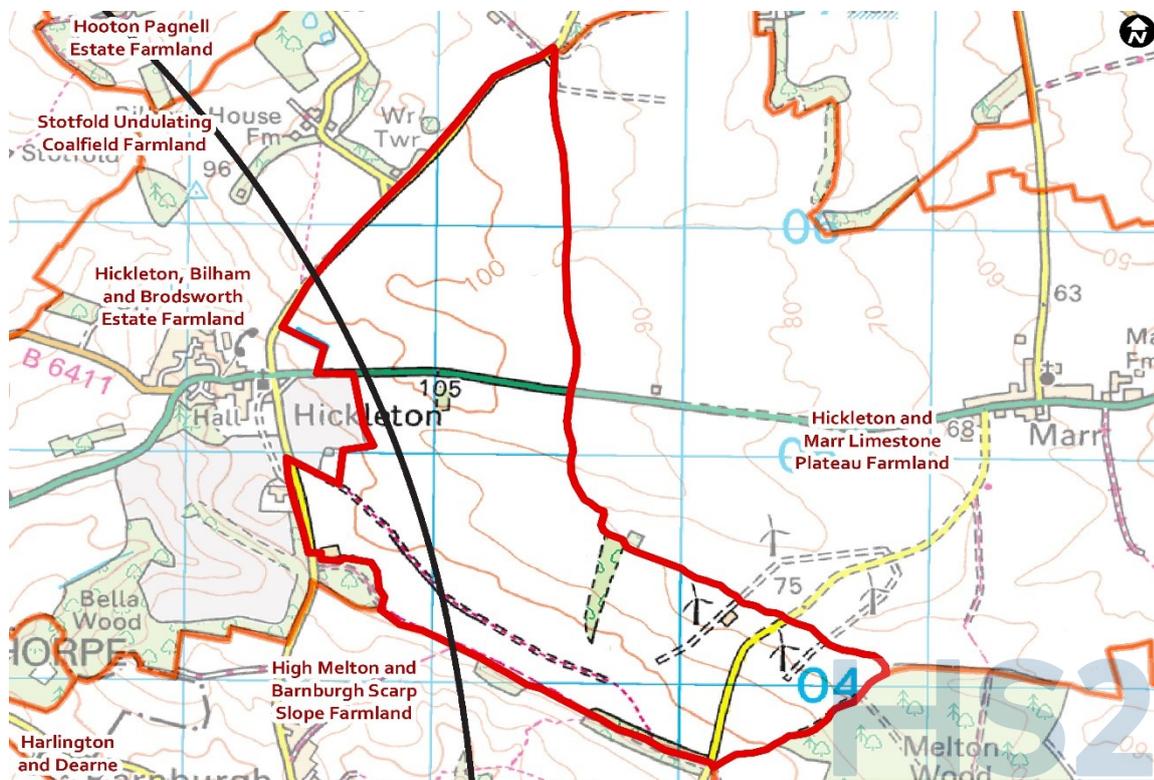


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The High Melton and Barnburgh Scarp Slope Farmland LCA is defined by a low limestone escarpment which is most noticeable at Barnburgh Cliff. Farmland is mostly arable with a patchwork of smaller 17th and 18th century fields around villages and along the escarpment (all of which have been subject to some enlargement), and larger 19th century fields. Field boundaries are mostly mature hedgerows with hedgerow trees. Broadleaved woodland including some blocks of ancient woodland is typically found on the steeper slopes or is associated with the designed estate parkland around the former Barnburgh Hall. High Melton Golf Club, close to High Melton Hall Grade II listed building, displays a manicured landscape with mixed woodland. The area is accessed via the network of historic roads and lanes, PRoW and tracks leading to the occasional dispersed farmstead. The landscape, which is designated as an ASLV, has an historic quality created by the estate parklands, woodlands, stone walls and picturesque limestone villages of High Melton and Barnburgh, with their conservation areas and historic churches.

The value of this LCA is medium-high due to use of Magnesian limestone for walls and buildings, which has given the historic settlements a distinctive sense of place and picturesque character.

Hickleton Limestone Plateau Farmland



The first image shows the historic tree avenue along the A635 Barnsley Road. The second image is of the gently undulating plateau farmland with wind turbines.

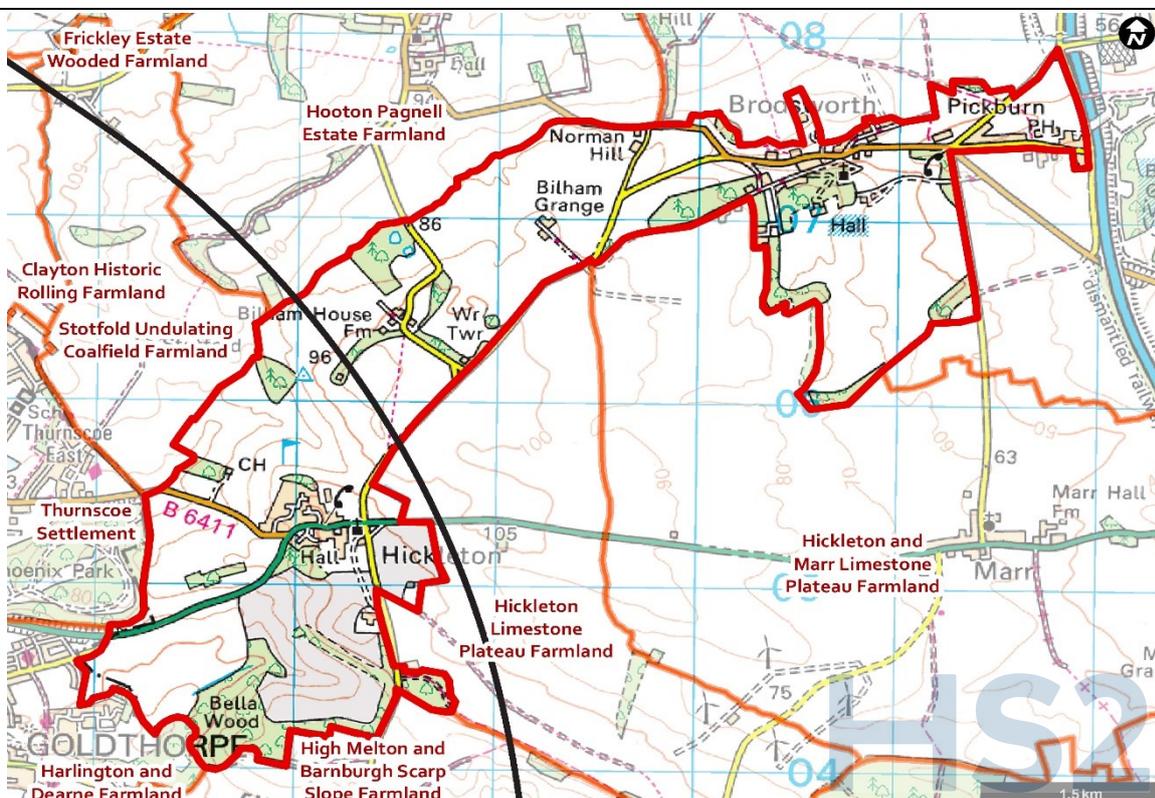
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The Hickleton Limestone Plateau Farmland LCA is a gently rolling plateau, which slopes gradually eastwards from the top of a low limestone escarpment. It is a strongly rural landscape supporting a patchwork of medium to large-scale arable fields bounded by clipped thorn hedges, which are often fragmented or absent. There are few hedgerow trees but small woodland blocks give some visual interest and enclosure to the otherwise open and expansive scenery. The landscape has a distinctive character that derives partly from the underlying Magnesian limestone geology and plateau landform and also from its historic associations with Hickleton Hall Estate, a Grade II registered park and garden just outside the LCA. The scenic quality, sense of openness and expanse of sky all contribute to its recognition as an ASLV. Away from the A635 Barnsley Road, the farmland has a remote and tranquil quality, due to the lack of settlement or access. Views of wind turbines outside the LCA to the south-east are one of the few detractors.

The value of this LCA is medium-high as the arable farmland is remote, expansive and unspoiled by development. It has a coherence and strength of character deriving from the underlying limestone and its elevation, which contrasts strongly with the lower lying coal measure landscapes to the west.

Hickleton, Bilham and Brodsworth Estate Farmland



First image is of properties within Hickleton village. The second image shows the use of Magnesian limestone as a building material.

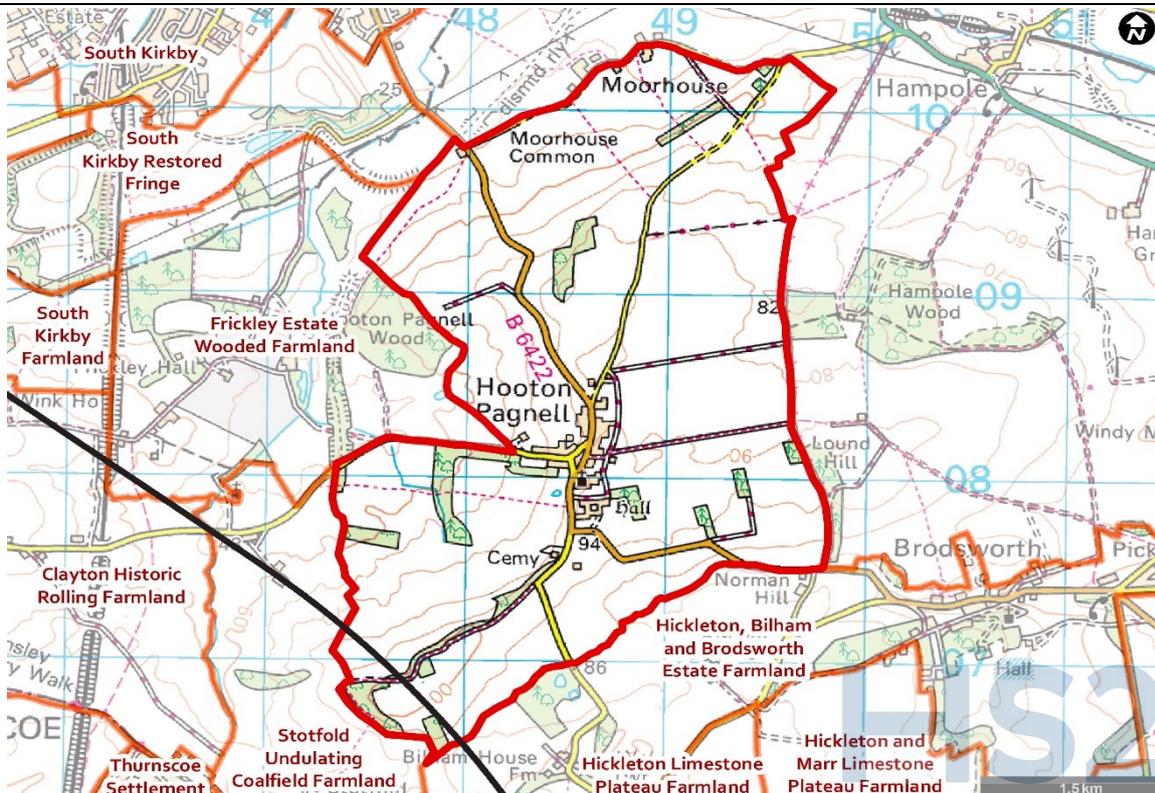
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The limestone underlying the Hickleton and Bilham Estate Farmland LCA has created a rolling escarpment to the south and west of the LCA that contrasts with the more gently rolling elevated plateau landform to the north and east. The distinctive character of this LCA derives from the historic ornamental parkland associated with Hickleton Hall Estate (a Grade II registered park and garden), Bilham Park and Brodsworth Estate. Bilham Park which is located centrally within the LCA includes many landscape features which formed part of a walking route known as a 'pleasure circuit'. One of these features is 'The Belvedere', an important garden building situated within an over-mature plantation upon a promontory to the south-west of the hall site, where it formerly exploited the panoramic views over the surrounding landscape. Trees and woodlands are also an important feature of the LCA, with plantation and ancient woodlands being not only ornamental, but also providing screening, enclosure and cover for game. Statuesque parkland trees punctuate the surrounding farmland, which is typically maintained as permanent pasture or under arable cultivation. The farmland, which is designated as ASLV, is attractive and tranquil with a strong sense of place and few detracting influences.

The value of this LCA is high due to its associations with historic parklands and designed landscapes including Hickleton Hall Estate, Bilham Park and Brodsworth Estate.

Hooton Pagnell Estate Farmland



The first image shows the use of Magnesian limestone as a building material within the historic village of Hooton Pagnell. The second image shows the distinctive linear hedged fields which are characteristic of the area.

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The Hooton Pagnell Estate Farmland LCA is an elevated area of gently rolling arable farmland, which includes a wooded limestone ridge that extends south from Hooton Pagnell before terminating at Watchley Crag, where there are long views west across the lower lying coal measure farmland. The field pattern is strongly rectilinear and is defined by a network of low hedges although many of these are fragmented. There are few trees, but a number of woodland blocks and small plantations impart a relatively well-wooded character. The area has few settlements other than Hooton Pagnell, which is a typical nucleated village built in Magnesian limestone that has retained much of its traditional character and has a large conservation area. Around the village, small irregular hedged and well-treed pastures, together with the Grade II* listed Hooton Pagnell Hall, tithe barn and green lanes date back to the medieval period and contribute to the historic landscape value of the area. A number of historic roads and lanes converge on Hooton Pagnell and the route of the prehistoric ridgeway known as Ricknield Street follows the eastern boundary of the LCA. Recreational opportunities are provided by a small PRoW network. This is a scenic and tranquil landscape, which is designated as an ASLV.

The value of this LCA is high due to the picturesque and historic qualities of the landscape as well as the tranquil character of much of the farmland.

Stotfold Undulating Coalfield Farmland



The first image is of the sloping farmland underneath Watchley Crag. The second image shows the open sloping arable fields to the north of the LCA.

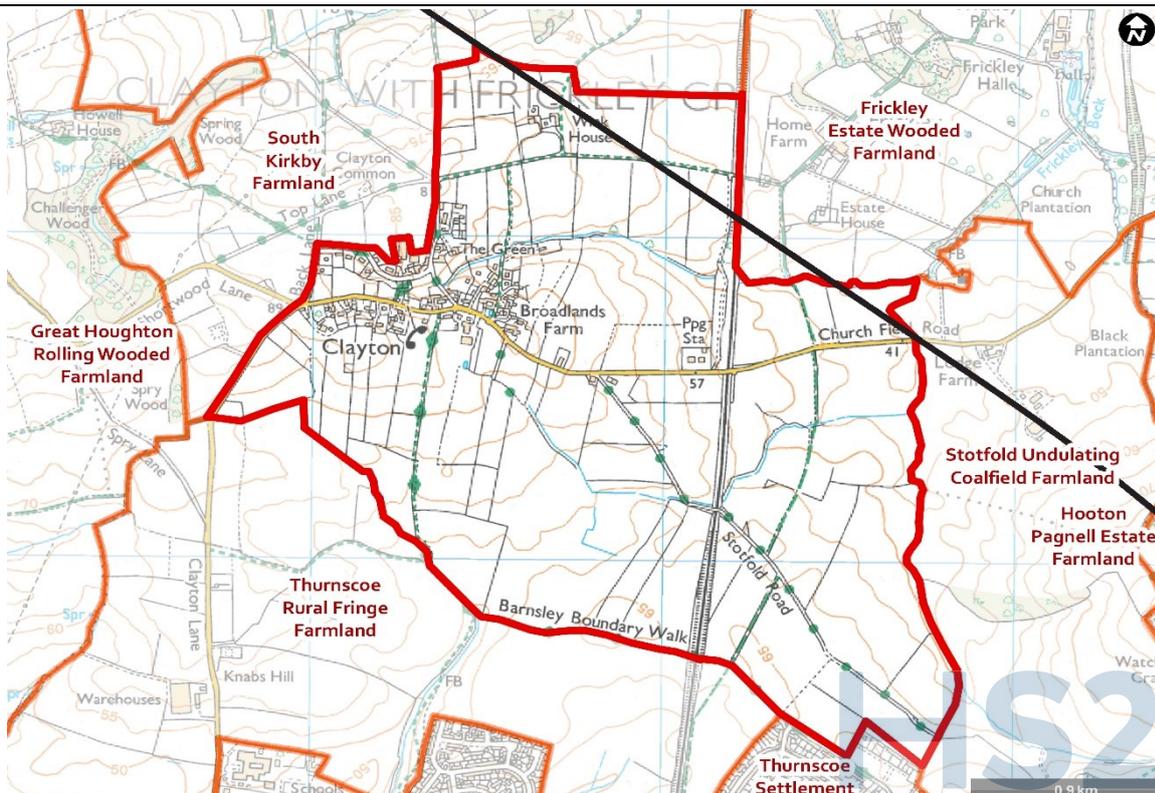
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The small Stotfold Undulating Farmland LCA slopes in a westerly direction away from the limestone ridgeline at Watchley Craggs to the east. The farmland comprises large open and intensively managed arable fields, which are bounded by low fragmented hedgerows. There are only a few small woodland blocks within the LCA but woodland cover generally appears high. This is due partly to the linear streamside tree belts but also because of the views and enclosure provided by the woodland and trees in the surrounding LCAs. The area has few roads or PRoW and is sparsely populated with only three isolated farmsteads. Despite the field enlargement and loss of hedgerows resulting from intensive farming, the area has a strongly rural character, with a sense of tranquillity and remoteness and few detracting features.

The value of this LCA is medium due to field amalgamation and hedgerow loss from agricultural intensification having diminished scenic quality and traditional landscape character.

Clayton Historic Rolling Farmland



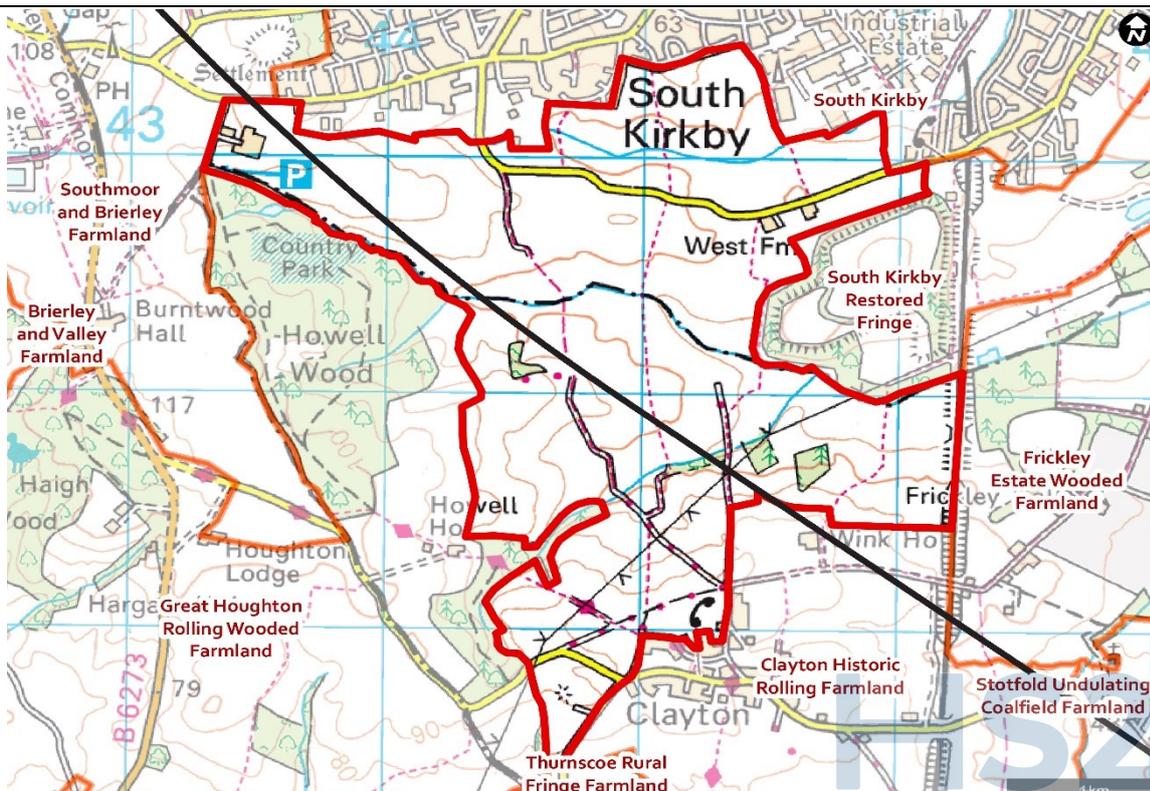
The first image shows the gently rolling arable fields which characterises much of the LCA. The second image shows historic stone built buildings in Clayton village.



The Clayton Historic Rolling Farmland LCA is a gently rolling rural area between Thurnscoe and South Kirkby. Farmland across much of the LCA is arable with medium to very large-scale rectilinear fields bounded by hedgerows, which are typically fragmented and afford long views across the farmland to the south. There is little settlement other than the historic agricultural village of Clayton, which extends along two sides of a small steep-sided and undeveloped valley. A conservation area encloses much of the village and the immediately surrounding area of small, well-treed irregular pastures. Beyond these to the south of the village, a distinctive pattern of long fields often with slightly sinuous boundaries preserves the outline of a post-medieval strip enclosure field system, while north of the village, a relic historic field pattern of medium sized, squarer fields results from parliamentary enclosure of the remnants of common fields. The area has retained its rural character and is within an ASLV.

The value of this LCA is medium-high which is due to the landscape in and around Clayton village being historic and scenic in character.

South Kirkby Farmland



The image shows the gently rolling arable farmland north of Broad Lane and the detracting influence of large pylons on the skyline.



The South Kirkby Farmland LCA is a gently rolling landscape of large-scale open arable farmland, which is intensively farmed and has experienced field amalgamation and hedgerow loss. Woodland cover is restricted to some small plantation woodlands such as Sheepwash Plantation and linear tree belts along the watercourses. The presence of blocks of woodlands in the surrounding LCAs imparts a more wooded character to the eastern and western edges of the LCA. The area has very few roads and settlement is limited to some isolated farms in the north. Several PRoW cross the farmland including the Barnsley Boundary Walk. While much of the LCA has a rural character and is identified as an ASLV, in the north of the LCA, the influence of South Kirkby imparts a more urban fringe character with horse paddocks, allotments, fragmented or absent hedgerows and roadside fly tipping. Overall, this is an area of remnant farmland in a landscape, which was extensively altered by coal mining but has been restored to intensive agricultural use.

The value of this LCA is medium as the quality of the landscape is variable, with a mix of more rural and tranquil farmland in the south and more urban fringe farmland closer to South Kirkby.

Visual baseline

- 11.3.13 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 viewpoint location maps (see Volume 2: LA13 Map Book, Map Series LV-03 and LV-04). 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 area), 2: Residential, 3: Recreational¹²³, 4: Transport, 5: Hotels/healthcare/education and 6: Employment (none within this area).
- 11.3.14 Views of the Proposed Scheme within the area would generally be gained from public highways, PRoW, settlements, residential properties, and employment areas within up to 1km distant.
- 11.3.15 Occupiers of residential properties likely to be affected by the Proposed Scheme are located mainly around the edges of the large settlements of Conisbrough, Mexborough, Thurnscoe, South Kirkby and South Elmsall as well as within the villages and hamlets. Residents are also found at the many dispersed properties and farmsteads.
- 11.3.16 Views from settlement edges are typically filtered and framed by intervening garden and field boundary vegetation but there are some locations, for example around the northern edge of Mexborough, where there are long northerly views out across the open low lying farmland within the Dearne valley.

¹²³ 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

- 11.3.17 A range of recreational visual receptors are found at the various country parks and golf clubs, Dearne Valley Outdoor Recreation Centre and at the various public open spaces within the valleys of the Rivers Don and Dearne. The PRow network includes many footpaths, bridleways and cycle paths including the Trans Pennine Trail, Barnsley Boundary Walk and Dearne Way. Views from the PRow network are variable depending on the local landscape and in many locations, are partially screened by landform or by hedgerows and trees. Views experienced by recreational users at elevated locations, for example from footpaths along the edge of the limestone plateau are longer and more panoramic.
- 11.3.18 Key transport receptors within the Ravenfield to Clayton area include users of A630 Doncaster/Sheffield Road/High Road, Denaby Lane, A6023 Low Road/Doncaster Road, Pastures Road, Ludwell Hill, A635 Barnsley Road, Red Hill Lane, Stotfold Road and Church Field Road. These roads pass through the rolling farmland comprising pastures and arable fields. Variations in landform, together with hedgerows and field trees provide a degree of filtering and framing of views.

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 would be visible from many locations and would have the potential to give rise to significant temporary effects that cannot practicably be mitigated. Such effects are temporary and would 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 would take place, including the presence 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. It is currently anticipated that the peak civil engineering stage in this area would be undertaken between the end of 2024 and the end of 2030. 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 Measures that have been incorporated into Sections 12 and 14 of the draft Code of Construction Practice (CoCP)¹²⁴ 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

¹²⁴ Supporting document: Draft Code of Construction Practice

existing trees in accordance with BS 5837: Trees in relation to design, demolition and construction¹²⁵;

- 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;
- designing 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.

11.4.5 Implementation of these measures has been taken into account in the assessment of the construction effects.

Assessment of temporary impacts and effects

11.4.6 The most apparent changes to the landscape and to the views experienced by visual receptors during construction would relate to the presence of construction plant, compounds and soils and material storage and stockpiling. Key construction activities that would give rise to the most apparent changes to landscape and visual receptors are: the removal of existing landscape elements; including trees and hedgerows; construction of viaducts, cuttings and embankments; the closure and diversion of existing roads and PRoW; the presence of construction plant; and stockpiling of soils and materials. Other key changes include the construction of overbridges and underbridges, utility diversions; the presence of transfer nodes and pre-cast yards; and demolition of buildings and structures.

Landscape assessment

11.4.7 Based on the current design it is anticipated that the LCAs set out in

11.4.8 Table 27 would be significantly affected during construction of the Proposed Scheme.

Table 27: Summary description and assessment of effects on LCAs

Micklebring Farmland	Medium susceptibility and sensitivity
<p>Susceptibility to change: The small-scale rolling landform, plentiful tree cover, level of tranquillity and rural qualities have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Much of this relatively small LCA which is designated as an ASLV would be directly or indirectly affected by construction activity associated with the Bramley North cutting and Ravenfield embankment, and associated earth moving equipment and material stockpiles. The nature and scale of the works would substantially alter the rural landscape with removal of trees and hedgerows, changes to the pattern of small to medium sized irregular fields and changes to the rolling landform. Removal of a section of woodland along the valley of Firsby Brook would alter the appearance and character of this minor stream valley, which forms the northern boundary of the LCA. The tranquillity of the wider landscape would be diminished by movement of construction vehicles and noise.</p>	<p>Level of effect: Major adverse (significant)</p>

¹²⁵ BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations, 2012, British Standard

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<p>Construction of the Proposed Scheme would therefore result in a high magnitude of change and major adverse effect.</p>	
<p>Conisbrough Parks Farmland</p>	<p>Medium-high susceptibility and sensitivity</p>
<p>Susceptibility to change: The complex undulating landform, small stream valleys, village of Hooton Roberts and the scenic quality of the farmland have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Construction activity associated with a series of embankments and cuttings and the A630 Doncaster Road overbridge would affect a central swathe of this large LCA, much of which is designated as an ASLV. The nature and scale of the works and presence of earth moving equipment and material stockpiles would substantially alter the character of the farmland with removal of trees and hedgerows, loss of field pattern and large-scale changes to the complex undulating landform. The presence of a construction compound and transfer node would introduce further disturbance into the mostly tranquil and scenic rural landscape. Although construction activity would be prominent in the central part of this LCA, much of the western and eastern parts would be unaffected.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Mexborough Settlement</p>	<p>Medium susceptibility and sensitivity</p>
<p>Susceptibility to change: From a landscape perspective, the new residential housing areas on the eastern edge of Mexborough are replicable elsewhere and therefore have a medium susceptibility to change arising from the Proposed Scheme.</p> <p>The eastern edge of this LCA would be directly affected by construction activity associated with the River Don viaduct and the Mexborough cutting. The nature and scale of the works including the presence of construction compounds and material stockpiles would substantially alter the appearance and character of the settlement around Comelybank Drive, and between the A6023 Doncaster Road and Pastures Court where a number of properties would be demolished. Construction of the cutting would require substantial earth moving in the area of open greenspace between Clayfield Avenue and the Pastures Road development, resulting in a complete alteration of the character of this area. The landscape around Mexborough Castle would be affected by visual and noise disturbance, while cranes used for construction of the River Don viaduct would be prominent skyline features. Although the construction activity would be prominent around the eastern edge of the Mexborough, much of the town would be unaffected</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>High Melton and Barnburgh Scarp Slope Farmland</p>	<p>High susceptibility and sensitivity</p>
<p>Susceptibility to change: The undulating and rolling landform, deciduous woodland, pattern of small to medium sized fields and scenic and rural qualities of the landscape have a high susceptibility to change arising from the Proposed Scheme. Barnburgh Cliff is particularly vulnerable to landform change and loss of vegetation.</p> <p>A central swathe of this relatively large LCA would be directly affected by construction activity associated with the River Dearne viaduct, Barnburgh embankment and Hickleton cutting. This and the presence of a construction compound, earth moving equipment and material stockpiles would substantially change the distinctive and historic landscape in terms of alterations to the complex undulating and rolling landform, severance of the patchwork of irregular fields and loss of scenic quality. Cranes used for construction of the River Don viaduct would change the rural skyline character. The visual disturbance and noise from the construction activities would reduce the tranquillity this area currently experiences and which contributes to much of the area being designated as an ASLV. The construction activity would be prominent between Ludwell Hill and</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>Barnburgh Cliff where the Hickleton cutting crosses the limestone escarpment, but much of the rest of the LCA would be unaffected.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	
<p>Hickleton Limestone Plateau Farmland</p>	<p>Medium-high susceptibility and sensitivity</p>
<p>Susceptibility to change: The historic association with Hickleton Hall, mature trees, openness and expansive views, remote and tranquil qualities and strongly rural sense of place have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Construction activity associated with the large Hickleton cutting and A635 Barnsley Road overbridge would affect much of this relatively small LCA which forms part of the wider landscape setting of the village and parkland of Hickleton (in the adjoining LCA) and is designated as an ASLV. These activities combined with the presence of a construction compound, transfer node, earth moving equipment and material stockpiles would substantially alter the key characteristics of the LCA in terms of loss of scenic quality and foreshortening of long distance views across the open plateau. Away from the A635 Barnsley Road, the tranquillity of the wider landscape would be reduced through the introduction of noise and visual disturbance caused by movement of construction vehicles. The removal of a section of the linear tree belt, which follows the A635 Barnsley Road east of Hickleton, would also be noticeable.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Hickleton, Bilham and Brodsworth Estate Farmland</p>	<p>High susceptibility and sensitivity</p>
<p>Susceptibility to change: The rolling landform, historic parkland landscapes, tree and woodland cover, scenic quality and strongly rural sense of place have a medium-high susceptibility to change arising from the Proposed Scheme. Bilham Park and the listed structure known as 'The Belvedere' Grade II listed summer house is particularly vulnerable to severance and loss of landscape setting.</p> <p>Construction activity associated with the large Hickleton cutting would bisect this linear LCA, which is part of a wider historic landscape that is designated as an ASLV. While The Belvedere would be retained, the landscape around it would be directly affected through loss of woodland and substantial landform changes. The presence of construction plant and material stockpiles would also alter the perceptual characteristics of the open farmland, with a reduction in scenic quality and severance of the 'pleasure circuit' and the historic link with Bilham House Farm and Bilham Park. Construction activity would be very intense around the Belvedere and the western edge of Bilham Park but much of the remainder of the LCA including the Hickleton and Brodsworth Estates would be largely unaffected.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Hooton Pagnell Estate Farmland</p>	<p>High susceptibility and sensitivity</p>
<p>Susceptibility to change: The rolling landform, historic settlement, rectilinear field pattern and highly scenic qualities of the rural landscape have a high susceptibility to change arising from the Proposed Scheme. The wooded limestone ridgeline and Watchley Crags are particularly vulnerable to severance and changes to the landform.</p> <p>The southern edge of this LCA, which is designated as an ASLV, would be directly affected by construction activity associated with the Hickleton cutting. This would substantially alter the landform and character of the landscape around Watchley Crags and result in loss of a section of mature woodland along the ridgeline. The presence of associated construction plant and material stockpiles would alter the perceptual characteristics of the landscape through the introduction of noise and visual disturbance. Scenic quality would be reduced and the historic connection from Watchley Crags along the ridgeline to Hooton Pagnell, would be physically and visually severed. The scale and intensity of</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>the construction activity close to the prominent and distinctive Watchley Craggs would be very high but only a small proportion of the wider LCA would be affected.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	
<p>Stotfold Undulating Coalfield Farmland</p>	<p>Medium susceptibility and sensitivity</p>
<p>Susceptibility to change: The linear woodlands, hedgerows, sense of remoteness and tranquillity and strongly rural quality of the farmland has a medium susceptibility to change arising from the Proposed Scheme.</p> <p>The northern part of this LCA which is designated as an ASLV would be directly affected by construction activity associated with the Thurnscoe embankment and Frickley viaduct. This activity and the presence of an associated construction compound, earth moving equipment and material stockpiles would be at variance with the existing undeveloped character of the farmland, while cranes used for constructing Frickley viaduct would be prominent and uncharacteristic skyline features. Agricultural buildings associated with Lodge Farm would be demolished, leaving only one isolated property within the LCA. The construction activity would be prominent between Watchley Craggs and Church Field Road, but much of the southern part of the LCA would be unaffected.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Clayton Historic Rolling Farmland</p>	<p>Medium-high susceptibility and sensitivity</p>
<p>Susceptibility to change: The gently rolling landform, tree cover, historic field patterns, level of tranquillity and rural qualities have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Much of this relatively small LCA would be directly or indirectly affected by large-scale and complex construction activity associated with three new railway lines (Hs2 mainline, Clayton Junction Down line spur and Clayton Junction Up line spur), Frickley viaduct, Clayton viaduct, auto-transformer station and associated embankments and cuttings. These, combined with the removal of mature trees and hedgerows and dissection of the medium to large-scale pattern of arable fields, would substantially alter the character of the landscape around the village of Clayton. There would be a loss of scenic quality across much of the LCA and an increased sense of severance caused by construction of three new railway lines and two viaducts. The tranquil setting of the farmland would be reduced through the introduction of noise and visual disturbance. The presence of cranes for constructing the Frickley and Clayton viaducts would also affect skyline character.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>South Kirkby Farmland</p>	<p>Medium susceptibility and sensitivity</p>
<p>Susceptibility to change: The gently rolling landform, remnant hedgerows, mature tree belts and rural character have a medium susceptibility to change arising from the Proposed Scheme.</p> <p>Construction activity associated with the Clayton North embankment and Howell Wood cutting in the South Kirkby to Sharlston Common area (LA14) would affect a central swathe of this LCA. Despite proximity to South Kirkby and to some large areas of reclaimed former colliery land, the rural landscape within the LCA is largely intact, with much of it designated as an ASLV. The construction activity and presence of construction plant and material stockpiles would substantially change the rural character through alterations to the gently rolling landform, fragmentation of the arable farmland, and loss of sections of mature tree belts near Sheepwash Plantation and Howell Wood. The tranquillity this area currently experiences would also be reduced through the presence of construction</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>plant and material stockpiles. The impacts on the central part of the LCA would be high, but much of the wider LCA would be unaffected.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.</p>	
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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, would be in leaf. The assessment does not include assessment of night time visual effects, although where general night time visual effects can be substantiated they are discussed in this section.
- 11.4.10 Where a viewpoint represents multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with lower sensitivity would be lower than those reported.
- 11.4.11 Potential visual impacts arising from additional lighting at night during construction within the area may arise from continuous working and/or overnight working. Night-time surveys will be undertaken to inform the assessment in the formal ES.
- 11.4.12 Table 28 describes the construction phase potentially significant visual effects based on the current design of the Proposed Scheme. Viewpoint locations are shown in Map Series LV-03 in the Volume 2: LA13 Map Book

Table 28: Construction phase potentially significant effects

<p>View west from a PRoW in farmland close to Conisbrough Grange Farm (VP 407.02.006) (Map Number LV-03-407b)</p> <p>Occupants of nearby Conisbrough Grange Farm and users of the bridleway would experience a substantial change to middle distance views resulting from construction of Bramley North cutting. The rural outlook across gently rolling arable fields with hedgerows and hedgerow trees would be also affected by the presence of a satellite compound and by construction of Common Lane overbridge in the Ulley to Bramley area (LA12). Loss of vegetation along the disused railway line south of Conisbrough Grange Farm would be noticeable as would movement of vehicles transporting material through what is currently a tranquil area despite proximity to the M18. Although there would be some filtering of views by remaining vegetation along the disused railway line and the occasional hedgerow trees, the presence of large-scale construction activity would reduce scenic quality, although it would be seen in the context of some large pylons.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>High sensitivity receptors</p> <p>Level of effect: Moderate adverse (significant)</p>
<p>View from Back Lane on the southern edge of Micklebring (VP 407.02.008) (Map Number LV-03-407b)</p> <p>Residents on the southern edge of Micklebring and users of Back Lane would have long distance slightly elevated westerly and south-westerly panoramic views towards construction activity associated with Bramley North cutting and Common Lane overbridge. The presence of Common Lane overbridge satellite compound, earth moving equipment and material stockpiles would also change the character of the view. Loss of vegetation along the disused railway line would be noticeable, particularly from Back Lane. The reduction in scenic quality would affect much of the</p>	<p>Medium-high sensitivity receptors</p> <p>Level of effect: Moderate adverse (significant)</p>

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<p>view but the overall effect would be lessened due to the partial screening by intervening trees and roadside vegetation. The construction activity would also be seen in the context of the M18, passing traffic, and overhead power lines.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	
<p>Views west from PRoW in Conisbrough Parks (VPs 408.03.002, 408.03.007, 408.03.008 and 408.03.009) (Map Number LV-03-408)</p>	<p>High sensitivity receptors</p>
<p>Users of the footpath, bridleway and Park Lane would have middle to long distance elevated views of construction activity associated with a series of cuttings and embankments. Views of gently rolling, arable farmland would be replaced by large-scale construction and associated earth moving equipment and material stockpiles resulting in a reduction in scenic quality. The construction of an accommodation underbridge and presence of construction compounds would also intrude on views. Loss of mature trees, hedgerows and vegetation along Firsby Brook would be noticeable. Long views towards Ravenfield on the horizon to the west would be interrupted.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View west from a PRoW on Beacon Hill (VP 408.03.004) (Map Number LV-03-408)</p>	<p>High sensitivity receptor</p>
<p>Users of the footpath and visitors to Beacon Hill would experience a substantial alteration to long distance panoramic and elevated rural views due to construction of a series of cuttings and embankments and associated earth moving equipment and material stockpiles. The current outlook across gently rolling farmland towards Firsby Reservoir and Ravenfield Park and distant views of Ravenfield and Bramley on the skyline would be replaced by views of large-scale construction.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View east from a PRoW in farmland close to Firsby Hall Farm (High sensitivity receptors) (VP 408.02.005)</p>	<p>High sensitivity receptors</p>
<p>Occupants of Firsby Hall Farm and users of the bridleway would have extensive near distance views of construction activity associated with Ravenfield cutting and Conisbrough Parks embankment. The outlook across gently undulating and relatively open arable fields would be substantially altered and views towards the rolling farmland of Conisbrough Parks towards Clifton and Beacon Hill would be interrupted.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views east from residences along the A630 Doncaster/Sheffield Road near Hooton Roberts (VPs 409.02.001, 409.02.002 and 409.03.003) (Map Number LV-03-409)</p>	<p>High sensitivity receptors</p>
<p>Residents on the eastern edge of Hooton Roberts, occupants of Hill Top Farm and users of the footpath and the A630 Doncaster/ Sheffield Road would experience a substantial alteration to existing views across the well-wooded arable farmland due to construction activity associated with Hooton Roberts cutting, Hooton Roberts embankment and the A630 Doncaster Road overbridge. The current outlook across well-wooded arable farmland would be replaced by views of large-scale construction.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View east from a PRoW in farmland near Grange Farm (VP 409.02.006) (Map Number LV-03-409)</p>	<p>Medium-high sensitivity receptors</p>
<p>Occupants of Grange Farm and users of the bridleway would have middle and long distance elevated views of construction activity associated with Hooton Roberts embankment, Denaby auto-transformer station, and Old Denaby cutting. There would be large-scale activity and movement of material which together with the presence of material stockpiles would substantially alter the current</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>outlook across large gently rolling and open arable fields with low hedgerows. More distant views towards Conisbrough on the skyline would also be interrupted by the construction activity.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	
<p>View south and west from a PRoW in farmland near Denaby Main (VP 409.03.007) (Map Number LV-03-409)</p> <p>Users of the footpath would have extensive middle distance views of construction activity associated with Old Denaby cutting and oblique long distance southerly views of construction activity associated with the northern end of the Hooton Roberts embankment. The removal of a section of Denaby Wood to the north would be noticeable. The current outlook across large, gently undulating and open arable fields with low hedgerows would be substantially altered.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Medium-high sensitivity receptors</p> <p>Level of effect: Major adverse (significant)</p>
<p>Views north-west from residences, a PRoW and North Cliff Park in Conisbrough (VPs 409.02.008 and 409.02.009) (Map Number LV-03-409)</p> <p>Residents on the northern edge of Conisbrough and users of North Cliff Park and the footpath would have elevated middle distance views of construction activity associated with Old Denaby cutting, River Don viaduct and Mexborough cutting. The construction activity would substantially change the outlook across Denaby Main and the Conisbrough Parks farmland. There would also be distant northerly views towards construction of the River Dearne viaduct and Hickleton cutting on the skyline where loss of woodland at Barnburgh Cliff would be noticeable.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>High sensitivity receptors</p> <p>Level of effect: Major adverse (significant)</p>
<p>View west from Pitman Road near Denaby Main (VP 410.02.002) (Map Number LV-03-410)</p> <p>Residents on the edge of Denaby Main and users of Pitman Road would have elevated, middle to long distance views of construction activity associated with Old Denaby cutting and River Don viaduct. Cranes used to construct the River Don viaduct would affect skyline views. Earth moving equipment, material stockpiles and a construction compound would also intrude on views, while removal of buildings within Denaby Main Industrial Estate would be noticeable. The construction activity would be partially screened by the intervening built development, trees and roadside vegetation, and it would also be seen in the context of the remaining warehouses on Denaby Main Industrial Estate, which would make it appear less uncharacteristic and reduce its overall effect on the view.</p> <p>Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Medium-high sensitivity receptors</p> <p>Level of effect: Moderate adverse (significant)</p>
<p>Views east from eastern edge of Mexborough near Comelybank Drive (VPs 410.02.006, 410.02.007, 410.02.005 and 410.02.009) (Map Number LV-03-410)</p> <p>Residents on the eastern edge of Mexborough and visitors to Mexborough Castle would have close to middle distance views of construction activity associated with the River Don viaduct which would include demolition of a number of residential and commercial properties and loss of open greenspace between Clayfield Avenue and Pastures Road. The construction activities, including the presence of cranes on the skyline, would substantially change the current outlook and interrupt longer views towards woodland in the River Don valley.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>High sensitivity receptors</p> <p>Level of effect: Major adverse (significant)</p>

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<p>Views east from PRoW on eastern edge of Mexborough (VP 410.02.010) (Map Number LV-03-410)</p>	<p>High sensitivity receptors</p>
<p>Residents on the eastern edge of Mexborough and users of recreational footpaths would experience a substantial alteration to existing near distance open views across gently rolling arable farmland due to the large-scale construction activity associated with Mexborough cutting and Mexborough embankment. Longer views towards the wooded ground at the Ings and woodland in the River Dearne valley would also be interrupted. The construction activity would be visible across most of the view and would substantially alter the rural outlook from the northern edge and eastern edge of Mexborough.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View east from residences along Denaby Lane (VP 410.02.013)(Map Number LV-03-410)</p>	<p>Medium-high sensitivity receptors</p>
<p>Residents along Denaby Lane and users of Denaby Lane would have near to middle distance views of construction activity associated with Old Denaby embankment and River Don viaduct. The construction activity would substantially alter the current outlook across arable fields and pastures while cranes to construct the viaduct would be visible on the skyline.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views from residences, the Trans Pennine Trail and Dearne Way in the Dearne valley (VPs 410.03.011, 410.02.012, 411.03.001 and 411.03.005) (Map Number LV-03-411)</p>	<p>High sensitivity receptors</p>
<p>Residents, users of the Trans Pennine Trail, Dearne Way, other recreational footpaths and road users within the Dearne valley would experience a substantial alteration to existing near to middle distance views across the valley due to construction activity associated with Mexborough embankment, River Dearne viaduct and Barnburgh embankment. Longer views out from the valley would also be interrupted and cranes to construct the viaduct would be visible on the skyline.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View west from a PRoW at Barnburgh Grange (VP 411.02.004) (Map Number LV-03-411)</p>	<p>High sensitivity receptors</p>
<p>Occupants of Barnburgh Grange and the footpath would have extensive near distance views of construction activity associated with the River Dearne viaduct and Barnburgh embankment. The construction activity would interrupt the rural, relatively open views towards Harlington, Barnburgh and the wooded ridgeline of Barnburgh Cliff.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views from residences and a PRoW at Melton Mill Lane, Hangman Stone Road and Barnburgh Cliff (VP 412.03.009) (Map Number LV-03-411) and (VPs 412.03.009, 412.03.004 and 412.03.007) (Map Number LV-03-412)</p>	<p>High sensitivity receptors</p>
<p>Residents, road users and users of the footpath at Barnburgh Cliff would have elevated and panoramic near to middle distance views of construction activity associated with Barnburgh embankment, which would substantially change the outlook across rolling well-wooded arable farmland towards Mexborough, Harlington and Barnburgh. Although the construction activity would not always be seen at close range, it would be visible across much of the panoramic views towards Barnburgh and Harlington.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>

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<p>Views west from farmland east of Barnburgh and Hickleton (VPs 412.03.003, 411.02.007, 412.02.001, 412.02.002, 412.2.010 and 412.02.006, 412.03.008) (Map Number LV-03-412) and (VPs 413.03.001, 413.02.002, 413.04.003 and 413.04.004) (Map Number LV-03-413)</p>	<p>High sensitivity receptors</p>
<p>Residents, users of the recreational footpaths and bridleways and road users on the eastern edge of Barnburgh and Hickleton would experience a substantial alteration to the near to middle distance views across undulating and gently rolling farmland due to construction activity associated with the Barnburgh embankment, Harlington auto-transformer station, and Hickleton cutting. The rural outlook across arable fields and pastures with plentiful trees would be replaced by views of large-scale construction.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View west from a PRoW in farmland near Bilham Lane (VP413.03.006) (Map Number LV-03-413)</p>	<p>High sensitivity receptors</p>
<p>Users of the footpath would experience a substantial alteration to the current rural outlook across an open arable field towards Shrog's Plantation and the managed landscape of Hickleton Golf Club due to construction activity associated with the large Hickleton cutting in the near to middle distance. Loss of existing landscape features, including hedgerows and an area of trees within Summer Plantation would be apparent.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View west from Bilham House Farm and Bilham Lane (VP413.02.007) (Map Number LV-03-413)</p>	<p>High sensitivity receptors</p>
<p>Occupants of Bilham House Farm and users of Bilham Lane would have slightly elevated near to middle distance views of construction activity associated with the northern section of Hickleton cutting. The rural outlook across gently rolling arable fields and pastures towards the distinctive wooded ridgeline of Watchley Crag would be replaced by large-scale construction. Loss of existing landscape features, including hedgerows and woodland at Watchley Crag would be apparent.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views south-west from residences, All Saints Church in Frickley and a PRoW in Frickley (VPs 415.03.003 and 415.02.004) (Map Number LV-03-415)</p>	<p>High sensitivity receptors</p>
<p>Occupants at Lodge Farm and Home Farm, visitors to All Saints Church and users of the bridleway would experience a substantial alteration to existing near distance views across gently rolling arable fields with hedgerows and plentiful hedgerow trees due to construction activity associated with Frickley viaduct, Thurnscoe embankment and Clayton South embankment.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views east from residences and a PRoW on the edge of Clayton (VPs 415.02.002, 415.02.014 and 415.02.013) (Map Number LV-03-415)</p>	<p>High sensitivity receptors</p>
<p>Residents and users of the footpath would have elevated middle distance views of construction activity associated with Clayton cutting and Clayton viaduct. The current rural outlook across medium to large-scale arable fields bounded by hedgerows and hedgerow trees would be replaced by large-scale construction. Loss of a section of riparian woodland along Frickley Beck would be apparent.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>

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<p>Views east from PRow at lanes at Clayton Common (VPs 415.03.005, 415.03.006 and 415.03.008) (Map Number LV-03-415)</p>	<p>High sensitivity receptors</p>
<p>Users of recreational footpaths and lanes on the edge of Clayton and Common Lane would experience a substantial alteration to existing near to middle distance views across gently rolling arable fields and pastures with a high proportion of mature trees and woodland due to the complex and extensive construction activity for a series of cuttings and embankments associated with the Sheffield Northern spur. Loss of vegetation, including hedgerows, hedgerow trees and a section of riparian woodland along an unnamed tributary of Howell Beck would be apparent.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View west from a PRow in farmland near Mushroom Plantation (VP 415.03.009) (Map Number LV-03-415)</p>	<p>High sensitivity receptors</p>
<p>Users of the footpath would have middle distance views of construction activity associated with Clayton viaduct, Clayton cutting and Clayton North embankment, which would be seen on the skyline, which would increase its prominence. Loss of trees from Sheepwash Plantation and riparian woodland from an unnamed watercourse to the west would be noticeable.</p> <p>Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>

Other mitigation measures

- 11.4.13 To further 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 would 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

- 11.4.14 The temporary residual significant effects during construction remain as described above. These effects would be temporary and reversible in nature lasting only for the duration of the construction works. These residual effects would generally arise from the widespread presence of construction activity and construction plant within the landscape and viewed by surrounding residents, and users of PRow and roads within the study area.
- 11.4.15 The significant effects that would remain after implementation of construction phase mitigation are summarised below:
- major adverse effects in relation to three LCAs;
 - moderate adverse effects in relation to seven LCAs;
 - major adverse effects at twenty-four residential viewpoint locations;
 - major adverse effects at sixteen recreational viewpoint locations;
 - moderate adverse effects at four residential viewpoint locations;
 - moderate adverse effects at four recreational viewpoint locations; and

- major adverse effects two transport viewpoint locations.

11.4.16 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 to help achieve earlier landscape and visual integration.

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.

Avoidance and mitigation measures

11.5.2 The operational assessment of impacts and effects is based on year 1 (2033) and year 15 (2048) of the Proposed Scheme, with Year 30 (2063) to be reported in the formal ES. A process of iterative design and assessment has been employed, and is ongoing, to avoid or reduce adverse effects during the operation of the Proposed Scheme. Measures that would be integrated into the design of the Proposed Scheme include:

- design of earthworks to tie the engineering earthworks for embankments (such as the Hooton Roberts embankment and Thurnscoe embankment) and cuttings (such as the Hickleton cutting) into their wider landscape context and to mitigate views of structures and overhead line equipment from sensitive receptors, where reasonably practicable. Earthworks design also takes account of the relationship to surrounding land uses and management, such as agriculture;
- compensatory woodland planting in areas of loss, using the same species composition and planting types (and appropriate planting density), such as woodland planting to compensate for the partial loss of Denaby Wood, and to provide habitat connectivity, enhanced landscape/green infrastructure connectivity, as well as connectivity of historic landscape features, where reasonably practicable, and to soften the appearance of the embankments and viaduct abutments;
- hedgerow replacement and restoration in areas of loss to restore habitat connectivity and landscape pattern, where reasonably practicable, and using an appropriate palette of hedgerow types and species to tie the Proposed Scheme mitigation into the wider landscape character; and
- compensation for loss of field ponds with new wetlands, ecological ponds and biodiversity wetland features and wetland enhancement such as west of Firsby Hall Farm.

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, cuttings, overbridges, underbridges, road and PRow realignments and diversions. Other aspects include the presence of overhead line equipment, noise barriers, and the presence of moving trains. Landscape bunds

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and new planting would also influence how the Proposed Scheme affects landscape and visual receptors.

Landscape assessment

11.5.4 Based on the current design, it is currently anticipated that the LCAs described in Table 29 would be significantly affected during operation of the Proposed Scheme.

Table 29: Operation phase significant landscape effects

Micklebring Farmland	Medium-high susceptibility and sensitivity
<p>Susceptibility to change: The small-scale rolling landform, plentiful tree cover, level of tranquillity and rural qualities have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Year 1: The western part of the landscape within this LCA which is designated as an ASLV (despite the presence of pylons and the M18), would be directly affected by the Proposed Scheme through severance and large-scale changes to the rolling landform and pattern of irregular pastures. Pastures would be reduced in size, and hedgerows and some mature hedgerow trees permanently lost due to the introduction of Bramley North cutting and Ravenfield embankment. The embankment would also sever the small scale wooded landscape along Firsby Brook, a small stream that forms the northern boundary of the LCA. The operational railway and artificial landforms would be uncharacteristic landscape features which would reduce scenic quality and levels of tranquillity in the western part of the LCA. The scale and intensity of the construction activity close to the prominent and distinctive Watchley Crag would be very high but only a small proportion of the wider LCA would be affected.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.</p>	Level of effect: Moderate adverse (significant)
Year 15: The magnitude of change would reduce to non-significant by year 15.	Level of effect: (non-significant)
Mexborough Settlement	Medium susceptibility and sensitivity
<p>Susceptibility to change: From a landscape perspective, the new residential housing areas on the eastern edge of Mexborough are replicable elsewhere and therefore have a medium susceptibility to change arising from the Proposed Scheme.</p> <p>Year 1: The eastern edge of this LCA would be directly affected by the presence of the River Don viaduct and the Mexborough cutting. New housing around Comelybank Drive would be partially replaced by the tall viaduct structure, which would be a prominent and uncharacteristic feature that would permanently alter the existing landscape pattern through loss of residential properties and reduce the intervisibility between Clayfield Avenue and Pastures Road residential areas. It would also interrupt the longer views out across the Don valley from the higher ground which is a characteristic feature of this LCA. To the north of the viaduct Mexborough cutting would alter the local landform and character of the open greenspace between the Clayfield Avenue and Pastures Road housing areas. The Proposed Scheme would be at variance with existing townscape character along the eastern edge of Mexborough but much of the wider LCA would be unaffected.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.</p>	Level of effect: Moderate adverse (significant)
Year 15: The medium magnitude of change and moderate adverse effect would remain as landscape mitigation woodland planting around Mexborough cutting would provide some integration of the new landform but the River Don viaduct would remain a prominent landscape feature.	Level of effect: Moderate adverse (significant)

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High Melton and Barnburgh Scarp Slope Farmland	High susceptibility and sensitivity
<p>Susceptibility to change: The undulating and rolling landform, deciduous woodland, pattern of small to medium sized fields and scenic and rural qualities of the landscape have a high susceptibility to change arising from the Proposed Scheme. Barnburgh Cliff is particularly vulnerable to landform change and loss of vegetation.</p> <p>Year 1: The central part of this large LCA, most of which is designated as an ASLV, would be directly affected by the prominent River Dearne viaduct, Barnburgh embankment, Harlington auto-transformer station and southern end of Hickleton cutting. These would substantially alter the key characteristics of the LCA, including its undulating and rolling landform, patchwork of mostly small to medium sized arable fields and pastures and high scenic quality. The Barnburgh embankment would cut across the grain of the landscape and sever some of the small deciduous woodlands, while Hickleton cutting would bisect Barnburgh Cliff, a section of wooded Magnesian limestone escarpment. The eastern slope of Barnburgh embankment would be reduced and returned to agriculture, which would provide some landscape integration. The effects of the Proposed Scheme would be particularly prominent between Ludwell Hill and Barnburgh Cliff but much of the LCA would be unaffected.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15: The magnitude of change would reduce to medium and there would be a moderate adverse effect as the landscape and ecological mitigation woodland planting along the western embankment slope and Hickleton cutting would provide some integration of the new landform and infrastructure within the landscape, but Hickleton cutting would remain an uncharacteristic landform feature between Ludlow Hill and Barnburgh Cliff.</p>	<p>Level of effect: Moderate adverse (significant)</p>
Hickleton Limestone Plateau Farmland	Medium-high susceptibility and sensitivity
<p>Susceptibility to change: The historic association with Hickleton Hall, mature trees, openness and expansive views, remote and tranquil qualities and strongly rural sense of place have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Year 1: The western part of this LCA which forms part of the wider landscape setting of Hickleton Hall Registered Park and Garden (in the adjacent LCA) and is designated as an ASLV would be directly affected by the presence of the large Hickleton cutting and A635 Barnsley Road overbridge. The local landform would appear substantially altered and the aesthetic qualities of the landscape and sense of historic continuity would be reduced. Arable fields would be reduced in size, while some hedgerows and mature hedgerow trees would be permanently lost. Noise from passing trains would add to the noise of vehicles on the A635 Barnsley Road and further reduce the sense of tranquillity. The effects of the Proposed Scheme would be particularly noticeable around Hickleton Hall in the west, but the eastern part of the LCA would be unaffected.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15: The magnitude of change would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
Hickleton, Bilham and Brodsworth Estate Farmland	High susceptibility and sensitivity
<p>Susceptibility to change: The rolling landform, historic parkland landscapes, tree and woodland cover, scenic quality and strongly rural sense of place have a medium-high susceptibility to change arising from the Proposed Scheme. Bilham Park and the listed structure known as 'The Belvedere' is particularly vulnerable to severance and loss of landscape setting.</p> <p>Year 1: This linear LCA, which is designated as an ASLV, would be directly affected through severance of the landscape and the historic parklands and changes to the landform and vegetation cover. The large Hickleton</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>cutting would create a deep notch in the ridgeline which extends from Bilham Park to The Belvedere and forms part of an historic circuitous walk known as the 'pleasure circuit'. Arable fields and pastures would be reduced in size and woodland, hedgerows and mature trees would be permanently lost. Scenic quality would be reduced and noise from passing trains would reduce the sense of tranquillity across the wider LCA. The changes introduced by the Proposed Scheme would be focussed on the central part of the LCA where the magnitude of change would be substantial due to the effects on the valued characteristic of Bilham Park. The remainder of the LCA would be relatively unaffected.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.</p>	
<p>Year 15: The medium magnitude of change and moderate adverse effect would remain as the ecological mitigation woodland and hedgerow planting around the retained Belvedere would provide some integration of the Hickleton cutting into the landscape but due to its scale the cutting would remain a prominent and uncharacteristic feature causing severance of the ridgeline and woodland.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Hooton Pagnell Estate Farmland</p>	<p>High susceptibility and sensitivity</p>
<p>Susceptibility to change: The rolling landform, wooded limestone ridge, historic settlement, rectilinear field pattern and highly scenic qualities of the rural landscape are designated as an ASLV and have a high susceptibility to change arising from the Proposed Scheme. The wooded ridgeline and Watchley Crag are particularly vulnerable to severance and changes to the landform.</p> <p>Year 1: The large Hickleton cutting would physically, visually and perceptually sever the sandstone outcrops of Watchley Crag from the wooded Magnesian limestone ridgeline which extends from the Crag north-east to Hooton Pagnell. Scenic quality would be eroded due to the presence of the new infrastructure and artificial landform, while intermittent disturbance from passing trains would reduce the tranquillity of the farmland. The changes introduced by the Proposed Scheme would be focussed on the southern corner of the LCA where the magnitude of change would be substantial due to the effects on the landform and tree cover of the limestone ridge and Watchley Crag, which is a popular local viewpoint. The remainder of the LCA would be relatively unaffected.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15: The ecological landscape mitigation woodland and hedgerow planting would provide some integration of Hickleton cutting into the landscape but due to its scale Hickleton cutting would remain a prominent and uncharacteristic feature causing severance of the wooded ridgeline close to Watchley Crag. The medium magnitude of change and moderate adverse effect would remain.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Clayton Historic Rolling Farmland</p>	<p>Medium-high susceptibility and sensitivity</p>
<p>Susceptibility to change: The gently rolling landform, tree cover, historic field patterns, level of tranquillity and rural qualities have a medium-high susceptibility to change arising from the Proposed Scheme.</p> <p>Year 1: The LCA would be directly affected through severance of the landscape and changes to the landform and vegetation cover with consequent effects on scenic quality. The introduction of three new railway lines (Hs2 main line, Sheffield Northern Spur (northbound) and Sheffield Northern Spur (southbound), Frickley viaduct, Clayton viaduct, Clayton auto-transformer station and associated embankments and cuttings would physically, visually and perceptually sever the landscape from the historic Frickley Estate to the north-east. The landform and field pattern would be substantially changed in an area, which already displays a decline in traditional farming practices, with field amalgamation and loss of hedgerows and mature hedgerow trees. There would also be a loss of tranquillity particularly to the north of the village of Clayton where the three railway lines and passing trains would be in proximity to each other. The Proposed Scheme would affect much of the LCA and be at variance with existing landscape character, diminishing the integrity of valued characteristics.</p>	<p>Level of effect: Major adverse (significant)</p>

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Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of change and major adverse effect.	
Year 15: The magnitude of change would reduce to medium and there would be a moderate adverse effect as the maturing landscape and ecological mitigation woodland and hedgerow planting would provide some visual integration of Frickley and Clayton viaducts, embankments, cuttings and associated railway infrastructure within the landscape but the structures would remain uncharacteristic landscape features.	Level of effect: Moderate adverse (significant)

Visual assessment

Introduction

- 11.5.5 The following section describes the likely significant effects on visual receptors during operation year 1 and year 15. Effects at operation year 30 will be reported in the formal ES. 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, would be in leaf.
- 11.5.6 Where a viewpoint represents multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with a lower sensitivity would be lower than those reported.
- 11.5.7 Identifies the locations where the operation of the Proposed Scheme would potentially result in significant effects. Viewpoint locations are shown in Map Series LV-04 in the Volume 2: LA13 Map Book.

Table 30: Operation phase significant visual effects

Views west from Park Lane and PRow in Conisbrough Parks (VP 408.03.002, 408.03.007 and VP 408.03.009) (Map Number LV-04-408)	Medium sensitivity receptors
<p>Year 1 – winter and summer:</p> <p>Users of a footpath and bridleway and road users would experience noticeable changes to middle and long distance elevated views due to the presence of a series of cuttings and embankments that would cut across the rolling landform and alter the landscape pattern through alterations to the size and shape of some of the arable fields. Moving trains and overhead line equipment would be intermittently visible particularly on Ravenfield embankment and Conisbrough Parks embankment where they would be partially seen against the skyline. Long distance views of Ravenfield on the horizon would be interrupted. In summer, views would be partially screened by the hedgerows along Park Lane and by mature field boundary trees, but the scale of the embankments would still noticeably change the view. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	Level of effect: Moderate adverse (significant)
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	Level of effect: (non-significant)
View west from a PRow on Beacon Hill (VP 408.03.004) (Map Number LV-04-408)	High sensitivity receptors
<p>Year 1 – winter and summer:</p> <p>Users of the footpath on Beacon Hill would experience noticeable changes to long distance panoramic and elevated views due to operation of the Proposed Scheme. A series of cuttings and embankments would be visible between Bramley cutting to the south and Old Denaby cutting to the north. These would cut across the gently rolling landform and alter the landscape pattern through a reduction in the</p>	Level of effect: Moderate adverse (significant)

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<p>size, and changes to the shape of some of the arable fields. Overhead line equipment and the movement of trains would also be apparent and create visual disturbance in what is a relatively tranquil scene. Although partially screened and filtered by intervening vegetation the Proposed Scheme would be intermittently visible across the full width of the view and would interrupt views towards Firsby Reservoir and Ravenfield Park and distant views of Ravenfield and Bramley on the skyline. Existing trees and hedgerows would provide some additional screening in summer, but the landscape and ecological mitigation woodland planting along the embankments and cuttings would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	
<p>Year 15 – summer:</p> <p>The mitigation woodland planting along the embankments and cuttings would be maturing and providing some visual integration but due to the elevation of this viewpoint the embankments and cuttings would still be visible and would contribute to a continuing reduction in scenic quality.</p> <p>The magnitude of visual change would remain medium and there would continue to be a moderate adverse effect.</p>	<p>Level of effect:</p> <p>Moderate adverse (significant)</p>
<p>View east from a PRoW in farmland close to Firsby Hall Farm (VP 408.02.005 and 408.03.008) (Map Number LV-04-408)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Firsby Hall Farm and users of the bridleway would experience a substantial alteration to near distance mostly open views across large, gently undulating and open arable fields due to the introduction of Conisbrough Parks embankment. Existing hedgerows would provide some screening in summer, but the embankment would remain prominent. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect:</p> <p>Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect:</p> <p>(non-significant)</p>
<p>View west from PRoW near Hilltop Farm and Firsby Lane (VP 409.02.001) (Map Number LV-04-409)</p>	<p>Medium-high sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Hill Top Farm and users of recreational bridleways and Firsby Lane would experience a marked change to the rural outlook across the large-scale gently rolling plateau landscape of arable fields with woodland. Hooton Roberts cutting and A630 Doncaster Road overbridge would be noticeable but the much of the effect would be due to the permanent loss of field boundary vegetation and a prominent area of woodland at the northern end of Hooton Cliff in the near distance. In summer, views would be more screened by the hedgerows along Park Lane and by the mature field boundary trees but the scale of the operational railway would still noticeably change the view. The ecological mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect:</p> <p>Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect:</p> <p>(non-significant)</p>

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<p>Views east from residences along the A630 Doncaster/Sheffield Road near Hooton Roberts (VP 409.02.002 and 409.03.003) (Map Number LV-04-409)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents on the eastern edge of Hooton Roberts and users of the footpath and the A630 Doncaster/ Sheffield Road would have near to middle distance elevated views of the large Hooton Roberts embankment which would be a prominent artificial landform in the large-scale rolling and well-treed arable farmland, where it would alter the landscape pattern through changes to the field size and shape. The permanent loss of field boundary vegetation and a section of woodland at the northern end of Hooton Cliff, foreshortening of views and presence of the A630 Doncaster Road overbridge would further alter the view. In summer, views would be more screened by hedgerows and field boundary trees, but the embankment and associated overhead line equipment and moving trains would still noticeably change the view. The ecological mitigation hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View east from a PRoW in farmland near Grange Farm (VP 409.02.006) (Map Number LV-04-409)</p>	<p>Medium-high sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Grange Farm and users of the bridleway would have middle and long distance elevated views of the large Hooton Roberts embankment, which would be a prominent artificial landform within the gently rolling arable farmland. More distant views towards Conisbrough would be interrupted by the embankment and the associated overhead line equipment and moving trains. Combined with the loss of hedgerows and mature hedgerow trees, the rural outlook would be substantially altered. In summer, existing hedgerows and hedgerow trees in full leaf would provide some screening, but the embankment would still be very noticeable. The ecological mitigation hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View west from a PRoW in farmland near Denaby Main (VP 409.03.007) (Map Number LV-04-409)</p>	<p>Medium-high sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the footpath would have middle distance views of the top of Old Denaby cutting and oblique long distance southerly views towards the northern end of Hooton Roberts embankment, which would be a prominent and uncharacteristic landform within the small-scale landscape of irregular pastures. The overhead line equipment would be visible above the top of the cutting slopes, although moving trains would be mostly screened from view. The new features combined with changes to the rolling landform would alter the rural outlook particularly to the south where the northern end of Hooton Roberts embankment. In summer, views of the Proposed Scheme would be more screened by the hedgerow adjacent to the footpath. The ecological mitigation hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View north-west from residences, a PRow and North Cliff Park in Conisbrough (409.02.008 and 409.02.009) (Map Number LV-04-409)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents on the northern edge of Conisbrough and users of North Cliff Park and the footpath would have long distance views towards Old Denaby cutting and longer more open views towards the River Don viaduct and Mexborough cutting. There would also be distant views of the River Dearne viaduct and Hickleton cutting on the skyline, where the landform changes would be very noticeable. Although seen at some distance and partially screened and filtered by intervening vegetation the Proposed Scheme would be intermittently visible across the full width of the view, which increases its overall effect. There is little vegetation to provide additional screening of views in summer and the ecological mitigation hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>Views from the eastern edge of Mexborough near Comelybank Drive (VP 410.02.006, 410.02.007, 410.02.005 and 410.02.009) (Map Number LV-04-410)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents on the eastern edge of Mexborough and visitors to Mexborough Castle would experience a substantial alteration to near to middle distance views of the town and River Don valley due to the presence of the River Don viaduct, which would be a prominent new townscape feature. This and the permanent loss of a number of residential and commercial properties would substantially change the current outlook across the east of the town and interrupt longer views across the River Don valley. In summer, views of the Proposed Scheme would be largely unchanged from the winter situation as there is little vegetation to provide additional screening.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due its proximity and size the River Don viaduct would remain a prominent feature.</p> <p>The magnitude of visual change would remain high and there would continue to be a major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>View west from a PRow at the Dearne valley viewing mound (VP 410.03.008) (Map Number LV-04-410)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the footpath and viewing mound would experience noticeable changes to long distance panoramic views due to the presence of the River Don viaduct, Mexborough cutting, River Dearne viaduct, Barnburgh embankment and Hickleton cutting. These structures and the associated overhead line equipment and movement of trains would be new uncharacteristic features in the view. In summer there would be additional screening and filtering of views by existing vegetation in full leaf. The ecological mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would therefore reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>Views east from residences and PRoW on eastern edge of Mexborough (VP 410.02. 010) (Map Number LV-04-410)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents and users of the recreational footpaths on the eastern edge of Mexborough would experience a substantial alteration to existing near distance views due to the introduction of the Mexborough cutting. The overhead line equipment and tops of moving trains would be visible at the northern end of the Mexborough cutting. The presence of the cutting would completely the view across the open green space between Clayfield Avenue and the Pastures Road development. In summer the views would remain largely unchanged as there is little vegetation to provide any additional screening. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View west from the Trans Pennine Trail on the River Dearne bridge at Denaby Ings (VP 410.03.011) (Map Number LV-04-410)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the Trans Pennine Trail would have mostly unobstructed panoramic views of the top of Mexborough cutting, Mexborough embankment with its associated noise barrier, and the River Dearne viaduct. The overhead line equipment and moving trains would be visible on the viaduct. The rural outlook across open gently rolling arable fields would be noticeably altered by the presence of the Proposed Scheme in the middle distance, while long distance views towards housing and trees on the hillside at Bolton Upon Dearne to the west would also be interrupted. There is little intervening vegetation to provide additional screening or filtering of views in summer and the ecological mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>The River Dearne viaduct would remain a clearly noticeable man-made feature within the rural landscape.</p> <p>The magnitude of visual change would remain medium and there would continue to be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>Views east from the Trans Pennine Trail/ Dearne Way and PRoW and Mill Lane in the Dearne valley (VP 410.02.012, 411.03.001 and 411.03.005) (Map Number LV-04-411)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the Trans Pennine Trail, Dearne Way, other recreational footpaths and Mill Lane would have near and middle distance views of the River Dearne viaduct with its associated overhead line equipment and passing trains. The viaduct would be a prominent and uncharacteristic feature within the rural low lying reclaimed valley landscape. Panoramic views across the open, relatively flat arable fields and wet grassland of the River Dearne valley would be substantially altered and the viaduct would interrupt long distance views to the well-wooded horizon above Denaby Ings Nature Reserve near High Melton. Other than at VP 411-03-005 which would have slightly more constrained views due to the presence of riparian vegetation, there is little intervening vegetation to provide additional screening or filtering of views in summer and the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>The River Dearne viaduct would continue to interrupt views across the rural Dearne valley and remain a prominent man-made feature.</p> <p>The magnitude of visual change would remain medium and there would continue to be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View east from residences along Denaby Lane (VP410.02.013) (Map Number LV-04-410)</p>	<p>Medium-high sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents along Denaby Lane and users of Denaby Lane would experience a substantial alteration to skyline views due to the presence of Old Denaby embankment and River Don viaduct. There is little intervening vegetation to provide additional screening or filtering of views in summer and the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>The landscape mitigation woodland planting would provide some screening and integration of the Old Denaby embankment and to a lesser extent the River Don viaduct, although the viaduct and its associated noise barrier would remain highly visible for a short section of the view above Denaby Lane and over Old Denaby Wetland LNR. There would remain a noticeable reduction in scenic quality compared to the current outlook.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View west from a PRoW at Barnburgh Grange (VP 411.02.004) (Map Number LV-04-411)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Barnburgh Grange and users of the footpath would experience a substantial alteration to the view due to the presence of the prominent River Dearne viaduct and Barnburgh embankment. Views from Barnburgh Grange would be particularly affected due to the property's elevation and proximity to the embankment. There is little existing vegetation to provide additional screening and filtering of views in summer and the landscape mitigation woodland would provide minimal screening or visual integration at this stage.</p>	<p>Level of effect: Major adverse (significant)</p>

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<p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	
<p>Year 15 – summer:</p> <p>The landscape mitigation woodland planting would provide some screening and integration of the Barnburgh embankment and to a lesser extent the River Dearne viaduct, although the overhead line equipment and movement of passing trains would still be noticeable on the viaduct, and in intermittent views above the establishing planting at the apex of Barnburgh embankment. There would remain a noticeable reduction in scenic quality compared to the current outlook.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View west from residences along Melton Mill Lane near High Melton (VP 411.02.006) (Map Number LV-04-411)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents and road users along Melton Mill Lane near High Melton would have middle distance elevated and open views of the River Dearne viaduct and the Barnburgh embankment, which would be prominent and uncharacteristic features within the large-scale sloping arable fields. Overhead line equipment and moving trains would also be very apparent. The eastern slope of the embankment would be reduced and the lower slopes returned to agriculture but in year 1 there would be a substantial alteration to the current outlook across open, gently undulating arable fields towards the edge of Mexborough and Harlington. There is little intervening vegetation to provide additional screening or filtering of views in summer other than an intermittent hedgerow and some small roadside trees and the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View west from Hangman Stone Road and PRoW (VP 412.04.009, 412.03.004 and 412.03.007) (Map Number LV-04-412)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of Hangman Stone Road and the footpath at Barnburgh Cliff would experience substantial alterations to middle distance elevated views across the rolling arable farmland due to the introduction of the large Barnburgh embankment. From VP 411.02.006 there would be additional long distance views of the River Dearne viaduct to the south. The roadside vegetation would provide some screening of views in summer but the landscape and ecological mitigation woodland and hedgerow would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 - summer:</p> <p>The Barnburgh embankment would become less apparent as the landscape and ecological mitigation woodland and hedgerow planting would partially screen views and provide some integration of the new landform, although overhead line equipment and passing trains would still be noticeable beyond the establishing planting at the apex of the embankment.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>View west from a PRoW close to St Helen’s Chapel (VP 412.03.003) (Map Number LV-04-412)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the footpath would experience a substantial alteration to existing near distance open and elevated views across the arable farmland due to the presence of the large Barnburgh embankment and its associated overhead line equipment and moving trains. In addition to loss of existing landscape features, including mature hedgerow trees and a block of woodland, the Barnburgh embankment would foreshorten views across the gently rolling arable fields, including more distance views of Barnburgh. Existing vegetation would provide some additional screening and filtering of views but the landscape and ecological mitigation woodland and hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>The landscape and ecological mitigation woodland and hedgerow planting would partially screen views and provide some integration of the new landform, but the Barnburgh embankment would still be prominent.</p> <p>The magnitude of visual change would remain high and there would continue to be a major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views east from residences, PRoW and roads on the eastern edge of Barnburgh (VPs 411.02.007, 412.02.001, 412.02.002, 412.02.010 and 412.03.006) (Map Number LV-04-412)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents and users of recreational footpaths and roads along the eastern edge of Barnburgh would experience a substantial alteration to existing open views across gently rolling well-treed arable fields and pastures towards Barnburgh Cliff and Melton Warren as a result of the introduction of the large Barnburgh embankment and its associated overhead line equipment and moving trains. In addition to loss of existing landscape features, including mature hedgerow trees and a block of woodland, the Barnburgh embankment would foreshorten views and completely alter the current rural outlook across gently rolling well-treed arable fields and pastures. In places, existing vegetation would provide some additional screening and filtering of views but the landscape and ecological mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 - summer:</p> <p>The magnitude of visual change would reduce to medium for residents, footpath and road users and there would be a moderate adverse effect (significant). Barnburgh embankment would become less apparent as the extensive landscape and ecological mitigation woodland planting along its western side would partially screen views and provide some visual integration of the embankment into the gently rolling landform, although the movement of passing trains and overhead line equipment would still be noticeable beyond the establishing planting at the top of the embankment. The outlook would become more wooded and enclosed in character but would remain rural in context.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View north-east from a PRoW at Barnburgh Cliff (VP 413.03.001) (Map Number LV-04-413)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the footpath would have near distance elevated views of the top of Hickleton cutting. The depth of the cutting would be such that the overhead line equipment and moving trains would not be visible in near distance views, although to the north there may be longer oblique views of the top of the</p>	<p>Level of effect: Moderate adverse (significant)</p>

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<p>cutting slopes and overhead line equipment. The new features in the view, combined with changes to the landform would alter the rural outlook from this viewpoint. There is no intervening vegetation to provide additional summer screening and landscape mitigation woodland and hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View east from Red Hill Lane near Hickleton Hall (VPs 413.02.002, 413.04.003 and 413.04.004) (Map Number LV-04-413)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Hickleton Hall and users of Hickleton Road and the A635 Barnsley Road would have near distance views of the landscape bund to the west of Hickleton cutting, the top of the Hickleton cutting and the A635 Barnsley Road realignment and associated new overbridge (although this would be only slightly above current ground level). From VP 413.02.002, views of the overhead line equipment and moving trains would be screened by the landscape bund. From VP 413.04.003 however, views along the A635 Barnsley Road would be substantially altered as the existing carriageway would be lost and the area planted. The realigned section of A635 Barnsley Road would pass through what is currently relatively flat pasture with trees. Over time, the Proposed Scheme would improve the outlook from these locations as views of passing traffic would be substantially reduced. In year 1, however, the realigned section of the A635 Barnsley Road and associated overbridge would be very noticeable. Depending on the viewpoint, some views would be screened by the existing mature parkland trees, particularly in summer when they are in full leaf but the landscape mitigation woodland and hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>
<p>View west from a PRow in farmland near Bilham House Farm (VP 413.03.006) (Map Number LV-04-413)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the footpath would have open, near to middle distance views of the top of Hickleton cutting and Bilham retaining wall in the open farmland between Hickleton and Bilham Park. The overhead line equipment may also be visible. The new features in the view, which would include long distance views of the A635 Barnsley Road overbridge, combined with changes to the landform, visual severance and permanent loss of existing landscape features including hedgerows and mature trees, would substantially change the rural outlook across an open arable field towards the managed landscape of Hickleton Golf Club. In summer, views of the Proposed Scheme would remain largely unchanged from the winter situation as there is little vegetation to provide additional summer screening. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15</p>	<p>Level of effect: (non-significant)</p>

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<p>View west from Bilham House Farm (VP413.02.007) (Map Number LV-04-413)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Bilham House Farm and users of Bilham Lane would have slightly elevated open, middle distance views of the northern part of Hickleton cutting. The loss of woodland and deep notch in the ridgeline at Watchley Crags would be very noticeable. Existing vegetation would provide some additional screening and filtering of views but the ecological mitigation hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Barnburgh embankment would become less apparent as the ecological mitigation hedgerow planting would partially screen views and visually integrate it into the landscape. The movement of passing trains and overhead line equipment would however still be noticeable, while the break in the woodland and ridgeline at Watchley Crags would remain very apparent. There would remain a noticeable reduction in scenic quality compared to the current outlook.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View south-west from residences, All Saint’s Church and a PRoW in Frickley (VPs 415.03.003 and 415.02.004) (Map Number LV-04-415)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Occupants of Lodge Farm and Home Farm, visitors to All Saints Church, Frickley and users of the bridleway would experience a substantial alteration to the current outlook across gently rolling pastures and arable farmland due to the presence of Frickley viaduct, Thurnscoe embankment and Clayton South embankment. In summer existing trees around All Saints Church would provide some screening and filtering of views but the viaduct would remain prominent. The landscape and ecological mitigation woodland and hedgerow planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Frickley viaduct, Thurnscoe embankment and Clayton South embankment would remain prominent features and continue to partially interrupt views. There would be an ongoing sense of visual severance with partial loss of long distance views and changes to skyline character. The landscape and ecological mitigation woodland and hedgerow planting would only partially screen views of the embankments and viaduct.</p> <p>The magnitude of visual change would remain high and there would continue to be a major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Views east from residences and a PRoW on the edge of Clayton (VPs 415.03.002, 415.02.014 and 415.02.013) (Map Number LV-04-415)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Residents on the edge of Clayton and users of the footpath would experience a substantial alteration to the rural views due to the presence of Clayton cutting and Clayton South embankment. Residents may also have distant views of the Frickley viaduct from their upper storeys. Existing hedgerows and hedgerow trees would provide some additional screening and filtering of views in summer but the new landform would remain prominent. The landscape and ecological mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>

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<p>Year 15 – summer:</p> <p>The Proposed Scheme would become less prominent by summer year 15 as the landscape and ecological mitigation woodland planting would partially screen views and provide some visual integration of Clayton cutting, Clayton viaduct and Clayton South embankment. The view would change from relatively open arable fields to one of developing woodland, but it would be rural in context. Clayton viaduct and Frickley viaduct would however remain partially visible above the trees in the distance.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Views east from PRoW and lanes at Clayton Common (VPs 415.03.005, 415.03.006 and 415.03.008) (Map Number LV-04-415)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of recreational footpaths and lanes on the edge of Clayton would experience a substantial alteration to existing near to middle distance views across gently rolling arable fields and pastures with a high proportion of mature trees and woodland due to the presence of Clayton cutting, Clayton North embankment and more distantly Clayton viaduct, which are associated with the Sheffield Northern Spur. Loss of vegetation, including hedgerows, hedgerow trees and a section of riparian woodland along an unnamed tributary of Howell Beck would be apparent. There is little existing vegetation to provide additional screening and filtering of views in summer and the landscape and ecological mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.</p>	<p>Level of effect: Major adverse (significant)</p>
<p>Year 15 – summer:</p> <p>The Proposed Scheme would become less prominent in the view by summer year 15 as the landscape and ecological mitigation woodland planting would partially screen views and provide some visual integration. The outlook would become more wooded in character, but it would remain rural in context. Clayton viaduct and Frickley viaduct would potentially remain visible above the trees in the distance.</p> <p>The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>View west from a PRoW in farmland near Mushroom Plantation (VP 415.03.009) (Map Number LV-04-415)</p>	<p>High sensitivity receptors</p>
<p>Year 1 – winter and summer:</p> <p>Users of the footpath would have middle distance elevated views of Clayton North embankment and Clayton viaduct, which would be prominent features that would be partially seen on the skyline. Overhead line equipment and moving trains would also be very apparent. The northern slope of the embankment would be reduced and planted but in year 1 there would be a substantial alteration to the current panoramic views across open undulating arable fields and pastures. In summer, views would be partially screened by intervening hedgerows and hedgerow trees in full leaf, but overall the Proposed Scheme would remain prominent. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage.</p> <p>Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.</p>	<p>Level of effect: Moderate adverse (significant)</p>
<p>Year 15 – summer:</p> <p>Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.</p>	<p>Level of effect: (non-significant)</p>

Other mitigation measures

- 11.5.8 The permanent effects of the Proposed Scheme on landscape and visual receptors have been reduced through integration of the measures described in this section. Effects in Year 1 may also be further reduced through establishing planting early or in advance of the main construction programme. Other features such as additional earthworks, planting or public greenspace, including use of materials would be considered as part of the ongoing development of contextual design. These measures would potentially provide additional screening and/or greater integration of the Proposed Scheme into the landscape.

Summary of likely residual significant effects

- 11.5.9 In many cases, significant effects would reduce over time as the proposed mitigation planting matures and reaches its designed intention. However, the following likely residual significant effects would remain following year 15 of operation:

- moderate adverse effects in relation to five LCAs;
- major adverse effects at five residential viewpoint locations;
- major adverse effects at one recreational viewpoint locations;
- moderate adverse effects at ten residential viewpoint locations;
- moderate adverse effects at eleven recreational viewpoint locations; and
- moderate adverse effect at one transport receptor.

Monitoring

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

12 Socio-economics

12.1 Introduction

- 12.1.1 This section reports on the environmental baseline, likely economic and employment impacts and significant effects identified to date during construction and operation of the Proposed Scheme within the Ravenfield to Clayton area. The assessment considers existing businesses, community organisations, local employment and local economies, including planned growth and development.
- 12.1.2 Engagement with Doncaster Metropolitan Borough Council (DMBC) has been undertaken as part of the development of the Proposed Scheme. Engagement with Rotherham Metropolitan Borough Council (RMBC) is planned and will also be undertaken. The purpose of the engagement was to increase the understanding of socio-economic characteristics identified through a review of publicly available data. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.
- 12.1.3 The socio-economic effects on employment at a route-wide level are reported in Volume 3: Route-wide effects.
- 12.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA13 Map Book.

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)¹²⁶.
- 12.2.2 The assessment of in-combination effects will draw upon the findings of other technical disciplines (e.g. air quality, sound, noise and vibration, landscape and visual and traffic and transport). Likely significant in-combination effects on socio-economic receptors and resources will be reported in the formal ES.
- 12.2.3 Businesses may experience significant isolation effects as a result of the Proposed Scheme. Likely significant isolation effects will be reported in the formal ES.

12.3 Environmental baseline

Existing baseline

Study area description

- 12.3.1 The following provides a brief overview of employment, economic structure, labour market and business premises availability within the Ravenfield to Clayton area. It lies within the administrative areas of DMBC. In addition, the area includes a small part of Barnsley Metropolitan Borough Council (BMBC) where the effects are considered to

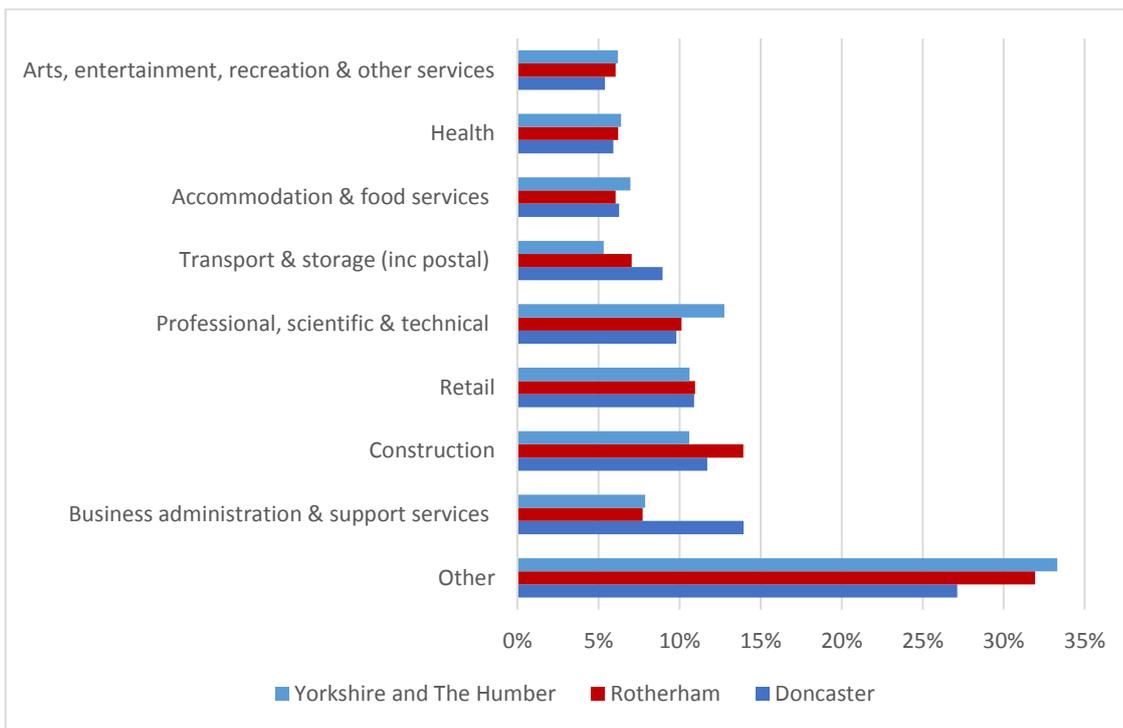
¹²⁶ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

be marginal in relation to the local economy concerned and is therefore not reported in this baseline analysis. It also falls entirely within the Sheffield City Region Local Enterprise Partnership (LEP)¹²⁷, area and the Yorkshire and the Humber region.

Business and labour market

12.3.2 Within the Ravenfield to Clayton area, socio-economic impacts may arise within the local economies covered by two administrative areas, DMBC and RMBC. Within the DMBC area, where most of the impacts are likely to arise, there is a wide spread of business types reflecting a diverse range of commercial activities. The business administration and support services accounts for the largest proportion of businesses (14%), with construction the second largest (12%), followed by retail (11%). In RMBC area, construction accounts for the largest proportion of business (14%), with retail (11%) and professional, scientific and technical (10%) also accounting for relatively large proportions. This is shown in Figure 9. For comparison within the Yorkshire and the Humber region, the largest sectors were professional, scientific and technical sector (13%), followed by retail (11%) and construction (11%)¹²⁸.

Figure 9: Business sector composition in RMBC and DMBC areas and the Yorkshire and the Humber Region¹²⁹



12.3.3 In 2016¹³⁰, approximately 122,000 people worked in the DMBC area and 107,000 in RMBC area. According to the Office for National Statistics Business Register and Employment Survey 2016, the top five sectors in terms of share of employment in

¹²⁷ Sheffield City Region Local Enterprise Partnership, (2014), *Strategic Economic Plan: A Focussed 10 Year Plan for Private Sector Growth 2015-2025*; <https://sheffieldcityregion.org.uk/wp-content/uploads/2018/01/SCR-Growth-Plan-March-2014-1.pdf>.

¹²⁸ Office for National Statistics, (2017), UK Business count –Local Units 2017. Available online at <https://www.nomisweb.co.uk>.

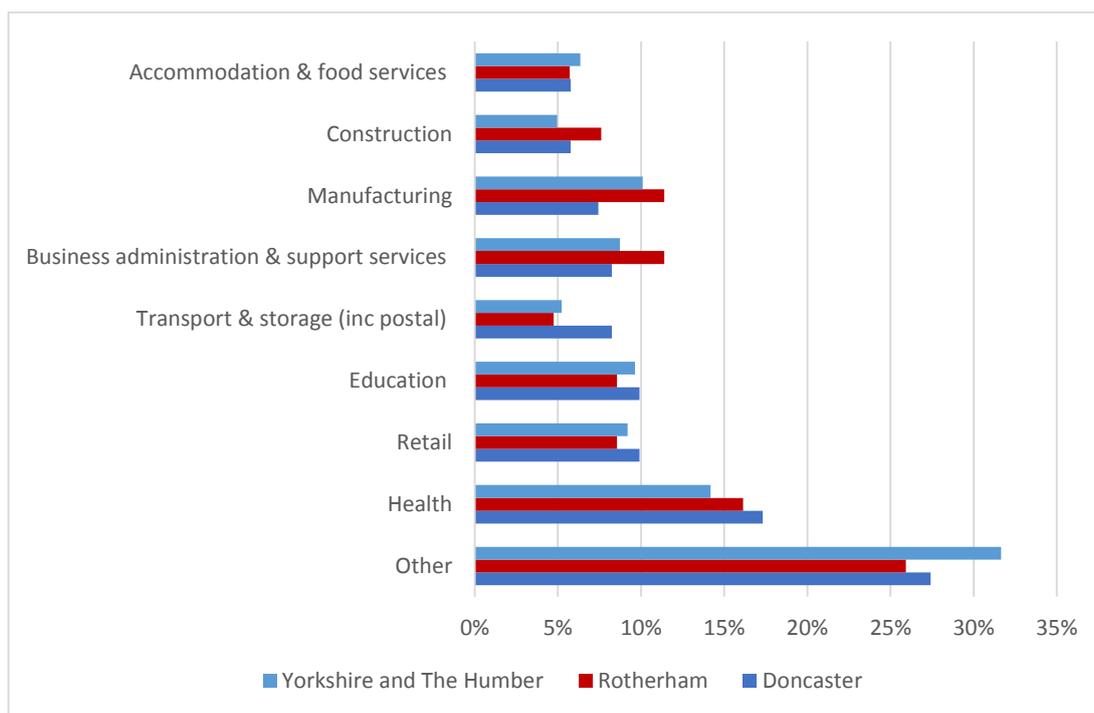
¹²⁹ 'Other' includes: Information & communication; Manufacturing; Wholesale; Transport & storage (including postal); Motor trades; Property; Education; Financial & insurance; Public administration & defence; Mining, quarrying & utilities.

¹³⁰ Office for National Statistics, (2017), Business Register and Employment Survey 2016. Available online at <http://www.nomisweb.co.uk> - This number includes both residents and non-residents who work within the local authority boundaries.

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DMBC area were: health (17%); retail (10%); education (10%); transport and storage (8%); and business administration and support services (8%). In the RMBC area, the top five sectors were: health (16%); manufacturing (11%); business administration and support services (11%); retail (9%) and education (9%). These compare with the top five sectors for the Yorkshire and the Humber region, which were: health (14%); manufacturing (10%); education (10%); retail (9%); and business administration and support services (9%). This is shown in Figure 9¹³¹.

Figure 10: Employment by industrial sector in the RMBC and DMBC areas and the Yorkshire and the Humber Region.



12.3.4 According to the Annual Population Survey (2016)¹³², the employment rate¹³³ within the DMBC area was 72% (134,000 people) and 67% (106,000 people) in the RMBC area, which is lower than that recorded for both the Yorkshire and the Humber region (73%) and England (75%). In 2016, the unemployment rate¹³⁴ in the DMBC and RMBC areas were 6% and 8% respectively, which was higher than that recorded for both the Yorkshire and the Humber region and England at 5%.

12.3.5 According to the Annual Population Survey (2016)¹³⁵, 25% of residents in the DMBC and RMBC areas aged 16-64 were qualified to National Vocational Qualification Level 4 (NVQ4) and above, compared to 31% in the Yorkshire and the Humber region and 38% in England, while 8% of DMBC residents and 12% of RMBC residents had no

¹³¹ Office for National Statistics, 2017; Business Register and Employment Survey 2016. Available online at: <http://www.nomisweb.co.uk> - This number includes both residents and non-residents who work within the local authority boundaries.

¹³² Annual Population Survey, (2016), NOMIS; Available online at: <http://www.nomisweb.co.uk>.

¹³³ The proportion of working age (16-64 year olds) residents that is in employment.

¹³⁴ 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.

¹³⁵ Office for National Statistics, (2016), Annual Population Survey 2016, NOMIS; Available online at: <http://www.nomisweb.co.uk>.

qualifications, compared to 10% recorded for the Yorkshire and Humber region and 8% for England.

Property

- 12.3.6 A review of employment land identified an employment land need of 474ha¹³⁶ in the DMBC area (2015) and 235ha in the RMBC area¹³⁷ (2017). Available employment land supply is estimated at 548ha¹³⁸ in DMBC and 260ha in RMBC. In quantitative terms, both DMBC and RMBC have more land than the areas are expected to require over the study period to meet projected need.
- 12.3.7 The average vacancy rate for industrial and warehousing property in the DMBC in December 2017 has been assessed as 29% based on marketed space against known stock¹³⁹. The average vacancy rate for industrial and warehousing property in the RMBC area for the corresponding period has been assessed as 14%.

12.4 Effects arising during construction

Avoidance and mitigation measures

- 12.4.1 The draft Code of Construction Practice (CoCP)¹⁴⁰ includes a range of provisions that would help mitigate socio-economic effects associated with construction within this area, including:
- reducing nuisance through sensitive layout of construction sites (Section 5 of the draft CoCP);
 - 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 (including local businesses) (Section 13);
 - monitor and manage flood risk and other extreme weather events that may affect socio-economic 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

¹³⁶ Doncaster Council, (2015), *Housing and Economic Land Availability Assessment*; Available online at

<http://www.doncaster.gov.uk/services/planning/housing-and-economic-land-availability-assessment-helaa>

¹³⁷ Sheffield City Council and Rotherham Metropolitan Borough Council, (2015), *Sheffield and Rotherham Joint Employment Land Review*; Available online at

http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKewi3od3Zhv7XAhXiAsAKHVtJAQIQFggvMAI&url=http%3A%2F%2Fwww.rotherham.gov.uk%2Fdownload%2Fdownloads%2Fid%2F2705%2Fsheffield_and_rotherham_employment_land_review_2015.pdf&usq=AOvVaw1K3kev-ghyjDC1xtMF-Wdj

¹³⁸ Doncaster Council (2017) *Employment Land Availability*; Available at <http://www.doncaster.gov.uk/services/planning/employment-land-availability>

¹³⁹ 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)

¹⁴⁰ Supporting document: 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:

- premises demolished with their occupants and employees needing to relocate to allow for construction of the Proposed Scheme;
- in-combination effects (e.g. air quality, noise, vibration, construction traffic and visual impacts) and isolation of an area, which could affect business operations, both will be reported in the formal ES. Any resulting effects on employment will be reported at a route-wide level (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 Businesses within the Ravenfield to Clayton area may experience air quality, noise and vibration or construction traffic impacts as a result of construction of the Proposed Scheme. Taken in combination, the residual effects from these other topic assessments may amount to a significant change in the environment. In-combination effects will be reported in the formal ES.

Isolation

12.4.4 Non-agricultural businesses may experience significant isolation effects as a result of the Proposed Scheme within the Ravenfield to Clayton area. Isolation effects would be reported in the formal ES.

Construction employment

12.4.5 It is currently expected that there would be three main construction compounds: Hooton Roberts cutting main compound, Hickleton cutting main compound and Clayton Junction South main compound, and nine satellite compounds in the Ravenfield to Clayton area. These compounds could result in the creation of up to 3,430 person years of construction employment opportunities¹⁴¹, broadly equivalent to 350 full-time jobs¹⁴², 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 (see 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 of construction workers.

¹⁴¹ 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

¹⁴² Based on the convention that 10 employment years is equivalent to one full time equivalent job

The impact of the indirect construction employment creation has been considered as part of the route-wide assessment (see Volume 3: Route-wide effects).

- 12.4.7 The resulting effects on employment are reported in aggregate at a route-wide level (see Volume 3: Route-wide effects).

Permanent effects

Businesses

- 12.4.8 Businesses directly affected, comprising those that lie within land 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 Ten business accommodation units or sites in the study area would experience direct impacts as a result of the Proposed Scheme. These ten business units or sites, together, form four defined resources comprising:
- Denaby Main Industrial Estate (six units engaged in light industrial uses including carpentry and joinery, manufacturing of other plastic products, development of building projects, food wholesale, furniture sales, and motor vehicle repairs);
 - Pastures Road, Mexborough (two units engaged with the maintenance and repair of motor vehicles and go-kart track racing);
 - Barnburgh Lakes Fishery (one unit providing retail services and a café); and
 - Lodge Farm (one unit engaged in a third party grain storage, separating and drying).
- 12.4.10 Of the four defined resources, only one of the resources is expected to experience direct impacts leading to potentially significant effects on business activities and employment. Table 31 sets out the resource which could potentially experience significant direct effects.

Table 31: Resources which would potentially experience significant direct effects

Resource	Description of business activity
Six business units or sites located at Denaby Main Industrial Estate	Light industrial and manufacturing uses including carpentry and joinery, manufacturing of plastic products, development of building projects, food wholesale, furniture sales, and motor vehicle repairs.

Impact magnitude

- 12.4.11 The magnitude of impact focuses on the number of jobs that would be affected by the Proposed Scheme, either through displacement or possible job loss. It also considers the implications of this impact in relation to the scale of economic activity and opportunity in the area.

Sensitivity

12.4.12 The sensitivity of resources considers the following:

- availability of alternative, suitable premises;
- size of the local labour market;
- skill levels and qualifications of local people; and
- levels of unemployment.

Significance of effects

12.4.13 Taking account of the sensitivity of the resource and the magnitude of impact, it is currently expected that the significance of the resultant effects would be as set out in Table 32.

Table 32: Significance of effects on resources

Resource	Impact magnitude	Sensitivity	Significance of effect
Denaby Main Industrial Estate	High	Medium	Major adverse - significant

12.4.14 The construction of the Old Denaby embankment satellite compound at Denaby Main would require the demolition of businesses located in the western part of Denaby Main Industrial Estate and the acquisition of employment land. Four businesses would experience direct impacts as a result of the Proposed Scheme. The loss of these jobs is likely to be important for the local area, which has slightly higher unemployment than the national average. The effect on this resource and its employees is assessed to be major adverse and would, therefore, be significant.

12.4.15 Across all of the employment areas reviewed, it is currently estimated that 170 jobs¹⁴³ would either be displaced or possibly lost within the Ravenfield to Clayton area. There is a reasonable probability that businesses would be able to relocate to places that would still be accessible to residents within the travel to work areas due to the general availability of vacant premises. However, there may be cases where alternative locations are problematic and the businesses may be unable to relocate on a like-for-like basis within the area. The impact on the local economy from the relocation or loss of jobs is considered to be relatively modest in the context of the total number of people employed in the DMBC and RMBC areas (approximately 229,000 jobs) and the scale of economic activity and opportunity in the area.

12.4.16 The resulting effects on employment are reported in aggregate at a route-wide level (see Volume 3: Route-wide effects).

Other mitigation measures

12.4.17 Businesses displaced by the Proposed Scheme would be compensated in accordance with the Compensation Code. HS2 Ltd recognises the importance of businesses,

¹⁴³ Employment within businesses has been estimated through a combination of sources, for example, surveys of businesses, the Experian employment dataset, employment floor space and the Homes and Communities Agency (HCA) Employment Densities Guide 3rd Edition (2015). The estimate is calculated using standard employment density ratios and estimates of floor areas and may vary significantly from actual employment at the sites.

displaced from their existing premises, being able to relocate to suitable alternative premises and at this stage it assumes that it would, therefore, adopt a policy to offer additional support over and above statutory requirements to facilitate this process as it has done on Phases One and 2a.

- 12.4.18 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the route of the Proposed Scheme in terms of supplying goods and services and obtaining employment. HS2 Ltd at this stage assumes that it would, therefore, adopt a policy to work with its suppliers to build a skilled workforce that promotes further economic growth across the UK as it has done on Phases One and 2a.

Summary of likely residual significant effects

- 12.4.19 Any likely residual significant socio-economic effects will be reported in the formal ES.

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.

Assessment of impacts and effects

Resources with direct effects

- 12.5.2 It is currently expected that no resources would experience significant direct socio-economic effects during the operation of the Proposed Scheme.

In-combination effects

- 12.5.3 In-combination effects will be assessed and reported in the formal ES.

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 of directly employed workers on goods and services.

- 12.5.5 The impact of operational employment creation will be assessed and reported at a route-wide level in Volume 3: Route-wide effects.

Other mitigation measures

- 12.5.6 No mitigation measures are proposed in relation to business resources during operation of the Proposed Scheme.

Summary of likely residual significant effects

- 12.5.7 Any likely residual significant socio-economic effects will be reported in the formal ES.

Monitoring

- 12.5.8 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 12.5.9 There are no area-specific requirements for monitoring socio-economic effects during the operation of the Proposed Scheme in the Ravenfield to Clayton area.

13 Sound, noise and vibration

13.1 Introduction

13.1.1 This section reports the initial assessment of the noise and vibration likely significant effects arising from the construction and operation of the Proposed Scheme within the Ravenfield to Clayton area on:

- 'residential receptors'; people, primarily where they live, in terms of individual dwellings and on a wider community basis including any shared community open areas¹⁴⁴; and
- 'non-residential receptors'¹⁴⁵ such as:
 - community facilities including schools, hospitals, places of worship and 'quiet areas'¹⁴⁶; and
 - commercial properties such as hotels.

13.1.2 The methodology for the assessment of likely significant noise and vibration effects was developed in alignment with Government noise policy¹⁴⁷, planning policy, planning practice guidance on noise (PPGN)¹⁴⁸ and EIA Regulations as described in the Scope and Methodology Report¹⁴⁹ (SMR).

13.1.3 Engagement has been undertaken with Rotherham Metropolitan Borough Council (RMBC) and Doncaster Metropolitan Borough Council with respect to the sound, noise and vibration assessment. This engagement process will continue as part of the development of the Proposed Scheme. The purpose of this engagement has been twofold. Firstly, engagement has been undertaken on a route wide basis covering matters including process, scope, method and the approach to baseline and mitigation strategy. Secondly, local engagement has been undertaken to obtain relevant information regarding residential and non-residential receptors and existing baseline sound levels, and to discuss the development of the mitigation to be included in the Proposed Scheme. Officers from local and county authorities are invited to attend and witness baseline sound measurements.

13.1.4 Maps of the route of the Proposed Scheme in the Ravenfield to Clayton area showing the location of the key environmental features (Map Series CT-10), key construction features (Map Series CT-05), key operational features (Map Series CT-06) and operational sound, noise and / or vibration impacts and proposed noise mitigation

¹⁴⁴ 'Shared community open areas' are those that the 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.

¹⁴⁵ Non-residential receptors with multiple uses would be assessed either based on the most noise sensitive use or would be subject to multiple assessments as appropriate

¹⁴⁶ 'quiet areas' are defined as either Quiet Areas as identified under the Environmental Noise Regulations 2007 (as amended) or are resources which are prized for providing tranquillity as noted in the NPPF and are therefore designated as such under the relevant local plan or are designated under local plans or neighbourhood development plans as local green spaces.

¹⁴⁷ Noise Policy Statement for England, (2015) Department for Environment, Food & Rural Affairs (Defra)

¹⁴⁸ Department for Communities and Local Government (DCLG) (2014), Planning Practice Guidance – Noise. Available online at:

<https://www.gov.uk/guidance/noise--2>

¹⁴⁹ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

(Map series SV-01), can be found in the Volume 2: LA13 Map Book. Map series SV-01 also presents key 'non-residential receptors'. These receptors will be reviewed and developed further to incorporate, where appropriate, consultation feedback and ongoing stakeholder engagement.

- 13.1.5 The assessment of noise and vibration likely significant effects on agricultural, heritage and ecological receptors and the assessment of tranquillity is ongoing and will be reported in the formal ES.

13.2 Scope, assumptions and limitations

- 13.2.1 The approach to assessing sound, noise and vibration and identifying envisaged mitigation is outlined in Volume 1 (Section 8 and Section 9) and the revised SMR.
- 13.2.2 In this assessment 'sound' is used to describe the acoustic conditions that people experience as a part of their everyday lives. Noise is taken as unwanted sound and hence adverse effects are noise effects and mitigation is, for example, by noise fence 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.
- 13.2.4 The effects of construction noise and vibration are assessed qualitatively, based on construction compound locations, construction routes, initial construction estimates and professional judgement. No quantitative assessment has been undertaken for the construction of the Proposed Scheme at this stage. The quantitative assessment will be reported in the formal ES.
- 13.2.5 The effects on operational noise and vibration are assessed quantitatively based on forecast noise emission from the Proposed Scheme combined with outline baseline information and professional judgement. As baseline information is limited at this stage the quantitative assessment including a full baseline will be reported in the formal ES.

13.3 Environmental baseline

- 13.3.1 The revised SMR describes the three rounds of baseline data collection covering existing sources, modelling and by targeted monitoring. Baseline sound levels will be published in the formal ES.
- 13.3.2 The Ravenfield to Clayton area is characterised by towns, villages, hamlets, isolated residential properties and farms in a predominantly rural setting. The sound environment is generally dominated by local and distant road traffic, rail traffic and local neighbourhood sources, with contributing natural and agricultural sounds.
- 13.3.3 The sound environment of the Ravenfield to Clayton area is affected by several main roads. These include: the M18; the A630 Doncaster Road/Sheffield Road/High Road; the A6023 Low Road/Doncaster Road; and the A635 Barnsley Road. Two railways also

contribute to the sound environment: the Sheffield to Doncaster Railway and the Dearne Valley Line.

- 13.3.4 Sound levels close to these main transportation routes are high during the daytime, but are lower at night. Sound levels decrease with increasing distance from the main transportation routes.
- 13.3.5 The effects of vibration at all receptors are being initially assessed using specific thresholds, below which receptors would not generally be adversely affected by vibration. Further information is provided in Volume 1, Section 8.
- 13.3.6 The baseline assessment presented in the formal ES will consider current sound levels and how these may change in the future. This will include any changes firstly due to national trends such as road traffic growth and the progressive electrification of road vehicles and secondly due to area specific changes caused either by local committed development and / or noise reduction provided in Important Areas identified in Defra's Noise Action Plans for Agglomerations¹⁵⁰, Roads¹⁵¹ or Railways¹⁵². HS2 Ltd will engage with the Competent Authorities responsible for the relevant Important Areas. Map Series SV-01 (Volume 2: LA13 Map Book) shows any noise Important Areas in the Ravenfield to Clayton area.

13.4 Effects arising during construction

Assumptions and limitations

- 13.4.1 The construction arrangements that form the basis of the assessment are presented in Section 2.3 of this report, in Volume 1, Section 8 and in the draft Code of Construction Practice (CoCP)¹⁵³. The assessment focuses on the initial identification of communities that may be affected by construction noise. The formal ES will include the assessment of likely significant effects from construction noise and / or vibration on individual receptors and communities.
- 13.4.2 The assessment takes account of people's sensitivity to noise during the day, evening and night. More stringent criteria are applied during evening and night-time periods, compared to the busier and more active daytime period.

Avoidance and mitigation measures

- 13.4.3 The assessment assumes the implementation of the principles and management processes set out in the noise and vibration section of the draft CoCP¹⁵⁴ (Section 13), which are:
- 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

¹⁵⁰ Noise Action Plan: Agglomerations (large urban areas) (2014) Department for Environment, Food & Rural Affairs

¹⁵¹ Noise Action Plan: Roads (including major roads) (2014) Department for Environment, Food & Rural Affairs

¹⁵² Noise Action Plan: Railways (including major railways) (2014) Department for Environment, Food & Rural Affairs

¹⁵³ Supporting document: Draft Code of Construction Practice

¹⁵⁴ All construction will be undertaken in accordance with the Code of Construction Practice. The CoCP will also contain generic control measures and standards to be implemented throughout the full duration of the construction phase

neighbouring residential properties and other sensitive receptors¹⁵⁵;

- 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 or the use of temporary stockpiles; 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 would be offered at qualifying properties.
- 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 and vibration, 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 would undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data would be provided regularly to, and be reviewed by, the nominated undertaker and made available to the local authorities; and
- contractors would be required to comply with the terms of the CoCP and appropriate action would be taken by the nominated undertaker as required to ensure compliance.

13.4.4 Noise insulation or, where appropriate, temporary re-housing would avoid residents of qualifying properties being significantly affected by levels of construction noise inside their dwellings. Work is being undertaken to provide a reasonable worst case estimate of the buildings that are likely to qualify for such measures and the estimate will be reported in the formal ES.

13.4.5 Qualification for noise insulation and temporary re-housing would be confirmed as part of seeking prior consent from the local authority under Section 61 of the CoPA. Qualifying properties would be identified, as required in the draft CoCP so that noise insulation could 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

13.4.6 Potential construction airborne noise significant effects could occur at the communities, or those parts of the communities, that are nearest to the Proposed

¹⁵⁵ Including local businesses and quiet areas designated by the local authority

Scheme in the following locations, as a result of the construction works illustrated on Map Series CT-05 (Volume 2: LA13 Map Book):

- Old Denaby, arising from construction activities such as demolition, cutting formation, embankment formation, balancing pond construction and landscape bund construction;
- Denaby Main, arising from construction activities such as demolition, use of transfer node, cutting formation and landscape bund construction;
- Mexborough, arising from construction activities such as demolition, use of transfer node, cutting formation, embankment formation, viaduct construction, balancing pond construction and landscape bund construction;
- Barnburgh, arising from construction activities such as cutting formation, embankment formation, road realignment and landscape bund construction;
- Hickleton, arising from construction activities such as cutting formation, embankment formation and landscape bund construction; and
- Clayton, arising from construction activities such as demolition, cutting formation, embankment formation and landscape bund construction.

13.4.7 Map Series SV01 (Volume 2: LA13 Map Book) shows key non-residential properties that have been identified within the study area as defined in the SMR. Of these, All Saints Church, Frickley is likely to experience significant effects (to be confirmed in the formal ES).

13.4.8 The avoidance and mitigation measures to be implemented would avoid or reduce airborne construction noise adverse likely significant effects. Residual temporary noise or vibration likely significant effects will be reported in the formal ES.

13.4.9 Construction traffic on the following local roads has the potential, on a precautionary basis, to cause adverse noise or vibration effects on the nearest parts of residential communities and nearest noise sensitive non-residential receptors:

- Old Road and Hill Top Road between the A630 Sheffield Road and Denaby Main in Conisbrough;
- Eland Road, Coalpit Road and Denaby Lane between the Old Denaby embankment satellite compound and the A6023 Low Road/Doncaster Road;
- Comelybank Drive between the River Don viaduct satellite compound and the A6023 Low Road/Doncaster Road;
- Pastures Road between Mexborough embankment satellite compound and the A6023 Low Road/Doncaster Road;
- Melton Mill Lane and Ludwell Hill between the River Dearne viaduct satellite compound and the Barnburgh embankment satellite compound;
- Hangman Stone Road and Blacksmiths Lane between High Melton and Marr;

- Red Hill Lane between Hickleton cutting main compound and the A635 Barnsley Road; and
- Church Field Road, Clayton Lane, the B6411 Thurnscoe Lane/Houghton Road and School Street between Thurnscoe embankment satellite compound and Clayton Junction South main compound.

13.4.10 The magnitude and extent of effect will depend on the level of construction traffic using the road. Any residual significant temporary noise or vibration effects will be reported in the formal ES.

Other mitigation measures

13.4.11 Further work is being undertaken to confirm the likely significant effects and identify any site-specific mitigation, or amendment to construction routes considered necessary in addition to the general measures set out in the draft CoCP. Any site-specific mitigation will be presented in the formal ES and would include an estimate of the number of properties that may qualify for noise insulation or temporary re-housing under provisions set out in the draft CoCP.

Summary of likely residual significant effects

13.4.12 Further work is being undertaken to confirm significant construction noise and vibration effects, including any temporary indirect effects from construction traffic.

13.4.13 Non-residential receptors identified at this stage as potentially subject to construction noise or vibration effects will be further considered, where necessary, on a receptor-by-receptor basis. Any likely significant effects will be reported in the formal ES.

13.5 Effects arising from operation

Assumptions and limitations

Local assumptions

13.5.1 The assessment of the effects of noise and vibration from the operation of the Proposed Scheme is based on the envisaged design as described in Section 2.2 of this report and in Volume 1 (Sections 4 and 8) and the highest likely train flows, assuming the service pattern including Phase One and Phase Two services. The expected passenger service frequency for Phase 2b is described in Volume 1 (Section 4) and as outlined below for the Ravenfield to Clayton area.

13.5.2 Passenger services would start at or after 05:00 from the terminal stations. In this area, with Phase One and Phase Two in operation, after 05:00 services would progressively increase to nine 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, and on the Sheffield Northern Spur up to two trains per hour in each direction would operate with an operating speed of around 160kph. This number of services is assumed to operate every hour from 07:00 to 21:00. The number of services would progressively decrease after 21:00 and the last service would arrive at terminal stations by midnight. Further information is presented in Volume 1 (Section 4).

Avoidance and mitigation measures

- 13.5.3 The development of the Proposed Scheme alignment has sought to reduce noise impact insofar as reasonably practicable.
- 13.5.4 Envisaged avoidance and mitigation measures that apply route-wide are described in Volume 1, Section 9.

Airborne noise

- 13.5.5 Through the procurement process for the trains and the track, the use of proven international technology would enable the railway to be quieter than implied by current minimum European standards. Details of operational train noise will be provided in the formal ES. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia where reasonably practicable. Overall it is assumed that proven international technology would reduce noise emissions by approximately 3dB at 360kph (225mph) compared to the current minimum European standards.
- 13.5.6 The Proposed Scheme would incorporate noise 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. The envisaged noise barrier locations based upon the currently available information are shown on Map Series SV-01 (Volume 2: LA13 Map Book) and described in Section 2.2.
- 13.5.7 In practice, barriers may differ from this description while maintaining the required acoustic performance. For example, where noise barriers are in the form of landscape earthworks, they would need to be higher above rail level to achieve similar noise attenuation to the noise fence barrier because the crest of the earthwork would be further than 5m from the outer rail.
- 13.5.8 Noise effects would also be reduced in other locations along the route by engineering structures and landscape earthworks provided to avoid or reduce significant visual effects.
- 13.5.9 As required by statute, noise insulation measures would be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 and the Noise Insulation Regulations 1975 ('the NI Regulations'). Additionally, HS2 Ltd will apply more onerous discretionary criteria, to provide the same mitigation as defined in 'the NI Regulations' at residential buildings where¹⁵⁶ noise from the use of the Proposed Scheme measured outside a dwelling exceeds the Interim Target defined by the World Health Organization's (WHO) Night Noise Guidelines for Europe¹⁵⁷ or the maximum noise level criteria¹⁵⁸ defined in the SMR. Noise insulation is designed to avoid residents experiencing any residual

¹⁵⁶ Following Government's National Planning Practice Guidance. Available online at: <https://www.gov.uk/government/collections/planning-practice-guidance>

¹⁵⁷ World Health Organization (2010), *Night time Noise Guidelines for Europe*

¹⁵⁸ Dependent on the number of train passes

significant effect on health and quality of life from resulting noise inside their dwelling.

Ground-borne noise and vibration

- 13.5.10 Significant ground-borne noise or vibration effects would be avoided or reduced through the design of the track and track-bed.

Assessment of impacts and effects

- 13.5.11 Map Series SV-01 (Volume 2: LA13 Map Book) indicates the likely long-term daytime noise level (defined as the equivalent continuous sound level from 07:00 to 23:00 or LpAeq,day) from HS2 operations alone. The contours are shown in 5dB steps from 50dB to 70dB. With the train flows described in Volume 1, the night-time noise level (defined as the equivalent continuous noise level from 23:00 to 07:00 or LpAeq,night) from the Proposed Scheme would be approximately 10dB lower than the daytime sound level. The 50dB contour, therefore, indicates the distance from the Proposed Scheme at which the night time noise level would be 40dB. This contour represents where adverse noise effects may start to be observed during the day (with respect to annoyance) and night (with respect to sleep disturbance). With regard to sleep disturbance the assessment also takes account of the maximum noise levels generated by each train pass by as defined in the SMR.
- 13.5.12 The potential for noise effects that are considered significant on a community basis in areas between the 50dB and 65dB daytime noise contours, or 40dB and 55dB night-time contours, is dependent on the baseline in that area and the change in level brought about by the Proposed Scheme. Baseline information will be confirmed in the formal ES.
- 13.5.13 A summary of the likely significant effects identified on a precautionary basis is presented at the end of this section.
- 13.5.14 Likely significant airborne noise effects arising from permanent changes to existing roads, will be reported in the formal ES.

Other mitigation measures

- 13.5.15 Further work is being undertaken to confirm the extent, location and type of the noise mitigation to be included within the design of the Proposed Scheme, which will be reported in the formal ES.

Summary of likely residual significant effects

- 13.5.16 Mitigation, including landscape earthworks and noise fence barriers, described in Volume 1, Section 9, Section 2.2 and presented in Map Series SV-01 (Volume 2: LA13 Map Book) and Map Series CT-06 (Volume 2: LA13 Map Book), would substantially reduce the potential airborne noise effects that would otherwise arise from the Proposed Scheme. It is anticipated that the mitigation would avoid likely significant adverse effects due to airborne operational noise on the majority of receptors and communities.
- 13.5.17 Taking account of the avoidance and mitigation measures this initial assessment has identified effects on a precautionary basis with the potential to be considered

significant on a community basis due to increased airborne noise levels in line with the SMR at or around:

- Firsby Hall Farm, Ravenfield: occupants of residential properties on Arbour Lane, located closest to the Proposed Scheme, identified by LA13-Co1 on Map SV-01-388b;
- Conisbrough: occupants of residential properties on Hill Top Road, located closest to the Proposed Scheme, identified by LA13-Co2 on Map SV-01-389;
- Mexborough: occupants of residential properties on Comelybank Drive, located closest to the Proposed Scheme, identified by LA13-Co3 on Map SV-01-389;
- Mexborough: occupants of residential properties on Clayfield View, The Pastures, James Street, New Street, Church Street, Castle Hill Avenue, A6023 Low Road/Doncaster Road, Pastures Court, Pastures Road, Kingfisher Drive and Wild Geese Way, located closest to the Proposed Scheme, identified by LA13-Co4 on Map SV-01-389;
- Mexborough: occupants of residential properties on Wild Geese Way, Green Shank Drive, Dove Road and Kingfisher Drive, located closest to the Proposed Scheme, identified by LA13-Co5 on Map SV-01-389;
- Mexborough: occupants of residential properties on Mallory Drive, Oulton Rise, Donnington Road, Clayfield Avenue, Ullswater Road, Thirlmere Crescent, Clayfield View and Haddon Rise, located closest to the Proposed Scheme, identified by LA13-Co6 on Map SV-01-389; and
- Frickley: occupants of residential properties on Common Lane, located closest to the Proposed Scheme, identified by LA13-Co7 on Map SV-01-392.

13.5.18 The initial assessment indicates that, the forecast noise from long-term railway operation may exceed the daytime threshold set by the Noise Insulation Regulations, the night-time Interim Target identified in the WHO Night Noise Guidelines for Europe 2009 or the maximum noise levels criteria set out in the SMR, at individual residential properties closest to the Proposed Scheme in:

- Mexborough, in the vicinity of Comelybank Drive (identified on Map SV-01-389 in Volume 2: LA13 Map Book);
- Mexborough, in the vicinity of Pastures Court (identified on Map SV-01-389 in Volume 2: LA13 Map Book);
- Mexborough, in the vicinity of Mallory Drive (identified on Map SV-01-389 in Volume 2: LA13 Map Book);
- Lodge Farm, in the vicinity of Church Field Road (identified on Map SV-01-392 in Volume 2: LA13 Map Book); and
- Frickley, in the vicinity of Frickley Park Lane (identified on Map SV-01-392 in Volume 2: LA13 Map Book).

- 13.5.19 Map Series SV01 (Volume 2: LA13 Map Book) shows key non-residential properties for the assessment of operational airborne noise impacts in the formal ES. Of these, All Saints Church, Frickley is most likely to experience significant effects:
- 13.5.20 Further assessment work is being undertaken to identify operational sound and vibration significant effects. This will be reported in the formal ES.
- 13.5.21 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 potentially affected receptor, its use and the benefit of the measures.

Monitoring

- 13.5.22 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.
- 13.5.23 Operational noise and vibration monitoring would 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.
- 13.5.24 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 would be shared with the relevant local authorities at appropriate intervals.

14 Traffic and transport

14.1 Introduction

- 14.1.1 This section considers the likely impacts on all forms of transport and the potential likely significant effects identified to date on transport users arising from the construction and operation of the Proposed Scheme through the Ravenfield to Clayton area.
- 14.1.2 Engagement with Highways England, Rotherham Metropolitan Borough Council (RMBC), Doncaster Metropolitan Borough Council (DMBC), Barnsley Metropolitan Borough Council (BMBC) and Sheffield City Region (SCR) has been undertaken. An important focus of this engagement has been to obtain relevant baseline information and discuss transport survey requirements and assessment methodology. This engagement process will continue as part of the development of the Proposed Scheme.
- 14.1.3 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: LA13 Map Book.

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 and the Scope and Methodology Report (SMR)¹⁵⁹.
- 14.2.2 The study area for traffic and transport includes: Conisbrough; Denaby Main; Mexborough; Harlington; Barnburgh; Hickleton; Thurnscoe; and Clayton.
- 14.2.3 The study area also includes all roads potentially affected by the Proposed Scheme including the M18 and the A1(M), which are strategic routes. It also includes the following local roads: the A630 Doncaster Road/Sheffield Road/High Road; the A635 Barnsley Road; the A6023 Low Road/Doncaster Road; the A6195 Dearne Valley Parkway/Rotherham Road; the B6273 Rotherham Road; the B6411 Thurnscoe Lane/Houghton Road; the B6422 Butt Lane/Hooton Road; Old Road; Hill Top Road; Denaby Lane; Coalpit Road; Eland Road; Comelybank Drive; Pastures Road; Pastures Court; Ludwell Hill; Hangman Stone Road; Blacksmiths Lane; Doncaster Road; Hickleton Road; Red Hill Lane; Middlecliff Lane/Billingley Lane; School Street; Clayton Lane/Church Field Road; Church Road; Hall Brig; Stotfold Road; Top Lane; and Common Lane.
- 14.2.4 The potential effects on traffic and transport have been assessed qualitatively, based on the Proposed Scheme design, proposed construction routes, initial estimates of construction traffic and professional judgement.
- 14.2.5 No quantitative assessment has been undertaken at this stage. A quantitative assessment will be presented in the formal ES.

¹⁵⁹ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

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, RMBC, DMBC, BMBC and SCR (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 junction turning counts and queue surveys and automatic traffic counts, were undertaken in June, July and November 2017. These data have been supplemented by existing traffic data from other sources, including from Highways England, RMBC and DMBC. Assessment of the data indicates that the peak hours in the area are 07:30-08:30 and 16:30-17:30. However, there are only small differences (4% to 5%) between the observed peak hours and the periods 08:00-09:00 and 17:00-18:00, which are the periods when HS2 construction traffic movements and workforce arrivals and departures would have the maximum impact. Consequently, the 08:00-09:00 and 17:00-18:00 periods have been used as the assessment hours representing a reasonable worst case.
- 14.3.3 PRoW surveys were undertaken in August and September 2017 to establish their nature and usage by non-motorised users (pedestrians, cyclists and equestrians). The surveys included PRoW and roads that would 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 PRoW surveys were undertaken during the weekend, at times when recreational use is expected to be highest, but where routes are likely to be used for non-leisure uses such as commuting, surveys were undertaken on a weekday.

Strategic and local highway network

- 14.3.4 The strategic routes that pass through the area are: the M18 and the A1(M). The strategic road network is busy at peak times and delays can be experienced in particular on the approaches to the A1(M) junctions 36 and 37.
- 14.3.5 The local roads that could be affected by the Proposed Scheme include: the A630 Doncaster Road/Sheffield Road/High Road; the A635 Barnsley Road; the A6023 Low Road/Doncaster Road; the A6195 Dearne Valley Parkway/Rotherham Road; the B6273 Rotherham Road; the B6411 Thurnscoe Lane/Houghton Road; the B6422 Butt Lane/Hooton Road; Old Road; Hill Top Road; Denaby Lane; Coalpit Road; Eland Road; Comelybank Drive; Pastures Road; Pastures Court; Ludwell Hill; Hangman Stone Road; Blacksmiths Lane; Doncaster Road; Hickleton Road; Red Hill Lane; Middlecliff Lane/Billingley Lane; School Street; Clayton Lane/Church Field Road; Church Road; Hall Brig; Stotfold Road; Top Lane; and Common Lane. The A630 High Road and the A635 Barnsley Road approaches to the A1(M) junctions 36 and 37 are busy at peak times, but the remainder of the local road network generally operates well, although some localised delays can be experienced in Mexborough, Conisbrough, Goldthorpe and Thurnscoe, particularly at peak times.

- 14.3.6 Relevant accident data for the road network subject to assessment have been obtained from the Department for Transport¹⁶⁰. Data for the three-year period (December 2014 to December 2017) have been assessed and any identified clusters (i.e. where there are nine or more accidents in the three year period) have been examined.
- 14.3.7 No accident clusters were identified within the Ravenfield to Clayton area.
- 14.3.8 The route of the Proposed Scheme would cross 10 roads with footways within the Ravenfield to Clayton area. These are: the A630 Doncaster Road; the A6023 Doncaster Road; Denaby Lane; Eland Road; Comelybank Drive; Pastures Road; Pastures Court; Ludwell Hill; Doncaster Road; and Common Lane. In addition, the A635 Barnsley Road, Hickleton Road, Red Hill Lane, Stotfold Road, Church Field Road and Top Lane have no footways but were observed to be used by pedestrians.

Parking and loading

- 14.3.9 There is on-street parking on some roads within the Ravenfield to Clayton area that could be impacted by the Proposed Scheme. There are also off-street parking and loading areas that could be impacted.

Public transport network

- 14.3.10 Seven bus routes operate on five roads that are crossed by the route of the Proposed Scheme in the Ravenfield to Clayton area. There are also bus stops primarily located to serve the main built up areas. The bus routes that could be affected by the Proposed Scheme include:
- A6023 Doncaster Road: Service 220 (Doncaster - Mexborough - Manvers - Wath - Cortonwood); and Service 221 (Doncaster - Mexborough - Rotherham), X20 (Doncaster - Mexborough - Barnsley);
 - A635 Barnsley Road: Service X19 (Doncaster - Goldthorpe - Barnsley);
 - Church Field Road: Service 203 (Doncaster - Clayton - Goldthorpe - Wombwell);
 - Doncaster Road: Service X19 (Doncaster - Goldthorpe - Barnsley); and
 - Ludwell Hill: Service 219 (Doncaster - Sprotborough - Thurnscoe - Barnsley); and Service 219a (Doncaster - Sprotborough - Thurnscoe - Barnsley).
- 14.3.11 National and local rail services are accessible via Doncaster Station and local rail services are accessible via Conisbrough, Mexborough, Swinton, Bolton upon Dearne, Goldthorpe and Thurnscoe. Doncaster Station provides access to national services to London, Leeds, Manchester, Newcastle and Edinburgh. Conisbrough and Mexborough Stations provide access to local services to Doncaster and Swinton on the Sheffield to Doncaster existing railway line. Swinton, Bolton upon Dearne, Goldthorpe and Thurnscoe are connected by the Wakefield Line between Leeds and Sheffield.

¹⁶⁰ Department for Transport; www.crashmap.co.uk CrashMap provides accident data for the UK

Non-motorised users

- 14.3.12 There are pedestrian footways adjacent to many of the roads in the built up areas of Conisbrough, Denaby Main, Mexborough, Harlington, Barnburgh, Hickleton, Thurnscoe and Clayton. 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.
- 14.3.13 The route of the Proposed Scheme would cross the route of 27 PRow within the Ravenfield to Clayton area that could be affected either temporarily or permanently due to, for example, temporary diversion of PRow during construction and permanent diversions or upgrades including for maintenance access to the Proposed Scheme. The surveys undertaken to inform the assessment showed that there were fewer than 10 people a day recorded on seven of the PRow. The routes with the greatest usage during the survey day were the A6023 Doncaster Road, used by 208 users (comprising 163 pedestrians and 45 cyclists); Pastures Road, used by 207 users (comprising 137 pedestrians and 70 cyclists); and Hickleton Bridleway 2, used by 114 users (comprising 82 pedestrians, 18 cyclists and 14 equestrians).
- 14.3.14 In the Ravenfield to Clayton area, National Route 62 (part of the National Cycle Network) 'the Trans Pennine Trail' would be crossed by the Proposed Scheme to the north of Mexborough. There is also a cycle route that runs along the towpath of the Sheffield and South Yorkshire Navigation canal where it would be crossed by the Proposed Scheme. There are several recommended 'on road' cycle routes in Conisbrough and Mexborough.
- 14.3.15 Red Hill Lane is an advisory 'on road' cycle route at the location where it would be crossed by the Proposed Scheme and a further 'traffic free' route would be crossed by the Proposed Scheme between Clayton and Frickley Hall, which continues via a bridleway to South Kirkby.

Waterways and canals

- 14.3.16 There is one navigable waterway in the Ravenfield to Clayton area, the Sheffield and South Yorkshire Navigation, which is located to the south of Mexborough.

Air transport

- 14.3.17 There is no relevant air transport in the Ravenfield to Clayton area. Consequently, this topic is not considered further in this assessment.

14.4 Effects arising during construction

Avoidance and mitigation measures

- 14.4.1 The following measures are currently proposed to avoid or reduce effects on transport users:
- new highways (roads and PRow) would be constructed and operational prior to the permanent closure of any existing highways, insofar as reasonably practicable;

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- the majority of roads crossing the route of the Proposed Scheme would be maintained or locally diverted during construction to limit the need for diversions of traffic onto alternative routes;
- traffic management measures would be implemented to limit any disruption;
- road closures would be restricted to overnight and weekends, insofar as reasonably practicable;
- temporary alternative routes for PRow would be provided during construction, insofar as reasonably practicable, where either the existing or final proposed route is not available;
- where reasonably practicable, site haul routes would 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;
- HGV would be routed, insofar as reasonably practicable, along the strategic and/or primary road network;
- the use of the local road network would, insofar as reasonably practicable, be limited to use for site set-up, access for surveys and on-going servicing (including refuse collection and general deliveries to compounds) during construction;
- the reuse of excavated material along the route of the Proposed Scheme, insofar as reasonably practicable;
- highway measures including junction improvements, passing places and carriageway widening would be provided, as required, to manage the safe passing of construction vehicles on construction HGV routes; and
- on-site welfare facilities would be provided which would reduce daily travel by site workers.

14.4.2 Section 14 of the draft Code of Construction Practice¹⁶¹ (CoCP) includes measures that aim to reduce the adverse impacts and effects on local communities and maintain public access. This includes the impacts of deliveries of construction materials and equipment.

14.4.3 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 would be implemented during the construction of the Proposed Scheme on or adjacent to public roads and PRow affected by the Proposed Scheme.

14.4.4 The draft CoCP includes the requirement to develop local traffic management plans in consultation with the highway and traffic authorities and the emergency services. These would consider the local traffic management strategy including consideration

¹⁶¹ Supporting document: Draft Code of Construction Practice

of sensitive receptors, such that adverse impacts would be reduced insofar as reasonably practicable and any effect on safety and accidents would not be significant

14.4.5 Specific measures would include core site operating hours of 08:00 to 18:00 on weekdays and 08:00 to 13:00 on Saturdays with site staff and workers generally arriving before the morning peak hour and departing after the evening peak hour.

14.4.6 The number of private car trips to and from the construction compounds (both workforce and visitors) would be reduced by encouraging alternative sustainable modes of transport or vehicle sharing. This would be supported by an overarching framework travel plan that would require construction workforce travel plans¹⁶² to be produced that would include a range of potential measures to mitigate the impacts of traffic and transport movements associated with construction of the Proposed Scheme.

14.4.7 Where works potentially affect Network Rail assets, disruption to travelling passengers and freight movements would be reduced insofar as reasonably practicable. This includes 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 so 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

14.4.8 The traffic and transport impacts during the construction period within the Ravenfield to Clayton area are likely to include:

- construction vehicle movements to and from the various construction compounds;
- road closures and associated realignments and diversions;
- alternative routes for PRow; and
- possessions on the conventional rail network.

14.4.9 The construction assessment has also considered any impacts in the Ravenfield to Clayton area that arise from construction of the Proposed Scheme in the adjoining community areas.

¹⁶² Construction and operational travel plans would promote the use of sustainable transport modes as appropriate to the location and types of trip. They would 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.

14.4.10 Construction vehicle movements required to construct the Proposed Scheme would include the delivery of plant and materials, movement of excavated materials and site worker trips. Works would include utilities diversions, earthworks, underpass, viaduct, bridge and highway construction.

14.4.11 Construction activities would be managed from compounds. Details of the construction compounds are provided in Section 2.3. The locations of the compounds are shown in Map Series CT-05 in the Volume 2: LA13 Map Book.

Highway network

Strategic and local highway network

14.4.12 The primary HGV access routes for construction vehicles would be the strategic and/or primary road network with the use of the local road network limited, where reasonably practicable. The construction routes would also provide access to compounds. Where reasonably practicable, HGVs would use the site haul routes alongside the route of the Proposed Scheme to reduce the impact on the local road network. In this area, it is expected that the main construction routes would use:

- the A1(M) junctions 36 and 37;
- the A630 Doncaster Road/Sheffield Road/High Road west of the A1(M);
- the A6023 Low Road/Doncaster Road between the A630 Doncaster Road and Pastures Road;
- the A635 Barnsley Road between the A1(M) junction 37 and Red Hill Lane;
- the A6195 Dearne Valley Parkway/Rotherham Road between the M1 junction 36 and Middlecliff Lane;
- the B6273 Rotherham Road between A6195 Rotherham Road and Middlecliff Lane;
- the B6411 Houghton Road between Billingley Lane and Clayton Lane;
- the B6411 Thurnscoe Lane between Billingley Lane and the B6273 High Street;
- Old Road;
- Hill Top Road;
- Denaby Lane;
- Coalpit Road;
- Eland Road;
- Comelybank Drive;
- Pastures Road;
- Ludwell Hill;
- Hangman Stone Road;

- Blacksmiths Lane;
- Red Hill Lane;
- Middlecliff Lane/Billingley Lane;
- Clayton Lane/Church Field Road;
- School Street;
- Hall Brig;
- Stotfold Road; and
- Common Lane.

- 14.4.13 There are a number of construction routes that would have limited¹⁶³ use including: Old Road; Hill Top Road; the B6273 Rotherham Road; the B6411 Thurnscoe Lane; the B6411 Houghton Road; School Street; Hall Brig; Stotfold Road; and Common Lane.
- 14.4.14 In addition to increases in traffic flows due to construction traffic, construction of the Proposed Scheme is expected to result in temporary highway closures and diversions or realignments as set out in Section 2.3. The works to construct both temporary and permanent highway diversions/realignments could also result in disruption to highway users. These are expected to include:
- closure of the A630 Doncaster Road west of Firsby Lane, with local diversion routes available;
 - overnight and weekend closures of the A6023 Doncaster Road at Pastures Road;
 - overnight and weekend closures of Pastures Road at the A6023 Doncaster Road;
 - Ludwell Hill east of Doncaster Road (expected to remain open);
 - overnight and weekend closures of Church Field Road to the east and west of the existing railway line; and
 - closure of Top Lane, with local diversion routes available.
- 14.4.15 Permanent changes to highways are reported under operation.
- 14.4.16 Changes in traffic have the potential, at some locations, to result in increased travel distance, congestion and delays and increased traffic severance for non-motorised users. The assessment of these changes will be reported in the formal ES.
- 14.4.17 Assessment of the traffic and transport impacts from utilities works, either separately or in combination with other works, will be reported in the formal ES.

¹⁶³ Limited use refers to a low level of HGV use generally over a short length of time, for example for site set up or minor works

Accidents and safety

- 14.4.18 Changes in traffic as a result of the Proposed Scheme could result in changes in accident risk. The impacts on accident risk during construction of the Proposed Scheme will be reported in the formal ES.

Parking and loading

- 14.4.19 It is currently expected that the Proposed Scheme could have impacts on parking and loading in Mexborough and Conisbrough. This would include where parking bays or other parking amenities could be affected or temporarily suspended due to construction works. Some roads that could be used as construction routes and have on-street parking could be affected. Any significant effects will be reported in the formal ES.

Public transport network

- 14.4.20 There are no temporary road closures or diversions required in this area that would substantially affect bus services or stops although any increase in general traffic delays could affect bus services. Any consequent effects will be reported in the formal ES.
- 14.4.21 There are interfaces with the existing rail network in this area, in particular on the operation of the Sheffield to Doncaster Railway, and the Dearne Valley Line. Rail possessions would be required to undertake localised works, including construction of the River Don viaduct and Dearne Valley Line existing railway underbridge. To facilitate the connection of the Proposed Scheme to the existing Dearne Valley Line, via the Sheffield Northern Spur, modifications would be required to the existing conventional rail infrastructure in the South Yorkshire area. These modifications would include electrification and re-signalling works. This could potentially result in disruption to services, although many of the interventions would be combined to reduce the frequency of potential disruption. The effects of railway possessions will be assessed and reported in the formal ES.

Non-motorised users

- 14.4.22 The construction works associated with the Proposed Scheme would require the temporary closure or diversion/realignment of PRow and roads. There would be temporary alternative routes for a number of PRow in the vicinity of the Proposed Scheme. Where necessary, PRow would be re-routed around construction compounds.
- 14.4.23 There would be temporary alternative routes for a number of PRow in the vicinity of the Proposed Scheme. It is currently expected that the following PRow would be temporarily diverted or realigned:
- Conisbrough Parks Bridleway 14 (east of Firsby Hall Farm);
 - Conisbrough Parks Footpath 3 (east of Firsby Hall Farm);
 - Conisbrough Parks Bridleway 2 (Firsby Lane, east of Firsby Hall Farm);
 - Conisbrough Footpath 3 (Old Hall Lane);

- Mexborough Footpath 9 (on the northern edge of Mexborough);
- Mexborough Footpath 7 (to the west of Pastures Road, north of Mexborough);
- Barnburgh Footpath 5 (north of Doncaster Road, near Barnburgh);
- Barnburgh Footpath 3 (north of Doncaster Road, near Barnburgh);
- Hickleton Footpath 1 (south of A635 Barnsley Road, near Hickleton);
- Hooton Pagnell Footpath 12 (east of Thurnscoe);
- Clayton with Frickley Bridleway 11 (east of Clayton);
- Clayton with Frickley Footpath 1 (Common Lane, north of Clayton);
- Clayton with Frickley Footpath 10 (north of Clayton);
- Clayton with Frickley Footpath 2 (north of Clayton);
- Clayton with Frickley Footpath 3 (north of Clayton);
- Clayton with Frickley Footpath 4 (north of Clayton);
- Clayton with Frickley Bridleway 5 (north of Clayton);
- Dearne Footpath 2 (on the northern edge of Thurnscoe); and
- Clayton with Frickley Footpath 13 (north of Thurnscoe).

14.4.24 It is expected that the following non-motorised user routes would require temporary diversion or short-term closure as a result of construction of the Proposed Scheme:

- Sheffield and South Yorkshire Navigation towpath (on the southern edge of Mexborough); and
- The Trans Pennine trail (north of Mexborough).

14.4.25 Permanently diverted PRoW are reported under operation, although these PRoW could also be subject to temporary closure or diversion/realignment.

14.4.26 The changes to PRoW are likely to result in some increases in travel distance with the potential for adverse significant effects. The assessment of these will be reported in the formal ES.

Waterways and canals

14.4.27 It is currently expected that the construction of the Proposed Scheme could have an effect upon the Sheffield and South Yorkshire Navigation in the Ravenfield to Clayton area where the proposed route would cross via the proposed River Don viaduct. This would require a temporary closure of this waterway. The assessment will be reported in the formal ES.

Permanent effects

14.4.28 Any permanent effects of construction will be 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

- 14.4.29 The implementation of the measures in the draft CoCP, in combination with the construction workforce travel plan would help mitigate transport-related effects during construction of the Proposed Scheme.
- 14.4.30 Any further traffic and transport mitigation measures required during the construction of the Proposed Scheme will be considered based on the outcomes of the assessment. These will be reported in the formal ES.

Summary of likely residual significant effects

- 14.4.31 Construction of the Proposed Scheme has the potential to lead to additional congestion and delays for road users on a number of routes including the: the M18; the A1(M); the A630 Doncaster Road/Sheffield Road/High Road; the A6023 Low Road/Doncaster Road; the A635 Barnsley Road; the A6195 Dearne Valley Parkway/Rotherham Road; the B6273 Rotherham Road; the B6411 Thurnscoe Lane/Houghton Road; Old Road; Hill Top Road; Denaby Lane; Coalpit Road; Eland Road; Comelybank Drive; Pastures Road; Ludwell Hill; Hangman Stone Road; Blacksmiths Lane; Red Hill Lane; Middlecliff Lane/Billingley Lane; School Street; Clayton Lane/Church Field Road; Hall Brig; Stotfold Road; Top Lane; and Common Lane. Increases in traffic could also result in increased traffic severance for non-motorised users of the routes and changes in traffic could result in changes in accident risk
- 14.4.32 Construction of the Proposed Scheme is also likely to result the temporary closures and diversions or realignments of the following: the A630 Doncaster Road; the A6023 Doncaster Road; Pastures Road; Ludwell Hill; Church Field Road; and Top Lane.
- 14.4.33 It is currently expected that construction of the Proposed Scheme could have impacts on parking and loading in Mexborough and Conisbrough.
- 14.4.34 Construction of the Proposed Scheme has the potential to result in delays to rail services and passengers on the Sheffield to Doncaster, and the Dearne Valley lines as a result of rail possessions.
- 14.4.35 Construction of the Proposed Scheme would require the temporary closure or diversion/realignment of PRow and non-motorised user routes, including: Conisbrough Parks Bridleway 14; Conisbrough Parks Footpath 3; Conisbrough Parks Bridleway 2 (Firsby Lane); Conisbrough Footpath 3 (Old Hall Lane); Mexborough Footpath 9; Mexborough Footpath 7; Barnburgh Footpath 5; Barnburgh Footpath 3; Hickleton Footpath 1; Hooton Pagnell Footpath 12; Clayton with Frickley Bridleway 11; Clayton with Frickley Footpath 1 (Common Lane); Clayton with Frickley Footpath 10; Clayton with Frickley Footpath 2; Clayton with Frickley Footpath 3; Clayton with Frickley Footpath 4; Clayton with Frickley Bridleway 5, Sheffield and South Yorkshire Navigation towpath; and the Trans Pennine Trail.
- 14.4.36 It is currently expected that the construction of the Proposed Scheme could have an effect upon the Sheffield and South Yorkshire Navigation.

14.4.37 The assessment of significant effects in relation to traffic and transport during construction of the Proposed Scheme will be reported in the formal ES.

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 would avoid or reduce impacts on transport users:

- reinstatement of roads on or close to their existing alignments, where reasonably practicable; 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. Operational effects arising from the Proposed Scheme in year 2033 and year 2046 will be reported in the formal ES.

Key operation transport issues

14.5.3 The operation of the Proposed Scheme would be unlikely to have any substantial impacts within this area due to increased traffic, as there are no stations or depots proposed within the Ravenfield to Clayton area. The maintenance of the Proposed Scheme would generate limited vehicular trips and the effect would not be significant.

14.5.4 The operational impacts are therefore primarily related to permanent diversion, realignment and closure of roads and the diversion or closure of PRoW.

Highway network

Strategic and local highway network

14.5.5 The Proposed Scheme would result in a number of permanent highway changes. These include:

- the A630 Doncaster Road, which would be realigned via an overbridge;
- the A635 Barnsley Road, which would be realigned to the north of its existing alignment with an overbridge;
- Common Lane, which would be realigned via an overbridge;
- Ludwell Hill, which would be realigned with an underbridge;
- Red Hill Lane, which would be permanently closed where it crosses the Proposed Scheme, forming two cul-de-sacs. Traffic would be diverted via routes along the B6422 Butt Lane/Hooton Road, Church Road, the A635 Barnsley Road, Clayton Lane/Church Field Road, and the B6411 Houghton Road;

- Church Field Road, which would be realigned via an overbridge; and
- Stotfold Road, which would be diverted to the east with a new junction onto Church Field Road.

14.5.6 The permanent highway changes are not expected to result in significant changes in travel distances with the exception of Red Hill Lane. The effects of these changes including on non-motorised users will be reported in the formal ES.

Accidents and safety

14.5.7 Changes in traffic could result in changes in accident risk. Operational effects arising from the Proposed Scheme will be reported in the formal ES.

Parking and loading

14.5.8 It is currently expected that there would be a permanent loss of car parking and loading at locations along the route of the Proposed Scheme in this area. Where car parking or loading is lost that would have served facilities that are displaced by the Proposed Scheme this is not considered a material effect. Any significant effects will be reported in the formal ES.

Public transport network

14.5.9 The permanent realignment of roads could increase travel distances for bus passengers. However, as most of the realignments are likely to be less than 1km in length, it is not currently expected that there would be significant effects on public transport within the Ravenfield to Clayton area.

Non-motorised users

14.5.10 A number of PRoW that cross the route of the Proposed Scheme would be either permanently realigned or diverted including:

- Conisbrough Parks Bridleway 14 (east of Firsby Hall Farm) would be diverted to the north to cross the route of the Proposed Scheme via an underbridge shared with Conisbrough Parks Bridleway 2 (Firsby Lane) and Conisbrough Parks Footpath 3 (east of Firsby Hall Farm);
- Conisbrough Parks Footpath 3 (east of Firsby Hall Farm) would be realigned to cross the route of the Proposed Scheme via the underbridge shared with Conisbrough Parks Bridleway 14 (east of Firsby Hall Farm) and Conisbrough Parks Bridleway 2 (Firsby Lane);
- Conisbrough Parks Bridleway 2 (Firsby Lane) would be diverted to the south to cross the route of the Proposed Scheme via the shared underbridge before re-joining the existing route to the north;
- Conisbrough Footpath 3 (Old Hall Lane) would be diverted to the north via Denaby Lane, Coalpit Road and Eland Road;
- Conisbrough Footpath 1 (north of Denaby Lane, to the south of Mexborough) would be realigned to the south-east, with a new connection onto Denaby Lane;

- Mexborough Footpath 9 (on the northern edge of Mexborough) would be realigned to the west of its existing alignment;
- Barnburgh Bridleway 4 (east of Barnburgh) would be diverted to the south with a new connection to Ludwell Hill;
- Barnburgh Footpath 7 (east of Barnburgh) would be realigned to the north-east of its existing alignment;
- Barnburgh Footpath 3 (north of Doncaster Road, near Barnburgh) would be realigned via the Barnburgh Footpath 3 accommodation underbridge;
- Barnburgh Bridleway 2 (north-east of Harlington) would be diverted to the south and north, crossing the route of the Proposed Scheme via an underbridge shared with Barnburgh Footpath 3 and Hickleton Bridleway 2 accommodation overbridge;
- Hickleton Bridleway 2 (north-east of Harlington) would be diverted to the north, crossing the route of the Proposed Scheme via the Hickleton Road Bridleway 2 accommodation overbridge;
- Hickleton Footpath 1 (south of A635 Barnsley Road, near Barnburgh) would be diverted to the north, crossing the route of the Proposed Scheme via an overbridge shared with Hickleton Bridleway 2 before re-joining the existing route;
- Hooton Pagnell Footpath 13 (north of A635 Barnsley Road, east of Hickleton) would be diverted to the south with a new connection onto the realigned A635 Barnsley Road and the remaining section of Red Hill Lane;
- Hooton Pagnell Footpath 12 (north of A635 Barnsley Road, east of Hickleton) would be diverted to the north, crossing the route of the Proposed Scheme via an overbridge;
- Clayton with Frickley Bridleway 11 (east of Clayton) would be diverted to the south to pass beneath the Frickley viaduct and again to the east to accommodate the Sheffield Northern Spur;
- Clayton with Frickley Footpath 1 (Common Lane) would be diverted to the north-west, crossing the route of the Proposed Scheme via Clayton with Frickley Bridleway 5 underbridge shared with Clayton with Frickley Footpath 2, Footpath 3, Footpath 4 and Bridleway 5;
- Clayton with Frickley Footpath 2 (north of Clayton) would be diverted to the north-west crossing the route of the Proposed Scheme via Clayton with Frickley Bridleway 5 underbridge and again to the south to connect to Clayton with Frickley Footpath 3;
- Clayton with Frickley Footpath 3 (north of Clayton) would be diverted to the north crossing the route of the Proposed Scheme via Clayton with Frickley Bridleway 5 underbridge;

- Clayton with Frickley Footpath 4 (north of Clayton) would be diverted to the south-east crossing the route of the Proposed Scheme via Clayton with Frickley Bridleway 5 underbridge;
- Clayton with Frickley Bridleway 5 (north of Clayton) would be diverted to the south-east crossing the route of the Proposed Scheme via Clayton with Frickley Bridleway 5 underbridge;
- Dearne Footpath 5 (on the northern edge of Thurnscoe) would be realigned via the Dearne Footpath 5 overbridge;
- Clayton with Frickley Footpath 13 (north of Thurnscoe) would be diverted to the east;
- Dearne Bridleway 4 (north of Thurnscoe) would be diverted to the east, crossing the route of the Proposed Scheme via an overbridge shared with Dearne Footpath 5; and
- Dearne Footpath 2 (on the northern edge of Thurnscoe) would be diverted to the south, crossing the route of the Proposed Scheme via an overbridge shared with Dearne Footpath 5 and Dearne Footpath 2.

14.5.11 The realignment of some of the PRow would increase journey distance and time for non-motorised users and may result in significant effects. It is expected that the greatest increases in journey distance (likely to be in excess of an additional 500m) would affect the users of Conisbrough Parks Bridleway 14, Conisbrough Parks Footpath 3, Conisbrough Footpath 3 (Old Hall Lane), Barnburgh Footpath 3, Hickleton Footpath 1, Hooton Pagnell Footpath 12 and Clayton with Frickley Footpath 1 (Common Lane). The assessment of changes to PRow will be reported in the formal ES.

Waterways and canals

14.5.12 It is not currently expected that the operation of the Proposed Scheme would have a significant effect upon navigable waterways or canals in the Ravenfield to Clayton area.

Other mitigation measures

14.5.13 HS2 Ltd is continuing to engage with local highway and transport authorities regarding the need for highway and public transport measures to mitigate the impacts of the Proposed Scheme in the area.

14.5.14 Any further traffic and transport mitigation measures required during the operation of the Proposed Scheme will be considered based on the outcomes of the assessment. These will be reported in the formal ES.

Summary of likely residual significant effects

14.5.15 Operation of the Proposed Scheme would require the permanent realignment or diversion of: Common Lane; the A630 Doncaster Road; the A635 Barnsley Road; Ludwell Hill; Church Field Road and Stotfold Road, and the permanent closure of Red Hill Lane. Increases in traffic could also result in increased traffic severance for non-

motorised users of the routes and changes in traffic could result in changes in accident risk.

- 14.5.16 It is currently expected that there would be a permanent loss of car parking or loading at locations along the route of the Proposed Scheme in this area.
- 14.5.17 Operation of the Proposed Scheme would require the permanent realignment or diversion of 24 PRow including: Conisbrough Parks Bridleway 14; Conisbrough Parks Footpath 3; Conisbrough Parks Bridleway 2 (Firsby Lane); Conisbrough Footpath 3 (Old Hall Lane); Conisbrough Footpath 1; Mexborough Footpath 9; Barnburgh Bridleway 4; Barnburgh Footpath 7; Barnburgh Footpath 3; Barnburgh Bridleway 2; Hickleton Bridleway 2; Hickleton Footpath 1; Hooton Pagnell Footpath 13; Hooton Pagnell Footpath 12; Clayton with Frickley Bridleway 11; Clayton with Frickley Footpath 1 (Common Lane); Clayton with Frickley Footpath 2; Clayton with Frickley Footpath 3; Clayton with Frickley Footpath 4; Clayton with Frickley Bridleway 5; Dearne Footpath 5; Clayton with Frickley Footpath 13; Dearne Bridleway 4; and Dearne Footpath 2.
- 14.5.18 The assessment of significant effects in relation to traffic and transport during operation of the Proposed Scheme will be reported in the formal ES.

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 There are no other area-specific monitoring requirements currently proposed for traffic and transport in the Ravenfield to Clayton area.

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 Ravenfield to Clayton area. The likely impacts and significant effects identified to date arising from the construction and operation of the Proposed Scheme on surface water and groundwater bodies and their associated water resources are reported. The likely impacts and significant effects of the Proposed Scheme on flood risk and land drainage are also reported.
- 15.1.2 Engagement has been undertaken with the Environment Agency, Canal & River Trust (CRT) and Lead Local Flood Authorities (LLFA), Rotherham Metropolitan Borough Council (RMBC) and Doncaster Metropolitan Borough Council (DMBC). Engagement has also been undertaken with Yorkshire Water Services Limited (the local water and sewerage undertaker). The purpose of this engagement has been to obtain relevant baseline information and to discuss the Proposed Scheme and potential effects. Engagement with these stakeholders will continue as part of the development of the Proposed Scheme.
- 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: LA13 Map Book. This map book also includes Map Series WR-01 and WR-02 showing surface water and groundwater baseline information respectively.
- 15.1.4 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;
 - a summary of how the Proposed Scheme aims to demonstrate compliance with the statutory requirements of the Water Framework Directive (WFD); and
 - route-wide flood risk issues related to alignment of the Proposed Scheme with the Sequential Test and Exception Test policies in the National Planning Policy Framework (NPPF)¹⁶⁴.

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 and the Scope and Methodology Report (SMR)¹⁶⁵.
- 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

¹⁶⁴ National Planning Policy Framework, DCLG, 2015

¹⁶⁵ Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

this report. Within the Ravenfield to Clayton area, the study area has been extended by approximately 6km to the south along the existing Dearne Valley railway line to incorporate land within the existing Dearne Valley railway corridor that is potentially required during the construction of the Proposed Scheme.

- 15.2.3 This assessment is based on desk study information, including information provided to date 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 analysis is currently being undertaken of watercourses and key structures within flood risk areas. This includes modelling of the River Don (including the Sheffield and South Yorkshire Navigation, due to its hydraulic connection with the River Don), the River Dearne and Frickley Beck.
- 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 Impacts on biological receptors such as aquatic fauna and flora are assessed in Section 7, Ecology and biodiversity.
- 15.2.8 The assessments in this working draft ES are based on professional judgement using the information that is currently available. A precautionary approach has been adopted with regard to assessing the potential for adverse impacts to occur. The surveys, analysis and modelling work currently in progress, and the results of the consultation process, will be used to refine the assessments reported in the formal ES.

15.3 Environmental baseline

Existing baseline - Water resources and WFD

Surface water

- 15.3.1 All surface water bodies in the study area fall within the Don and Rother catchment of the Humber river basin district (RBD).
- 15.3.2 The river basin management plan¹⁶⁶ identifies the chemical¹⁶⁷ and ecological¹⁶⁸ status of surface water bodies, and the quantitative¹⁶⁹ and chemical¹⁷⁰ status of groundwater bodies within this RBD.

¹⁶⁶ Environment Agency (2015), Water for life and livelihoods Part 1: Humber river basin district: River basin management plan

¹⁶⁷ The chemical status of surface waters reflects concentrations of priority and hazardous substances present

¹⁶⁸ 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.

¹⁶⁹ 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

¹⁷⁰ 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

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- 15.3.3 To be compliant with WFD legislation, the Proposed Scheme should not cause deterioration of a water body from its current status; nor prevent future attainment of good status where this has not already been achieved. The Proposed Scheme should also avoid adverse impacts on protected or priority species and habitats.
- 15.3.4 Specialist field surveys are being undertaken, where access is available. Receptor values will be 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 potentially affected by the Proposed Scheme within the study area is provided in Table 33. The receptor value attributed to each individual water body is based on the methodologies set out in the SMR.

Table 33: Surface water body receptors

Water body name and location ¹⁷¹	Designation	Q95 value (m ³ /s) ¹⁷²	Receptor value	Parent WFD water body name and identification number ¹⁷³	Current WFD status / Objective ¹⁷⁴
Tributary of Hooton Brook 1 WR-01-365b B6	Ordinary watercourse	<0.002	Low	Hooton Brook from Source to River Don GB104027057430	Good/ Good 2015
Firsby Brook WR-01-365b C6	Ordinary watercourse	<0.002	Moderate		
Tributary of Hooton Brook 2 WR-01-365b D6	Ordinary watercourse	<0.002	Low		
Tributary of Hooton Brook 3 WR-01-365b D6	Ordinary watercourse	<0.002	Low		
Tributary of Hooton Brook 4 WR-01-365b F5	Ordinary watercourse	<0.002	Low		
Tributary of Hooton Brook 5 WR-01-365b F5	Ordinary watercourse	<0.002	Low		
Tributary of Hooton Brook 6	Ordinary watercourse	<0.002	Low		

¹⁷¹ The feature locations are indicated by the grid coordinates on the relevant Volume 2: LA13 Map Book figure (in this case WR-01)

¹⁷² This is the flow within the watercourse that is exceeded for 95% of the time

¹⁷³ The Environment Agency has attributed each surface water and groundwater body a unique water body identification (ID) number

¹⁷⁴ Status and objectives are based on those set out in the 2015 River basin management plan

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Water body name and location ¹⁷¹	Designation	Q95 value (m3/s) ¹⁷²	Receptor value	Parent WFD water body name and identification number ¹⁷³	Current WFD status / Objective ¹⁷⁴
WR-01-365b F5					
Tributary of the River Don	Ordinary watercourse	<0.002	Low	Don from River Rother to River Dearne GB104027057452	Moderate/ Moderate 2015
River Don WR-01-365b H5	Main river	3	High		
Sheffield and South Yorkshire Navigation (Mexborough New Cut) WR-01-365b H5	Canal	n/a	High		
Tributary of the River Dearne 1 WR-01-365b I6	Ordinary watercourse	0.004	Low	Dearne Darfield STW to River Don GB104027063173	Moderate/ Moderate 2015
River Dearne (main channel) WR-01-365b I6 WR-01-366 D1	Main river	0.5	High		
River Dearne (old course) WR-01-365b I6	Main river	0.003	High		
Brook Dike WR-01-366 C1	Ordinary watercourse	<0.002	Low		
Crane Well Dike WR-01-366 E2	Ordinary watercourse	<0.002	Low		
Ludwell spring channel 1 WR-01-366 B6	Ordinary watercourse	<0.002	Low		
Ludwell spring channel 2	Ordinary watercourse	<0.002	Low		
St Helen's spring channel WR-01-366 C6	Ordinary watercourse	<0.002	Low		
Barnburgh Lakes WR-01-366 C6	Static water body	n/a	Low		
Tributary of St Helen's spring channel 1	Ordinary watercourse	<0.002	Low		

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Water body name and location ¹⁷¹	Designation	Q95 value (m3/s) ¹⁷²	Receptor value	Parent WFD water body name and identification number ¹⁷³	Current WFD status / Objective ¹⁷⁴
WR-01-366 D7					
Tributary of St Helen's spring channel 2 WR-01-366 D7	Ordinary watercourse	<0.0021	Low		
Washington Road drain WR-01-366 E2	Minor ditch	NA	Low		
Thurnscoe Dike WR-01-366 F3	Ordinary watercourse	<0.002	Low	Ings/Carr/Thurnscoe Dikes from Source to Dearne	Moderate/ Good by 2027
Tributary of Thurnscoe Dike 1 WR-01-366 H4	Ordinary watercourse	<0.002	Low	GB104027057550	
Tributary of Frickley Beck 1 WR-01-366 G7 WR-01-366 H6	Ordinary watercourse	<0.002	Low		Moderate/ Moderate 2015
Frickley Beck WR-01-366 I6 WR-01-366 I5	Ordinary watercourse	<0.002	Moderate		
Tributary of Frickley Beck 2 WR-01-366 H5	Ordinary watercourse	<0.002	Low		
Tributary of Frickley Beck 3 WR-01-366 H5	Ordinary watercourse	<0.002	Low	Frickley Beck from Source to Ea Beck GB104027063140	
Tributary of Frickley Beck 4 WR-01-366 H5	Ordinary watercourse	<0.002	Low		
Tributary of Frickley Beck 5 WR-01-366 H5	Ordinary watercourse	<0.002	Low		
Tributary of Frickley Beck 5 WR-01-366 I6	Ordinary watercourse	<0.002	Low		
Tributary of Howell Beck 1	Ordinary watercourse	0.002	Low		

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Water body name and location ¹⁷¹	Designation	Q95 value (m3/s) ¹⁷²	Receptor value	Parent WFD water body name and identification number ¹⁷³	Current WFD status / Objective ¹⁷⁴
WR-01-367a C6					
Tributary of Howell Beck 2 WR-01-366 D5	Ordinary watercourse	<0.002	Low		
Tributary of Howell Beck 3 WR-01-366 D5	Ordinary watercourse	0.002	Moderate		
Howell Beck WR-01-366 D5	Ordinary watercourse	0.002	Moderate		

Abstractions and permitted discharges (surface water)

- 15.3.6 There are four licensed surface water abstractions in the study area. None of these are located within the land required for the construction and operation of the Proposed Scheme. These are considered to be high value receptors.
- 15.3.7 Records of private unlicensed surface water abstractions, which comprise those for quantities less than 20m³ per day, have been obtained from the local authorities. These data indicate that there are no registered private unlicensed surface water abstractions within the study area. As there is no obligation to register private water supplies, unregistered private surface water supplies may be present. Private water supplies would be assessed as high value receptors unless details obtained from the owner indicate otherwise.
- 15.3.8 There are 18¹⁷⁵ consented discharges to surface waters within the study area, four of which are located within the land required for the Proposed Scheme. These have been assessed as being receptors of low value.

Groundwater

- 15.3.9 The geology of the study area is described in Section 10, Land quality, and the superficial and bedrock hydrogeology is summarised in Table 34. Unless stated otherwise, the geological groups listed would all be crossed by the Proposed Scheme. Table 34 also identifies the receptor values attributed to each groundwater receptor based on the methodologies set out in the SMR.

¹⁷⁵ The number of consents listed here is different to the number listed in Section 10, Land quality. This is because the Water resources and flood risk default study area comprises all land within 1km of the centreline of the Proposed Scheme; the Land quality default study area extends 250m from the land required for the construction of the Proposed Scheme. These default study areas are extended where the potential for wider pathways exists.

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Table 34: Summary of geology and hydrogeology in the study area

Geology ¹⁷⁶	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status ¹⁷⁷	WFD status objective ¹⁷⁸	Receptor value
Superficial deposits						
Alluvium	Along the River Dearne, River Don and Frickley Beck including tributaries.	Clays, organic clays, peat, silts, sands and gravels	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Glaciofluvial Deposits	Situated to the north and north-east of Hooton Roberts	Sand and gravel	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Bedrock						
Cadeby formation - Dolostone	Isolated outcrop along the A630 Doncaster Road, south of Denaby Main. Extended outcrops around Hickleton.	Oolitic compact and granular well bedded dolomitic Limestone. Mudstone interbeds present at the base of the unit.	Principal	Aire and Don Magnesian Limestone (GB40401G700900) Poor	Good by 2027	High
Basal Permian Sands	Limited outcrops underlying the Cadeby Formation north of Hickleton.	Yellow to brown evenly graded fine to medium false-bedded loosely cemented sand and sandstone	Principal	Aire and Don Magnesian Limestone (GB40401G700900) Poor	Good by 2027	High

¹⁷⁶ 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. 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.

¹⁷⁷ These objectives are as stated in the 2015 River basin management plan

¹⁷⁸ These objectives are as stated in the 2015 River basin management plan

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Geology ¹⁷⁶	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status ¹⁷⁷	WFD status objective ¹⁷⁸	Receptor value
Pennine Upper Coal Measures	Layered formation along the majority of the Ravenfield to Clayton area, outcropping in both the southern and northern extents	Interbedded mudstone/siltstone/sandstone. Dominantly sandstone, with rare, poor quality coal seams Outcrops of named sandstone deposits include Ravenfield Rock, Wickersley Rock, Dalton Rock and Ackworth Rock. ,	Secondary A	Don and Rother Millstone grit and Coal Measures (GB40402G992300) Poor	Good by 2027	Moderate
Pennine Middle Coal Measures	Layered formation located along a 3km section of the route of the Proposed Scheme between the area south of the River Don to Harlington.	Interbedded mudstone/siltstone/sandstone with coal seams. Formation includes the major sandstone unit the Mexborough Rock.	Secondary A	Don and Rother Millstone grit and Coal Measures (GB40402G992300) Poor	Good by 2027	Moderate

Superficial deposit aquifers

15.3.10 The basis of the receptor values attributed to the superficial deposit aquifers present within the study area, as shown in Table 34, is outlined briefly as follows:

- alluvium has been classified by the Environment Agency as Secondary A aquifer. These aquifers may be capable of supporting water supplies at a local rather than regional scale and may also form an important source of baseflow to rivers. They have therefore been classified as moderate value receptors; and
- glaciofluvial deposits have been classified as Secondary A aquifer by the Environment Agency. These aquifers may be capable of supporting water supplies at a local rather than regional scale and may also form an important source of baseflow to rivers. They have therefore been classified as a moderate value receptor.

Bedrock aquifers

15.3.11 The basis of the receptor values attributed to the bedrock aquifers present within the study area, as shown in Table 34, is outlined briefly as follows:

- the Cadeby Formation including Basal Permian Sands has been classified as a Principal Aquifer by the Environment Agency. This aquifer is capable of supporting water supplies on a regional scale and provide an important source

of baseflow to rivers. It has therefore been assessed as a high value receptor;

- the Pennine Upper Coal Measures Formation (including local unnamed sandstone bands) has been classified as a Secondary A Aquifer by the Environment Agency. This also includes the key sandstone units of the Ackworth Rock, Newstead Rock, Ravenfield Rock and Wickersley Rock. These aquifers may be capable of supporting water supplies at a local rather than regional scale and may also form an important source of baseflow to rivers. They have therefore been assessed as moderate value receptors; and
- the Pennine Middle Coal Measures Formation (including local unnamed sandstone bands) has been classified as a Secondary A Aquifer by the Environment Agency. This also includes the key sandstone unit of the Mexborough Rock. These aquifers may be capable of supporting water supplies at a local rather than regional scale and may also form an important source of baseflow to rivers. They have therefore been assessed as moderate value receptors.

WFD status of groundwater bodies

- 15.3.12 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 34. The value attributed to each of these receptors is also indicated.
- 15.3.13 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.

Abstraction and permitted discharges (groundwater)

- 15.3.14 There are no groundwater abstractions licenced for public water supply within the study area. There are no source protection zones (SPZs) associated with licensed public water supplies within the study area.
- 15.3.15 There are a total of three private groundwater abstraction licences registered in the study area, as shown on Map WR-02-365b, 366 and 367a. Of the three private groundwater abstraction licenses, one has been assessed as a high value receptor, and two have been assessed as moderate value receptors.
- 15.3.16 Information obtained from the local authorities indicates that there is one unlicensed private groundwater abstraction registered within the study area at Frickley Hall. Access to confirm the nature and source of this abstraction has not yet been obtained. This private water supply has currently been assessed as a high value receptor. As there is no obligation to register private water supplies, other 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.

- 15.3.17 There are two¹⁷⁹ consented discharge to groundwater within the study area. This discharge has been assessed as a low value receptor.

Groundwater – surface water interactions

- 15.3.18 Desk based assessment using Ordnance Survey maps and detailed river network data provided by the Environment Agency identified 35 features within the study area that had the potential to be springs. Access was possible to inspect eight of these features, of which:

- six were verified as being minor land drainage features of low value and removed from the assessment; and
- two were identified as springs of low value based on the WFD value of their receiving watercourses.

- 15.3.19 The 27 potential spring features that have yet to be inspected are assumed to be high value receptors on a precautionary basis. Eight of the potential 27 features are within the land required for the construction of the Proposed Scheme, including one south of the River Don, Ludwell spring, one west of Ludwell spring, St Helen's spring, one north-east of Barnburgh, one south of Frickley, and two springs east of Howell Wood (numbers i. and ii.).

- 15.3.20 There are five 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 would have on them, and the mitigation proposed, are outlined in Section 7, Ecology and biodiversity.

Water dependent habitats

- 15.3.21 The following nature conservation sites within the study area are potentially groundwater dependent:
- Denaby Ings Site of Special Scientific Interest (SSSI), a mosaic of open water, reed swamp, which is likely to be partially groundwater fed and connected to the River Dearne, is situated to the south-west of High Melton and adjacent to the Proposed Route. The groundwater dependency of this feature is yet to be surveyed. This feature is assumed to be of ecological importance. Further details of the ecology of this site, including the reporting on the effects and associated other mitigation, are provided in Section 7, Ecology and biodiversity;
 - Old Denaby Wetland Local Nature Reserve (LNR) located within the land required for the Proposed Scheme would be crossed directly by viaduct to the east of Denaby Main. The Old Denaby Wetland LNR covers an area of approximately 18ha and comprises two floodplain wetland sites that are likely to be partially groundwater fed. Groundwater dependency of this feature is yet

¹⁷⁹ The number of consents listed here is different to the number listed in Section 10, Land quality. This is because the Water resources and flood risk default study area comprises all land within 1km of the centreline of the Proposed Scheme; the Land quality default study area extends 250m from the land required for the construction of the Proposed Scheme. These default study areas are extended where the potential for wider pathways exists.

to be surveyed. This feature is assumed to be of ecological importance. Further details of the ecology of this site, including the reporting on the effects and associated other mitigation, are provided in Section 7, Ecology and biodiversity; and

- Thunderhole Local Wildlife Site (LWS) would be crossed directly by the Proposed Scheme to the north-east of Barnburgh. The feature comprises of series of interconnected springs and ponds that are likely to be groundwater fed, but this feature has yet to be surveyed to determine groundwater dependency. This feature is assumed to be of high ecological importance.

15.3.22 Further details of the ecology of this site, including the reporting on the effects and associated other mitigation, are provided in Section 7, Ecology and biodiversity. The following nature conservation sites are potentially dependent on surface water flows, for example periodic flooding from a watercourse:

- Firsby Reservoirs Local Nature Reserve (LNR) covers an area of 6.7ha. It comprises two ponds. The open water habitat present is subject to large seasonal fluctuations; and
- Old Denaby Wetland LNR which comprises two floodplain wetlands.

15.3.23 Further details of the ecology of these sites, including the reporting on the effects and associated other mitigation, are provided in Section 7, Ecology and biodiversity.

Existing baseline - flood risk and land drainage

15.3.24 The Environment Agency's Flood map for planning (rivers and sea)¹⁸⁰ 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).

15.3.25 The updated Flood map for surface water¹⁸¹ 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 dataset¹⁸². The British Geological Survey's (BGS) Groundwater flooding susceptibility data set¹⁸³, has been used to assess the future risk of groundwater flooding.

15.3.26 The following reports were used to help determine the baseline flood risk within the study area:

- DMBC Preliminary Flood Risk Assessment (PFRA) (2011)¹⁸⁴;

¹⁸⁰ Environment Agency, *Flood map for planning*. Available online at: <https://flood-map-for-planning.service.gov.uk/>

¹⁸¹ Environment Agency, *Risk of Flooding from Reservoirs National Dataset*. Available online at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?eastng=402498&northing=282043&address=100070518535>

¹⁸² Environment Agency, *Risk of Flooding from Reservoirs National Dataset*. Available online at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?eastng=402498&northing=282043&address=100070518535>

¹⁸³ British Geological Survey (BGS) (2018) BGS groundwater flooding. Available online at: <http://www.bgs.ac.uk/products/hydrogeology/groundwaterFlooding.html>

¹⁸⁴ Doncaster Metropolitan Council, (2011), *Doncaster PFRA*

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- DMBC Strategic Flood Risk Assessment (SFRA) Level 1 (2015)¹⁸⁵ (update to the 2009 version);
- DMBC SFRA Level 2 (2010)¹⁸⁶;
- DMBC Local Flood Risk Management Strategy (LFMRS)(2014)¹⁸⁷;
- RMBC SFRA (2008)¹⁸⁸;
- RMBC Local Flood Risk Management Strategy (LFRMS) (2014)¹⁸⁹; and
- Don Catchment Flood Management Plan (2010)¹⁹⁰.

River flooding

15.3.27 The study area includes substantial areas of floodplain (Flood Zone 2 and 3) associated with the River Don, the River Dearne main channel and the River Dearne former channel. Other floodplains that would be crossed by the route of the Proposed Scheme include those associated with Frickley Beck, located south-west of Frickley and east of Clayton. Table 35 shows all relevant 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 the definitions in Table 57 of the SMR, is also indicated.

Table 35: River flood risk sources and receptors

Source	Location description and figure/coordinate ¹⁹¹	Receptor potentially affected	Receptor value / sensitivity to flooding
River Don	River Don WR-01-365b H5	Sheffield and South Yorkshire Navigation	Low
		Denaby Lane	Moderate
		Sewage treatment works	Very high
		Sheffield to Doncaster Railway	Very high
		Industrial estates	Moderate
		Dearne Valley Leisure Centre	Moderate
		A6023 Doncaster Road	Moderate
		Residential properties at Mexborough	High
		Sports Ground west of River Don viaduct	Low
	River Dearne	Dismantled Railway	Low

¹⁸⁵ Doncaster Metropolitan Council (2015), *Doncaster MBC SFRA Level 2*

¹⁸⁶ Doncaster Metropolitan Council (2010), *Doncaster SFRA Level 1*

¹⁸⁷ Doncaster Metropolitan Council (2014), *Doncaster MBC LFMRS (2014)*

¹⁸⁸ Jacobs, (2008), *Rotherham SFRA*

¹⁸⁹ Rotherham Metropolitan Borough Council, (2014), *Rotherham MBC LFRMS*

¹⁹⁰ Environment Agency (2010), *Don Catchment Flood Management Plan*

¹⁹¹ This is the location at which the source intersects the Proposed Scheme, as indicated by the grid coordinates on the relevant Volume 2: LA13 Map Book figure (in this case WR-01)

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Source	Location description and figure/coordinate ¹⁹¹	Receptor potentially affected	Receptor value / sensitivity to flooding
River Dearne (main channel and former channel)	WR-01-365b I6	Denaby Ings SSSI	High
		Agricultural land	Moderate
River Dearne	River Dearne WR-01-366 D1	Residential properties along Mexborough Rd, Hound Hill and Water Mead	High
		Sewage Treatment Works	Very high
Thurnscoe Dike	Thurnscoe Dike WR-01-366 F3	Residential properties at Thurnscoe	High
Tributary of Thurnscoe Dike	Tributary of Thurnscoe Dike WR-01-366 G3	Residential properties at Thurnscoe	High
Frickley Beck	Frickley Beck WR-01-366 I6	Church Field Road	Moderate
		Top Lane	Moderate
		Frickley Lane	Moderate
		Agricultural land	Moderate
		All Saints Church, Frickley	Moderate
		Church Plantation	Low
		Park Farm Hall	High

Surface water flooding

15.3.28 There are numerous areas that are susceptible to surface water flooding within the study area. The key sources and receptors with potential to be affected are shown in Table 36. The value of these receptors, based on Table 57 of the SMR, is also indicated.

Table 36: Surface water flood risk sources and receptors

Source	Location description and figure/coordinate ¹⁹²	Receptor potentially affected	Receptor value
Surface water flow path crossing at Braithwell Common drop inlet culvert	Braithwell Common WR-01-365b B6	Agricultural land	Moderate
		Dismantled railway	Low
Surface water flow path crossing at Ravenfield culvert	Ravenfield culvert WR-01-365b C6	Agricultural land	Moderate
Surface water flow path at Firsby Brook culvert	Firsby Brook culvert WR-01-365b C6	M18	Very high
		Birk Lodge Farm	High
		Agricultural land	Moderate

¹⁹² This is the location at which the source intersects the Proposed Scheme, as indicated by the grid coordinates on the relevant Volume 2: LA13 Map Book figure (in this case WR-01)

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Source	Location description and figure/coordinate ¹⁹²	Receptor potentially affected	Receptor value
		Firsby reservoir	Low
Surface water path crossing at Conisbrough Parks culvert	Conisbrough Parks culvert WR-01-365b D6	Agricultural land	Moderate
Surface water flow path at Crooked Lane North culvert	Crooked Lane North culvert WR-01-365b F5	Agricultural land	Moderate
Surface water flow path at Denaby Wood South inverted siphon	Denaby Wood South inverted siphon WR-01-365b G5	Woodland	Low
Surface water flow path at Denaby Wood North inverted siphon	Denaby Wood North inverted siphon WR-01-365b G5	Woodland	Low
Surface water flow path at Owlcr Carr culvert	Owlcr Carr culvert WR-01-366 B6	Agricultural land	Moderate
Surface water flow path at St Helen's spring culvert	St Helen's spring culvert WR-01-366 C6	Agricultural land	Moderate
Surface water flow path at Thunder Hole culvert	Thunder Hole culvert WR-01-366 D7	Woodland	Low
		Agricultural land	Moderate
Surface water flow path at Sheep Walks inverted siphon	Sheep Walks inverted siphon WR-01-366 E7	Agricultural land	Moderate
Surface water flow path at Hickleton drop inlet culvert	Hickleton drop inlet culvert WR-01-366 E7	Agricultural land	Moderate
Surface water flow path at The Wilderness culvert (tributary of Frickley Beck 1)	The Wilderness culvert WR-01-366 G7	Agricultural land	Moderate
Surface water flow paths associated with tributary of Frickley Beck and Frickley Beck 2 viaduct	Frickley viaduct and Frickley Beck inverted siphon WR-01-366 I6	Residential properties in Clayton	High
		Sewage treatment works	Low
		Existing Dearne Valley line (also called the Wakefield line railway)	Very High
		Agricultural land	Moderate
Surface water flow path associated with, tributary of Frickley Beck 3 r	Stotfold Road inverted siphon WR-01-366 H5	Stotfold road	Moderate
		Agricultural land	Moderate
Surface water flow path at Sheepwash Plantation culvert	Sheepwash Plantation culvert WR-01-367a C6	Agricultural land	Moderate
	Howell Beck culvert	Agricultural land	Moderate

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Source	Location description and figure/coordinate ¹⁹²	Receptor potentially affected	Receptor value
Surface water flow path at Howell Beck culvert	WR-01-367a D5	Woodland	Low
Surface water flow path	Sidney Street and Highcliffe Drive WR-01-366 C1	Residential properties	High
Surface water flow path	Wath Road WR-01-366 C1	Wath Road	Moderate
Surface water flow path	WR-01-366 C1	Dearne Valley line	Very high
Surface water flow path	WR-01-366 D1	Residential properties at Park Crescent,	High
Surface water flow path	WR-01-366 D1	Bolton Upon Dearne station and Dearne Valley railway line	Very high
Surface water flow path at Crane Well Dike	WR-01-366 E1	Residential properties at Furlong Road	High
Surface water flow path	WR-01-366 F2	Dearne Valley railway line	Very high
Surface water flow path	WR-01-366 G4	Dearne Valley railway line	Very high
Surface water flow path	WR-01-366 G4	Thurnscoe station and Dearne Valley railway line	Very high

Artificial water bodies

- 15.3.29 Flooding from artificial water bodies may occur due to failure of an impounding structure, such as a dam or canal embankment. Artificial water bodies with potential implications for flood risk within the study area include Firsby Reservoir. Firsby Reservoir, which is 200m to the east of the route, is the only artificial water body with potential to affect flood risk of relevance to the Proposed Scheme. However, as this is a large raised reservoir, subject to the requirements of reservoir safety legislation¹⁹³, the inundation risk posed by this reservoir is considered negligible.
- 15.3.30 There are a number of other reservoirs located outside the study area within the River Don and River Dearne catchments upstream of the Proposed Scheme with potential implications for flood risk within the study area. The closest of these is Thrybergh Reservoir located approximately 6km to the south-west of the River Don viaduct. However as these are large raised reservoirs, subject to the requirements of reservoir safety legislation¹⁹⁴, the inundation risk posed by these reservoirs is considered negligible.

¹⁹³ Department for Communities and Local Government (DCLG), (2014), Reservoirs: Owners and Operator Requirements (Updated 2016). <https://www.gov.uk/guidance/reservoirs-owner-and-operator-requirements>

¹⁹⁴ Department for Communities and Local Government (DCLG), (2014), Reservoirs: Owners and Operator Requirements (Updated 2016). <https://www.gov.uk/guidance/reservoirs-owner-and-operator-requirements>

Groundwater flooding

- 15.3.31 Information related to historical incidents of groundwater flooding within the Ravenfield to Clayton area has been investigated within the Doncaster SFRA¹⁸⁶, the Rotherham SFRA¹⁸⁸, the Doncaster LFRMS¹⁸⁷, and the Rotherham LFRMS¹⁸⁹. These documents do not make any reference to specific locations or incidents of historical groundwater flooding within the study area.
- 15.3.32 The BGS Groundwater flooding susceptibility data set indicates that there is some potential for groundwater flooding to occur central to the study area around the floodplains of the River Dearne and River Don where the Proposed Scheme would be underlain by superficial alluvial deposits. There is limited potential for further groundwater flooding across the study area where the underlying geology consists of various sandstones or the Magnesian limestone of the Cadeby Formation.

Land drainage

- 15.3.33 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.

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 (CoCP)¹⁹⁵ includes a range of mitigation measures that aim to reduce construction impacts insofar 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 strategy include:
- avoidance of channels and floodplains, where reasonably practicable – the route of the Proposed Scheme would avoid passing along river or stream valleys, such as that of the River Don, the River Dearne and Frickley Beck and their associated floodplains. Instead it would pass over these larger watercourses on viaducts spanning the floodplain, with piers set back from the channel;

¹⁹⁵ Supporting document: Draft Code of Construction Practice

- avoidance, where reasonably practicable, of water dependant habitats, 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 the Volume 2: LA13 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 Watercourse realignments are proposed at the following locations: tributary of Firsby Brook 1 downstream of Braithwell drop inlet culvert; tributary of the River Dearne at River Dearne viaduct; Ludwell spring channels 1 at Owler Carr culvert; St Helen's spring channel at St Helen's spring culvert; tributary of Frickley Beck 2 at Clayton South culvert; tributary of Howell Beck 1 at Sheepwash Plantation culvert; and Howell Beck at Howell Beck culvert. The aim will be to design these with equivalent hydraulic capacity to the existing channels. The Proposed Scheme would also aim to ensure that field subsurface drainage systems can be adapted to discharge into the new channels. Where such watercourses are natural channels, the design aim will be to incorporate appropriate features to retain and, where reasonably practicable, enhance their hydromorphological condition¹⁹⁶.
- 15.4.6 Watercourse diversions, which would result in changes in flow regime within discrete sections of channel, have been avoided wherever possible. There are nine diversions proposed within this study area:
- Firsby Brook at Firsby Brook culvert;
 - tributary of Hooton Brook at Conisbrough Parks culvert;
 - tributaries of Hooton Brook 4 and 5 at Crooked Lane South culvert;
 - tributary of Hooton Brook 6 at Crooked Lane North culvert;
 - Ludwell spring channels 2 at Owler Carr culvert;
 - tributary of St Helen's spring channel 1 at Thunder Hole culvert;
 - tributary of Frickley Beck 6 at Frickley viaduct;
 - tributary of Howell Beck 2 at Howell Beck culvert; and
 - tributary of Howell Beck 3 at Howell Beck culvert.

¹⁹⁶ '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

- 15.4.7 For watercourses that are not in their natural condition, the design aim for realignments and diversions will be to incorporate measures, where reasonably practicable, to improve their hydromorphological condition, provided this is compatible with their flood risk and land drainage functions.
- 15.4.8 The design of infrastructure required within or in proximity to an existing channel (including bridge abutments, intermediate piers and outfalls) will aim to reduce impacts on the natural hydromorphology of watercourse channels, insofar as is reasonably practicable.
- 15.4.9 The draft CoCP 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.
- 15.4.10 Method statements will be required for all watercourse crossings and channel realignments required for site haul routes. The method statements will describe how potential changes to flood risk, water quality and channel hydromorphology will be managed during the establishment, use and decommissioning of all site haul routes.
- 15.4.11 Permanent culverts proposed on the smaller watercourse crossings within this study area include: Firsby Brook culvert; Conisbrough Parks culvert; Crooked Lane South culvert; Crooked Lane North culvert; Owlerr Carr culvert; St Helen's spring culvert; Thunder Hole culvert; the Wilderness culvert; Stotfold Road inverted siphon; Clayton South culvert; Sheepwash Plantation culvert; Howell Beck Culvert and Frickley Beck inverted siphon. The detailed design of these culverts will be developed in general accordance with 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 and inverted siphons have been avoided wherever reasonably practicable. The exceptions being Frickley Beck inverted siphon on

Frickley Beck, an ordinary watercourse of moderate value, and Stotfold Road inverted siphon on tributary of Frickley Beck 2, an ordinary watercourse of low value;

- culvert lengths have been reduced insofar 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.

15.4.12 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 bodies WFD quality elements, will be considered within the formal ES.

15.4.13 Existing groundwater abstraction boreholes or monitoring points would 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 contractors would follow the latest good practices. This would also be applicable to springs potentially affected by the Proposed Scheme, although additional measures may be required to mitigate temporary construction impacts. Wherever reasonably practicable, the design will aim to recreate affected spring features nearby.

15.4.14 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 and cuttings insofar as is reasonably practicable. The types of measure likely to be adopted could include:

- installation of cut-off¹⁹⁷ structures around excavations;
- ensuring cut-off structures are driven to sufficient depths to meet an underlying strata or zone of lower permeability;
- promoting groundwater recharge, such as discharging pumped water to recharge trenches around excavations to maintain baseline groundwater and surface water conditions; and
- incorporating 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.

15.4.15 The exact requirements will be refined and method of mitigation would be designed following ground investigation at foundations, tunnels or cutting locations.

Flood risk and land drainage

15.4.16 The design of the Proposed Scheme will aim to mitigate permanent impacts on flood risk and land drainage as follows:

- The floodplain avoidance strategy would ensure that the impacts on flood

¹⁹⁷ Impermeable barrier preventing water flow

flows within rivers and streams, and their floodplains, would be limited to those associated with the intermediate pier structures on the viaducts, which would be located in the River Don, River Dearne and Frickley Beck floodplain. The Proposed Scheme includes replacement floodplain storage areas to replace losses associated with the piers;

- the temporary works shown on Map Series CT-05 in the Volume 2: LA13 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 would 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 flood with an allowance for climate change based on latest guidance issued by the Environment Agency¹⁹⁸;
- 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 new sections of highway 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 would pass in cutting, drainage measures 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 would 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 would be introduced to reduce any potentially significant effects on groundwater flood risk insofar 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

¹⁹⁸ Environment Agency (2016) Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities

material such as gravel.

15.4.17 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 to the potential for impacts on existing land drainage systems during construction. Some of the specific measures referred to in 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.

15.4.18 In accordance with the Section 16 of the draft CoCP, monitoring would 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 impact on existing land drainage systems are managed appropriately.

Assessment of impacts and effects

15.4.19 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 would 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

15.4.20 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.

Groundwater

Aquifers

- 15.4.21 The proposed cuttings in the study area would intersect the Pennine Middle Coal Measures and the Pennine Upper Coal Measures Secondary A aquifers; as well as various alluvium Secondary A aquifers and the Cadeby Formation (including the Basal Permian Sands) Principal Aquifer. Whilst it is likely there would be minor localised impacts, the implementation of the measures outlined in the draft CoCP is likely to mean that any impacts on the overall status of these aquifers would not be significant.
- 15.4.22 Where the cuttings could affect local receptors, such as groundwater abstractions or springs, this is reported in the sections below.

Abstractions

- 15.4.23 No temporary significant effects on groundwater abstractions have been identified.

Groundwater - surface water interactions

- 15.4.24 No potential for temporary significant effects has been identified in connection with water dependent habitats.

Water dependent habitats

- 15.4.25 Denaby Ings SSSI lies external to the predicted zone of influence of potential dewatering for Mexborough Cutting, and is at sufficient distance from temporary earthworks associated with Mexborough embankment, such that groundwater flow or quality to this feature should not be affected. Therefore, any effects to the water dependent habitat during the temporary construction would result in a negligible hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.
- 15.4.26 Shallow groundwater flow may provide baseflow to the areas of floodplain within Old Denaby Wetland LNR. Temporary earthworks associated with Old Denaby cutting and the River Don viaduct may also have the potential to alter localised groundwater quality. The temporary dewatering associated with cutting and installation of viaduct piers may also change the dynamics of groundwater flow and reduce baseflow, resulting a minor hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.
- 15.4.27 Shallow groundwater flow pathways are likely to be feeding three springs north-east of Barnburgh, south of Stables Wood and Thunderhole that are supporting the surface water environment at Thunderhole LWS. Temporary earthworks associated with Hickleton cutting have the potential to alter localised groundwater quality. The temporary dewatering associated with the cutting may result in the loss of groundwater feeding the spring features which would result in a moderate hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.

Temporary effects - Flood risk and land drainage

- 15.4.28 Construction of the River Don viaduct, River Dearne viaduct and Frickley Beck viaduct would require temporary working within flood zones. Construction sequencing and temporary works design will be carefully considered and assessed in terms of potential impacts on flood risk. Method statements detailing how these works will be undertaken will be produced by the nominated undertaker in consultation with the Environment Agency and the LLFA. It is not anticipated that these temporary activities would result in significant effects related to flood risk and land drainage.

Permanent effects – Water resources and WFD

- 15.4.29 Permanent effects are those initially caused by activity to construct the Proposed Scheme but which would also remain after the Proposed Scheme has been constructed and is present in the area.

Surface water

- 15.4.30 The crossing of the Frickley Beck requires the construction of an inverted siphon at Church Field Road cutting. This has the potential to have a localised moderate adverse impact on channel hydromorphology. As Frickley Beck is a moderate value receptor the effect would be moderate adverse, which is significant.

Groundwater

Aquifers

- 15.4.31 It is currently anticipated that implementation of the avoidance and mitigation measures would 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.
- 15.4.32 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.

Abstractions

- 15.4.33 The construction of Thurnscoe embankment would likely result in the permanent loss of Frickley Lodge borehole. However, the implementation of the measures outlined in the draft CoCP is likely to mean that any impacts resulting in adverse effects would be mitigated accordingly, resulting in a negligible effect, which is not significant.

Groundwater – surface water interactions

- 15.4.34 The Proposed Scheme could affect the following potential spring features, all of which have been assumed to be high value receptors, pending further site survey. The Proposed Scheme is likely to result in the permanent reduction of groundwater catchment to two potential spring features, one north-east of Barnburgh, and at Thunder Hole due to the construction of Hickleton cutting. This would potentially result in moderate adverse effects, which would be significant.
- 15.4.35 The Proposed Scheme is likely to result in the permanent reduction of groundwater catchment to a potential spring feature at Conisbrough Parks (ii.) due to the

construction of Ravenfield cutting. This would potentially result in a moderate adverse effect, which would be significant.

- 15.4.36 The Proposed Scheme is likely to result in the permanent reduction of groundwater catchment to a potential spring feature at Birk Lodge Farm due to the construction of Bramley North cutting. This would potentially result in a moderate adverse effect, which would be significant.
- 15.4.37 Construction of the Proposed Scheme is likely to result in the permanent loss of St Helen's spring and a potential spring west of Ludwell spring. A soil stockpile area associated with the construction of Barnburgh embankment is scheduled to be temporarily positioned above the emergence points of both potential spring features. This would potentially result in moderate adverse effects, which would be significant.
- 15.4.38 The Proposed Scheme is likely to result in the permanent loss of the potential spring feature south of Frickley due to the construction of Clayton South embankment. This would potentially result in a permanent major adverse effect, which would be significant.
- 15.4.39 The Proposed Scheme is likely to result in the permanent loss of Ludwell spring due to the construction of Barnburgh embankment. This would potentially result in a permanent major adverse effect, which would be significant.

Water dependent habitats

- 15.4.40 Denaby Ings SSSI lies external to the predicted zone of influence of potential dewatering for Mexborough cutting such that groundwater flow to this feature should not be affected. Therefore, any affects to the water dependent habitat during the permanent construction would result in a negligible hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.
- 15.4.41 Shallow groundwater flow may provide baseflow to the areas of floodplain within Old Denaby Wetland LNR. The permanent dewatering associated with Hickleton cutting and installation of viaduct piers for the River Don viaduct may also change the dynamics of groundwater flow and reduce baseflow, resulting in a minor hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.
- 15.4.42 Shallow groundwater flow pathways are likely to be feeding three springs north-east of Barnburgh, south of Stables Wood and Thunderhole that are supporting the surface water environment at Thunderhole LWS. The temporary dewatering associated with Hickleton cutting may result in the loss of groundwater feeding the spring features, resulting in a moderate hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.
- 15.4.43 Old Denaby Wetland LNR is located within the River Don floodplain. The track drainage design incorporates a balancing pond adjacent to the route, to the north of Denaby Main Industrial Estate. This is also located within the floodplain of the River Don, in Flood Zone 3. The location of this pond could potentially cause flood levels to

increase, resulting in a minor hydrological impact. The assessment of effects and associated other mitigation for water dependent habitats are provided in Section 7, Ecology and Biodiversity.

Permanent effects - Flood risk and land drainage

- 15.4.44 The track drainage design incorporates a balancing pond adjacent to the route, to the north of Denaby Main Industrial Estate. This is located within the floodplain of the River Don, in Flood Zone 3. The Proposed Scheme makes provision for a replacement floodplain storage area to mitigate the loss of flood storage. The Doncaster to Sheffield existing railway passes approximately 40m to the north of the proposed balancing pond. Until hydraulic analysis has been undertaken to verify the effectiveness of this proposed replacement floodplain storage area, the potential for a minor impact on this very high value receptor cannot be discounted. This minor impact would result in a moderate adverse effect, which is significant.

Other mitigation measures

- 15.4.45 Additional mitigation measures to further reduce the temporary and permanent impacts of construction stage activities, where there is potential for the Proposed Scheme to result in significant effects are described in the sections below.

Surface water

- 15.4.46 The design of the inverted siphon on Frickley Beck at Church Field Road cutting would be developed further in consultation with the Environment Agency and the LLFA in order to reduce any adverse impacts on channel hydromorphology insofar as reasonably practicable.

Groundwater

- 15.4.47 The assessment has not identified the requirement for any additional groundwater mitigation to take place.

Groundwater-surface water interactions

- 15.4.48 Further surveys of the springs and potential spring features, likely to have a reduction of groundwater catchment area due to temporary dewatering, permanent presence of the cuttings, or site drainage, shall be undertaken to determine whether further mitigation is required. Based on the outcomes of the risk assessment measures would be implemented to mitigate the effect on these features, for example to re-establish the springs nearby in a manner that ensures any adverse impacts are mitigated.
- 15.4.49 In addition, further surveys of the springs and potential spring features, likely to be permanently lost due to the construction of the Proposed Scheme shall be undertaken to determine whether further mitigation is required. Based on the outcomes of the risk assessment measures would be implemented to mitigate the effect on these features, for example to re-establish the springs nearby in a manner that ensures any adverse impacts are mitigated.

Summary of likely residual significant effects

- 15.4.50 In the absence of the other mitigation measures set out above, the Proposed Scheme would potentially result in residual significant effects as follows:

- a permanent moderate adverse effect has been identified at the crossing of the Frickley Beck related to the construction of the Stotfold Road inverted siphon, which is significant;
- a temporary and permanent moderate adverse effect related to the potential loss of groundwater catchment to two potential springs situated north-east of Barnburgh and at Thunder Hole due to Hickleton cutting, which are significant;
- a temporary and permanent moderate adverse effect related to the potential loss of groundwater catchment to a potential spring at Conisbrough Parks (ii.) due to Ravenfield cutting, which is significant;
- a temporary and permanent moderate adverse effect related to the potential loss of groundwater catchment to a potential spring at Birk Lodge Farm due to Bramley North cutting, which is significant;
- a permanent moderate adverse effect related to the loss of the potential spring features St Helen's spring and spring west of Ludwell spring due to the proximity of a temporary soil stockpile, which are significant;
- a permanent major adverse effect related to the loss of the potential spring feature Ludwell spring due to the construction of Barnburgh embankment, which is significant;
- a permanent major adverse effect related to the loss of a spring feature south of Frickley due to the construction of Clayton South embankment, which is significant; and
- a permanent moderate adverse effect on flood risk caused by the encroachment of the track drainage balancing pond north of Denaby Main Industrial Estate into the floodplain of the River Don, which is significant.

15.4.51 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.

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 will be provided in the formal ES.

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. 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 would have a negligible impact on the water environment.
- 15.5.4 A summary of the route-wide WFD compliance assessment process is provided in Volume 3: Route-wide effects. This describes the ongoing assessment process and how measures will be embedded into the design that are specifically designed to ensure that the Proposed Scheme complies with the requirements of the WFD, where reasonably practicable. It is currently anticipated that the Proposed Scheme will be compliant with WFD legislation.

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 The assessment shows that there will be no residual significant effects on surface water, groundwater or flood risk during operation of the Proposed Scheme.

Monitoring

- 15.5.8 Volume 1, Section 9 sets out the general approach to monitoring of water resources and flood risk during operation of the Proposed Scheme.
- 15.5.9 There are no area-specific requirements for monitoring water resources and flood risk during operation of the Proposed Scheme.

16 References

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