LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA10 | Dunsmore, Wendover and Halton

November 2013

VOL 2

ES 3.2.1.10

LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA10 | Dunsmore, Wendover and Halton

November 2013

ES 3.2.1.10

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.

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

ARUP ATKINS CAPITA ERM

ineco Mott MacDonald PARSONS BRINCKERHOFF TEMPLE URS

High Speed Two (HS2) Limited,
Eland House,
Bressenden Place,
London SW1E 5DU

Details of how to obtain further copies are available from HS2 Ltd.

Telephone: 020 7944 4908

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

recycle

Printed in Great Britain on paper containing at least 75% recycled fibre.

Contents

List of figures

List of tables

Structure of the HS2 Phase One Environmental Statement

The Environmental Statement (ES) documentation comprises:

- **Non-technical summary (NTS)** - which provides a summary in non-technical language of the Proposed Scheme, the likely significant environmental effects of the Proposed Scheme, both beneficial and adverse, and the means to avoid or reduce the adverse effects;
- **Volume 1: Introduction to the ES and the Proposed Scheme** - This describes High Speed Two (HS2), and the environmental impact assessment process, the approach to consultation and engagement, details of the permanent features and generic construction techniques as well as a summary of main strategic and route-wide alternatives and local alternatives (prior to 2012) considered;
- **Volume 2: Community forum area reports and map books** - 26 reports and associated map books providing a description of the scheme and of environmental effects in each area;
- **Volume 3: Route-wide effects** - provides an assessment of the effects of the Proposed Scheme where it is not practicable to describe them within the CFA descriptions in Volume 2;
- **Volume 4: Off-route effects** - provides an assessment of the off-route effects of the Proposed Scheme;
- **Volume 5: Appendices and map books** – contains supporting environmental information and associated map books; and
- **Glossary of terms and list of abbreviations** – contains terms and abbreviations, including units of measurement, used throughout the ES documentation.

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, South Yorkshire and the East Midlands will be served by high speed trains running at speeds of up to 360kph (225mph).

1.1.2 HS2 is proposed to be built in two phases. Phase One, the subject of this ES, will involve the construction of a new railway line of approximately 230km (143 miles) between London and Birmingham. Construction will begin in 2017 and the line will become operational by 2026; with a connection to the West Coast Main Line (WCML) near Lichfield and to the existing HS1 railway line in London.

1.1.3 During Phase One beyond the dedicated high speed track, high speed trains will connect with and run on the existing WCML to serve passengers beyond the HS2 network to destinations in the north. A connection to HS1 will also allow some services to access that high speed line through east London and Kent and connect with mainland Europe via the Channel Tunnel.

1.1.4 Phase Two will involve the construction of lines from Birmingham to Leeds and Manchester; with construction commencing approximately 2023, and planned to be operational by 2033.

1.1.5 Section 4 of Volume 1 describes the anticipated operational characteristics of HS2, including the anticipated frequency of train services. As Volume 1 shows, the frequency of trains is expected to increase over time and to increase further upon opening of Phase Two. In assessing the environmental effects of the Proposed Scheme the anticipated Phase 2 operational frequency has been used. For further detail of the anticipated operation of the Proposed Scheme in the Ladbroke and Southam area (CFA16), see Section 2.4.

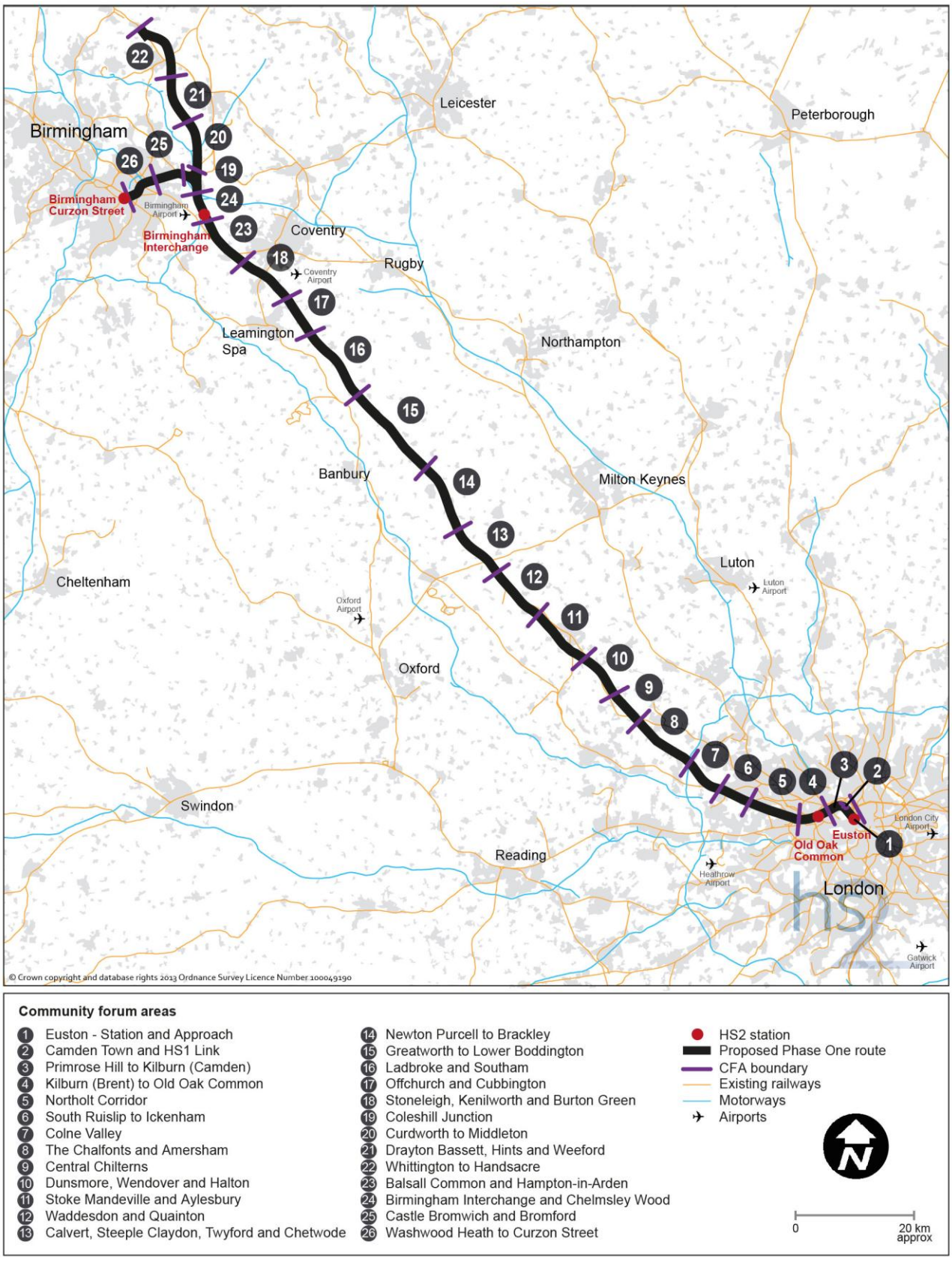
1.1.6 The Government believes that the HS2 network should link to Heathrow and its preferred option is for this to be built as part of Phase Two. However, the Government has since taken the decision to pause work on the Heathrow link until after 2015 when it expects the Airports Commission to publish its final report on recommended options for maintaining the country's status as an international aviation hub.

1.1.7 For consultation and environmental assessment purposes, the proposed Phase One route has been divided into 26 community forum areas (CFA), as shown in Figure 1. This has enabled wider public engagement on the Proposed Scheme design and on the likely adverse and beneficial effects.

1.2 Purpose of this report

1.2.1 This CFA report presents the likely significant effects of the construction and operation of the Proposed Scheme on the environment within CFA10 (Dunsmore, Wendover and Halton). The report describes the mitigation measures that are proposed for the purpose of avoiding, reducing or managing the likely significant adverse effects of the Proposed Scheme on the environment within CFA10.

Figure 1: HS2 Phase One route and community forum areas



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 area, description of the Proposed Scheme within the area and its construction and operation, and a description of the main local alternatives.
- **Sections 3-13** – an assessment for the following environmental topics:
  - agriculture, forestry and soils (Section 3);
  - air quality (Section 4);
  - community (Section 5);
  - cultural heritage (Section 6);
  - ecology (Section 7);
  - land quality (Section 8);
  - landscape and visual assessment (Section 9);
  - socio-economics (Section 10);
  - sound, noise and vibration (Section 11);
  - traffic and transport (Section 12); and
  - water resources and flood risk assessment (Section 13).

1.3.2 Each environmental topic section comprises: an introduction to the topic; a description of the environmental baseline within the area; the likely significant environmental effects arising during construction and operation of the Proposed Scheme; and proposed mitigation measures.

1.3.3 Environmental effects have been assessed in accordance with the methodology set out in Volume 1, the Scope and Methodology Report (SMR) (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2).

1.3.4 Where appropriate, potential climate change impacts and adaptation measures are discussed in the relevant environmental topic section. Volume 1 and Section 6A of the SMR Addendum (Volume 5: Appendix CT-001-000/2) also include additional information about climate change adaptation and resilience.

1.3.5 The maps relevant to Dunsmore, Wendover and Halton are provided in a separate corresponding document entitled Volume 2: CFA10 Map Book that should be read in conjunction with this report.

1.3.6 The Proposed Scheme described in this report is that shown on the Map Series CT-05 (construction) (Volume 2, CFA10 Map Book) and CT-06 (operation) (Volume 2, CFA10

Map Book). There is some flexibility during detailed design to alter the horizontal and vertical alignments and other details within the limits shown on the plans and sections submitted to Parliament and as set out in the hybrid Bill, and this flexibility is included within the scope of the environmental assessment. Further explanation is provided in Volume 1, Section 1.4.

1.3.7 In addition to the environmental topics covered in Sections 3-13 of this report, electromagnetic interference is addressed in Volume 1 and climate (greenhouse gas emissions and carbon), and waste and material resources are addressed in Volume 3. An assessment of potential environmental effects beyond the CFA has also been undertaken and this 'off-route' assessment is reported in Volume 4.

2 Overview of the Area and Description of the Proposed Scheme

2.1 Overview of the area

2.1.1 The Dunsmore, Wendover and Halton area (CFA10) comprises an approximately 8km section of the Proposed Scheme passing through the parishes of The Lee, Wendover and Ellesborough within the districts of Chiltern, Wycombe and Aylesbury. The boundary between Wendover, The Lee and Great Missenden parishes forms the southern boundary of the study area. The boundary between Ellesborough and Stoke Mandeville parishes forms the northern boundary.

2.1.2 Central Chilterns (CFA9) lies to the south and Stoke Mandeville and Aylesbury (CFA11) lies to the north as shown in Figure 2.

Settlement, land use and topography

2.1.3 The area is predominantly rural in character, with agricultural land interspersed with large areas of woodland, small villages and isolated farmsteads. The Proposed Scheme will run along the south-western edge of Wendover, the largest settlement in the area.

2.1.4 At the southern end of this section, the route will pass within 1km of the settlements of Hunt's Green and Kingsash that lie to the east of the Proposed Scheme and Wendover Dean that lies to the west. The route will continue towards Wendover, with Dunsmore Village approximately 1.6km to the west. The village of Halton lies north-east of Wendover and is approximately 2km from the Proposed Scheme.

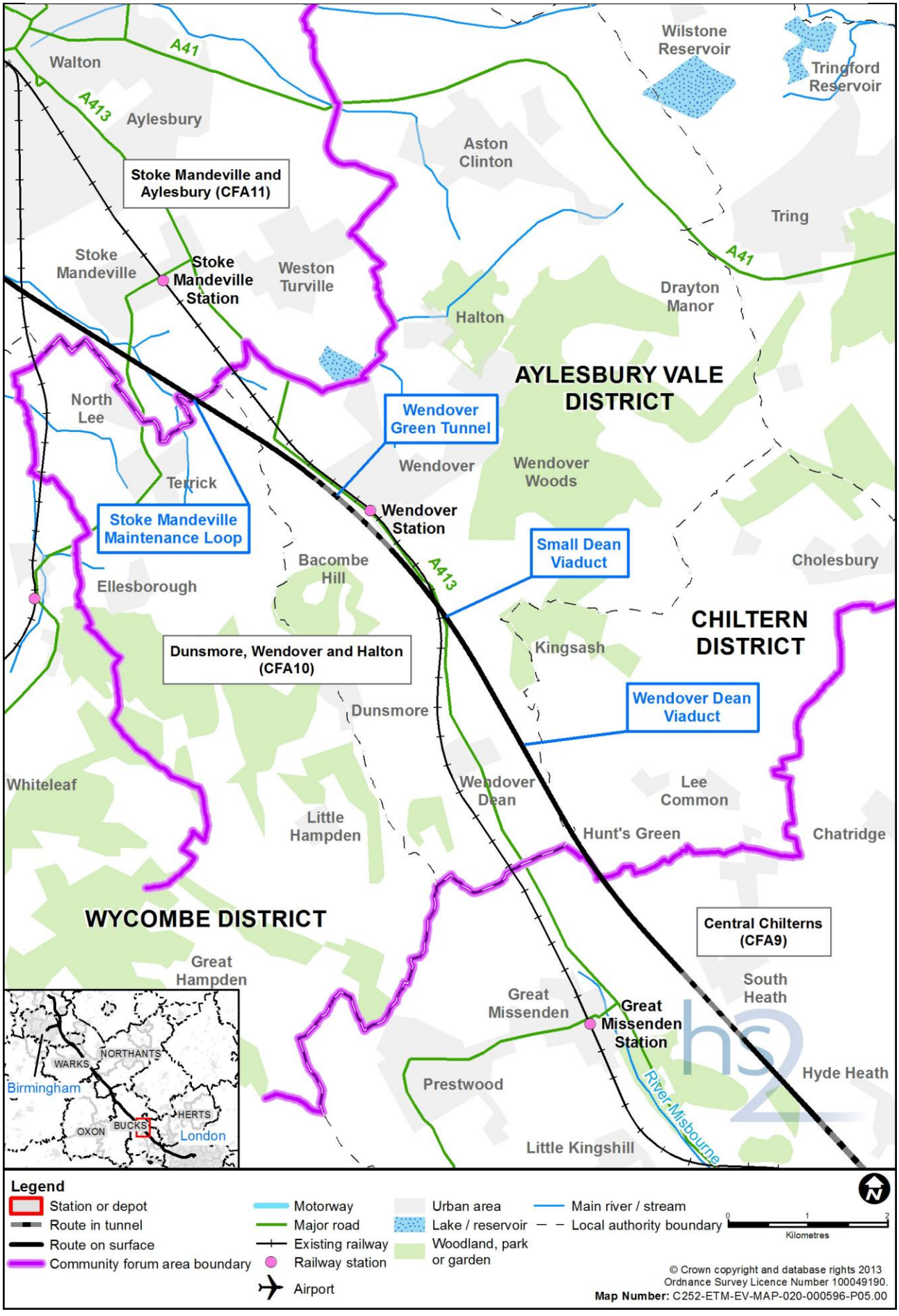
2.1.5 Approximately 7km of the route in this section of the Proposed Scheme lies within the Chilterns AONB from Leather Lane to the north of Wendover.

Key transport infrastructure

2.1.6 The principal highway in the Dunsmore, Wendover and Halton area is the A413 London Road/Nash Lee Road that runs south to north roughly parallel to the Proposed Scheme and connects Great Missenden, Wendover and Stoke Mandeville as shown on Maps CT-10-019 to CT-10-021a (Volume 2, CFA10 Map Book). The A413 broadly follows the Marylebone to Aylesbury Line along the valley floor. In the north of the area, the B4009 Nash Lee Road links the villages of Terrick and The Hollies to Wendover, crossing the Proposed Scheme. The remainder of the road network consists of unclassified roads and narrow country lanes.

2.1.7 Three long-distance footpaths intersect the Proposed Scheme in this area (see Maps CT-06-035 to CT-06-040, Volume 2, CFA10 Map Book). The Chiltern Way crosses the route to the east of Wendover Dean, whilst the South Bucks Way and the Aylesbury Ring public rights of way (PRoW) link Bacombe Hill to Haddington Hill, crossing the route to the south of Wendover. Numerous other footpaths, byways, bridleways and access roads provide connections between villages and isolated settlements in the area.

Figure 2: Area context map



Socio-economic profile

2.1.8 To provide a socio-economic context for the area, data for the demographic character areas (DCA) of Wendover Dean, Hunt's Green, Kingsash and Lee Common, Wendover, Dunsmore and Nash Lee and North Lee are used[1]. In total, the population of the DCA is approximately 8,800.

2.1.9 The area's labour market outperforms England's as a whole; unemployment at 3.8% is significantly lower than the national level of 7.4%, while 72.4% of the population aged 16-74 is economically active compared to the national figure of 69.9%[2].There are approximately 2,900 people who work within the area[3].

Notable community facilities

2.1.10 The main shops and services in the area are located in Wendover with many of the surrounding villages having a limited range of facilities. Wendover has a post office, public library, public hall (Wendover Memorial Hall), tourist information centre, youth centre and a wide range of shops, including a bank, estate agents and several restaurants, cafes and public houses. There are two nurseries in Wendover (The Children's Day Room and Little Acorns Kindergarten); four primary schools (Wendover Church of England (CofE) Junior School, the John Hampton Infant School, Halton Combined Primary School and Lee Common CofE School); two secondary schools (the John Colet School that caters for 11-18 year-olds, and Wendover House School, a boy's special school), one health centre, two dentists and two churches (St Mary's and St Anne's). In the settlements outside of Wendover, public houses and community halls provide a focus for social gatherings and for village events.

Recreation, leisure and open space

2.1.11 There are a wide range of recreational facilities in Wendover and the surrounding area including a rifle range, a tennis and squash club, a recreation ground, a bowls club (on Dobbins Lane), a skate park and a cricket ground that is open for local sports clubs, as well as the cricket ground at Witchell. St Mary's Church is used for music concerts and recitals as well as services. Wendover also has three allotment sites (Hogtrough Lane, Bacombe Lane and Aylesbury Road).

2.1.12 This is a predominantly rural area, with open space, woodland and some farmland. It is crossed by several PRoW, including the Aylesbury Ring (Footpath WEN/6), Chiltern Way (Footpath WEN/36), Wendover Rambles No.1, 3 and 5, Icknield Way (Bridleway WEN/57), Chilterns Cycleway, the Ridgeway Trail (a National Trail, Footpath WEN/15A) and Coombe Hill Walk. There is also a wildflower meadow near Heron Path House and Hampden Meadow and a pond next to St Mary's Church.

Planning and policy context

2.1.13 Given that the Proposed Scheme is being developed on a national basis to meet a national need, it is not included or referred to in many local plans. Nevertheless, in seeking to consider the Proposed Scheme in the local context, relevant local plan documents and policies have been considered in relation to environmental topics.

[1] A DCA represents a community that, depending on the area, may consist of a local ward, neighbourhood or village(s).
[2] Office for National Statistics (ONS) (2012), *Census 2011*, ONS, London.
[3] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London.

2.1.14 The following local policies have been considered and referred to where appropriate to the assessment. Where a policy document is not referred to within a particular technical section, it is due to the absence of policies of relevance to that topic:

- Aylesbury Vale District Council Local Plan Saved Policies (2007)[4];
- Aylesbury Vale District Council Vale of Aylesbury Plan Strategy 2011-2031 (2013)[5];
- Buckinghamshire County Council Minerals and Waste Core Strategy DPD (MWCS) (2012)[6];
- Buckinghamshire Structure Plan[7];
- Chiltern District Council Core Strategy (2011)[8];
- Chiltern District Council Local Plan (Consolidated policies) (2011)[9];
- Wycombe District Council Adopted Core Strategy Development Plan Document (DPD) (2008)[10];
- Wycombe District Council Delivery and Site Allocations Plan (2013)[11]; and
- Wycombe District Council Local Plan Saved Policies (2008)[12].

2.1.15 There are a number of key planning designations in the area including scheduled monuments, Grade II listed buildings, a site of special scientific interest (SSSI), and parts of three conservation areas. These are shown on Map Series CT-10 (Volume 2, CFA10 Map Book).

2.1.16 Emerging policies are not generally considered within this report, unless a document has been submitted to the Secretary of State for approval. However, the Local Development Framework Delivery Development Plan Document (Development Management Policies), that is expected to be adopted in late 2014/early 2015, will replace many of the existing Saved Policies from the Chiltern Local Plan[9].

2.1.17 Aylesbury Vale District Council requested the Secretary of State's direction to withdraw its Core Strategy[13]. The Aylesbury Vale District Local Plan Saved Policies[14] form the current development plan within the district. The Aylesbury Vale Local Development Framework (LDF) is currently under preparation. The Vale of Aylesbury Plan Strategy Document[15] was submitted to the government for an independent examination on 12th August 2013. This document, along with a separate development

[4] Aylesbury Vale District Council (2007), *Aylesbury Vale District Local Plan Written Statement 2004: Saved Policies*.
[5] Aylesbury Vale District Council (2013), *Vale of Aylesbury Plan Strategy 2011-2031, Submission*.
[6] Buckinghamshire County Council (2012), *Minerals and Waste Core Strategy Development Plan Document.*
[7] Buckinghamshire County Council (1991), *Buckinghamshire Structure Plan 1991-2011: Saved Policies.*
[8] Chiltern District Council (2011), *Adopted Core Strategy.*
[9] Chiltern district Council (2011), *Adopted Local Plan, Consolidated September 2007 and November 2011.*
[10] Wycombe District Council (2008), *Adopted Core Strategy Development Plan Document.*
[11] Wycombe District Council (2013), *Delivery and Site Allocations Plan for Town Centres and Managing Development*.
[12] Wycombe District Council (2004), *Adopted Local Plan, Saved Policies.*
[13] Aylesbury Vale District Council (2009), *Submission Core Strategy*.
[14] Aylesbury Vale District Council (2007), *Aylesbury Vale District Local Plan Written Statement 2004, Saved Policies*.
[15] Aylesbury Vale District Council (2013), *Vale of Aylesbury Plan Strategy 2011-2031, Submission*.

management policies document, will ultimately replace the Aylesbury Vale District Local Plan Saved Policies4.

Committed development

2.1.18 Developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme, are shown on Map Series CT-13 (Volume 5, Cross Topic Appendix 1 Map Book) and listed in Volume 5: Appendix CT-004-000. Except where noted otherwise in Volume 5: Appendix CT-004-000, it has been assumed that these developments will have been completed by 2017. These are termed 'committed developments' and are treated as potential receptors to the Proposed Scheme. Where these developments have a particular relevance to an assessment topic, this is noted in the future baseline section for that topic.

2.1.19 No committed developments have been identified that lie within the land required for the Proposed Scheme in this area. There is one committed development within the Wendover Landscape Character Area (LCA), however this is not within the land required for the Proposed Scheme. The Chiltern Way Federation development will introduce new buildings and new tree planting within the Wendover LCA; this development is relatively small scale within an enclosed area.

2.1.20 Planning applications yet to be determined and sites that are proposed allocations in development plans that have yet to be adopted, on or close to the Proposed Scheme, are termed 'proposed developments'. These are shown on Maps CT-13-019 to CT-13-021a (Volume 5: Cross Topic Appendix 1 Map Book) and listed in Volume 5: Appendix CT-004-000. They are not included in the assessment. The progress of these proposals is being monitored by HS2 Ltd.

2.2 Description of the Proposed Scheme

2.2.1 The following section describes the main features of the Proposed Scheme in the Dunsmore, Wendover and Halton area, including the main environmental mitigation measures. Further generic information on typical permanent features is provided in Volume 1, Section 5. Similarly, a general description of the approach to mitigation is set out in Volume 1, Section 9.

2.2.2 The Proposed Scheme will require land on a permanent basis (land required for the operation of the Proposed Scheme). Land required on a permanent basis is illustrated in Maps CT-06-034b to CT-06-040a (Volume 2, CFA10 Map Book). Land that will only be required on a temporary basis for construction (land required for the construction of the Proposed Scheme) is illustrated on Maps CT-05-034b to CT-05-040a (Volume 2, CFA10 Map Book). Land required for the Proposed Scheme is set out in Section 2.3.

2.2.3 In general, features are described from south to north along the route (and east to west for features that cross the route).

2.2.4 Since the draft ES was published the following changes have been introduced to permanent features of the Proposed Scheme:

- a sustainable placement area for the disposal of surplus excavated material has been introduced north of Leather Lane and west of King's Lane;
- drainage pond locations and sizes have been rationalised along the route; and

- Bacombe Lane will no longer be stopped up and will be reinstated over the Wendover green tunnel.

Overview

2.2.5 The Proposed Scheme through this area will be approximately 8km in length. It will commence in cutting at the Leather Lane overbridge, north of Great Missenden, and will proceed in a south-east to north-west direction onto a viaduct to the north-east of Wendover Dean. It will pass to the east of Dunsmore on a series of embankments and cuttings, before crossing over the A413 London Road and the Marylebone to Aylesbury Line on a viaduct at Small Dean. It will then continue parallel to the A413 and the Marylebone to Aylesbury Line in tunnel, emerging into a cutting just beyond the western edge of Wendover. It will leave the Dunsmore, Wendover and Halton area on embankment.

South Heath cutting

2.2.6 The Proposed Scheme will leave the Central Chilterns area (CFA9) in the South Heath cutting that continues into the Dunsmore, Wendover and Halton area up to 17m in depth. This section of the Proposed Scheme extends from Leather Lane, north of Great Missenden to north of Bowood Lane. Key permanent features of this section, that is approximately 1.6km long, are shown on Maps CT-06-035 to CT-06-036 (Volume 2, CFA10 Map Book) and will include:

- a new overbridge north of Great Missenden approximately 4m above existing ground level, carrying Leather Lane over the route;
- planting on the approaches to the overbridge to integrate the structure into the landscape and maintain and enhance existing habitat links across the route for bats and other wildlife;
- an area of landscape mitigation planting to the west of the Proposed Scheme north of Leather Lane, to provide better integration of the route into the landscape;
- a land drainage area and associated access track north of Leather Lane to the east of the Proposed Scheme;
- a sustainable placement area[16] will be used to permanently deposit approximately 1,000,000m^3 of surplus excavated materials from cuttings in this area and from the Central Chilterns area (CFA9). The area will be approximately 1.3km long, up to 450m wide, and up to 5m in height. It will be located immediately to the east of the Proposed Scheme, between Leather Lane and Bowood Lane;
- a new overbridge east of Cottage Farm, approximately 1m above existing ground level, providing an offline replacement of a farm access;
- areas of landscape planting to the east of the Proposed Scheme south of

[16] This feature is to allow on-site placement of compatible materials from South Heath cutting directly onto adjacent farmland to avoid the environmental impacts that would otherwise occur as a result of the transportation of that material via the road network through the Chiltern Hills. The material will be re-graded and integrated into the landscape and returned to agricultural use.

King's Lane to replicate the alignment of the Grim's Ditch Scheduled Monument, some of which will be permanently lost, and to better integrate the Proposed Scheme into the landscape;

- areas of landscape planting to the east and west of the Proposed Scheme south of Bowood Lane to better integrate the overbridge and the linear features of the Proposed Scheme into the landscape;
- a new overbridge south of Bowood Lane, approximately 1m above existing ground level, carrying Footpath TLE/2 over the route (TLE/2 becomes WEN/38 on the west side of the route) and providing accommodation access;
- a land drainage area south of Bowood Lane to the west of the Proposed Scheme;
- a new overbridge south of Strawberry Hill Farm, approximately at ground level, carrying Bowood Lane over the route;
- areas of landscape planting on both sides of the Proposed Scheme to the north and south of Bowood Lane to better integrate the scheme into the landscape; and
- an area of ecological planting to the north-east of the Bowood Lane overbridge to compensate for the loss of ancient woodland at Jones' Hill Wood and to provide ecological connectivity to the ancient woodland at Rushmoor Wood. This area will also provide a suitable receptor site for great crested newts and reptiles.

2.2.7 Construction of this section will be managed from the Leather Lane overbridge satellite compound (see Section 2.3).

Wendover Dean viaduct and adjacent earthworks

2.2.8 The Proposed Scheme will continue in a south-east to north-west direction onto Wendover Dean viaduct. This section of the route extends from north of Bowood Lane to south of Rocky Lane and comprises an embankment approximately 100m long and up to 9m high; a viaduct approximately 500m long and up to 18m high; an embankment 150m long and up to 8m high; and a cutting approximately 500m long and up to 7m deep. An aerial visualisation of the Wendover Dean viaduct at year 15 of operation (2041) is shown in Figure LV-15-003 (Volume 2, CFA10 Map Book). Key permanent features of this section, that is approximately 1.25km long are shown on Maps CT-06-036 to CT-06-037 (Volume 2, CFA10 Map Book) and will include:

- an embankment approximately 100m long and up to approximately 9m high;
- areas of landscape woodland planting and earthworks to the east of the Proposed Scheme, north of Bowood Lane to integrate the Wendover Dean viaduct southern approach into the landscape;
- a balancing pond for railway drainage to the south-west of Wendover Dean Farm, to the west of the Proposed Scheme;
- a land drainage area south of Durham Farm to the west of the Proposed Scheme;

- a viaduct at Wendover Dean carrying the Proposed Scheme over Footpath WEN/39. The viaduct will be approximately 500m long and up to 18m above existing ground level and will have a 1.4m high protection barrier adjacent to the tracks on each side. The protection barrier will be modified along the west side to also act as an absorptive noise fence barrier;
- noise fence barriers up to 3m high will extend along the west side of the Proposed Scheme from the start of the embankment to 70m north of the viaduct;
- diversion of the access to Strawberry Hill Farm to pass underneath the viaduct;
- a land drainage area east of Upper Wendoverdean Farm to the west of the Proposed Scheme;
- diversion of Footpath WEN/39 and access to Upper Wendoverdean Farm to pass underneath the viaduct;
- an embankment approximately 150m long and up to 8m high;
- a cutting approximately 500m long and up to 7m deep. The cutting is formed in chalk and extra width has been allowed for the provision of a rock fall trap with a catch fence and associated access track for maintenance;
- noise mitigation earthworks contoured into the existing topography to the south of Rocky Lane and to the east and west of the Proposed Scheme for approximately 1km; and
- areas of landscape planting to the east and west of the Proposed Scheme south of Rocky Lane to integrate the earthworks into the existing landscape and field patterns.

2.2.9 Construction of this section will be managed from the Bowood Lane overbridge satellite compound and the Wendover Dean viaduct satellite compound (see Section 2.3).

Small Dean viaduct and adjacent earthworks

2.2.10 The Proposed Scheme will continue onto Small Dean viaduct and adjacent earthworks. This section extends from just south of Rocky Lane to just south of Bacombe Lane on the western edge of Wendover and comprises an embankment approximately 900m long and up to 11m high; a viaduct approximately 500m long and up to 13m high; and an embankment approximately 700m long and up to 12m high. Key permanent features of this section, that is approximately 2.1km long are shown on Maps CT-06-037 to CT-06-038 (Volume 2, CFA10 Map Book) and will include:

- an embankment approximately 900m long and up to 11m high;
- noise fence barriers 3m high on the east side of the route, from the start of the embankment to approximately 210m north of Rocky Lane;
- noise mitigation earthworks, up to 5m in height, to the west of the route both north and south of Rocky Lane, with a 3m noise fence barrier on along each edge as the route passes over Rocky Lane;

- Wendover auto-transformer station[17] and associated access track approximately 180m south of Rocky Lane on the west side of the Proposed Scheme;
- areas of landscape planting to the east of the route to screen the noise fence barriers from local receptors including Hartley Farm;
- a land drainage area to the south of Rocky Lane and to the east of the route, with an associated access track from Rocky Lane;
- a balancing pond for railway drainage to the south of Rocky Lane and to the west of the route, with an associated access track from Rocky Lane;
- hedgerow planting to the east and west of the Proposed Scheme to reinstate the existing field boundaries;
- an underbridge east of the A413, the finished road level of which is approximately 3m below existing ground level, providing a replacement of Rocky Lane. The approaches to the underbridge will be planted to integrate the structure into the landscape and maintain and enhance existing habitat links across the route for bats and other wildlife;
- a balancing pond for railway drainage and associated access track along the eastern side of the Proposed Scheme north of Rocky Lane;
- a linear balancing pond for railway drainage and associated access track north of Rocky Lane to the east of the A413 and to the west of the Proposed Scheme;
- noise fence barriers along the west side of the Proposed Scheme 40m from the end of the embankment to Small Dean viaduct that continues along the western edge of the Small Dean viaduct. The barrier will be up to 3m high, except across the viaduct where the 1.4m high protection barrier will be modified to also act as an absorptive noise fence barrier;
- a viaduct approximately 500m long at Small Dean, to carry the Proposed Scheme over the A413 London Road, the Marylebone to Aylesbury Line and Small Dean Lane. The viaduct will be up to 14m above ground level and will have a 1.4m high protection barrier adjacent to the tracks on each side. The protection barrier will be modified along the west side to also act as an absorptive noise fence barrier;
- an area of landscape planting to the east of the Proposed Scheme to provide screening for views from residential receptors towards the Small Dean viaduct and to integrate the Proposed Scheme into the landscape;
- an embankment approximately 700m long and up to 12m high;
- a retaining wall, approximately 50m long, retaining a small length of the

[17] HS2 trains will draw power from overhead line equipment, requiring feeder stations and connections to the 400kV National Grid network. In addition to feeder stations, smaller auto-transformer stations will be required at more frequent intervals. There will be no feeder stations within the local area, but two auto-transformer stations will be required.

embankment to provide space for the Grove Farm access track;

- reinstatement of hedgerows along the realigned Small Dean Lane to the west of the Proposed Scheme;
- a balancing pond for railway drainage and associated access track, north-east of Grove Farm to the west of the Proposed Scheme;
- noise fence barriers 4m high on the east side of the Proposed Scheme from the end of the viaduct to the Wendover green tunnel southern portal, also on the west side approximately 230m from the end of the viaduct to the tunnel portal;
- a new underbridge west of the A413 to provide access to Grove Farm, the nearby drainage areas and the green tunnel portal buildings. The underbridge will be approximately 9m below the railway, although the crossing itself will be up to 2m above the existing ground level;
- areas of landscape planting to the east and west of the Proposed Scheme to provide visual screening of the Proposed Scheme and to integrate it into the landscape; and
- a land drainage area north of Grove Farm to the west of the Proposed Scheme.

2.2.11 Construction of this section will be managed from the Rocky Lane underbridge satellite compound; the Small Dean viaduct launch satellite compound and the Wendover auto-transformer station satellite compound (see Section 2.3).

Wendover green tunnel

2.2.12 The Proposed Scheme will continue to the west of Wendover through the Wendover green tunnel, emerging just beyond the western edge of Wendover. Key permanent features of this section, which is approximately 1.3km long are shown on Maps CT-06-038 to CT-06-039 (Volume 2, CFA10 Map Book) and will include:

- Wendover green tunnel southern portal south of Bacombe Lane, comprising portal buildings to the south of the Proposed Scheme, with an associated access track;
- landscape earthworks and planting on both sides of the Proposed Scheme, integrating the Wendover green tunnel southern portal into the landscape;
- reinstatement of Bacombe Lane on an alternative alignment over the green tunnel, to include the permanent diversions of Footpath WEN/14 and WEN/13A;
- landscape earthworks to integrate the green tunnel and Bacombe Lane into the surrounding landscape;
- reinstatement of Ellesborough Road over the green tunnel;
- reinstatement of Footpaths WEN/11, WEN/6 , access to Dobbins Lane and Footpath WEN/55 on alternative alignments over the green tunnel;
- Wendover green tunnel northern portal just beyond the western edge of Wendover, comprising portal buildings to the east of the Proposed Scheme,

with an associated access track; and

- landscape earthworks and planting to screen the portal and adjacent cutting from residential receptors and to integrate the Proposed Scheme into the landscape.

2.2.13 Construction of this section will be managed from the Wendover green tunnel (south) satellite compound, the Wendover green tunnel (north) satellite compound, the Wendover green tunnel (south portal) satellite compound and the B4009 Nash Lee Road overbridge satellite compound for rail systems (see Section 2.3).

Wendover north cutting and the start of the Stoke Mandeville south embankment

2.2.14 The Proposed Scheme continues into the Wendover north cutting and Stoke Mandeville south embankment. This section of route extends from the western edge of Wendover to just north of Footpath ELL/20 and comprises a cutting approximately 1.55km long and up to 11m deep; and an embankment approximately 250m long and up to 2m high. Key permanent features of this section, that is approximately 1.8km long are shown on Maps CT-06-039 to CT-06-040a (Volume 2, CFA10 Map Book) and will include:

- a cutting approximately 1.6 km long and up to 11m deep;
- landscape earthworks on the west of the Proposed Scheme to integrate it into the landscape and screen views of the railway from residential receptors;
- landscape planting on both sides of the Proposed Scheme to better integrate the Proposed Scheme into the landscape and to screen views of the railway from residential receptors, including tree planting to the east and hedgerow reinstatement to the west;
- noise fence barriers on the east side of the Proposed Scheme, including 3m high barriers for approximately 350m at the bottom of the cutting from approximately 200m south of the B4009 Nash Lee Road, and 5m high barriers at the top of the cutting from the B4009 Nash Lee Road for approximately 300m;
- noise fence barriers up to 3m high and approximately 600m long at the top of the cutting on the west side of the Proposed Scheme from approximately 100m south of B4009 Nash Lee Road to approximately 100m before the ELL/20 footbridge;
- a new overbridge east of Nash Lee, approximately 5m above existing ground level, carrying the realigned B4009 Nash Lee Road over the route;
- a balancing pond for highway drainage and an associated access track north of the B4009 Nash Lee Road to the east of the Proposed Scheme;
- diversion of Nash Lee Lane to the B4009 Nash Lee Road, that will be stopped up on either side of the Proposed Scheme;
- an embankment 250m long and up to 2m high, that continues into the Stoke Mandeville and Aylesbury area (CFA11);

- landscape planting on the east and west side of the Proposed Scheme to better integrate the Proposed Scheme and the B4009 Nash Lee Road into the landscape and to screen views of the route from residential receptors;
- Stoke Grove auto-transformer station and associated access track approximately 100m north of the B4009 Nash Lee Lane on the east side of the Proposed Scheme;
- maintenance loops north of the B4009 Nash Lee Road extending into the Stoke Mandeville and Aylesbury area (CFA11), including access tracks along either side of the maintenance loops from the B4009 Nash Lee Road;
- a land drainage area and associated access track north of the B4009 Nash Lee Road and south of Footpath ELL/20 over bridge with associated access track from B4009 Nash Lee Road to the west of the Proposed Scheme;
- a balancing pond for railway drainage and associated access track north of the B4009 Nash Lee Road and south of Footpath ELL/20 over bridge with associated access track from B4009 Nash Lee Road to the east of the Proposed Scheme;
- a new overbridge north of Nash Lee Lane approximately 10m above existing ground level, carrying Footpath ELL/20 over the route;
- landscape planting around the edges of the overbridge to integrate the structure into the landscape; and
- an ecological mitigation area extending into the Stoke Mandeville and Aylesbury area (CFA11) to the east of the Proposed Scheme for the creation of wetland and grassland habitats.

2.2.15 Construction of this section will be managed from the B4009 Nash Lee Road overbridge satellite compound (see Section 2.3).

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the strategy for construction of the Proposed Scheme in the Dunsmore, Wendover and Halton area, including:

- overview of the construction process;
- description of the advance works;
- description of the engineering works to build the railway;
- construction waste and material resources;
- commissioning the railway; and
- indicative construction programme (see Figure 5).

2.3.2 The assessment presented in this ES is based on the construction arrangements as described in this section.

2.3.3 In addition to the land that will be required permanently by the Proposed Scheme (see Section 2.2), land will be required on a temporary basis for construction. Key temporary construction features are illustrated on the construction Maps Series CT-05 (Volume 2, CFA10 Map Book). Following construction works, land required temporarily will be prepared for its eventual end use that will include being returned to its pre-construction use wherever possible.

2.3.4 A guide to standard construction techniques is provided in Volume 1, Section 6. In instances for which more than one possible construction technique might be possible, this section specifies which technique has been assumed for the purposes of the assessment.

Overview of the construction process

2.3.5 Building and preparing the railway for operation will 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; site preparation and enabling works; main earthworks and structure works; site restoration; and removal of construction compounds;
- railway installation works including: establishment of construction compounds; infrastructure installation; connections to utilities; changes to the existing rail network; and removal of construction compounds; and
- system testing and commissioning.

2.3.6 General provisions relating to the construction process are set out in more detail in Volume 1, Section 6.4 and the draft Code of Construction Practice (CoCP) (see Volume 5: Appendix CT-003-000) including:

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

Advance works

2.3.7 General information about advance works can be found in Volume 1, Section 6.4. Advance works will be required before commencing construction works and will typically include:

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

- site establishment with temporary fence construction; and
- utility diversions.

Engineering works

2.3.8 Construction of the railway will require engineering works along the entire length of the route and within land adjacent to the route. This will comprise two broad types of engineering work:

- civil engineering works such as earthworks and erection of bridges and viaducts; and/or
- railway installation works such as laying ballast or slabs and tracks and/or installing power supply and communications features.

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

2.3.10 In the Dunsmore, Wendover and Halton area there will be one main compound and eight civil engineering satellite compounds and three railway installation satellite compounds (of which two will continue to use compounds previously established for the civil engineering works).

2.3.11 Figure 3 shows the management relationship for civil engineering works compounds and Figure 4 for the railway installation works compounds. Details about individual compounds are provided in subsequent sections of this report.

General overview of construction compounds

2.3.12 Main compounds will be used for core project management staff (i.e. engineering, planning and construction delivery), and commercial and administrative staff. These management teams will directly manage some works and/or coordinate satellite compounds that will manage other works. In general, main compounds will contain:

- space for the storage of bulk materials (aggregates, structural steel and steel reinforcement);
- space for the receipt, storage and loading/unloading of excavated material either onto or off the site;
- an area for the fabrication of temporary works equipment and finished goods;
- fuel storage;
- plant and equipment storage;
- office space for management staff, limited car parking for staff and site operatives and welfare facilities; and
- operational parking.

2.3.13 Satellite compounds will be used as the base to manage specific works along a section of the route. They will usually provide office accommodation for limited numbers of staff, local storage for plant and materials, limited car parking for staff and site operatives, and welfare facilities.

2.3.14 Some compounds will also accommodate additional functions as listed below. Where this is the case they will be included in the description of the compound:

- railheads will connect the existing railway network to enable loading and unloading to and from trains delivering material to the HS2 site or removing excavated material;
- roadheads will require an additional area of land adjacent to the compound for the storage and loading and unloading of bulk earthworks materials that are moved to and from the site on public highways; and
- living accommodation for the construction workforce.

2.3.15 In addition, areas adjacent to some compounds will be used for the storage of topsoil stripped as part of the works prior to it being used when the land is reinstated to its former use.

2.3.16 Further information on the function of compounds, including general provisions for their operation, including security fencing, lighting, utilities supply, site drainage and codes of worker behaviour are set out in Volume 1, Section 6.6, and the draft CoCP, Section 5.

Construction traffic routes

2.3.17 The movement of construction vehicles carrying materials, plant, other equipment and workforce (or moving empty) will take place both within the construction sites, on public roads and via the rail network. The construction compounds will provide the interface between the construction works and the public highway or rail network, and the likely road routes to access compounds are described in subsequent sections below.

2.3.18 Movements between the construction compounds and the worksites will be on designated haul roads within the site, often along the line of the route or running parallel to it.

Figure 3: Schematic of site compounds for civil engineering works

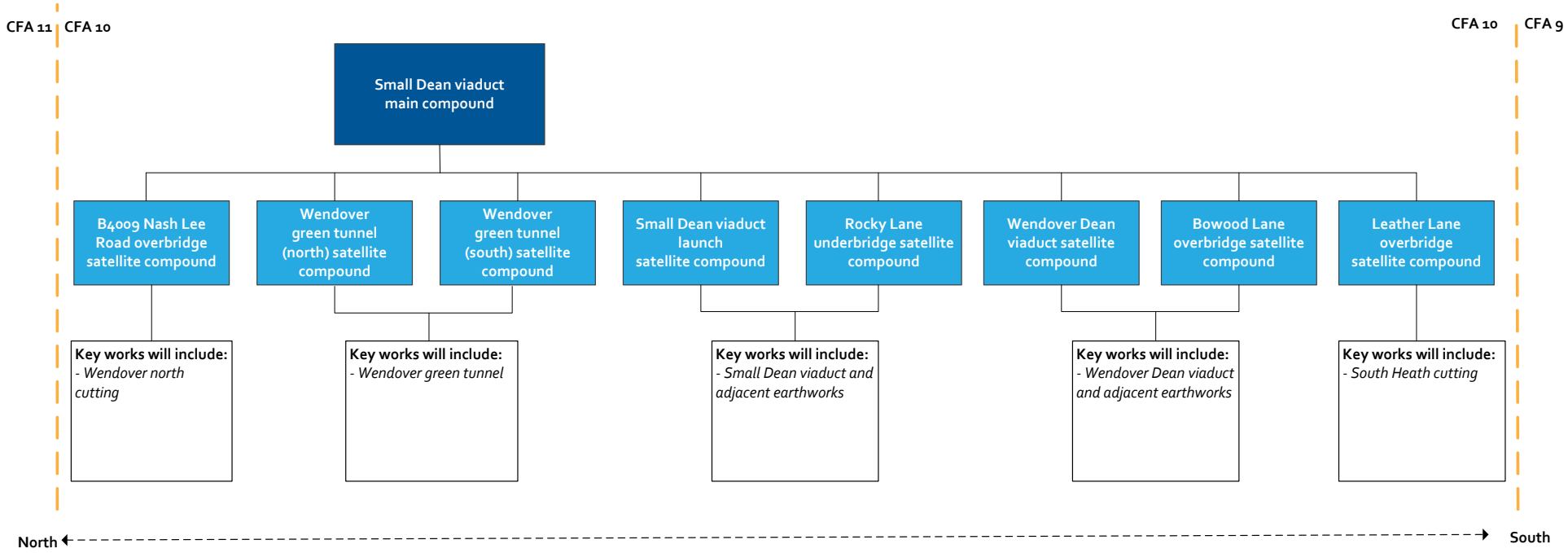
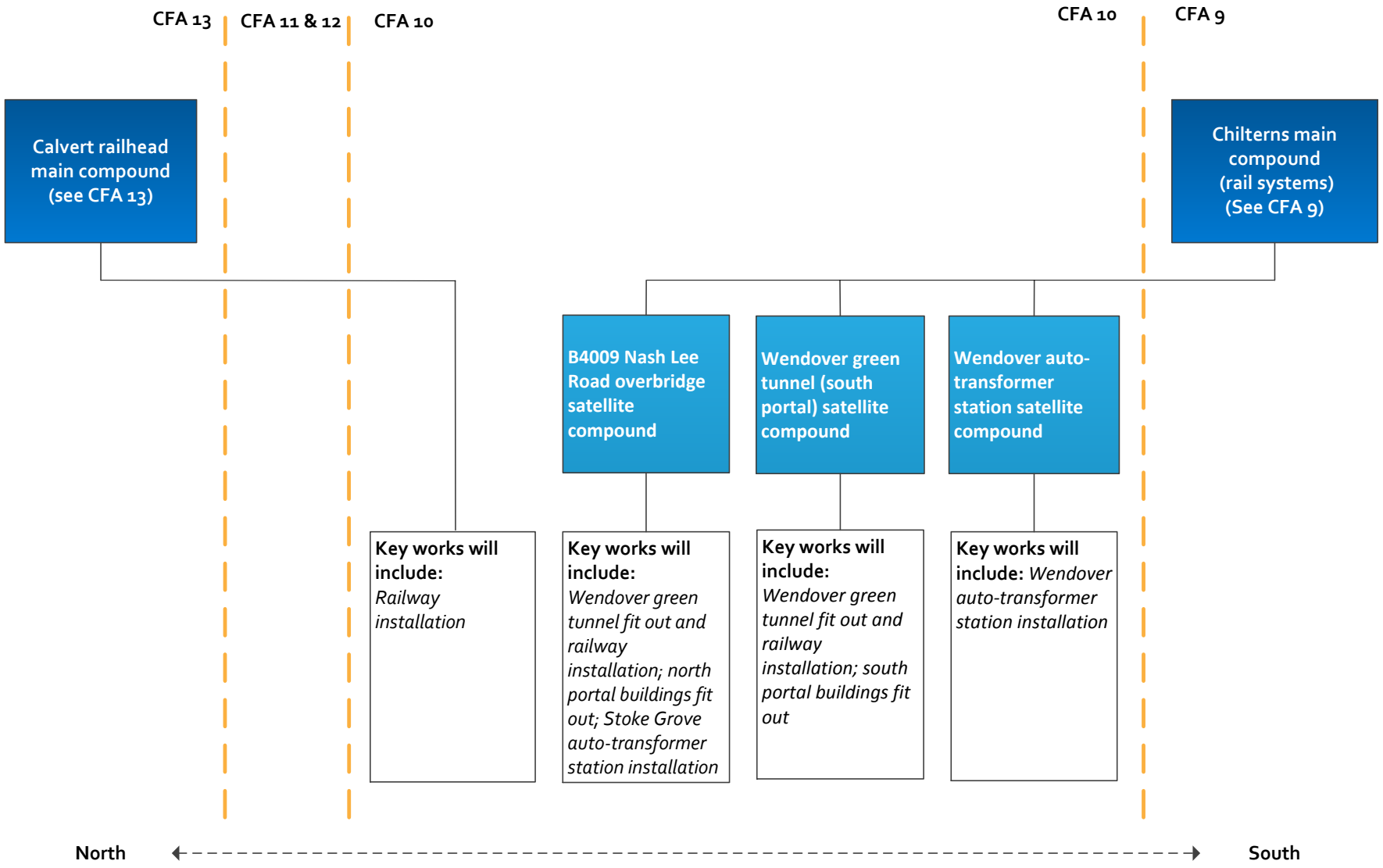


Figure 4: Schematic of site compounds for railway installation works



Chilterns main compound (rail systems)

2.3.19 This compound is located within the Central Chilterns area (CFA9). It will provide administrative support to all rail installation works satellite compounds, as illustrated in Figure 4, that provide directly for the construction of the Proposed Scheme throughout this area. See CFA Report 9 for more information about this compound.

Small Dean viaduct main compound

2.3.20 This compound will be used for civil engineering works only, between The Lee and the north of Wendover. The compound will:

- be operational for approximately four years and three months, commencing approximately 2017;
- support approximately 90 workers each day throughout much of the civil engineering works period, increasing to a maximum of 135 workers each day during the peak period of activity;
- provide living accommodation for between 170 to 240 people for an estimated period of 45 months, with the accommodation occupying the western part of the compound;
- be accessed via the A413, B4009, A4010 and the M40 and/or to the M40 via A4129 and A418 from A4010 and/or A413, A355, A40 and the M40 in the west, and the A413, A40 and the M40 in the east; and
- provide main compound support to eight satellite compounds, as illustrated in Figure 3 for the civil engineering works.

Leather Lane overbridge satellite compound

2.3.21 This compound will be used for civil engineering works only, between The Lee and the south of Wendover Dean. The compound will:

- be operational for approximately one year and three months, starting in 2017;
- support approximately 75 workers each day throughout much of the civil engineering works period, increasing to a maximum of 130 workers each day during the peak period of activity;
- not provide worker accommodation facilities;
- be accessed via Leather Lane, Potter Row, Frith Hill, B485 Chesham Road, A413 and the M40 and/or A413, A355, A40 and the M40; and
- be managed from the Small Dean viaduct main compound.

2.3.22 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- culverts and drainage;
- construction of bridges;

- cuttings, embankments and landscape earthworks;
- permanent fencing;
- railway systems installation; and
- landscaping and planting.

2.3.23 The compound will be used to manage construction of the South Heath cutting that will take approximately one year and three months to complete. Volume 1, Section 5.3 describes a typical cutting, and Volume 1, Section 6.8, describes the associated construction activities.

2.3.24 No demolitions, utility diversions or watercourse diversions will be required.

2.3.25 Temporary closure and realignment of Bowood Lane will be required. The temporary alternative route will be via the A413 London Road, Rocky Lane/Chesham Lane and King's Lane, for a period of nine months to one year, with permanent reinstatement across Bowood Lane overbridge along its original alignment.

2.3.26 Diversion of two PRoW will be required:

- a temporary alternative route for Footpath TLE/2, to the south for a period of approximately six to nine months, adding an additional 50m. It will then be permanently reinstated across Footpath TLE/2 accommodation overbridge broadly along its original alignment; and
- a temporary alternative route for Footpath TLE/3, to the south for a period of approximately nine months to one year, adding an additional 550m. It will then be permanently diverted across Bowood Lane overbridge, adding a negligible distance.

Bowood Lane overbridge satellite compound and Wendover Dean viaduct satellite compound

2.3.27 The Bowood Lane overbridge satellite compound and Wendover Dean viaduct satellite compound will be used for civil engineering works, between the south of Wendover Dean and the south of Wendover.

2.3.28 Both compounds will be operational for approximately two years, starting in 2018 and will be managed from the Small Dean viaduct main compound. Neither will provide worker accommodation facilities.

2.3.29 The Bowood Lane overbridge satellite compound will:

- support approximately 65 workers each day throughout much of the civil engineering works period, increasing to a maximum of 125 workers each day during the peak period of activity; and
- be accessed via site haul road from Leather Lane, Potter Row, Frith Hill, B485 Chesham Road, A413 and the M40.

2.3.30 The Wendover Dean viaduct satellite compound will:

- support approximately 95 workers each day throughout much of the civil

engineering works period; and

- be accessed via the site haul road from Rocky Lane from the A413.

2.3.31 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- building demolition;
- culverts and drainage;
- construction of bridges and viaducts;
- cuttings, embankments and landscape earthworks;
- permanent fencing; and
- landscaping and planting.

2.3.32 The Bowood Lane overbridge satellite compound and Wendover Dean viaduct satellite compound will be used to manage construction of the Wendover Dean viaduct and adjacent earthworks that will take approximately two years to complete. Volume 1, Section 5.2 and 5.9 describe typical viaducts, cuttings and embankments, and Volume 1, Sections 6.8 and 6.16 describe the typical associated construction sequences for these structures.

2.3.33 No diversions of roads, key utilities or watercourses will be required.

2.3.34 Demolitions will be required at Durham Farm, including a residential property and four associated outbuildings.

2.3.35 Alternative routes for three PRoW will be required:

- a temporary alternative route for Footpath TLE/5, to the north via WEN/36 for a period of six to nine months, adding an additional 100m. It will then be permanently diverted under the Wendover Dean viaduct adding a negligible distance;
- a temporary alternative route for Footpath WEN/36, to the south for a period of one year and six months to two years, adding an additional 100m. It will then be permanently reinstated along its existing alignment under the Wendover Dean viaduct; and
- a temporary alternative route for Footpath WEN/39, to the south-east for a period of one year and six months to two years, adding an additional 100m. It will then be permanently reinstated along its existing original alignment under the Wendover Dean viaduct.

Rocky Lane underbridge satellite compound/Wendover auto-transformer station satellite compound and Small Dean viaduct launch satellite compound

2.3.36 The Rocky Lane underbridge satellite compound and Small Dean viaduct launch satellite compound will be used for civil engineering works, between the south of

Wendover Dean and the south of Wendover. Both compounds will be managed from the Small Dean viaduct main compound.

2.3.37 Rocky Lane underbridge satellite compound will also be used for railway installation works. It will reduce in size to become the Wendover auto-transformer station satellite compound for that phase of works, and will be managed from the Chilterns main compound (rail systems) (CFA 9) for the railway installation works.

2.3.38 The Rocky Lane underbridge satellite compound/Wendover auto-transformer station satellite compound will:

- be in place for six years and nine months. During this period there will be civil engineering works for approximately two years and nine months, starting in 2018, followed by a two year and six month period of inactivity before the railway installation works that will last for approximately one year and six months, starting in 2023;
- support approximately 25 workers each day throughout much of the civil engineering works period, increasing to a maximum of 80 workers each day during the peak period of activity , and approximately 27 workers each day throughout much of the railway systems installation works, increasing to a maximum of 40 workers each day during the peak period of activity; and
- be accessed via Rocky Lane, A413, B4009, A4010 and the M40 and/or the M40 via A4129 and A418 from A4010 and/or A413, A355, A40 and the M40 in the west; and A413, A40 and the M40 in the east.

2.3.39 The Small Dean viaduct launch satellite compound will:

- be operational for approximately two years, starting in 2018;
- support approximately 100 workers each day throughout much of the civil engineering works period; and
- be accessed via the site haul road from Rocky Lane;

2.3.40 Neither compound will provide worker accommodation facilities

2.3.41 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- building demolition;
- culverts and drainage;
- construction of bridges and viaduct;
- cuttings, embankments and landscape earthworks;
- permanent fencing; and
- landscaping and planting.

2.3.42 The Rocky Lane underbridge and Small Dean viaduct launch satellite compounds will be used to manage construction of the Small Dean viaduct and its approach embankments that will take approximately two years to complete. Volume 1, Section 5.9 describes typical viaduct structures, and Volume 1, Sections 6.16 describes the typical associated construction sequences for these structures.

2.3.43 Demolition of four buildings at one property and five structures:

Description	Location
Residential property at Road Barn Farm and three associated outbuildings	A413 London Road
Network Rail railway bridge	Between A413 London Road and Small Dean Lane
National Grid pylon	Adjacent to the Marylebone to Aylesbury Line
Two National Grid pylons	Adjacent to Small Dean Lane
National Grid pylon	Bacombe Lane

2.3.44 Diversion of two roads will be required:

- the permanent realignment of Rocky Lane, 50m to the west, under the railway in an underbridge; and
- the temporary realignment of approximately 140m of the A413 London Road for a period of nine months to one year.

2.3.45 Diversion of three PRoW will be required:

- Bridleway (unknown reference) along the old link road between Small Dean Lane and A413 London Road will be permanently stopped up through a traffic regulation order that will allow access to non-motorised users only;
- a temporary alternative route for Footpath WEN/57, via WEN/14, WEN/13/B and WEN/13/C for a period of six to nine months, adding a negligible distance. It will then be permanently reinstated along its original alignment; and
- a temporary alternative route for Bridleway WEN/57, via WEN/14, WEN/14, WEN/27(BW) and WEN/13(BW) for a period of six to nine months, adding an additional 2200m. It will then be permanently reinstated along its original alignment.

2.3.46 Diversion of four utilities and the installation of two new utilities will be required, the key ones being:

- permanent realignment of 400kV National Grid overhead power line and pylons, 50m to the south; and
- permanent new UK Power Network, connecting electricity power to Wendover auto-transformer station.

2.3.47 Diversion of one watercourse will be required; the permanent realignment of a dry valley at Bacombe Lane will require a diversion of approximately 160m to the south with a culvert crossing under the railway.

2.3.48 Key railway systems installation works in this section of the Proposed Scheme will be the installation of an auto-transformer station at Wendover that will take approximately one year and three months to complete. See Volume 1, Section 5.16 for a generic description of power supply and Volume 1, Section 6.23 for a description of associated construction activities.

Wendover green tunnel (south) satellite compound and Wendover green tunnel (north) satellite compound

2.3.49 The Wendover green tunnel (south) satellite compound and (north) satellite compounds will be used for civil engineering works only, to the west of Wendover. Both compounds will be managed from the Small Dean viaduct main compound.

2.3.50 The Wendover green tunnel (south) satellite compound will:

- be operational for approximately two years and nine months, starting in 2017;
- support approximately 70 workers each day throughout much of the civil engineering works period, increasing to a maximum of 90 workers each day during the peak period of activity;
- not provide worker accommodation facilities;
- be accessed via a site haul road at Small Dean viaduct main compound from the A413, B4009, A4010 and the M40 and/or the M40 via A4129 and A418 from A4010 and/or A413, A355, A40 and the M40 in the west; and A413, A40 and the M40 in the east; and

2.3.51 The Wendover green tunnel (north) satellite compound will:

- be operational for approximately two years and six months starting in 2018;
- support approximately 65 workers each day throughout much of the civil engineering works period, increasing to a maximum of 80 workers each day during the peak period of activity;
- not provide worker accommodation facilities; and
- be accessed via site haul road at Small Dean viaduct main compound from the A413, B4009, A4010 and the M40 and/or the M40 via A4129 and A418 from A4010 and/or A413, A355, A40 and the M40 in the west; and A413, A40 and the M40 in the east;

2.3.52 Works in this section of the Proposed Scheme will be carried out in the following broad phases

- site clearance and enabling works;
- building demolition;
- culverts and drainage;
- construction of green tunnel;
- cuttings, embankments and landscape earthworks;

- permanent fencing; and
- landscaping and planting.

2.3.53 The Wendover green tunnel satellite compounds north and south will be used to manage construction of the Wendover green tunnel that will take approximately three years to complete.

2.3.54 Demolition will be required at seven properties and for one structure:

Description	Location
Residential properties, 30, 32, 34, 36, 38 and 40	Ellesborough Road, Wendover
Community facility, Ellesborough Road Cricket Ground and pavilion	Off Ellesborough Road at Wendover
National Grid pylon	Adjacent to A413 Nash Lee Road

2.3.55 Diversion of two roads will be required:

- temporary closure of Bacombe Lane, realigned via a temporary link road from Ellesborough Road for a period of one year, with permanent offline reinstatement across the Wendover green tunnel; and
- an alternative temporary route for Ellesborough Road realigned via a temporary link road to the north of the current alignment, for a period of one year and nine months to two years, with permanent reinstatement along its existing alignment across the Wendover green tunnel.

2.3.56 Diversion of seven PRoW will be required:

- public bridleway WEN/14 remains open during construction. It will then be permanently diverted 100m to the west of its original alignment along the reinstated Bacombe Lane across the Wendover green tunnel, adding an additional 200m;
- a temporary alternative route for public Footpath WEN/13A, to the south for a period of one year, adding an additional 200m. It will then be permanently reinstated along its existing alignment across the Wendover green tunnel;
- a temporary alternative route for public Footpath WEN/6, to the south via Ellesborough Road for a period of two years and three months, adding an additional 800m. It will then be permanently diverted 80m to the south of its original alignment, adding a negligible distance;
- a temporary alternative route for public Footpath WEN/6, to the south via Ellesborough Road for a period of two years and three months, adding an additional 800m. It will then be permanently reinstated along its existing alignment across the Wendover green tunnel;
- a temporary alternative route for public Footpath WEN/11, via Ellesborough Road for a period of two years and three months, adding an additional 300m. It will then be permanently reinstated along its existing alignment across the

Wendover green tunnel; and

- a temporary alternative route for public Footpath WEN/55, to the south for a period of two years and three months, adding an additional 200m. It will then be permanently reinstated 20m to the east of its original alignment across the Wendover green tunnel.

2.3.57 Diversion of eight utilities and installation of four new utilities will be required, the key ones being:

- temporary diversion of 400kV National Grid overhead power lines and pylons, 70m to the south, for a period of approximately two years, with permanent reinstatement along its existing alignment; and
- permanent new underground UK Power Network cable, connecting electricity to the Proposed Scheme at Wendover green tunnel portal building.

2.3.58 No watercourse diversions will be required.

Wendover green tunnel (south portal) satellite compound (rail systems)

2.3.59 This compound will be used for railway systems installation works only, to the west of Wendover. The compound will:

- be operational for approximately one year and three months, starting in 2023;
- support approximately 10 workers each day throughout this period;
- not provide worker accommodation;
- be accessed via the site haul road at Small Dean viaduct main compound from A413, B4009, A4010 and the M40 and/or the M40 via A4129 and A418 from A4010 and/or A413, A355, A40 and the M40 in the west; and A413, A40 and the M40 in the east; and
- be managed from the Chilterns main compound (rail systems) (see CFA Report 9).

2.3.60 Key railway systems installation works in this section of the Proposed Scheme, will take approximately one year and three months to complete and will include:

- fit out of the Wendover green tunnel south portal buildings; and
- fit out of the tunnel systems and railway within Wendover green tunnel.

2.3.61 See Volume 1, Section 5.17 for a generic description of power supply and tunnel systems and Volume 1, Section 6.23 for a description of associated construction activities.

B4009 Nash Lee Road overbridge satellite compound

2.3.62 This compound will be used for civil engineering and railway systems installation works, to the north of Wendover. The compound will:

- be in place for seven years. During this period there will be civil engineering works for approximately three years starting in 2018, followed by a two year period of inactivity before the railway installation works that will last for

approximately two years, starting in 2023.

- support approximately 30 workers each day throughout much of the civil engineering works period, increasing to a maximum of approximately 45 workers each day during the peak period of activity, and approximately 25 workers each day throughout much of the railway systems installation works, increasing to a maximum of 45 workers each day during the peak period of activity;
- not provide worker accommodation facilities;
- be accessed via Nash Lee Road, A413, B4009, A4010 and the M40 and/or the M40 via A4129 and A418 from A4010 and/or A413, A355, A40 and the M40 in the west; and A413, A40 and the M40 in the east; and
- be managed from Small Dean viaduct main compound for the civil engineering works and from the Chilterns main compound (rail systems) (CFA9) for the railway systems installation works.

2.3.63 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- building demolition
- culverts and drainage;
- construction of bridges;
- cuttings, embankments and landscape earthworks;
- permanent fencing;
- rail systems installation; and
- landscaping and planting.

2.3.64 The compound will be used to manage construction of Wendover north cutting that will take approximately two years and nine months to complete. Volume 1, Section 5.3 describes a typical cutting, and Volume 1, Section 6.8, describes the associated construction activities.

2.3.65 The demolition of two National Grid steel frame pylons, adjacent to A413 Nash Lee Road will be required.

2.3.66 Diversion of two roads will be required (both of which will remain open during construction):

- permanent realignment of B4009 Nash Lee Road, 50m to the north across new offline B4009 Nash Lee Road overbridge; and
- permanent realignment of Nash Lee Lane junction with B4009 Nash Lee Road, 200m to the east of original alignment.

2.3.67 A temporary alternative route for Footpath ELL/25 will be required, via the existing Nash Lee Road for a period of approximately one year to one year and six months, adding an additional 650m. It will then be permanently diverted 200m to the east across the new B4009 Nash Lee Road overbridge, adding an additional 600m.

2.3.68 Diversion of three utilities and the installation of two new utilities will be required, the key ones being:

- temporary diversion of 400kV National Grid overhead power lines and pylons, 70m to the south, for a period of approximately two years, with permanent reinstatement along its existing alignment; and
- permanent new UK Power Network underground supply, connecting electricity to the Proposed Scheme at Stoke Grove auto-transformer substation.

2.3.69 No watercourse diversions will be required.

2.3.70 Key railway systems installation works in this section of the Proposed Scheme will take approximately two years to complete and will include:

- fit out of the Wendover green tunnel north portal buildings;
- fit out of the tunnel systems and railway within Wendover green tunnel; and
- installation of Stoke Grove auto-transformer station.

2.3.71 See Volume 1, Section 5.17 for a generic description of power supply and tunnel systems and Volume 1, Section 6.23 for a description of associated construction activities.

Calvert railhead main compound

2.3.72 This compound is located in the Calvert, Steeple Claydon, Twyford and Chetwode area (CFA13). It will provide support to all rail installation works, as illustrated in Figure 4, that provide directly for the construction of the Proposed Scheme throughout this area. See CFA Report 13 for more information about this compound.

2.3.73 The railway systems installation works will include track, overhead line equipment, communications equipment and traction power supply. The installation of track in open areas will be of standard ballast or slab track configuration. The track installation through green tunnels in this area will also comprise standard ballast or slab track construction.

2.3.74 Works in this area will take approximately one year and three months, commencing in 2023.

2.3.75 The track will be laid in a southerly direction away from the Calvert railhead main compound. Before the railway systems installation can commence, adequate civil engineering work will need to be completed to allow a continuous track laying sequence. Volume 1, Section 5.16 describes a typical track, and Section 6.22 describes the associated track laying activities and sequence.

2.3.76 The railway systems installation has its own mobile welfare facilities for the site staff.

Construction waste and material resources

2.3.77 Forecasts of the amount of construction, demolition and excavation waste (CDEW) and worker accommodation site waste produced during the construction of the Proposed Scheme in the Dunsmore, Wendover and Halton area have been prepared and are presented in Volume 5: Appendix WM-001-000.

2.3.78 The majority of excavated material that will be generated across the Proposed Scheme will be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either with or without treatment.

2.3.79 Sustainable placement of inert surplus excavated material will be used where the material cannot be reused beneficially along or locally beyond the route and where it cannot be removed by either rail or along the construction corridor. One area of sustainable placement will be used within the Dunsmore, Wendover and Halton area (CFA10) to permanently dispose of surplus excavated material generated from this area and the Central Chilterns area, to avoid causing significant environmental effects associated with the road transport of that material. The sustainable placement area of surplus excavated material is located near Hunt's Green Farm.

2.3.80 The quantity of surplus excavated material originating from the Dunsmore, Wendover and Halton area that will require off-site disposal to landfill as excavation waste is shown in Table 1. This is the forecast quantity of contaminated excavated material that is chemically unsuitable for reuse within the Proposed Scheme and that will be taken directly from the Dunsmore, Wendover and Halton area for off-site disposal to either non-hazardous or hazardous landfill. This represents a proportion of the total quantity of surplus excavated material that will require disposal which altogether is reported on a route-wide basis in Volume 3, Section 14.

2.3.81 The quantities of demolition, construction and worker accommodation site waste that will be reused, recycled and recovered (i.e. diverted from landfill) have been based on the performance of similar projects as follows:

- demolition waste 90%;
- construction waste 90%; and
- worker accommodation site waste 50%.

2.3.82 The quantities of demolition, construction and worker accommodation site waste that will require off-site disposal to landfill are shown in Table 1.

Table 1: Estimated construction, demolition and excavation waste

Waste type	Estimated material quantities that will be generated (tonnes)	Estimated quantity of waste for off-site disposal to landfill (tonnes)
Excavation	5,105,809	0
Demolition	11,637	1,164
Construction	41,606	4,161
Worker accommodation site	266	133
TOTAL	**5,159,318**	**5,458**

2.3.83 The assessment of the likely significant environmental effects associated with the disposal of CDEW and worker accommodation site waste has been undertaken for the Proposed Scheme as a whole (see Volume 3, Section 14).

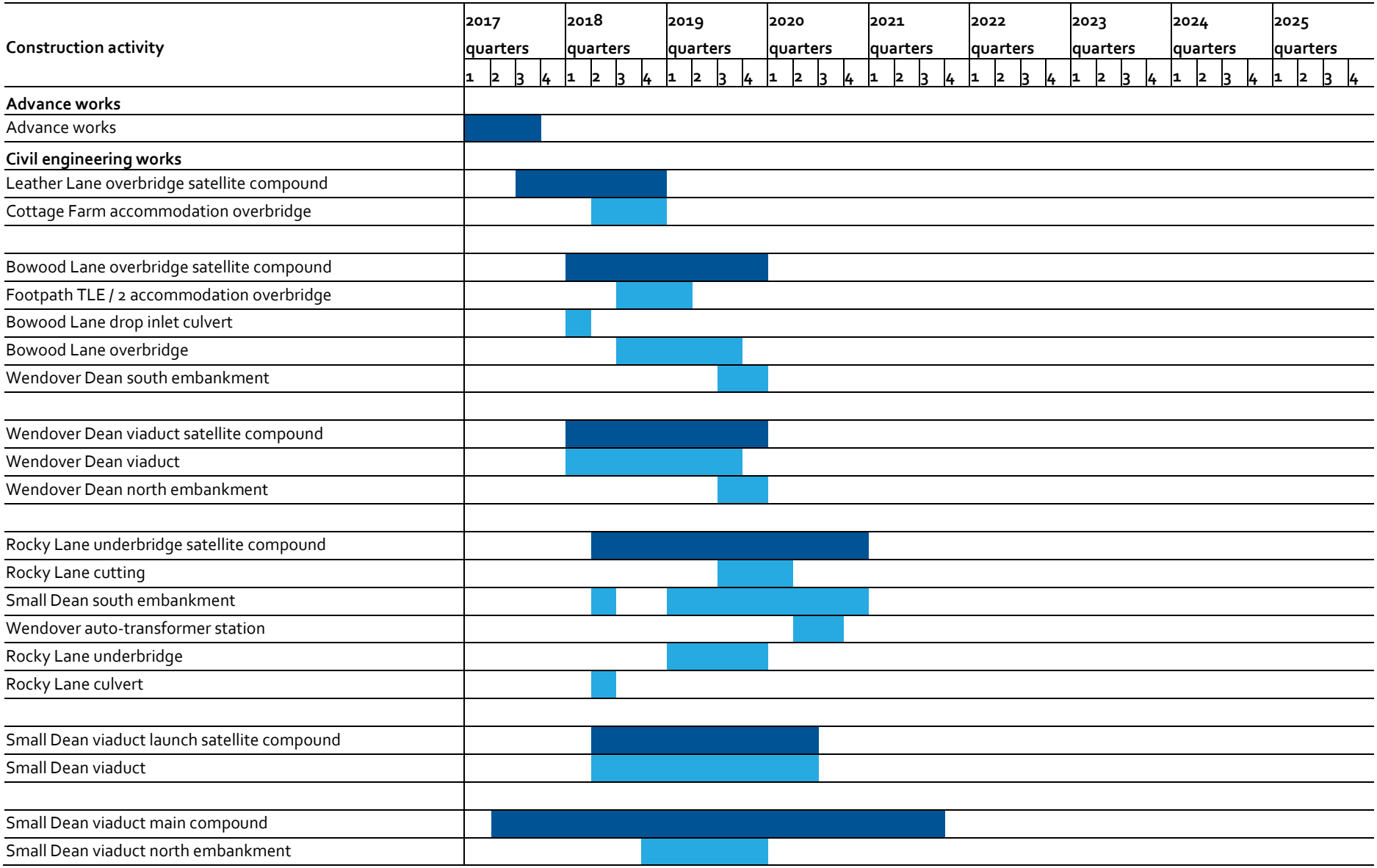
Commissioning of the railway

2.3.84 Commissioning is the process of testing the infrastructure to ensure that it operates as expected. This will take place in the period prior to opening. Further details are provided in Volume 1, Section 6.26.

Construction programme

2.3.85 A construction programme that illustrates indicative periods for the construction activities in this area described above is provided in Figure 5.

Figure 5: Indicative construction programme



Construction activity	2017 quarters				2018 quarters				2019 quarters				2020 quarters				2021 quarters				2022 quarters				2023 quarters				2024 quarters				2025 quarters			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grove Farm culverts																																				
Grove Farm accommodation underbridge																																				
Wendover green tunnel south satellite compound																																				
Wendover green tunnel																																				
Wendover green tunnel north satellite compound																																				
Wendover north cutting																																				
B4009 Nash Lee Road overbridge satellite compound																																				
B4009 Nash Lee Road overbridge																																				
Stoke Grove auto-transformer station																																				
Rail infrastructure and systems works																																				
Calvert railhead main compound	See CFA13																																			
High speed railway installation																																				
Wendover auto-transformer station satellite compound																																				
Wendover auto-transformer substation installation																																				
Wendover green tunnel (south) satellite compound																																				
Wendover green tunnel south portal buildings																																				
Tunnel systems and railway fit out																																				
Wendover green tunnel (north) satellite compound																																				
Wendover green tunnel north portal buildings																																				
Tunnel systems and railway fit out																																				
Stoke Grove auto-transformer station installation																																				
Commissioning																																				
Commissioning (until end 2026)																																				

Construction activity	2017 quarters				2018 quarters				2019 quarters				2020 quarters				2021 quarters				2022 quarters				2023 quarters				2024 quarters				2025 quarters			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Key	Construction works		Compound duration																																	

2.4 Operation of the Proposed Scheme

Operational specification

2.4.1 Volume 1, Section 4.3 describes the envisaged operational characteristics of Phase One of HS2 as a whole and how they may change when Phase Two is also operational.

HS2 services

2.4.2 It is anticipated that initially there would be 11 trains per hour each way passing through the Dunsmore, Wendover and Halton area in the morning and evening peak hours, and fewer during other times. The first trains of the day would leave the terminus stations no earlier than 05:00 Monday to Saturday (and 08:00 on Sundays) and the last would arrive no later than midnight.

2.4.3 It is anticipated that with Phase One in place the frequency of services could rise to 14 trains per hour each way during peak hours, and that with Phase Two in place the frequency could rise to 18 trains per hour each way during peak hours. The assessment of sound, noise and vibration has taken into account the frequency during Phase Two.

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

Operational waste and material resources

2.4.5 Forecasts of the amount of operational waste that will be produced annually during operation of the Proposed Scheme have been prepared and are presented in Volume 5: Appendix WM-001-000.

2.4.6 Railway station and train waste refers to waste that will arise at each station. It will include waste from station operations and passenger waste removed from trains at terminating stations. This has only been reported for areas along the route in which these stations will be located.

2.4.7 Rolling stock maintenance waste is that which will be generated by the relevant train operating company at rolling stock maintenance facilities. This has only been reported for the areas along the route in which these facilities will be located.

2.4.8 Track maintenance waste and ancillary infrastructure waste (for example waste from depots, signalling locations, operations and maintenance sites) has been estimated using an average waste generation rate per kilometre length of total track. For this reason, both track maintenance waste and ancillary infrastructure waste has been reported for each area along the route.

2.4.9 The quantity of operational waste that will be reused, recycled and recovered (i.e. diverted from landfill) has been based on landfill diversion performance information from Network Rail and other sources as follows:

- railway station and trains: 60%;
- rolling stock maintenance: 80%;
- track maintenance: 85%; and

- ancillary infrastructure: 60%.

2.4.10 On this basis, approximately 118 tonnes of operational waste will be reused, recycled and recovered during each year of operation of the Proposed Scheme in the Dunsmore, Wendover and Halton area. Approximately 24 tonnes will require disposal to landfill (see Table 2).

Table 2: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste generated per annum (tonnes)	Estimated quantity of waste for disposal to landfill per annum (tonnes)
Railway station and train	0	0
Rolling stock maintenance	0	0
Track maintenance	131	20
Ancillary infrastructure	11	4
TOTAL	**142**	**24**

2.4.11 The assessment of the likely significant environmental effects associated with the disposal of operational waste has been undertaken for the Proposed Scheme as a whole (see Volume 3, Section 14).

2.5 Community forum engagement

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

2.5.2 The engagement undertaken within this community forum area is summarised below. A series of community forum meetings and discussions with individual landowners, organisations and action groups were undertaken. A community forum meeting was held on:

- 20 March 2012, at Wendover Library Room (this meeting covered both this area and the Missendens area before the boundary change);
- 25 June 2012, at Wendover Library Room;
- 10 September 2012, at Wendover Library Room;
- 13 November 2012, at Wendover Library Room;
- 12 February 2013, at Wendover Bowls Club; and
- 12 September 2013, at St Anne's Hall.

2.5.3 In addition to HS2 Ltd representatives, attendees at these community forum meetings typically included local residents and residents groups, public representatives, representatives of local authorities and parish and district councils, action groups, affected landowners and other interested stakeholders.

2.5.4 The main themes to emerge from these meetings were:

- the potential impact of road and footpath diversions on local communities and journey times;
- potential noise impacts along sections of the route in cutting or on viaduct when the Proposed Scheme is operational;
- potential visual impacts of the Proposed Scheme, particularly from the viaducts at Wendover Dean and Rocky Lane respectively;
- measures for mitigating noise and visual impacts of viaducts for residents living close to the route, particularly where dwellings would overlook the route;
- potential impacts from construction traffic and construction activity including air-borne particles and potential effects on health;
- the stress felt by residents about HS2 and impacts on well-being;
- potential impacts on St Mary's Church, a popular concert venue, due to its proximity to the route;
- the potential for construction and operation of HS2 to deter tourists from visiting the area, which would have an effect on local economies;
- potential impacts on watercourses, particularly two major springs at the north-western boundary of the CFA, a well head at St Mary's Church, and at Dobham Lane;
- concern that construction traffic, particularly the increase in heavy goods vehicles (HGV), would impact on road safety and journey times;
- concern that there would be an increased number of families in the area and that this would impact on local services, including school intake figures and other local resources;
- concerns over safety risks arising from construction activities; and
- concern that suggested road realignments be kept open, including Ellesborough Road and Bacombe Lane.

2.5.5 In addition to the engagement through the community forums, the draft ES consultations were launched on 16 May 2013 for a period of eight weeks and closed on the 11 July 2013. As part of these consultations, members of local communities and other interested parties were notified, provided with information and invited to engage on issues pertinent to the draft ES and the development of the Proposed Scheme. Details of the local consultation events were provided on HS2 Ltd website, social media, posters at local venues, national and regional advertising and to properties within 1km of the Proposed Scheme. In the Dunsmore, Wendover and Halton area (CFA10) consultations on the draft ES and on the Design Refinement were held on 29 June 2013, Wendover Memorial Hall.

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

2.5.7 Responses from the draft ES consultation have been analysed and an overview of those received and how the ES has taken account of responses is contained in the Draft Environmental Statement Consultation Summary Report (Volume 5: Appendix CT-008-000).

2.6 Route section main alternatives

2.6.1 The main strategic alternatives to the Proposed Scheme are presented in Volume 1. The main local alternatives considered for the Proposed Scheme within the local area are set out within this section.

2.6.2 Since April 2012, as part of the design development process, a series of local alternatives have been reviewed within workshops attended by engineering, planning and environmental specialists. During these workshops the likely significant environmental effects of each design option have been reviewed. The purpose of these reviews was to ensure that the Proposed Scheme draws the right balance between engineering requirements, cost and potential environmental impacts.

Extended Chilterns bored tunnel

2.6.3 A number of alternatives have been considered to extend the length of the Chilterns bored tunnel. None of these options have been adopted in the Proposed Scheme. However, the longer options that have been considered would result in the northern portal of the tunnel being within CFA10, north of the town of Wendover. This would incur additional visual, community and traffic impacts for this area, since tunnel boring activities would commence from a main worksite at the tunnel portal. The construction site would need to have treatment facilities for the material coming out of the tunnel and would result in vehicles and workers travelling to and from it. These factors were part of the consideration in deciding not to include a longer tunnel within the Proposed Scheme. Details of the options considered are provided in the Central Chilterns area (CFA9) report.

Sustainable placement of surplus excavated material

2.6.4 The Proposed Scheme in CFA 10 includes an area for the sustainable placement of surplus excavated materials. This area comprises four fields between Hunt's Green Farm, King's Lane and the South Heath cutting/route. The placement will comprise surplus excavated material from the adjacent South Heath cutting and from cuttings in the Central Chilterns area (CFA9).

2.6.5 Three options were considered for the management of this surplus excavated material:

- Option A: remove surplus excavated material by road to Calvert, 35km away, for onward transfer via the rail network;
- Option B: the Proposed Scheme, using the construction route to avoid local roads, sustainably place surplus excavated material on over four fields between Hunt's Green Farm, King's Lane and the South Heath cutting/route; and
- Option C: removal of surplus excavated material by road directly to the nearest suitable landfills.

2.6.6 Options A and C would require the removal of approximately 1,000,000 m^3 of surplus excavated material by road along temporary access roads, the B485 Chesham Road, the A413 London Road and beyond. This would equate to approximately 240,000 lorry movements, equivalent to more than one lorry movement every minute, eight hours a day for approximately three years. Under these options, the introduction of large volumes of construction traffic between South Heath and Calvert would result in a major adverse impact on the B485 Chesham Road. On the A413 London Road this traffic in combination with other construction traffic generated by the Proposed Scheme would exceed the threshold set by Buckinghamshire County Council beyond which significant adverse traffic effects would be likely. This increased traffic would also result in adverse impacts on communities along the proposed traffic routes including those facing directly onto the A413 London Road and A41 Bicester Road through Aylesbury. Due to the potential scale of adverse impacts associated with these lorry movements Options A and C were not included in the Proposed Scheme.

2.6.7 Option B would include a permanent modification to the landform within a nationally designated area. In practice, the site is on farmland with few existing trees or landscape features and is relatively well concealed lying behind the crest of the Chiltern scarp and behind a dense hedge line of oaks along King's Lane. The construction of South Heath cutting will result in the loss of the eastern part of Grim's Ditch scheduled monument. The construction of the sustainable placement area will not result in further direct impacts on the scheduled part of the monument, but will alter the landform above the unscheduled section of the monument further to the north. The sustainable placement area will form an extension to the landscape mitigation earthwork and will achieve an equivalent height of up to 5m but with gentler slope profiles. Following reinstatement to agricultural use, the visual and landscape impact will be negligible notwithstanding its position within the AONB. This proposal will also avoid the use of local roads and the major adverse impacts associated with the additional lorry movements required to remove the surplus excavated material off-site.

2.6.8 Option B has therefore been included in the Proposed Scheme.

Enclose the viaduct at Wendover Dean

2.6.9 The Proposed Scheme includes a 500m long viaduct that would pass across Wendover Dean south of Wendover. This viaduct would be up to approximately 18m above the valley floor. This was part of the January 2012 announced scheme.

2.6.10 The local community has proposed that the viaduct be covered or enclosed in order to remove views of passing trains and to reduce potential noise effects. However, artificial above ground covering along the route where it is at surface or already on elevated structures (e.g. embankment or viaduct) has not been adopted due to the associated additional costs and environmental impacts.

2.6.11 In this location, the enclosure of the viaduct would require significant additional engineering works. In particular, the size of the enclosure to provide the required aerodynamic performance would require an increase in bridge width and a much more substantial support structure. Enclosure of the viaduct would in effect create a tunnel and would require inclusion of appropriate measures to mitigate pressure waves

created by trains. Enclosure would increase construction complexity and time, with increased construction and ongoing maintenance costs for the structure.

2.6.12 The increased size and visual appearance of an enclosed structure would be difficult to mitigate with the result that the visual intrusion of a covered viaduct would be more significant than the impacts from the viaduct that is proposed. Particularly within the setting of Chilterns AONB, the visual appearance of the structure will be an important aspect of the final design adopted.

2.6.13 With regard to noise effects, a covered structure would reduce potential noise impacts for the length of the viaduct. However, the Proposed Scheme incorporates earthworks and noise fence barriers to provide noise attenuation without the permanent visual impacts and additional costs of a covered structure.

2.6.14 For these reasons, covering or enclosure of viaduct structures has not been included in the Proposed Scheme.

Rocky Lane road realignment

2.6.15 The Proposed Scheme includes a new bridge on Rocky Lane to maintain vehicular access (see Map CT-05-037, Volume 2, CFA10 Map Book). This was included within the January 2012 announced route. An alternative option was proposed by the community forum. Two alternatives were considered:

- Option A: underbridge at Rocky Lane to maintain vehicular access, the Proposed Scheme; and
- Option B: a new highway diversion constructed on the east side of the Proposed Scheme that would connect Rocky Lane with the A413 via a new junction at the entrance to the private access for Boswells Farm.

2.6.16 Option B would require an increase in the use of agricultural land in order to construct a new highway in comparison with the smaller footprint to construct an offline realignment of the bridge for Rocky Lane as proposed in Option A. Whilst Option B would divert traffic away from The Laurels it would result in a lengthy diversion of approximately 1.8km, and would sever direct access from Kingsash to the A413 and Dunsmore, as well as field access for Hartley Farm either side of the Proposed Scheme. This would also create additional cost for the project.

2.6.17 For these reasons Option B has not been adopted in the Proposed Scheme.

Small Dean viaduct

2.6.18 The Proposed Scheme passes over the A413 London Road and the Marylebone to Aylesbury Line, south of Wendover, on a viaduct. This was included within the January 2012 announced scheme. Four construction options were subsequently considered:

- Option A: the Proposed Scheme, a viaduct constructed of concrete, over the A413 London Road and Marylebone to Aylesbury Line;
- Option B: replacing the viaduct with box structures with embankments between them;
- Option C: replacing the viaduct with box structures with short span viaducts

between them; and

- Option D: viaduct, constructed as a concrete - steel hybrid, over the A413 London Road and Marylebone to Aylesbury Line.

2.6.19 Each of the four options would be designed to avoid or limit impact on the Marylebone to Aylesbury Line during construction and to avoid impact during the operational phase.

2.6.20 Options B and C would have visual impacts on the landscape and residential receptors due to the solid nature of the box structures and embankments in Option B blocking wider views. In particular, the box sections over the A413 London Road would introduce a long tunnel along the A413 London Road, with some restrictions on driver visibility and posing a potential additional safety hazard for road users.

2.6.21 Option B would introduce a more complex structure to build and maintain, due to the short lengths of embankment placed between structures, which would give rise to differential settlement concerns. Option C would address the settlement concerns, but would still remain a more complex structure to build and maintain than a continuous viaduct. For these reasons, neither Option B nor Option C has been adopted.

2.6.22 Options A or D would both provide a viaduct across the A413 and the Marylebone to Aylesbury Line. Whilst both options would require long spans over the road and rail line, the construction will have less impact adjacent to the structures. Option D would provide a different form of structure with slightly different visual impact to Option A. Both Options would be of similar cost and construction would be similar.

2.6.23 Option A will provide a standard form of viaduct with consistent concrete finish. It will limit the visual impact of the structure along the A413 and construction will be undertaken to avoid significant impact on the traffic use of the A413.

2.6.24 Option A is considered the most practicable design to include in the Proposed Scheme from an engineering perspective at this time and is thus adopted in the Proposed Scheme. However, Option D will be given further consideration during detailed design.

Overhead power line at Wendover

2.6.25 The Proposed Scheme includes a realignment of the National Grid overhead power line and relocation of pylons to the west of Wendover. This is necessary due to a conflict of existing pylons with the position of the southern portal of the Wendover green tunnel.

- Option A: the Proposed Scheme, alignment to the east of Grove Farm and to the west of the A413; and
- Option B: alignment to the west of Grove Farm.

2.6.26 Option B would have required a greater land take as the alignment dog-legged out to the west. As a result this would have greater impacts on Grove Farm by surrounding them with construction activities as well as potentially compromising the viability of the farm to continue operations.

2.6.27 Option A requires a smaller footprint as the alignment will follow the working corridor required to construct the Proposed Scheme. Construction activities adjacent to Grove Farm will be kept to the east side and so minimising the impact on farm operations. Both options have equal impacts on the Grade ll listed buildings at Smalldean Farm and on the nearby PRoW including the Icknield Way Trail.

2.6.28 Option A is included within the Proposed Scheme as there will be less land required and less impact from construction activities with this option compared to Option B.

Bacombe Lane

2.6.29 Within the draft ES it was proposed that the access to Bacombe Lane from the A413 would be stopped up. Residential access to Bacombe Lane would have been accessed via a permanent link road connecting Ellesborough Road and Bacombe Lane. Since the draft ES and in dialogue with the local community and, Buckinghamshire Country Council consideration has been given to the reinstatement of Bacombe Lane.

2.6.30 The Proposed Scheme now includes an offline realignment of Bacombe Lane, connecting to the overbridge crossing the A413 London Road, leading to South Street. Four alternatives were considered:

- Option A: The January 2012 announced route, as presented in the draft ES – link road between Ellesborough Road and Bacombe Lane with Bacombe Lane stopped up at junction with South Street;
- Option B: offline diversion over green tunnel, re-joining Bacombe Lane;
- Option C: offline diversion over green tunnel, re-joining Bacombe Lane with T junction; and
- Option D: the Proposed Scheme, an offline diversion over green tunnel, re-joining Bacombe Lane with T-junction and smaller footprint.

2.6.31 Option B was discounted immediately on the grounds that the approach embankments would require the demolition of a number of properties along Bacombe Lane. For this reason Option B was not included in the Proposed Scheme.

2.6.32 Option A would have required a new permanent link road between Ellesborough Road and Bacombe Lane requiring more land for a larger footprint as well as being visually dominant on the slope of a hill. Although this was the chosen design for the draft ES other alternatives were investigated following representations from the local community and Buckinghamshire County Council.

2.6.33 Options C and D were similar in design. However, Option D will have a smaller footprint and therefore take less land during both construction and operation. It will therefore be less visually intrusive than the other options for the residents along Bacombe Land and to wider landscape.

2.6.34 For these reasons Option D has now been adopted in the Proposed Scheme. As a consequence the link road, originally intended to be permanent, is now only required on a temporary basis. During construction of the green tunnel, access to Bacombe Lane from the South Street will be temporarily closed with an alternative route provided via the temporary link road and Ellesborough Road. Access to South Street

will be reinstated over the green tunnel once construction works are sufficiently progressed in this area.

Ellesborough Road

2.6.35 The Proposed Scheme includes a temporary diversion of Ellesborough Road north of the properties alongside the current Ellesborough Road. This has been proposed in order to maintain access to Wendover during construction of the Wendover green tunnel. This new temporary diversion will be required in order to deliver the January 2012 announced scheme that showed Ellesborough Road reinstated over the green tunnel after construction was completed. Three alternatives were considered:

- Option A: the Proposed Scheme, diversion of Ellesborough Road to the north behind the existing properties;
- Option B: divert Ellesborough Road to the south; and
- Option C: stop up Ellesborough Road during construction of the green tunnel.

2.6.36 Option C was not considered feasible because of the volume of traffic travelling along Ellesborough Road. It would have involved an extended diversion via the B4009 Nash Lee Road, A413 and then continuing along the B4009 Aylesbury Road to High Street, ending at Pound Street. This was considered not to be practicable for road users.

2.6.37 Option B was not proposed as a result of the requirement for land within the Wendover Memorial Woodland east of Ellesborough Road. HS2 Ltd has been working to reduce the impacts on the woodland; and for this reason this option was not adopted in the Proposed Scheme.

2.6.38 The Proposed Scheme, Option A, will have potential effects on the properties adjacent to Ellesborough Road. A new road will be constructed to the rear of these properties that, for part of the duration of the construction of the green tunnel, will be used by through-traffic that currently uses Ellesborough Road. However, these properties will already be significantly affected by the construction of the green tunnel and the additional effects of having a temporary diversion to the rear of the properties will be minor. Residential access will be maintained to the front and rear of the properties during construction.

2.6.39 For these reasons Option A has been adopted in the Proposed Scheme.

Extended green tunnel at Wendover

2.6.40 The Proposed Scheme includes a green tunnel west of Wendover, adjacent to the A413. This was part of the January 2012 announced scheme. Local groups proposed additional options for extending the green tunnel at Wendover and four alternatives were considered:

- Option A: the Proposed Scheme, a green tunnel of 1.2km adjacent to Wendover, consistent with the January 2012 announced scheme;
- Option B: an extended green tunnel to the west, past where Nash Lee Lane would cross the Proposed Scheme;
- Option C: an extended green tunnel to the east, in the direction of Small Dean;

and

- Option D: an extended green tunnel east of the Small Dean crossing of the A413.

2.6.41 The local community suggested Options B, C and D would reduce the potential noise and visual effects and allow reinstatement of land for agricultural use.

2.6.42 In terms of potential noise impacts, extending the green tunnel to the west would benefit a few additional dwellings at Nash Lee Lane, whilst extending the green tunnel to the east would benefit dwellings on Bacombe Lane. However, in both locations the noise effects can be effectively managed by adopting noise fence barriers.

2.6.43 Option D would increase the length of green tunnel past Wendover to 3.7km and it would also require the inclusion of an additional vent shaft due to the overall length of tunnel. This longer tunnel would avoid the permanent visual impacts of the A413 crossing. However, it would also create significant construction impacts resulting from the construction under the existing A413 and the existing Marylebone to Aylesbury Line, with likely disruptions to services. As a result, construction periods would also be likely to increase. This would create significant additional cost for the project that is not considered justified for the benefits that would be gained from a longer tunnel. Therefore Option D was not adopted in the Proposed Scheme.

2.6.44 It is acknowledged that a green tunnel would reinstate a greater area of land for use once the Proposed Scheme was constructed. However, any additional benefits of Options B and C beyond this would be more marginal.

2.6.45 Options A, B and C would all result in some visual impacts due to the crossing of the A413. Whilst any difference between Options A and B would be marginal, Option C could also result in visual impacts arising from the top of the green tunnel being above existing ground level, which could require further mitigation works.

2.6.46 HS2 Ltd has considered the likely cost of increasing the extent of the green tunnel based on the estimate for the proposed green tunnel and both Options B and C would increase the costs. The additional length of tunnel for Options B and C would result in significant additional cost for the project. Consequently, it was considered that the scale of the potential noise and visual benefits of extending the tunnel under Options B and C were not sufficient to justify these options.

2.6.47 For these reasons Option A has been adopted in the Proposed Scheme.

Maintenance loops at Stoke Mandeville

2.6.48 The Proposed Scheme now includes maintenance loops at Stoke Mandeville. This has altered the vertical alignment of the railway between Wendover and Stoke Mandeville which in this area includes a lowering of the alignment northwards of Wendover and the provision of access roads from Nash Lee Road northwards alongside the railway. This will have some small benefits including lowering the height of the road crossing at the B4009 Nash Lee Road. The options considered, and the reasons for the selection of the location of the maintenance loop, are detailed in CFA 11 report – Stoke Mandeville and Aylesbury.

3 Agriculture, forestry and soils

3.1 Introduction

3.1.1 This section provides a description of the current baseline for agriculture, forestry and soils and an assessment of the likely impacts and significant effects as a result of the construction and operation of the Proposed Scheme. 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.

3.1.2 The quality of agricultural land in England and Wales is assessed according to the Agricultural Land Classification (ALC) 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 the impacts on agricultural land is the extent to which land of best and most versatile (BMV) agricultural quality (Grades 1, 2 and 3a) is affected by the Proposed Scheme.

3.1.3 Forestry is considered as a land use feature and the impacts have been calculated quantitatively. The qualitative effects on forestry land and woodland are addressed principally in the ecology and landscape and visual assessments (see Sections 7 and 9).

3.1.4 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 cultural heritage, ecology and landscape and visual assessment (see Sections 6, 7 and 9).

3.1.5 The main issue for farm holdings is the disruption by the Proposed Scheme of the physical structure of agricultural holdings and the operations taking place upon them, during both its construction and operational phases. Key engagement has been undertaken with farmers and landowners affected by the Proposed Scheme to obtain factual information on the scale and nature of the farm and forestry operations and related farm-based uses.

3.1.6 Details of published and publicly available information used in the assessment, and the results of surveys undertaken within the study area, are contained in Volume 5: Appendix AG-001-010.

3.2 Scope, assumptions and limitations

3.2.1 The assessment scope, key assumptions and limitations for the agriculture, forestry and soils assessment are set out in Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

3.2.2 The study area for the agriculture, forestry and soils assessment covers all of the land that will be 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 BMV land and forestry in the general locality, taken as a wider 4km corridor centred on the Proposed Scheme.

3.2.3 Common assumptions that have been applied to the Proposed Scheme, such as the restoration of agricultural land to pre-existing quality, the handing back of land used temporarily to the original landowner and the non-replacement of capital items demolished, are set out in Volume 1. There are no other assumptions or limitations that are specific to the assessment in this local area.

3.3 Environmental baseline

Existing baseline

3.3.1 This section sets out the main baseline features that influence the agricultural and forestry use of land within this study 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.

Soils and land resources

Topography and drainage

3.3.2 The main topographical features within the study area are described in detail in the landscape and visual assessment (Section 9), and include the series of hills and predominantly dry valleys of the Chilterns at altitudes of between 150m to 225m above Ordnance Datum (AOD). The Wendover Gap extends southwards from Wendover and is characterised by a flat valley bottom from which the valley sides rise into the Chilterns. The valley joins that of the River Misbourne to the south. Tributaries of the River Thame extend into the northern-most sections of the area and lie at approximately 115m AOD.

Geology and soil parent materials

3.3.3 The main geological features are described in detail in the land quality assessment (Section 8). The principal underlying geology mapped by the British Geological Survey (BGS) is Cretaceous Chalk of the Holywell Nodular, Lewes Nodular and West Melbury Marly Formations. In the north-west, bedrock geology becomes that of the Gault and Upper Greensand Formations that comprise mudstone, sandstone and limestone.

3.3.4 Between the south-eastern boundary of this area and the south-east of Wendover, the chalk of the dry valleys is overlain by superficial Quaternary head deposits of clay, silt, sand and gravel. On the top slopes of hills around Little Hampden, Dunsmore and Ellesborough, and between The Lee and Halton, the chalk bedrock is overlain by clay, silt, sand and gravel of the Clay-with-Flints Formation.

Description and distribution of soil types

3.3.5 The characteristics of the soils are described by the Soil Survey of England and Wales[18] and shown on the National Soil Map[19]. The soils are grouped into associations

[18] Soil Survey of England and Wales (1984), *Soils and Their Use in South East England.*
[19] Cranfield University (2001), *The National Soil Map of England and Wales* 1:250,000 scale, National Soil Resources Institute.

of a range of soil types and are described in more detail in Volume 5; their distribution is shown on Map AG-02-010 (Volume 5, Agriculture, Forestry and Soils Map Book).

3.3.6 The National Soil Map shows seven soil associations. The Wendover Gap dry valley is occupied by the well-drained (WC I), silty loam Charity 2 association that develops in flinty chalky drift over Chalk bedrock. Upslope from the Charity 2 soils are those of the Batcombe association (WC II or III), developed in Clay-with-Flints that caps chalk plateaux and comprises silty loam topsoils over clayey subsoils.

3.3.7 In the north-west, bands of Andover 1, Wantage 1, Upton 1, Block and Bignor soils are aligned roughly north-east to south-west and generally reflect the geology and sloping topography. Andover 1 soils comprise well drained (WC I) variably flinty and chalky silty loam soils overlying chalk, found on undulating chalkland. Wantage 1 soils are also well drained (WC I), and comprise silty clay loam topsoils over silty clay loam subsoil and that occur on moderately sloping chalk. Soils of the Upton 1 association occur mainly on steep slopes and escarpments and comprise shallow, well drained (WC I), silty loam topsoils over chalk or chalk rubble. All are slightly to moderately droughty for common agricultural crops.

3.3.8 The Block association, developed in chalky and gravelly drift is characterised by calcareous profiles that are of clay loam or sandy clay loam texture throughout and are moderately well drained (WC II).

3.3.9 As the geology changes from chalk to Gault and Upper Greensand Formations, soils of the Bignor association are present and comprise sandy silt loam topsoils with clay loam subsoils. These are affected by periodic and localised waterlogging and the soils are commonly found to be of WC II or III.

Soil and land use interactions

Agricultural land quality

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

3.3.11 The main soil properties that affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. There are two distinct soil types within the area, namely the clay loam or silty loam topsoil textures over heavier subsoils on the plateaux, overlying Clay-with-Flints and those that are well drained with silty loam topsoils, overlying chalk. It is likely that on some of the slopes in the section, soil depth and droughtiness may be a limiting factor.

3.3.12 Climate in this area does not in itself place any limitation upon land quality but the interactions of climate with soil characteristics are important in determining the workability and droughtiness limitations of the land. The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point data set for two points within this area and are set out in Volume 5: Appendix AG-001-010. The data show average rainfall and temperature to be moderate to moderately high, with annual average rainfall of approximately 710mm and an average of 1,360 accumulated

day degrees[20]. The resulting field capacity day (FCD) regime[21] is slightly greater than average for lowland England at around 159 days and is slightly unfavourable for providing opportunities for land working.

3.3.13 Gradient and microrelief, with complex changes of slope angle or direction over short distances, are limiting factors across a large proportion of the agricultural land within this section.

3.3.14 The Charity 2, Andover 1, Upton 1 and Wantage 1 associations are all well drained soils of WC I with silty clay loam topsoil textures, and permeable silty clay loam subsoils or chalk. The soils are all also slightly to moderately droughty, imposing a probable limitation to Grade 2 or 3a, though Subgrade 3a is predominant along the route of the Proposed Scheme.

3.3.15 Overall, interactions between climate and the moderately to imperfectly drained soils of the Batcombe association that typically have medium silty clay loam topsoils limits the land by soil wetness to Grade 2 quality where it is WC II. Soils of WC III are a little less variable with silt loam, medium silty clay loam and medium clay loam topsoils all resulting in Subgrade 3a and the remaining fine silty and loamy textures resulting in Subgrade 3b. These soils are rarely more than slightly droughty for any of the main crops, though they are moderately droughty for grass.

3.3.16 The Block association soils of WC II and with sandy clay loam or clay loam topsoil textures are limited to Grade 2 or Subgrade 3a by soil workability. These soils may be slightly droughty for grass and hence would be expected to be also limited to Subgrade 3a by droughtiness. Soils of the Bignor association with sandy silt loam topsoil and WCII, will have a workability limitation to Subgrade 3a, and are also slightly droughty.

3.3.17 Department for Environment, Food and Rural Affairs (Defra) mapping[22] shows that there is a high likelihood of encountering BMV land in this locality, which makes such land a resource of low sensitivity in this area.

Other soil interactions

3.3.18 Soil fulfils a number of functions and services for society in addition to those of food and biomass production that are central to social, economic and environmental sustainability. These are outlined in sources such as the Soil Strategy for England[23] and The Natural Choice: securing the value of nature[24], and include:

- the storage, filtration and transformation of water, carbon and nitrogen in the biosphere;
- support of ecological habitats, biodiversity and gene pools;
- support for the landscape;

[20] Accumulated temperature is the excess of daily air temperatures above 0°C between January and June and can be used as an indication of heat energy input and soil drying potential which correlates with crop growth and yield.
[21] 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 and opportunities for mechanised fieldwork are then possible.
[22] Defra (2005), *Likelihood of Best and Most Versatile Agricultural Land.*
[23] Defra (2009), *Soil Strategy for England.*
[24] Defra (2011), *The Natural Choice: Securing the value of nature.*

- protection of cultural heritage;
- providing raw materials; and
- providing a platform for human activities, such as construction and recreation.

3.3.19 Forestry resources represent a potentially multifunctional source of productive timber, landscape amenity, and biodiversity and carbon storage capacity. Although there is limited woodland close to the Proposed Scheme, across the wider area there are large swathes of woodland including Rushmoor Wood to the south, Barn Wood to the east and Coxgrove and Bacombe Woods to the west. The value and sensitivity of the forestry resource is assessed in Section 7.

3.3.20 The potential presence of buried cultural assets within the soils of the area is assessed in Section 6. The study area lies in the middle of the Chilterns and although there is presently little evidence for early and later prehistoric activity, such activity is to be expected on the higher ground overlooking river valleys and better drained areas. The largest landscape feature in the study area, Grim's Ditch, is of Iron Age date and represents a substantial land division that still survives as standing earthworks.

Land use

Land use description

3.3.21 Agricultural land use in the southern part of this section is predominantly arable with pockets of grassland restricted to the steeper valley slopes and valley bottoms. Through the centre of the study area in the Wendover Gap, agriculture is more mixed with grassland predominating. To the west of Wendover arable crops again dominate the land use.

3.3.22 A number of environmental designations potentially influence land use within the study area. The whole area is designated a nitrate vulnerable zone (NVZ), which is an area in which nitrate pollution of surface or groundwater is a problem. Statutory land management measures apply that seek to reduce nitrogen losses from agricultural sources to water. Some agricultural land is also subject to management prescriptions associated with the Environmental Stewardship Scheme that seeks either generally (the Entry Level Scheme - ELS) or specifically (the Higher Level Scheme - HLS) to retain and enhance the landscape and biodiversity qualities and features of farm land. Holdings that have land entered into an agri-environment scheme are identified in Table 3.

3.3.23 As noted above, although there is limited woodland close to the Proposed Scheme, across the wider area woodland is extensive and covers approximately 18% of the land compared to the national average of 10%. As such woodland is a resource of low sensitivity to change in land use terms.

Number, type and size of holdings

3.3.24 There is a mixture of owner-occupation and tenancies and the boundaries of the holdings are shown on Maps AG-01-019 to AG-01-021 (Volume 5, Agriculture, Forestry and Soils Map Book) along with the location of the main farm buildings. Field drainage is common throughout the study area, but no farms have been identified that undertake routine field irrigation of crops.

3.3.25 Table 3 sets out brief details of the holdings and 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 which 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. Smaller (less intensively used) units, such as pony paddocks associated with residential properties, have a low sensitivity. The holding/reference name provides a unique identifier and relates to Map AG-01-019 to AG-01-021 (Volume 5, Agriculture, Forestry and Soils Map Book) and Volume 5: Appendix AG-001-010.

Table 3: Summary characteristics of holdings

Holding reference /name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA10/1 Hunt's Green Farm	Arable, beef cattle and sheep	100	None	ELS	Medium
CFA10/2 Strawberry Hill Farm	Arable, beef cattle and sheep	220	None	ELS	Medium
CFA10/3* Durham Farm	Arable and beef cattle	63	Not known	None	Medium
CFA10/5 Upper Wendover Dean Farm	Arable and beef cattle	50	None	None	Medium
CFA10/6 Hartley Farm	Grassland	7	Buildings let	None	Low
CFA10/7 Road Barn Farm	Grassland	28	None	None	Low
CFA10/8 * Boswells Farm	Arable and sheep	95	Not known	ELS	Medium
CFA10/9 Bank Farm	Arable and sheep	202	None	ELS	Medium
CFA10/10 Grove Farm	Grassland	89	None	None	Medium
CFA10/11 Smalldean Farm	Grazing let	66	None	None	Low
CFA10/12 Wellwick Farm	Arable and equine	81	DIY Livery yard	None	Medium
CFA10/13 Orchard Farm	Derelict orchard and grazing	22	None	None	Low

Holding reference /name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA10/14 Nash Lee Farm	Beef cattle, sheep, arable	89	Farm shop	None	Medium
CFA10/15 * Un-named paddock	Grazing	5	Not known	None	Low
CFA10/16 * Stocken Farm	Arable	48	Not known	None	Medium
CFA10/17 * Hunters Leaze	Grazing	16	Not known	None	Low
CFA10/18 * Chiltern Million	Grazing	3	Not known	None	Low

* No Farm Impact Assessment interview conducted; data estimated
(Holding CFA10/4 is unaffected by the construction of the Proposed Scheme)

Future baseline

Construction (2017)

3.3.26 No committed developments have been identified in this area that will materially alter the baseline conditions in 2017 for agriculture, forestry and soils.

3.3.27 The future of agri-environment schemes is uncertain at present due to ongoing reform of the Common Agricultural Policy. The majority of schemes seem likely to cease over the next two to three years and replacements are uncertain. Whilst this will remove a level of support from the agricultural industry that has been used to offset some of the costs incurred in managing land in an environmentally responsible manner, it is unlikely to materially alter the way agricultural land is managed in the future. Whilst some field margins may be cropped closer to hedgerows and stocking rates may increase in some locations, the stocking and cropping baseline set out in the previous section is unlikely to change significantly.

Operation (2026)

3.3.28 No committed developments have been identified in this area that will materially alter the baseline conditions in 2026 for agriculture, forestry and soils.

3.4 Effects arising during construction

Avoidance and mitigation measures

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

- agricultural accommodation bridge near Cottage Farm (CFA09/23)[25];

[25] The impact on this holding is assessed in the CFA9 report.

- new field accesses associated with the realigned Small Dean Lane and Bacombe Lane;
- new farm access for Grove Farm (CFA10/10);
- reinstated farm access tracks associated with the land presently farmed by Durham Farm (CFA10/3) and Upper Wendover Dean Farm (CFA10/5) under Wendover Dean viaduct;
- new farm access over Wendover green tunnel for Strawberry Hill Farm (CFA10/2) and Bank Farm (CFA10/9);
- new field accesses associated with the Rocky Lane underbridge; and
- new field accesses associated with the Bowood Lane and Nash Lee Road overbridges.

3.4.2 In addition, there is a need to avoid or reduce environmental impacts to soils during construction. It is an essential element of the construction process that the soil resources from the areas required temporarily and permanently are stripped and stored so that land required temporarily for construction purposes which is currently in agricultural use can be returned to that use, where agreed, and to its pre-existing agricultural condition.

3.4.3 Subject to the adoption of good practice techniques in handling, storing and reinstating soils on land where agricultural or forestry uses are to be resumed, there will be no reduction in the long term capability of disturbed land, though some land with heavier textured soils will need careful management during the aftercare period to ensure this outcome.

3.4.4 Compliance with the draft CoCP will reduce environmental impacts during construction. Of particular relevance to agriculture, forestry and soils are the following measures (see Volume 5: Appendix CT-003-000):

- the reinstatement of agricultural land which is used temporarily during construction to agriculture, where this is the agreed end use (draft CoCP, Section 6);
- the provision of a method statement for stripping, handling, storing and replacing agricultural and woodland soils to reduce risks associated with soil degradation on areas of land to be returned to agriculture and woodland following construction, based on detailed soil survey work to be undertaken prior to construction. This will include any remediation measures necessary following the completion of works (draft CoCP, Section 6);
- a requirement for contractors to pay due consideration to the impacts of extreme weather events and related conditions which may affect agriculture, forestry and soil resources during construction (draft CoCP, Section 5);
- arrangements for the maintenance of farm and field accesses affected by construction (draft CoCP, Section 6);
- the protection and maintenance of existing land drainage and livestock water

supply systems, where reasonably practicable (draft CoCP, Sections 6 and 16);

- the protection of agricultural land adjacent to the construction site, including the provision and maintenance of appropriate stock-proof fencing (draft CoCP, Sections 6 and 9);
- the adoption of measures to control the deposition of dust on adjacent agricultural crops (draft CoCP, 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 (draft CoCP, Section 9);
- the adoption of measures to prevent, as far as reasonably practicable, the spread of soil-borne, crop and animal diseases from the construction area (draft CoCP, Sections 6 and 9); and
- liaison and advisory arrangements with affected landowners, occupiers and agents, as appropriate (draft CoCP, Sections 5 and 6).

Assessment of impacts and effects

3.4.5 The cessation of existing land uses will be required in the area required to construct and operate the Proposed Scheme. This includes not only the land on which permanent works will be sited, but also that required temporarily to facilitate construction of those permanent works.

3.4.6 All of the land required to implement the Proposed Scheme will, therefore, be affected during the construction period. The land required for the construction and operation of the Proposed Scheme will, in places, sever and fragment individual fields and operational units of agricultural and forestry land. This will result in potential effects associated with the ability of affected interests to continue 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 scheme design seeks, however, to reduce this structural disruption, and to incorporate inaccessible severed land as part of environmental mitigation works.

3.4.7 The timing and duration of various construction elements are set out in Section 2.3. Where land is restored to agricultural use, where appropriate, it will be subject to a further period of five years of managed aftercare to ensure stabilisation of the soil structure.

Temporary effects during construction

Impacts on agricultural land

3.4.8 During the construction phase, the total area of agricultural land used will be 235.9ha, as shown in Table 4. Of this total, 145.6ha will be restored and available for agricultural use following construction.

Table 4: Agricultural land required temporarily

Agricultural land quality	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Grade 1	0	0	0

Grade 2	0	0	0
Subgrade 3a	171.1	73	112.9
BMV Subtotal	171.1	73	112.9
Subgrade 3b	64.8	27	32.7
Grade 4	0	0	0
Grade 5	0	0	0
Total agricultural land	**235.9**		**145.6**

3.4.9 The disturbance during construction to 171.1ha of land of BMV quality is assessed as an impact of high magnitude, comprising more than 60% of the overall agricultural land requirement. However, as BMV land in this area is a receptor of low sensitivity, the effect on BMV land is assessed as a moderate adverse effect of the Proposed Scheme, though this remains significant.

3.4.10 Following construction the land required temporarily will be primarily reinstated to its pre-existing agricultural condition. It is estimated that there will not be any significant surplus of topsoil or subsoil material arising from the Proposed Scheme in the area.

3.4.11 Included in the land required figures is an area for sustainable placement (affecting Hunt's Green Farm, CFA10/1) that will be used to permanently deposit excavated material, referred to in Section 2. In this location the soil will be stripped and stored and the land restored to agriculture following the placement of the excavated material.

Nature of the soil to be disturbed

3.4.12 The sensitivity of the soils is greatest in relation to those which will be disturbed by construction activity and returned to an agricultural or rural land-based use upon completion of the Proposed Scheme. The quantum of each disturbed soil type is less important than the sensitivity of particular soils to the effects of handling during construction and reinstatement of land.

3.4.13 Successful soil handling is dependent upon movements being undertaken under appropriate weather and ground conditions using the appropriate equipment. The principles of soil handling are well established and set out in advisory material such as Defra's Code of Practice for the Sustainable Use of Soils[26]. These principles will be followed throughout the construction period.

3.4.14 Compliance with the draft CoCP will ensure that the magnitude of the impact on soil is low and that the effect on soil is negligible.

Impacts on holdings

3.4.15 Land may be required from holdings both permanently and temporarily (i.e. the latter just during the construction period). In most cases, the temporary and permanent land requirement will occur simultaneously at the start of the Proposed Scheme and it is

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

the combined effect of both that will have the most impact on the holding. In due course some agricultural land will be restored and the impact on individual holdings will reduce, but the following assessment focuses on the combined effect during the construction phase. The residual permanent effects are discussed at the end of this section.

3.4.16 The effects of the Proposed Scheme on individual agricultural and related interests during the construction period are summarised in Table 5. This table shows the total area of land required on a particular holding in absolute terms and as a percentage of the total area farmed. It also shows the area of land that will be returned to the holding following the construction period. The degree of impact is based on the proportion of the holding required rather than the absolute area of land. The holding/reference name provides a unique identifier and relates to Map Series AG-01 (Volume 5, Agriculture, Forestry and Soils Map Book) and Volume 5: Appendix AG-001-010.

3.4.17 The effects of severance during construction are judged on the ease and availability of access to severed land. For the most part these will be the same during and post construction but occasionally they will differ between the two phases. The disruptive effects, principally of construction noise and dust, are assessed according to their effects on land uses and enterprises. Full details of the nature and significance of effects are set out in Volume 5: Appendix AG-001-010. Where the area of land summed by ALC grade differs from the area of land summed by holding, the difference is because some holdings are affected in more than one CFA area and some holdings include non-agricultural land. Where holdings are affected in more than one CFA the combined impact has been reported in the CFA report where the main holding is located.

Table 5: Summary of temporary construction effects on holdings

Holding reference/name	Total area required	Construction Severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA10/1 Hunt's Green Farm	47.8ha (48%) High	Although accommodation structure provided, use of highway will be required during sustainable placement Medium	Negligible	Major/moderate adverse effect due to percentage of farm required during sustainable placement of surplus excavated material .	33.5ha
CFA10/2 Strawberry Hill Farm	43ha (20%) High	Land inaccessible east of Bacombe Lane High	Negligible	Major/moderate adverse due to proportion of holding required and severance	19.5ha
CFA10/3 Durham Farm	15.9ha (25%) High	Realigned farm track utilising viaduct Low	Negligible	Major/moderate adverse due to proportion of holding required - but see permanent effect	9.4ha
CFA10/5 Upper Wendover Dean	23.1ha (46%)	Small area of severed land to the north of	Negligible	Major/moderate adverse due to	16.9ha

Holding reference/name	Total area required	Construction Severance	Disruptive effects	Scale of construction effect	Area to be restored
Farm	High	the viaduct downgraded due to small area Medium		proportion of the holding required and severance.	
CFA10/6 Hartley Farm	5.7ha (88%) High	Negligible	Negligible	Moderate adverse due the proportion of the holding required and low sensitivity of holding	2ha
CFA10/7 Road Barn Farm	10.3ha (37%) High	Land inaccessible High	Negligible	Moderate adverse due to the proportion of the holding required, severance and low sensitivity of holding	6ha
CFA10/8 Boswells Farm	11.3ha (12%) Medium	No new severance; off-lying land will continue to be accessed from public highway. Negligible impact	Negligible	Moderate adverse due to the proportion of the holding required and medium sensitivity of holding	9.3ha
CFA10/9 Bank Farm	31.7ha (16%) Medium	Small area severed during construction - but downgraded due to small area. Medium impact	Negligible	Moderate adverse due to the proportion of the holding required	23.4ha
CFA10/10 Grove Farm	7.9ha (9%) Low	Small area severed Low	Negligible	Minor adverse	3.9ha
CFA10/11 Smalldean Farm	6ha (9%) Low	Negligible	Negligible	Negligible (low sensitivity)	4.9ha
CFA10/12 Wellwick Farm	25.6ha (32%) High	Negligible	Negligible	Major/moderate adverse due to the proportion of the holding required	14ha
CFA10/13 Orchard Farm	0.9ha (4%) Negligible	Negligible	Negligible	Negligible (low sensitivity)	0.2ha
CFA10/14 Nash Lee Farm	5.5ha (6%) Low	Negligible	Negligible	Minor adverse	0.8ha
CFA10/15 Un-named paddock	3.3ha (67%) High	Negligible	Negligible	Moderate adverse due to proportion of the holding required (low sensitivity)	1.5ha
CFA10/16 Stocken Farm	3.7ha (8%) Low	Negligible	Negligible	Minor adverse	3.6ha
CFA10/17	12.7ha (80%)	All remnant land	Negligible	Moderate effect due to proportion of the	1.3ha

Holding reference/name	Total area required	Construction Severance	Disruptive effects	Scale of construction effect	Area to be restored
Hunters Leaze	High	severed High		holding required, severance, demolition (low sensitivity)	
CFA10/18 Chiltern Milion	2.7ha (100%) High	Negligible	Negligible	Moderate adverse due to proportion of the holding required (low sensitivity)	1ha

3.4.18 Overall, it is considered that 12 holdings will experience moderate or moderate to major temporary effects during construction, which are significant.

3.4.19 No farm enterprises which are particularly sensitive to noise or vibration emitted during the construction period, for example intensive poultry houses, have been identified near to the Proposed Scheme.

Cumulative effects

3.4.20 As no development has been identified in this area that will affect agricultural land there are no cumulative effects to report.

Permanent effects

Impacts on agricultural and forestry land

3.4.21 Land used for the construction of the Proposed Scheme will fall into a number of categories when work is complete, as follows:

- part of the operational railway and kept under the control of the operator;
- returned to agricultural use (with restoration management);
- used for drainage or flood compensation which may also retain some agricultural use; or
- used for ecological and landscape mitigation.

3.4.22 Following construction and restoration, the area of agricultural land that will be permanently required will be 90.3ha, as shown in Table 6.

Table 6: Agricultural and forestry land required permanently

Agricultural land quality	Permanent works	
	Area (ha)	% agricultural land
Grade 1	0	0
Grade 2	0	0
Subgrade 3a	58.2	64
BMV Subtotal	58.2	64
Subgrade 3b	32.1	36
Grade 4	0	0

Grade 5	0	0
Total	**90.3**	
Forestry land	2.1	

3.4.23 The permanent change of 58.2ha of land of BMV quality to non-agricultural use is assessed as an impact of high magnitude, comprising more than 60% of the agricultural land required for the construction of the Proposed Scheme. As stated previously, BMV land in this local area is a receptor of low sensitivity so that the permanent effect on BMV land is assessed as a moderate adverse effect of the Proposed Scheme, which is significant.

3.4.24 Along the route of the Proposed Scheme, only small areas of woodland will be affected. Overall, the total amount of forestry land required within this area to construct the Proposed Scheme will be 2.1ha, out of a total permanent land requirement (including non-agricultural land) of approximately 263.3ha (less than 1%). As the extent of forest cover in the area is considerably greater than the national average woodland cover (10%) the loss of woodland is not significant.

Impacts on holdings

3.4.25 The permanent effects of the Proposed Scheme on individual agricultural and related interests is summarised in Table 7. The land required column refers to the area of land permanently required to operate the Proposed Scheme (in absolute terms and as a percentage of the overall area farmed). The scale of effect is based on the proportion of land required. The effects of severance are judged on the ease and availability of access to severed land once construction is completed and the impact on farm infrastructure refers mainly to the loss of or damage to farm capital, such as property, buildings and structures, and the consequential effects on land uses and enterprises. Full details of the nature and scale of effects are set out in Volume 5: Appendix AG-001-010.

Table 7: Summary of permanent effects on holdings from construction

Holding reference / name	Land required	Severance	Infrastructure	Scale of effect
CFA10/1 Hunt's Green Farm	14.3ha (14%) Medium	Accommodation bridge provided Low	Negligible	Moderate adverse due to percentage of farm required
CFA10/2 Strawberry Hill Farm	23.5ha (11%) Medium	Negligible	Negligible	Moderate adverse due to percentage of farm lost.
CFA10/3 Durham Farm	6.5ha (10%) Medium	Access under viaduct Negligible	Residential and building demolition High	Major/moderate adverse due to proportion of the holding required and farmstead demolition.
CFA10/5 Upper Wendover Dean Farm	6.2ha (12%) Medium	Access under viaduct Low	Negligible	Moderate adverse due to percentage of farm required

Holding reference / name	Land required	Severance	Infrastructure	Scale of effect
CFA10/6 Hartley Farm	3.7ha (56%) High	Access to severed land along highway Medium	Negligible	Moderate adverse due the proportion of the holding required
CFA10/7 Road Barn Farm	4.3ha (15%) Medium	Land inaccessible High	Residential and agricultural building demolition High	Moderate adverse due to farmstead demolition, the proportion of the holding required, severance (low sensitivity)
CFA10/8 Boswells Farm	2ha (2%) Negligible	Negligible	Negligible	Negligible
CFA10/9 Bank Farm	8.3ha (4%) Negligible	Negligible	Negligible	Negligible
CFA10/10 Grove Farm	4ha (4%) Negligible	Negligible	Negligible	Negligible
CFA10/11 Smalldean Farm	1.1ha (2%) Negligible	Negligible	Negligible	Negligible
CFA10/12 Wellwick Farm	11.6ha (14%) Medium	Small area severed access from highway Low	Negligible	Moderate adverse due to the proportion of the holding required
CFA10/13 Orchard Farm	0.7ha (3%) Negligible	Negligible	Negligible	Negligible
CFA10/14 Nash Lee Farm	4.7ha (5%) Low	Negligible	Negligible	Minor adverse
CFA10/15 Un-named paddock	1.8ha (37%) High	Small parcels severed and no access available. High	Negligible	Moderate adverse due to proportion of the holding removed.
CFA10/16 Stocken Farm	0.1ha (< 1%) Negligible	Negligible	Negligible	Negligible
CFA10/17 Hunters Leaze	11.4ha (71%) High	Small areas severed access from highway Medium	Farm building demolition High	Moderate adverse due to proportion of the holding required, severance, demolition (low sensitivity)
CFA10/18 Chiltern Million	1.7ha (68%) High	Negligible	Negligible	Moderate adverse due to proportion of the holding required

3.4.26 Overall, it is likely that 10 holdings will experience moderate or moderate to major permanent effects from the construction of the Proposed Scheme, which are significant.

3.4.27 These include Durham Farm (CFA10/3) and Road Barn Farm (CFA10/7) which both require the demolition of the residential property and farmstead for the construction of the Wendover viaduct; Hunt's Green Farm (CFA10/1) and Strawberry Hill Farm (CFA10/2) which are predominantly arable farms that lose more than 10% of the holding; and Upper Wendover Dean (CFA10/5) and Wellwick Farms (CFA10/12) which farm with beef cattle and/or horses, that also lose more than 10% of the holding.

3.4.28 Five holdings are likely to cease due to the construction of the Proposed Scheme. These are Durham Farm (CFA10/3) and Road Barn Farm (CFA10/7) due to demolition and three smaller grazing due to the proportion of the holding removed, CFA10/15, CFA10/17 (including demolition) and CFA10/18.

3.4.29 Although financial compensation will be available, there can be no certainty that this will be used to reduce the adverse effects by the purchase of replacement land or construction of replacement buildings. Therefore the assessment should be seen as the worst-case, which could be reduced if the owners and/or occupiers are able, and choose, to use compensation payments to replace assets.

Cumulative effects

3.4.30 As no development has been identified in this area that will affect agricultural land, there are no cumulative effects to report.

Other mitigation measures

3.4.31 A number of areas of woodland planting are proposed and, where appropriate soils from the ancient and other woodland areas that will be removed during construction of the Proposed Scheme will be utilised in this process, as discussed in Section 7.

Summary of likely significant residual effects

3.4.32 Once the construction process is complete and land required temporarily has been restored, the residual permanent loss of agricultural land will be 90.3ha of which 58.2ha is BMV. This is assessed as a moderate adverse residual effect, which is significant.

3.4.33 A total of 10 properties have been identified that will experience moderate or moderate to major permanent adverse effects, which are significant. Of these five will be likely to remain as agricultural or rural businesses and the use of compensation payments to purchase replacement land or farm buildings could reduce the effects to not significant. The remaining five include Durham Farm and Road Barn Farm where residential demolition will occur, and three smaller grazing holdings.

3.5 Effects arising from operation

Avoidance and mitigation measures

3.5.1 No measures are proposed to mitigate operational effects of the Proposed Scheme on agriculture, forestry or soils.

Assessment of impacts and effects

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

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

3.5.3 The potential for significant effects on sensitive livestock receptors from noise has been assessed. No likely significant effects have been identified.

3.5.4 The propensity of linear transport infrastructure to harbour and spread noxious weeds is not only a consequence of the management of the highway and railway land, but also of the readiness of weed spread onto such land from adjoining land, which could be exacerbated with the effects of climate change. The presence of noxious weeds, ragwort in particular, will be controlled through the adoption of an appropriate management regime which identifies and remedies areas of weed growth which might threaten adjoining agricultural interests.

Other mitigation measures

3.5.5 No other mitigation measures are proposed for agriculture, forestry and soils.

Summary of likely significant residual effects

3.5.6 No significant residual effects on agriculture, forestry and soils have been identified from operation of the Proposed Scheme.

4 Air quality

4.1 Introduction

4.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality arising from the construction and operation of the Proposed Scheme, covering nitrogen dioxide (NO_2) , fine particulate matter (PM10 and PM2.5)[27] and dust.

4.1.2 With regard to air quality, the main potential effects are anticipated to result from the emissions of the above pollutants from construction activities and changes in traffic flows and new road alignments when the Proposed Scheme is operational. Dust emissions will be associated with demolition, site preparation works and construction of structures for the Proposed Scheme.

4.1.3 Detailed reports on the air quality data and assessments for this area, as well as relevant maps are contained in the Volume 5 Appendices. These include:

- Volume 5: Appendix AQ-001-010;
- Map AQ-01-010 (Volume 5, Air Quality Map Book); and
- Maps AQ-02-010-01 to AQ-02-010-02 (Volume 5, Air Quality Map Book).

4.1.4 Maps showing the location of the key environmental features can be found in the Volume 2 map books.

4.2 Scope, assumptions and limitations

4.2.1 The assessment scope, key assumptions and limitations for the air quality assessment are set out in Volume 1, the SMR (Appendix CT-001-000/1), the SMR Addendum (Appendix CT-001-000/2) and appendices presented in Volume 5: Appendix AQ-001-0. This report follows the standard assessment methodology.

4.2.2 The study area for the air quality assessment has been determined on the basis of where impacts on air quality may occur from construction activities, from changes in the volume of traffic during construction and operation or where road alignments have changed.

4.2.3 The assessment of impacts arising from construction dust emissions has been undertaken using the methodology based on that produced by the Institute of Air Quality Management (IAQM)[28]. It is important to note that this methodology provides a means of assessing the scale and significance of effects that is partly dependent on the approximate number of receptors within close proximity to the dust generating activities. In doing so, it assigns a lower scale of effect to cases where the number of properties is small, e.g. fewer than 10 within 20m of dust generating activities. Thus, a single property very close to a construction site cannot experience a significant effect using this methodology. The assessment presented here reaches a conclusion that

[27] PM2.5 and PM10 describe two size fractions of airborne particles that can be inhaled and therefore are of concern for human health. The designations refer to particles of size less than 2.5 and 10 microns in diameter.
[28] IAQM (2012), *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance*.

incorporates this concept of significance being dependent on the number of people affected. However, in cases where less than 10 properties are within 20m of the construction activity, it will still be the case that mitigation in accordance with the CoCP will be applied.

4.2.4 The assessment of construction traffic impacts has used traffic data that is based on an estimate of the average daily flows in the peak month throughout the construction period (2017-2026). However, the assessment assumes 2017 vehicle emission rates and 2017 background pollutant concentrations. The reason for this is that both pollutant emissions from exhausts and background pollutant concentrations are expected to reduce year by year as a result of vehicle emission controls and so the year 2017 represents the worst case for the assessment. Furthermore, it has been assumed that the changes in construction traffic would occur for the whole year. In many cases, this represents a pessimistic assumption, as the duration of the proposed construction works may be much shorter.

4.3 Environmental baseline

Existing baseline

4.3.1 The environmental baseline reported in this section represents the existing air quality within the study area. The air quality in the Dunsmore, Wendover and Halton area is typical of the generally rural nature of this part of Buckinghamshire, with concentrations of airborne pollutants being well within air quality standards, reflecting the few roads and low traffic flows.

4.3.2 Estimates of background air quality have been obtained from Defra background maps[29] for 2012. These data are estimated for 1km grid squares for NOx, NO2, PM10 and PM2.5. All average background pollutant concentrations are within relevant air quality standards. Further details regarding the air quality data are shown in Volume 5: Appendix AQ-001-010.

4.3.3 Aylesbury Vale and Wycombe District Councils currently conduct routine diffusion tube monitoring at 20 and 32 locations respectively. However, almost all of these are at roadside locations and/or in the towns in locations that are distant from the Proposed Scheme and will not be affected by scheme-related traffic. Several monitoring locations within Aylesbury are relevant to the assessment, as they are at locations close to construction traffic routes associated with the Proposed Scheme.

4.3.4 Chiltern District Council does not conduct any routine diffusion tube monitoring. On this basis, no monitoring data are available that are relevant to this assessment.

4.3.5 The available mapping data indicate that all parts of the area currently experience concentrations of PM10 and PM2.5 that meet air quality standards, as supported by the absence of any AQMAs declared for these pollutants. Background map data and five-year concentration trends at monitoring sites are provided in Volume 5: Appendix AQ-01-010.

[29] Defra (2010), *Defra background maps 2010*; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed: July 2013.

4.3.6 Three AQMAs have been declared by Aylesbury Vale District Council; all are located in the town of Aylesbury and all declared because of elevated concentrations of NO2. Of these three, the corner of the Friarage/Oxford Road AQMA has been identified as a proposed route taken by traffic during the construction phase of the Proposed Scheme. These three AQMAs are outside of the study area and in the Stoke Mandeville and Aylesbury area.

4.3.7 Wycombe District Council has declared the M40 as an AQMA and Chiltern District Council has declared Chesham an AQMA for NO2 concentrations not meeting the standard. These areas are too far from the Proposed Scheme to be affected by construction activities and associated traffic.

4.3.8 Potential receptors are primarily those residential properties close to construction activity and alongside roads where traffic flows will change as a consequence of construction activity or realignment of roads. Notable receptors in close proximity to construction activity are residential properties on Ellesborough Road, Bacombe Lane, Nash Lee Lane and Nash Lee Road. Further properties potentially affected include Hartley Farm and The Laurels.

4.3.9 One site of special scientific interest (SSSI), Bacombe Hill has been considered in the construction assessment.

Future baseline

4.3.10 Section 2.1 and Volume 5: Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the future baseline for the assessment of effects from the construction and operation of the Proposed Scheme.

4.3.11 The potential cumulative impact from committed developments on air quality acting in conjunction with the effects from the construction and operation of the Proposed Scheme have been considered as part of this assessment. This has been achieved by including changes in traffic predicted as a result of the committed developments within the traffic data used for the air quality assessments for construction and operation, in which the future air quality baselines are defined as the 'without Proposed Scheme scenarios' at each stage

4.3.12 The data used for the air quality assessment take account of predicted changes in traffic, that are derived from a combination of regional traffic growth factors and consideration of major locally consented schemes, as described in this section of the report. In this way, the assessment accounts for cumulative effects.

Construction (2017)

4.3.13 Future background pollutant concentrations have been sourced from Defra background maps29 for 2017 which predict NO2 and PM10 concentrations in 2017 to be lower than in the 2012 baseline.

Operation (2026)

4.3.14 Future background pollutant concentrations have been sourced from Defra background maps29 for 2026 which predict NO2 and PM10 concentrations in 2026 to be lower than in the 2012 baseline.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 Emissions to atmosphere will be controlled and managed during construction through the route-wide implementation of the CoCP, where appropriate. The draft CoCP includes a range of mitigation measures that are accepted by the IAQM as being suitable to reduce impacts to as low a level as reasonably practicable. It also makes provision for the preparation of Local Environmental Management Plans (LEMPs) which will set out how the project will adopt 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.

4.4.2 The assessment has assumed that the general measures detailed in Section 7 of the draft CoCP (Volume 5: Appendix CT-003-000) will be implemented. These include:

- contractors being required to manage dust, air pollution, odour and exhaust emissions during construction works;
- inspection and visual monitoring after consultation with the local authorities to assess the effectiveness of the measures taken to control dust and air pollutant emissions;
- cleaning (including watering) of haul routes and designated vehicle waiting areas to suppress dust;
- keeping material stockpiles away from sensitive receptors where reasonably practicable taking into account the prevailing wind direction relative to sensitive receptors;
- using enclosures to contain dust emitted from construction activities; and
- undertaking soil spreading, seeding and planting of completed earthworks as soon as reasonably practicable following completion of earthworks.

Assessment of impacts and effects

Temporary effects

4.4.3 Impacts from the 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 human receptors sensitive to dust and exposure to NO2 and PM10, as well as ecological receptors sensitive to dust.

4.4.4 An assessment of construction traffic emissions has also been undertaken for two scenarios in the construction period, a without the Proposed Scheme scenario and a with the Proposed Scheme scenario.

4.4.5 Within the Dunsmore, Wendover and Halton area, dust-generating activities will occur at the construction of the Wendover green tunnel, the Wendover Dean and Small Dean viaducts, a series of cuttings and embankments, and the B4009 Nash Lee Road overbridge. Particular activities with the potential to generate dust at these sites include: the demolition of buildings, earthworks required for the preparation of the ground, bulk excavation, processing and stockpiling of fill materials, the construction of structural embankments, the construction of permanent replacement road infrastructure and bridges; and the movement of vehicles from the construction site with the possible transfer of dust and mud onto local roads. The use of haul route for the removal of excavated material will also be a source of dust emissions.

4.4.6 Given the mitigation contained within the draft CoCP, including the provision to use LEMPs to control the impacts at receptors close to the haul route, the assessment of impacts on all receptors arising from dust emissions has concluded that they will be negligible in magnitude and that the effect will not be significant. The basis for this conclusion can be found in Volume 5: Appendix AQ-001-010, which describes the magnitude of the emissions and their proximity to receptors.

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

4.4.8 Examination of the changes in traffic flows for 2017 along the affected roads has identified some roads that meet the criteria set out in Volume 1 of the SMR (Appendix CT-001-000/1) for a more detailed assessment. Examination of the changes in traffic flows for the construction period along the affected roads has identified that there are four roads that meet the criteria for a more detailed assessment. There are negligible impacts at all receptors assessed, for NO2, PM10 and PM2.5.The effect will not be significant.

Permanent effects

4.4.9 There are no permanent effects anticipated to arise during construction of the Proposed Scheme.

Cumulative effects

4.4.10 The construction dust assessment has considered the potential cumulative air quality effects of the Proposed Scheme and other committed developments. The traffic data used for the assessment include the traffic changes expected from the committed developments and therefore their impacts have been included within the assessment.

Other mitigation measures

4.4.11 No other mitigation measures during construction are proposed in relation to air quality in this area.

Summary of likely significant residual effects

4.4.12 The methods outlined within the draft CoCP to control and manage potential effects of construction dust are considered effective in this location. No significant residual effects are considered likely.

4.5 Effects arising from operation

Avoidance and mitigation measures

4.5.1 No mitigation measures are proposed during operation in relation to air quality in the area.

Assessment of impacts and effects

4.5.2 There are no direct atmospheric emissions from the operation of trains that will cause an impact on air quality. In normal operations, there will be no pollutant emissions and indirect emissions from sources such as rail wear and brakes have been assumed to be negligible.

4.5.3 The assessment of operational traffic emissions has been undertaken for two scenarios in the operation year 2026, a without the Proposed Scheme scenario and a with the Proposed Scheme scenario. The traffic data include the additional traffic from any future committed developments.

4.5.4 Traffic data in the Dunsmore, Wendover and Halton area have been screened to identify roads that require further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2026.

4.5.5 Three roads will require realignment and therefore meet the criteria for a more detailed assessment outlined in the SMR (Appendix CT-001-000/1). These roads are Rocky Lane, Ellesborough Road and the B4009 Nash Lee Road. The assessment concluded that there would be an imperceptible decrease in concentrations for the most affected receptors. Therefore, no significant effect associated with the Proposed Scheme is predicted.

Other mitigation measures

4.5.6 No other mitigation measures are proposed in relation to air quality in this area during operation.

Cumulative Effects

4.5.7 The traffic data used for the assessment include the traffic changes expected from any committed developments and therefore their impacts have been included within the assessment.

Summary of likely significant residual effects

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

5 Community

5.1 Introduction

5.1.1 This section reports the impacts and likely significant effects on local communities resulting from the construction and operation of the Proposed Scheme.

5.1.2 Key issues concerning the community for this study area comprise:

- demolition of properties in this area;
- permanent loss of Ellesborough Road Cricket Ground and pavilion owned by Wendover Cricket Club;
- impacts on amenity for residential properties on Bacombe Lane, Ellesborough Road and the A413 London Road during construction;
- impacts on amenity for residential properties in Nash Lee during construction and operation; and
- temporary re-routing of the Aylesbury Ring Public Right of Way (PRoW) (WEN/6); and

5.1.3 Further details of the community assessment and write-ups of open space surveys and recreational PRoW surveys undertaken within the area are contained in Volume 5: Appendix CM-001-010.

5.1.4 Significantly affected community resources are shown in Maps CM-01-031 to CM-01-033a (Volume 5, Community Map Book).The current assessment draws on information gathered from regional and local sources including: Buckinghamshire County Council; Wendover House School; Wendover Parish Council, The Children's Room nursery and Wendover Cricket Club.

5.2 Scope, assumptions and limitations

5.2.1 The assessment scope, key assumptions and limitations for the community assessment are set out in Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

5.3 Environmental baseline

Existing baseline

5.3.1 Baseline data on community resources were collected up to 1km from the centre line of the Proposed Scheme and, additionally, up to 250m from the boundary of the land required for construction.

5.3.2 The study area includes the area of land required both temporarily and permanently for the construction and operation of the Proposed Scheme. This 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, construction dust, poor air quality and visual intrusion. In addition, the study area has regard to the

proposed routeing of construction traffic and takes account of catchment areas for community facilities that could be affected where intersected by the Proposed Scheme. Overall, the study area is taken as the area of land that encompasses the likely significant effects of the Proposed Scheme. This area includes land within and surrounding the settlements of Wendover Dean, Dunsmore, Wendover, Nash Lee and North Lee.

Wendover Dean and Dunsmore

5.3.3 Wendover Dean is a small village approximately 3km south of Wendover. The village comprises a cluster of farmsteads interspersed by fields crossed by the Chiltern Way PRoW heading in a north-east to south-west direction. The A413 London Road is the main access route to and from Wendover Dean, passing directly through the centre. Cobblershill Lane is also located on the north-western outskirts of the village, linking traffic to the A413. The Firecrest Public House is located on the A413 London Road to the north of Wendover Dean.

5.3.4 Dunsmore is a small village approximately 2.7km south of Wendover. It is located on an unnamed road that links with the A413 London Road to the east. The village comprises a cluster of houses with several outlying farmsteads, such as Road Barn Farm, in the surrounding countryside. The main community facilities in the village include the Church of Resurrection and the village hall. The Icknield Way Trail (WEN/57) links Dunsmore with Wendover on PRoW WEN/13 and WEN/57.

Wendover

5.3.5 Wendover is a town situated to the east of the A413. The area to the west of the town (broadly defined as 300m from the route of Proposed Scheme, including Dobbins Lane, Pound Street, South Street, Witchell and Church Lane) is included within the study area. There is a range of local facilities in this area of the town including: a train station, St Mary's Anglican Church (which is a venue for music concerts as well as a place of worship) and associated cemetery; the Wendover Campus of Wendover House School (part of the Chiltern Way Federation); two public houses (the Shoulder of Mutton and King and Queen in Wendover); Cherry Tree House residential care home; supported accommodation for older people (Abbeyfield House and Clarence Court); Hampden Meadow recreation ground; a nursery; and local shops. There are two cricket grounds within the study area that are both owned by Wendover Cricket Club: Ellesborough Road cricket ground and Witchell cricket ground. There are also several promoted PRoW traversing through and near to Wendover including the Ridgeway (WEN/14), the Aylesbury Ring (WEN/6 and WEN/6), the Chiltern Link (WEN/46) and the Icknield Way Trail (WEN/57).

Nash Lee and North Lee

5.3.6 Nash Lee and North Lee are two small villages to the north-west of Wendover. Nash Lee is centred on the B4009 Nash Lee Road and the A4010. North Lee is to the north of Nash Lee on the A4010 Risborough Road. There are no community facilities in either settlement.

Future baseline

Construction (2017)

5.3.7 Volume 5: Appendix CT-004-025/1 provides details of the developments that are assumed to have been implemented by 2017. The existing baseline is likely to change due to future development that may introduce new residents and community facilities to the study area. The following development is likely to be completed prior to the commencement of construction in 2017.

5.3.8 A number of new facilities are to be developed as part of the Chiltern Way Federation's Wendover Campus (planning reference CC/13/12) on Church Lane. The development includes the demolition of the existing sports hall and the removal of an existing multi use games area. A new teaching block, vocational block and replacement sports hall and associated multi use games area will be constructed alongside three relocated vocational sheds.

Operation (2026)

5.3.9 The review of future baseline conditions has not identified any additional committed developments within the study area that will be completed by the year of operation.

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 The following measures have been incorporated into the scheme design as part of the design development process to avoid or minimise adverse environmental impacts during construction:

- provision of a temporary link for Ellesborough Road residents so that access to Wendover is maintained during the construction of the green tunnel; and
- provision of a temporary link between Ellesborough Road and Bacombe Lane to prevent the temporary isolation of residential properties on Bacombe Lane during works on the green tunnel.

5.4.2 The draft CoCP includes a range of provisions that will help mitigate community effects associated with construction within this area, including:

- appointment of community relations personnel (draft CoCP, Section 5);
- community helpline to handle enquires from the public (draft CoCP, Section 5);
- sensitive layout of construction sites to minimise nuisance (draft CoCP, Section 5);
- where reasonably practicable, maintenance of PRoW for pedestrians, cyclists and equestrians around the perimeter of construction sites and across entry and exit points (draft CoCP, Section 5);
- monitoring and management of flood risk and other extreme weather events that may affect community resources during construction (draft CoCP, Sections 5 and 16);

- specific measures in relation to air quality and noise to reduce impacts on communities including discretionary noise insulation for sensitive community resources and, in special circumstances, temporary rehousing (draft CoCP, Sections 7 and 13); and
- where practicable, the avoidance of large goods vehicles operating adjacent to schools during drop off and pick up period (draft CoCP, Section 14).

Assessment of impacts and effects

5.4.3 Details of all assessments of community resources are included in Volume 5: Appendix CM-001-010. Each assessment form presents information that explains the rationale for determining the rating for sensitivity of the affected community resource, magnitude of impact and the assessment of significance.

Wendover Dean and Dunsmore

Temporary effects

5.4.4 Approximately five residential properties on the A413 London Road (north-west of Wendover Dean and east of Dunsmore) are predicted to experience the following in-combination effects:

- significant effects due to views associated with the construction of the Small Dean viaduct and the new access track for Boswell Farm. There will also be increased lighting associated with the Small Dean viaduct satellite compound;
- significant increases in HGV traffic on both the A413.

5.4.5 The A413 London Road is a construction route for HGV accessing the compounds in this CFA and also CFA9 and CFA11. These in-combination effects are likely to be experienced for the duration of operation of these compounds (see Section 2.3 and Figure 6). The combination of these effects will have a major adverse effect on residential amenity. This is therefore considered to be significant.

Permanent effects

Residential properties

5.4.6 East of Wendover Dean, the Proposed Scheme will run for approximately 500m on viaduct. Construction of this viaduct will require piers and foundations and as a result Durham Farm will need to be demolished. The permanent loss of this property is not considered to be significant at a community level.

5.4.7 The Proposed Scheme will continue over the Small Dean viaduct north-east of Dunsmore. One residential property, Road Barn Farm on the A413 London Road will be permanently lost due to the construction of this viaduct and the temporary construction access off the A413. This is not considered to be significant at a community level.

Cumulative effects

5.4.8 No temporary or permanent cumulative effects during construction have been identified.

Wendover

Temporary effects

Residential properties

5.4.9 Approximately five residential properties on Bacombe Lane to the west of Wendover are predicted to experience in-combination effects. These effects will be associated with the construction of the Wendover green tunnel. These in-combination effects are:

- significant visual effects due to the visibility of construction of the Wendover green tunnel, Ellesborough Road temporary realignment and temporary connection between Ellesborough Road and Bacombe Lane. Large scale plant and machinery associated with earthworks and temporary material stockpiles will also be visible; and
- significant daytime noise effects due to construction and earthwork activities for the Wendover green tunnel.

5.4.10 The combination of these effects, which will coincide for up to 16 months, will have a major adverse effect on residential amenity and is therefore considered to be significant.

5.4.11 Just north of Bacombe Lane, up to twenty residential properties on Ellesborough Road to the west of Wendover are predicted to experience in-combination effects. These effects will be associated with the construction of the Wendover green tunnel. These in-combination effects are:

- significant visual effects due to views of construction of the Wendover green tunnel, the realignment of Ellesborough Road, the temporary link road and the Nash Lee Road overbridge satellite compound. There will also be additional lighting in this location associated with the satellite compound and construction of the green tunnel;
- significant daytime noise effects due to the construction of Wendover green tunnel and construction works on Ellesborough Road.

5.4.12 The combination of these effects, which will coincide for up to 15 months, will have a major adverse effect on residential amenity and is therefore considered to be significant.

Open space and recreational PRoW

5.4.13 The Wendover green tunnel will cross the Aylesbury Ring PRoW (WEN/6), a promoted route to the west of Wendover. The Aylesbury Ring will be re-routed for approximately two years and three months during the construction of the Wendover green tunnel. The additional distance of the PRoW during this re-routing will be 800m. Following construction the Aylesbury Ring will be reinstated over Wendover green tunnel.

5.4.14 There are also some alternative PRoW within walking distance of the Aylesbury Ring, including the Chiltern Link, the Icknield Way Trail and the Ridgeway. The latter two PRoW however, will also both be impacted by the Proposed Scheme (although the

effects are not considered significant due to re-routing). The survey data for this PRoW suggests that usage is sporadic; it is frequently used on some days but with very low patronage on others days.

5.4.15 Whilst there are possible alternatives that can be used and usage is inconsistent, given that there is a re-routing of 800m for approximately two years and three months, the effect on users is considered to be moderate adverse and therefore it is significant.

Permanent effects

Residential properties

5.4.16 The construction of the Wendover green tunnel will require the demolition of six residential properties on Ellesborough Road in Wendover. The demolition of these residential properties will be significant at a community level.

Community infrastructure

5.4.17 The construction of the Wendover green tunnel will require the permanent loss of the Ellesborough Road Cricket Ground and pavilion owned by Wendover Cricket Club. In addition to frequent matches, practice sessions are held at the club from April through to August. For the last three years there has been an after-school club run during the summer term for Wendover Middle School. There is another cricket pitch in Wendover (Witchell Cricket Ground) also owned by Wendover Cricket Club, approximately 800m south of Witchell, used for recreational cricket for some junior games and non-club games, including the village cup. However this is not suitable for regular senior cricket because it is too small, has no cricket square and only an artificial pitch to play on. In addition, there are various hazards nearby, including a children's play area and public footpaths that traverse the ground.

5.4.18 Given the high frequency of use of the Ellesborough Road site, the loss of the pavilion and the cricket ground will have a major adverse effect and is therefore considered to be significant.

Cumulative effects

5.4.19 No temporary or permanent cumulative effects during construction have been identified within the assessment.

Nash Lee and North Lee

Temporary effects

5.4.20 No significant temporary effects have been identified in the community assessment for Nash Lee and North Lee.

Permanent effects

Residential properties

5.4.21 No significant permanent effects arising from construction have been identified in the community assessment for Nash Lee and North Lee.

Cumulative effects

5.4.22 No temporary or permanent cumulative effects have been identified during construction within the assessment.

Other mitigation measures

5.4.23 The assessment has concluded there are significant adverse effects arising during construction in relation to community resources.

5.4.24 HS2 Ltd will continue to work with Wendover Cricket Club to assist it to identify a solution to promote the continued operation of the club, within the scope of the National Compensation Code.

Summary of likely significant residual effects

5.4.25 There will be significant effects in Wendover due to the demolition of six residential properties and the loss of the Wendover Cricket Club's cricket ground and pavilion on Ellesborough Road. Also in Wendover there will be significant temporary residential amenity effects for properties on both Bacombe Lane and Ellesborough Road. Significant residential amenity effects will also be experienced by properties on London Road east of Dunsmore.

5.5 Effects arising from operation

Assessment of impacts and effects

Wendover Dean and Dunsmore

5.5.1 No significant operational effects have been identified within the community assessment for Wendover Dean and Dunsmore.

Wendover

5.5.2 No significant operational effects have been identified within the community assessment for Wendover.

Nash Lee and North Lee

Residential properties

5.5.3 Approximately five residential properties in Nash Lee, located on Nash Lee Lane, are predicted to experience in-combination effects during the operation of the Proposed Scheme. These in-combination effects are:

- significant visual effects due to visibility of the B4009 Nash Lee Road overbridge and partial visibility of the overhead line equipment; and
- significant airborne noise increases from the new train services.

5.5.4 The combination of these effects will have a major adverse effect on residential amenity and is therefore considered to be significant.

Cumulative effects

5.5.5 No permanent cumulative inter-project effects have been identified during operation within the assessment.

Other mitigation measures

5.5.6 No other mitigation measures are proposed.

Summary of likely significant residual effects

5.5.7 The assessment has concluded that there are likely significant residual adverse effects on residential amenity for some properties in Nash Lee.

6 Cultural heritage

6.1 Introduction

6.1.1 This section of the report provides a description of the current baseline for heritage assets and reports the likely impacts and significant effects resulting from the construction and operation of the Proposed Scheme. Consideration is given to the extent and heritage value (significance) of assets including archaeological and palaeoenvironmental remains; historic buildings and the built environment; and historic landscapes.

6.1.2 With regard to heritage assets, the main issue is the extent to which designated and non-designated assets are affected by the Proposed Scheme. Impacts on assets as a result of the Proposed Scheme will occur largely through the physical removal and alteration of assets and changes to their setting.

6.1.3 Maps showing the location of the key environmental features can be found in Volume 2: Community Forum Area (CFA) Map Books. Maps showing the location of all designated and non-designated heritage assets can be found in Volume 5, Cultural Heritage Map Book. Detailed reports on the cultural heritage character and surveys undertaken within the local area are contained in the Volume 5 Appendices. These include:

- Appendix CH-001-010 - Baseline Report;
- Appendix CH-002-010 - Gazetteer of Heritage Assets;
- Appendix CH-003-010 - Impact Assessment Table; and
- Appendix CH-004-010 - Survey Reports.

6.1.4 Throughout this section, assets within the study areas are identified with a unique reference code, DWHXXX; further detail on these assets can be found in the gazetteer in Volume 5: Appendix CH-002-010.

6.1.5 Engagement has been undertaken with the Buckinghamshire County Council planning archaeologist and conservation officer for Aylesbury Vale District Council with regard to the nature of the cultural heritage assets within the local area.

6.2 Scope, assumptions and limitations

6.2.1 The assessment scope, key assumptions and limitations for the cultural heritage assessment are set out in Volume 1, the SMR (Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

6.2.2 The setting of all designated heritage assets within the zone of theoretical visibility (ZTV) (see Section 9) of the Proposed Scheme has been considered. 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, temporarily or permanently, to construct the Proposed Scheme plus 500m.

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

6.2.4 In undertaking the assessment the following limitations were identified:

- the LiDAR[30] data examined did not encompass the full extent of the study area; and
- not all areas of survey as identified in the archaeological risk model[31] were not available for survey.

6.2.5 However, non-intrusive field survey was undertaken in one area within the study area to provide data regarding the nature of sub-surface archaeological assets. Information from other sources of data, including the historic environment record (HER) and local archives was utilised to provide information relating to the potential archaeological assets that may be present.

6.3 Environmental baseline

Existing baseline

6.3.1 In compiling this assessment, documentary baseline data was collected from a variety of sources as set out in Volume 5: Appendix CH-001-010.

6.3.2 In addition to collating this baseline data, the following surveys were undertaken:

- walkover and site reconnaissance from areas of public access or in locations where access was granted. This was undertaken to understand the character and form of heritage assets and the historic landscape, to review the setting of assets, and to identify previously unknown assets;
- desktop review of remote sensing data including LiDAR, aerial photographs and hyperspectral data (see Volume 5: Appendix CH-004-010); and
- a programme of non-intrusive surveys including geophysical surveys (see Volume 5: Appendix CH-004-010).

Designated assets

6.3.3 The following designated heritage assets are located partially or wholly within the land required, temporarily or permanently, for the construction of the Proposed Scheme (see Maps CH-01-031 and CH-01-0033 in Volume 5, Cultural Heritage Map Book):

- one scheduled monument of high value: Grim's Ditch comprising an approximately 350m long section which is oriented south-west to north-east (DWH008);

[30] Light detection and ranging (LiDAR) is a high resolution remote sensing technique to capture 3D data.
[31] The archaeological risk model is an approach that enables the identification of those areas of the Proposed Scheme where archaeological assets are known or suspected and provides a mechanism for the prioritisation of the programme of survey.

- one ancient woodland of high value: Jones' Hill (DWH030); and
- Hunt's Green Farm, a Grade II listed building of moderate value (DWH007).

6.3.4 The following designated assets are located within the ZTV (see Maps CH-02-015 and CH-02-016 in Volume 5, Cultural Heritage Map Book):

- seven scheduled monuments of high value: Grim's Ditch: approximately 1500m length between Great Widmore Wood and Oaken Grove (DWH077). This is a separately scheduled length of Grim's Ditch to that located 2.5km to the south (DWH008); a pond, bell and bowl barrow located on Bacombe Hill comprising two scheduled monuments (DWH100); Boddington Camp (Boddington Banks) Hillfort, a univallate hillfort (DWH122); a moated site approximately 90m west of Terrick House (DWH134); a moated site at Grove Farm (DWH140); and a moated site at Apsley Manor Farm (DWH146);
- one Grade I listed building of high value: the Old Church of St John the Baptist, The Lee (within grouping DWH022);
- six Grade II* listed buildings of high value: Hale Farmhouse, Hale Lane, Wendover (DWH090); Wellwick Manor, Ellesborough Road, Wendover (DWH109); Parish Church of St Mary, Wendover (DWH117); the Lychgate and Churchyard Wall at the Parish Church of St Mary, Wendover (DWH117); the Red House, Wendover (DWH120); and Bank Farmhouse, Wendover (DWH120);
- 17 areas of ancient woodland of high value: King's Wood (DWH006); Hawthorn Wood (DWH017); Cockshoots Wood (DWH018); Hamdenleaf Wood (DWH020); Rushmoor Wood (DWH021); Sermons Wood (DWH055); Grove Wood (DWH058); Lordling Wood (DWH067); Ming's Wood (DWH072); High Scrubs (DWH073); Chisley / Fugsden Wood (DWH074); two un-named woodlands (DWH075); Barn Wood (DWH078); Mercer's Wood (DWH079); Baldwin's Wood (DWH081); Coxgrove Wood (DWH087); and Hale Wood (DWH123);
- two conservation areas of moderate value: The Lee (DWH022); and Wendover (DWH120); and
- a total of 140 Grade II listed buildings of moderate value: 87 of these lie within the historic core of Wendover (DWH120); three lie in the south of the town, associated with Wendover House School (DWH117); and 11 lie within the conservation area at The Lee (DWH022). The remaining 40 principally comprise houses, such as Old Mill House (DWH118), cottages, public houses, such as the Halfway House (DWH070), and agricultural buildings associated with farms, farmsteads and dispersed hamlets, such as Manor Farm and Mayertorne Manor (DWH043), Wendover Dean Farm (DWH045), Upper Wendoverdean Farm (DWH053) and Smalldean Farm (DWH083).

Non-designated assets

6.3.5 The following non-designated asset of high value lies wholly or partially within the land required, temporarily or permanently, for the construction of the Proposed Scheme:

- a series of metal detector rallies, fieldwalking and geophysical survey on land to the east of Wellwick Farm and north of Coneycroft Farm yielded evidence of a possible Romano-British villa site and included a buried human cremation of Roman date (DWH111).

6.3.6 The following non-designated assets of moderate value lie wholly or partially within the land required, temporarily or permanently, for the construction of the Proposed Scheme:

- 16 hedgerows and groups of hedgerows are considered to be historically important under the Hedgerow Regulations 1997 criteria for archaeology and history[32];
- elements of pre-18th century enclosure which are likely to represent the expanding agricultural hinterland of medieval and post-medieval settlements such as The Lee (DWH022) and outlying hamlets and farmsteads (DWH156);
- a series of metal detector rallies on land around Upper Wendoverdean Farm, Wendover Dean Farm and Manor Farm yielded a range of metal artefacts of prehistoric to post-medieval date (DWH042);
- a complex of linear and rectilinear cropmarks identified during a LiDAR survey (Appendix CH004-010, J21) could represent the location of buried remains associated with a former medieval chapel, though are more likely to indicate former field boundary ditches or enclosure ditches (DWH116);
- Nash Lee, a focus of medieval settlement activity. This site is recognised from scatters of finds, archaeological evaluation and its proximity to other known sites of medieval date. This may indicate the presence of relatively ephemeral prehistoric activity and possibly, in-situ medieval remains (DWH132); and
- the Lower Icknield Way is located along the line of a former Roman road, which it may predate. The former Roman road passes through areas in which there may be potential Romano-British sites (DWH129).

6.3.7 The following identified non-designated assets of low value lie wholly or partially within the land required, temporarily or permanently, for the construction of the Proposed Scheme:

- metal detector surveys on land on the west side of Hunt's Green Farm yielded a small assemblage of finds of Romano-British, medieval and post-medieval date (DWH014);
- Durham Farm, depicted on the 1st Edition Ordnance Survey (OS) mapping in the 1880s (DWH044);
- Road Barn Farm, depicted on the 1st Edition OS mapping in the 1880s (DWH082);
- a railway overbridge just north of Road Barn Farm, depicted on the 2nd Edition

[32] Hedgerow Regulations 1997 Act (1997), *Statutory Instrument 1997 No. 1160*, London. Her Majesty's Stationery Office.

OS mapping in 1899 (DWH151);

- Clerk's Mill, Poyntz Mills and Birche's Peece Brickworks (DWH076). Documentary sources tentatively indicate a location for these former medieval and post-medieval industrial sites just to the south-east of Grove Farm;
- numbers 30-40 Ellesborough Road, depicted on the 1st Edition OS mapping in the 1880s (DWH096);
- possible ridge and furrow earthworks identified on LiDAR and recorded during hedgerow survey (Appendix CH-004-010, J39; DWH143);
- Upper Icknield Way, an important early routeway between Wessex and East Anglia, with a band of tracks following the Chiltern scarp just above the spring line and marked today reasonably closely by bridleways and paths (DWH119);
- possible ridge and furrow earthworks identified during a remote sensing survey (Appendix CH-004-010, J38; DWH153); and
- Wycombe Railway, a branch railway authorised in 1846 between Oxford and Maidenhead, with a branch to Aylesbury passing about 4 km to the west of Wendover (DWH152).

6.3.8 All non-designated heritage assets within 500m of the land required, temporarily or permanently, for the construction of the Proposed Scheme are listed in the gazetteer in Volume 5: Appendix CH-002-010 and identified on Maps CH-01-031, CH-01-032, CH-01-033a, CH-01-033b, CH-01-034 and CH-01-034L1 (Volume 5, Cultural Heritage Map Book). There are a number of built heritage assets, the settings of which have been considered, for example:

- Dutchlands Farm (DWH163);
- The Refuge, Bowood Lane (DWH164);
- a cottage on King's Lane south of Hunt's Green Farm (DWH165);
- buildings at Hunt's Green (DWH166);
- Strawberry Hill Farm (DWH033);
- Strawberry Hill Cottage (DWH149);
- Sainfoin (DWH150);
- Robertswood Cottage (DWH167);
- Chiltern Cottage (DWH168);
- Aylesbury to Chorleywood Railway (DWH159)
- Cuckoo Farm, now Rocketer Cottage and Cuckoo Farm Barn (DWH080);
- Wellhead Farm (DWH169);
- Wellhead Cottage (DWH170);

- 10 - 28 Bacombe Terrace (DWH158);
- The Coach House, Nashlee Farm (DWH171);
- The Gables (DWH172);
- buildings at Terrick (DWH173);
- North Lee Farm (DWH144);
- Dodd's Farm (DWH141); and
- Wycombe Railway (DWH152).

Cultural heritage overview

6.3.9 The study area lies on the dipslope of the Chilterns and flanks the valley of the River Misbourne, which drains eastward to the River Colne and then to the River Thames. The northern part of the study area straddles the Chiltern Scarp and the edge of the Icknield Belt.

6.3.10 The underlying geology comprises Chalk, with Clay-with-Flints deposits on the plateau to the east. Colluvial (Head) and alluvial deposits lie along the valley floor. Where the route crosses these colluvial and alluvial deposits there is a potential for waterlogged deposits and/or palaeoenvironmental remains. Once into the Vale of Aylesbury the underlying geology becomes the Gault and Upper Greensand Formations of the Icknield Belt.

6.3.11 The Misbourne Valley forms a natural routeway across the Chiltern dipslope from its confluence with the River Colne to the scarp slope overlooking the Vale of Aylesbury near Wendover.

6.3.12 Settlement is predominantly dispersed within the study area of which, Wendover is the largest; the remainder comprising farmsteads and small hamlets set within a wooded landscape.

6.3.13 There is some potential for Palaeolithic circa 500,000 BC – 10,000 BC) through to Mesolithic (circa 10,000 BC – 4,000 BC) remains to survive in areas of colluvial deposits along the Misbourne Valley floor. There is a reduced potential elsewhere, since the geology is less suitable for the survival of such remains. The only evidence of Palaeolithic date within the study area is the discovery of an unspecified artefact by a metal detectorist on the south side of Bacombe Hill (DWH094). Pleistocene mammal remains were also recovered in a former gravel pit just south of Wendover (DWH157).

6.3.14 Isolated Mesolithic/Neolithic flint flakes and tools have been recovered during fieldwalking near Hunt's Green Farm (DWH162), east of Chalkshire Farm (DWH114) and Nashlee Farm (DWH130). Typically Mesolithic activity has been identified on the higher slopes overlooking the floor of the Misbourne Valley though finds on the lower lying land to the north could reflect movement between the flint resources of the plateau to the south and east and the Vale of Aylesbury.

6.3.15 Evidence for Neolithic (circa 4,000 BC – 2,400 BC) and Early Bronze Age (circa 2,400 BC – 1,500 BC) ceremonial/burial monuments is absent from the Chiltern dipslope and the Misbourne Valley but exists along the Chiltern scarp. Three round barrows of Late

Neolithic – Early Bronze Age date represent the only known examples of prehistoric funerary monuments in the study area. These comprise two scheduled monuments on Bacombe Hill (DWH100).

6.3.16 Discoveries elsewhere comprise flint tools, cores and flakes, recovered during fieldwalking to the east of Chalkshire Farm, (DWH114), at Nashlee Farm (DWH130), near the Chiltern Brewery on B4009 Nash Lee Road (DWH132) and at North Lee (DWH144). Two gold torcs of probable Middle Bronze Age date (circa 1,500 BC – 1,000 BC) were also recovered by metal detector at Terrick (DWH133).

6.3.17 Settlement evidence of Neolithic and Early Bronze Age date is scarce in Buckinghamshire (typically comprising only shallow pits or scrapes). Discovery is hampered by destruction through slope erosion and burial under later colluvium.

6.3.18 Within the study area later Bronze Age and Iron Age activity is also predominantly demonstrated by the recovery of surface finds during fieldwalking surveys and metal detector rallies. Artefacts have been recovered on land near Wendover Dean Farm and Manor Farm (DWH042), near Wellwick Farm (DWH111), east of Chalkshire Farm (DWH114), east of the Marylebone to Aylesbury Line (DWH124) and Nashlee Farm (DWH130).

6.3.19 Late Bronze Age and Iron Age hillforts and cross-ridge dykes running perpendicular to the Chiltern scarp elsewhere in the Chilterns have been thought to indicate a pattern of routeways. These prehistoric cross-ridge dykes, however, are all short earthworks that often run across promontories and could be evidence of stock management rather than of routeways. There is little real evidence for a network of prehistoric routeways in the central Chilterns, although a co-axial landscape trend evident in surviving routeways and field boundaries has been identified.

6.3.20 Large scale land division in the Iron Age is indicated by Grim's Ditch (DWH008 and DWH077), which may have been a tribal boundary (possibly with its origins in the Bronze Age), but is more likely to have been established to constrain cattle being driven within valleys linking to the Rivers Wye and Chess.

6.3.21 In the wider area droveways, extensive field systems and palaeo-environmental data, comprising the buried and preserved remains of organic material, all point to extensive land clearance having occurred by the Middle to Late Iron Age.

6.3.22 The relatively high density of ceramic finds on the Gault Clay and Greensands north of Bacombe Hill strongly suggests a transition to more intensive use of the local landscape for agriculture, especially from the Late Iron Age onwards. Elsewhere within and adjacent to the Misbourne Valley evidence for activity in the Iron Age is scarce.

6.3.23 In the wider area settlement of Roman (AD 43 – AD 410) date is usually more extensive in scale than that of later prehistoric date, with a far greater and more diverse range of material culture.

6.3.24 Romano-British villas often appear to have developed from Iron Age settlements and in the Chilterns are typically located at approximately 2-3km intervals. A probable villa site is known within the study area to the north-east of Terrick (DWH133), with

another on King's Lane, Cobblers Hill in the south of the study area but outside the ZTV.

6.3.25 Metal detector rallies and fieldwalking have yielded numerous ceramic and metal artefacts including a cremation burial near Wellwick Farm which could indicate the potential location of a Roman period building (DWH111), large quantities of pottery to the east of the Marylebone to Aylesbury Line (DWH124) and possible building remains around Nashlee Farm (DWH130). On the Nash Lee Road near Loudwater Farm coins, ceramic artefacts and possible building remains were also recorded (DWH126). It could be that Roman farmsteads concentrated along the Lower Icknield Way (DWH129). Occasional finds have been recovered elsewhere throughout the study area.

6.3.26 Evidence of material culture such as pottery is drastically reduced during the early medieval period; it does not survive well in plough soils, coinage is also very rare and many settlements have since been built over by later ones.

6.3.27 Grim's Ditch earthwork, extant in two places in the study area each as separate scheduled monuments (DWH008 and DWH077), remained a notable feature in later centuries, acquiring its present name during the period of Anglo-Saxon settlement in the 5th and 6th centuries. Otherwise there is only scant evidence of early medieval settlement (AD 410 - 1066) or associated activity within the study area. This comprises a possible cobbled floor, a few artefacts and skeletal remains from Wendover (DWH120), and artefacts recovered near on land near Wellwick Farm (DWH-111 and DWH113) and just south of Wendover (DWH121).

6.3.28 By the Norman Conquest (1066) the present settlement pattern had probably been broadly established and was focused on the town and manor of Wendover, which is recorded in the Doomsday Book.

6.3.29 The first settlement at Wendover appears to have been focused around St Mary's Church to the south of the modern town (DWH117), and was probably agricultural in nature. Some evidence of medieval settlement has been recovered in the area at Wendover House School. The centre of the settlement probably moved to its present location during the late 12th or early 13th century (DWH120). The Upper Icknield Way passes through the historic core of the town rather than the earlier site of Wendover Manor (DWH119).

6.3.30 In the north-west part of the study area the remains of three scheduled moated farmsteads survive: just west of Terrick (DWH134), at Grove Farm (DWH140) and at Apsley Manor Farm (DWH146), the latter a farmhouse of early 16th century origin, though much altered subsequently. The remains of moated sites also survive at the Chiltern Brewery, Nashlee Farm (DWH132) and at North Lee (DWH144). The moated site at Nashlee Farm and the area to the east of the farm where medieval ceramics have been recovered during field walking may represent the remains of the former medieval settlement of Nash Lee Green (DWH132). There is also a very tenuous candidate for a motte and bailey type site near St Mary's Church in Wendover (DWH117) and for the site of a former medieval chantry chapel and hospital of St John the Baptist, though it is more likely the complex of linear and rectilinear cropmarks

identified during a LiDAR survey (Appendix CH004-010, J21) represent former field boundary ditches or enclosure ditches (DWH116).

6.3.31 Hale Farmhouse to the south-east of Wendover is of 15th century origin, one of the earliest surviving farmhouses in the study area, though altered in the following centuries (DWH090). Earthworks, or buried remains are also recorded at Terrick where the remains of a substantial medieval fishpond were exposed (DWH133). Documentary evidence also points to the presence of a medieval to post-medieval farmstead at Mayertorne Manor (DWH043) and evidence for milling exists at Clerk's Mill (DWH076) that was part of Wendover Manor.

6.3.32 The medieval core of The Lee, designated as a conservation area, comprises boundary earthwork remains, and evidence of a hollow-way and moat focused around Church Farm and the 12th century Grade I listed Old Church of St John the Baptist (DWH022).

6.3.33 Medieval artefacts have been recovered throughout the study area in fieldwalking surveys and at metal detector rallies. The main foci of these lie on land around Wendover Dean Farm and Manor Farm (DWH042), south (DWH130) and east (DWH132) of Nashlee Farm (DWH147) and at North Lee (DWH144). These concentrations could indicate potential locations of dispersed medieval settlements, perhaps focused on moated sites.

6.3.34 Medieval ridge and furrow survives only very sparsely within the study area near Fox Close Farm to the north of Wendover (DWH124) and north of Dodd's Farm (DWH145). LiDAR imagery indicates another area east of Stoke Grove Farm (DWH143) and one just south of Nash Lee Lane (DWH153).

6.3.35 It is likely that the pattern of scattered settlement set within a relatively wooded landscape established in the medieval period forms the basis for the pattern that continued through the post-medieval period (1539 – 1900) to the present day.

6.3.36 The Chilterns landscape has been designated as an area of outstanding natural beauty (AONB), and is an essentially 'ancient' rural landscape of fields and woodlands which have been strongly influenced and affected by development in the 20th century. Further north the landscape of Aylesbury Vale District is predominantly agricultural and primarily formed by private and parliamentary enclosure during the post-medieval period. Urban settlement is represented in Wendover, with the village of Dunsmore to the south the next most populated settlement. Wycombe District has an 'ancient' landscape akin to the Chiltern District but with less 20th century change away from the main towns. North of the Chiltern Scarp there is a 'planned' landscape like that of Aylesbury Vale District.

6.3.37 In Wycombe and Chiltern Districts the settlement pattern is a combination of nucleated and dispersed forms with dispersed settlement tending to be located on higher ground taking the form of common edge settlements and widely distributed farmsteads. Historic nucleated villages, represented in these districts by The Lee, Lee Common and Dunsmore are examples of this type of distribution.

6.3.38 Wycombe District has the highest proportion of ancient and secondary woodland in the study area, and in Buckinghamshire as a whole. Woodlands also comprise a

significant proportion of the historic landscape in the Chiltern District, but far less so within the parts of the study area that lie within the Aylesbury Vale District.

6.3.39 The agricultural landscape in the Aylesbury Vale District is primarily formed by private and parliamentary enclosure during the post-medieval period. Within this post-medieval framework, aspects of the pre-existing medieval landscape survive, principally in a few areas of ridge and furrow indicating areas in which an open field system existed during the medieval period (DWH125, DWH143, DWH145 and DWH153). These are associated with the existing historic settlement of Wendover (DWH117 and DWH120) and smaller settlements with moated sites such as at Nash Lee, Terrick, Apsley Manor or North Lee.

6.3.40 As a whole the historic landscape within the study area comprises pockets of surviving remnant medieval and post-medieval enclosure (DWH156) and possibly pre-medieval coaxial (on the same orientation) field systems around The Lee, within a more widespread landscape of private and parliamentary enclosure. This is set within a well preserved mosaic of ancient semi-natural and replanted woodlands, especially in the southern half of the study area. Much of this woodland, and there are 18 examples within the study area, may have at least medieval origins; the route will pass through one, Jones' Hill Wood (DWH030).

6.3.41 There has been little change in the field boundaries within the study area since the 1st Edition OS mapping of the 1880s. There is a total of 16 hedgerows that are considered to be historically important under the Hedgerow Regulations 1997 within the area of land required to construct the Proposed Scheme.

6.3.42 Several large houses and farmhouses established in the post-medieval period are associated with surrounding planned estates, parks and gardens or smaller scale designed landscapes. These include Grade II listed Wendover House School, formerly known as Wendover Manor House (DWH117), and Grade II listed Mayertorne Manor (DWH043), Smalldean Farmhouse (DWH083) and Grade II* listed Wellwick Manor (DWH109).

6.3.43 The majority of the farmsteads within the study area were built between the 17th and 19th centuries. The majority of buildings within the study area of these dates, however, are focused within the settlements of Wendover (DWH117 and DWH120) and to a far lesser extent The Lee (DWH022), Hunt's Green (DWH166) and Terrick (DWH173).

6.3.44 There are a number of outlying farmsteads and houses of post-medieval date in the study area, both isolated and grouped examples. The majority are Grade II listed and comprise: Hunt's Green Farmhouse (DWH007), Field End Grange (DWH015), Cobblershill Farm (DWH019), Manor Farmhouse and Mayertorne Manor (DWH043), Wendover Dean Farm (DWH045), Upper Wendoverdean Farm (DWH053), Bassibones Farmhouse (DWH059), King's Ash Farmhouse (DWH061), Smalldean Farmhouse (DWH083), Malthouse Farmhouse and Chalkshire Farmhouse (DWH110), Terrick House (DWH135) Seytons Manor (DWH136) and Nashlee Farmhouse (DWH147). Wellwick Manor is the only example which is Grade II* listed (DWH109).

6.3.45 Eight farmsteads or former farmsteads, still extant, are depicted on the 1st Edition OS mapping of the 1880s. These comprise Dutchlands Farm (DWH163), Strawberry Hill Farm (DWH033), Durham Farm (DWH044), Cuckoo Farm, now Rocketer Cottage and Cuckoo Farm Barn (DWH080), Road Barn Farm (DWH082), Wellhead Farm (DWH169), Dodd's Farm (DWH141) and North Lee Farm (DWH144).

6.3.46 Post-medieval industry is predominantly represented by former chalk extraction and clay pits which are distributed quite widely around the study area. Mills such as Clerk's Mill and Poyntz Mills and Birche's Peece brickworks (DWH076), are probably located close to Grove Farm.

6.3.47 Post-medieval historic transport infrastructure in the study area is represented by the turnpike road (DWH160) that follows the route of the modern B4009/London Road/Aylesbury Road and the turnpike road that generally follows the route of the modern Nash Lee Road/Nash Lee Lane (DWH161). The current Marylebone to Aylesbury Line, formerly called the Aylesbury to Chorleywood Railway (DWH159), and the dismantled Wendover to RAF Halton Line are the only historic railway lines within the study area.

6.3.48 Development within the modern period has been quite small-scale within the study area, comprising predominantly limited expansion of residential and commercial development around Wendover (DWH120). Villages such as The Lee (DWH022) have expanded to the south at Lee Common, though again only on a very limited scale over the last century. Elsewhere within the study area commercial development predominantly comprises modern structures associated with agriculture and communications. Modernisation of the A413 and Marylebone to Aylesbury Line are the most notable examples of the latter.

Future baseline

Construction (2017)

6.3.49 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. None of the identified developments affect the assessment of the Proposed Scheme's likely construction impacts on heritage assets.

Operation (2026)

6.3.50 No committed developments have been identified in this local area that will materially alter the baseline conditions in 2026.

6.4 Effects arising during construction

Avoidance and mitigation measures

6.4.1 The draft CoCP sets out the provisions that will be adopted to control effects on cultural heritage assets. The provisions include the following (see Volume 5: Appendix CT-003-000):

- management measures that will be implemented for assets that are to be retained within the land required, temporarily or permanently, for construction of the Proposed Scheme (draft CoCP, Section 8);

- the preparation of project wide principles, standards and techniques for works affecting heritage assets (draft CoCP, Section 8);
- a programme of archaeological investigation and recording to be undertaken prior to/or during construction works affecting the assets (draft CoCP, Section 8); and
- a programme of historic building investigation and recording to be undertaken prior to modification or demolition of the assets (draft CoCP, Section 8).

6.4.2 The following measures have been incorporated into the design of the Proposed Scheme to reduce impacts on assets:

- an area of planting to the north-west of the Bowood Lane overbridge to compensate for the loss of ancient woodland at Jones' Hill Wood (DWH030) and to provide ecological connectivity to the ancient woodland at Rushmoor Wood (DWH021); and
- general landscape earthworks and planting to reduce impacts on the setting of designated assets within the ZTV.

Assessment of impacts and effects

Temporary effects

6.4.3 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 will occur to assets both within the land required, temporarily or permanently, for construction of the Proposed Scheme and assets in the wider study area due to the visibility of plant, cranes and equipment.

6.4.4 There will be an adverse effect on the character and setting of Grim's Ditch scheduled monument (DWH008). The Proposed Scheme will be in the South Heath cutting which will pass through Grim's Ditch scheduled monument, a prehistoric earthwork bank and ditch of high value. Construction works for the cutting will require the removal of an approximately 150m length of the monument and excavated material stockpiling at the north-eastern end of the asset will also impinge on it. An area of sustainable placement will be located immediately to the east of the scheduled monument. Construction works will be intermittent lasting approximately three years and three months. The Leather Lane overbridge satellite construction compound will be located on the north side of Leather Lane 550m to the south-east. Construction of the Leather Lane overbridge will be undertaken 530m to the south and will be operational for approximately one year and three months. Construction vehicles will utilise an access track linking the scheduled monument with Hunt's Green Farm and the road network at King's Lane. The setting of the surviving elements of Grim's Ditch comprising its earthworks and the surrounding agricultural landscape will be impacted by the severing of the scheduled monument, sustainable placement works to the east and the insertion of the cutting. This will cause a change such that the value of the asset is totally altered and the setting comprehensively changed reducing the ability to understand and appreciate the resource in its historical context and setting. This will cause a high adverse impact and a major adverse effect.

6.4.5 The Proposed Scheme will require the construction of the Wendover Dean viaduct and associated overhead structures along with landscaping works and temporary earthworks stockpiling as the route passes approximately 150m to the east of a group of four Grade II listed buildings at Wendover Dean Farm (DWH045) and a group of two Grade II listed buildings at Upper Wendoverdean Farm (DWH053), all of moderate value. These construction works will be intermittent lasting approximately one year and nine months. They will also require the installation of the Wendover Dean viaduct satellite compound to the north-east that will be in operation for approximately two years, balancing ponds to the south and east close to Durham Farm and the diversion of Footpath WEN/39. The rural, agricultural setting of these two asset groups, situated on the floor of the Misbourne Valley, rising to the eastern flank, contributes to their value and will be comprehensively altered by construction activities. This will cause a high adverse impact on each of these two groups of assets resulting from the dominance of views eastwards towards the viaduct works, proximity of landscaping works and associated construction activities and associated sound. This will result in a major adverse effect.

6.4.6 The Proposed Scheme will require the construction of the Wendover green tunnel and the Wendover north cutting on the west side of the town. These construction works will be intermittent lasting approximately two years and ten months and one year and six months respectively and will be approximately 450m to the north-east of Wellwick Farm, a group of assets comprising the Grade II* listed Wellwick Manor of high value and two Grade II listed barns of moderate value (DWH109). Landscape earthworks will also be undertaken on the western side of the line extending to within approximately 250m of the farmstead. The farm is set within relatively flat lying, large open agricultural fields. Within this setting there is minimal existing sound intrusion arising from traffic on the A413 and from the Marylebone to Aylesbury Line, however, this does not impinge on the rural quality of the farm group's setting. Views to the north and east towards Wendover and Nash Lee are open and relatively uninterrupted. This relatively open rural, agricultural setting contributes to the farmstead's value and will be noticeably altered. There will be a medium adverse impact on the asset group arising from construction works for the Wendover green tunnel, the Wendover north cutting and associated landscaping works. This will result in a major adverse effect.

6.4.7 There will be an adverse effect on the character and setting of a group of assets within the southern part of Wendover Conservation Area (DWH117). The Proposed Scheme will require the construction of the Small Dean viaduct approximately 700m to the south of Wendover, then the Small Dean north embankment. Construction works will be intermittent lasting approximately two years and three months and one year and three months respectively and will pass about 200m to the west of the southern part of the town, the focus of the original medieval town. The route will then be in the Wendover green tunnel passing the west side of Wendover. Construction works for this will be intermittent lasting approximately two years and ten months. The southern part of Wendover lies within the town's conservation area which comprises an asset group of high value including two Grade II* listed buildings, the Church of St Mary and its lychgate and churchyard walls and three Grade II buildings associated with Wendover House School. This is a peaceful part of Wendover, with a village-like rural quality, which is a key element in the setting of St Mary's Church and churchyard,

contributing to the value of the asset group as a whole. Construction activities for the viaduct and extensive landscaping and earthworks for the construction of the embankment about 200m to the west, and the location of the Wendover green tunnel (south) satellite compound 275m to the west, which will be operational for two years and nine months, will alter the sound environment and this will change the setting noticeably causing a medium adverse impact and a major adverse effect.

6.4.8 The Proposed Scheme will require the construction of the South Heath cutting approximately 500m to the west of Hunt's Green Farm (DWH007). An extensive area of sustainable placement will be located within 100m of the asset group comprising two Grade II listed buildings of moderate value. Construction works will be intermittent lasting approximately three years and three months. Hunt's Green Farm is set within a wider rural, agricultural setting on the eastern flank of the Misbourne Valley as it rises towards the plateau in undulating fields, stands of woodland, isolated trees and hedgerows. This setting contributes to the asset group's value. There will be broadly unobstructed views downslope to the west during the construction period and changes to the local sound environment at this time are also likely. The Leather Lane overbridge satellite construction compound will be located on the north side of Leather Lane 350m to the south and will be operational for approximately one year and three months, and construction vehicles will utilise an access track which passes through the farmstead. As a result there will be a noticeable change to the asset group's setting. This will cause a medium adverse impact and a moderate adverse effect.

6.4.9 There will be an adverse effect on the character and setting of a group of assets within The Lee Conservation Area (DWH022). The Proposed Scheme will require the construction of the South Heath cutting, construction of which will be intermittent lasting approximately three years and three months. These works will be 1km to the west of The Lee conservation area, which comprises an asset group of high value, encompassing medieval earthworks, the Grade I church of St John the Baptist and 11 Grade II listed buildings. A sustainable placement will be located within 500m of the western edge of the village. The Lee Conservation Area is located on the Chiltern dipslope and its wider setting comprises the gently undulating ground of the plateau just east of the Misbourne Valley. This is a peaceful, rural landscape of agricultural fields, woodlands and other stands of trees, isolated farms, footpaths and bridleways. This setting makes a notable contribution to the value of the asset group. Construction activities and associated changes to the local noise environment will slightly alter the appreciation of this setting. This will cause a low adverse impact and a moderate adverse effect.

6.4.10 The Proposed Scheme will require the construction of the South Heath cutting to the south-east of Manor Farmhouse and Mayertorne Manor, two Grade II listed buildings of moderate value (DWH043). The asset group's setting comprises the flatter rural, agricultural land on the floor of the Misbourne Valley, contributing to its value. The A413 London Road and Marylebone to Aylesbury Line 'bracket' the buildings of the asset group close by on the east and west sides respectively and these have a slight impact on the peacefulness of the rural surroundings. Views to the east are partially screened by mature trees and intervening topography. Construction works will be intermittent lasting approximately three years and three months. The cutting will exit

onto the Wendover Dean viaduct, construction of which will be intermittent lasting approximately one year and nine months, passing the asset group at a distance of approximately 800m. Landscape earthworks will also be required up to 650m from the asset group. The A413 London Road, 250m to the east will be used as a construction traffic route and balancing ponds will be required approximately 500m to the south-east. These construction activities will noticeably change the asset group's setting and cause a medium adverse impact and a moderate adverse effect.

6.4.11 The Proposed Scheme will require the construction of the Small Dean south embankment leading to the Small Dean viaduct as it passes Smalldean Farm, a group of four Grade II listed buildings of moderate value 500m to the east (DWH083). These construction works will be intermittent lasting approximately two years and three months and two years respectively. The buildings are set within the wider rural, agricultural landscape on the lower west flank of the Misbourne Valley and are linked by Small Dean Lane to the A413. General views from the farmstead to the north, east and south-east are well screened by mature trees surrounding the farm buildings. This setting contributes to the asset group's value. There will be landscape earthworks approximately 250m away to the east and north-east, the Small Dean main compound, operation of which will last approximately four years, excavated material stockpiling 350m to the north-east, and the A413 London Road will also be utilised as a construction traffic route so will experience increased traffic flow above its normal levels. There will also be increased levels of visual impact and noise resulting from construction activities for the embankment and viaduct and associated overhead structures. This will cause a noticeable change to the setting of the asset group affecting its value and resulting in a medium adverse impact and a moderate adverse effect.

6.4.12 There will be an adverse effect on the character and setting of non-designated buildings. The Proposed Scheme will require the construction of the Wendover green tunnel as it passes through Bacombe Terrace on Ellesborough Road, immediately adjacent to numbers 10 to 28 which form part of a late 19th century terrace of houses (DWH158). Construction works will be intermittent lasting approximately two years and ten months. This will require construction works for the green tunnel, extensive material stockpiling, the siting of the Wendover green tunnel (south) satellite compound, which will be operational for approximately two years and nine months, and temporary highway and pedestrian diversions on Bacombe Lane and Ellesborough Road. There will also be noticeable construction noise. These are non-designated buildings of low value. Their setting is restricted to their association with Ellesborough Road and this will be comprehensively altered resulting in a high adverse impact and a moderate adverse effect.

6.4.13 There will be an adverse effect on the character and setting of two scheduled monuments, comprising three barrows on Bacombe Hill (DWH100). The Proposed Scheme will require the construction of the Wendover green tunnel passing west of Wendover and east of Bacombe Hill before emerging into the Wendover north cutting to the north-west of the town. Construction works for this will be intermittent lasting approximately two years and ten months and one year and six months respectively. The route lies approximately 500m to the east of two scheduled monuments comprising three Late Neolithic – Early Bronze Age barrows of high value on the

eastern end of Bacombe Hill (DWH100). The monuments' setting primarily comprises their above ground earthwork remains and their quiet, relatively isolated location at the top of Bacombe Hill with views over the low-lying farmland to the north and north-east. This setting contributes to their value. Tree cover on the slopes of Bacombe Hill obscures all views to and from the barrows and the Misbourne Valley floor toward the south and east. Extensive excavated material stockpiling will be required to the east and north-east, skirting the eastern slopes of Bacombe Hill from Bacombe Lane north-eastwards past Coneycroft Farm towards the A413 Nash Lee Road. A temporary link road will also be built between Bacombe Lane and Ellesborough Road and construction noise will also be noticeable. This will slightly affect the setting of the asset group affecting its value. This will result in a low adverse impact causing a moderate adverse effect.

6.4.14 The Proposed Scheme will require the construction of the Small Dean south embankment rising to the Small Dean viaduct as it passes approximately 330m to the west of Old Mill House, a Grade II listed building of moderate value located on the north side of Wellhead Farm, just outside the southern periphery of Wendover (DWH118). Construction works will be intermittent lasting approximately two years and three months, and two years respectively. The Small Dean viaduct main compound will be located approximately 500m to the south-west and will be operational for approximately four years. Old Mill House's setting comprises its roadside location on Hogtrough Lane and the buildings of Wellhead Farm on the floor of the Misbourne Valley, which contribute to its value. The building lies approximately 250m north-east of an elevated roundabout on the A413, traffic on which can be clearly heard. Key views from Old Mill House are generally northwards toward Wendover and north-eastwards towards Boddington Hill. Views toward the embanking works, the viaduct construction works and associated overhead structures and plant will only be partially screened by existing landscape features such as the mature hedgerow along the Hale Road and the prevailing topography. This will cause a medium adverse impact resulting in a moderate adverse effect.

6.4.15 There will be an adverse effect on the character and setting of a group of assets within the core of the Wendover Conservation Area (DWH120). The Proposed Scheme will require the construction of the Small Dean north embankment, Wendover green tunnel and the Wendover north cutting as the route passes within 200m of Wendover. Construction works for these will be intermittent lasting approximately one year and three months, two years and ten months, and one year six months respectively. The core of Wendover lies within the town's conservation area which comprises an asset group of high value including the Grade II* listed Red House and Bank Farmhouse along with 87 Grade II listed buildings. The immediate setting of the town comprises its historic character and the inter-relationship of its buildings and historic streetscape. Wendover's wider setting comprises its historically important position at the point where the valley crosses between Boddington Hill and Bacombe Hill. This contributes to the asset group's value. Within this setting there is slight existing sound intrusion from traffic on the A413 and from the Marylebone to Aylesbury Line. Construction works for the embankment and the green tunnel, and extensive material stockpiling between Bacombe Lane north-eastwards past Coneycroft Farm towards the Nash Lee Road will be required. There will also be noticeable change in the local

sound environment. This will slightly change the asset group's setting affecting its value, resulting in a low adverse impact causing a moderate adverse effect.

Cumulative effects

6.4.16 There are no temporary cumulative effects from committed developments on heritage assets within the study area.

Permanent effects

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

Physical Impacts

6.4.18 Disturbance of known and potential archaeological remains of high value will occur at Grim's Ditch scheduled monument (DWH008). The Proposed Scheme will be in the South Heath cutting as it passes through Grim's Ditch scheduled monument, a prehistoric earthwork bank and ditch. Construction works for the cutting will require the removal of an approximately 150m length of the monument and the sustainable placement site at the north-eastern end of the asset will also impinge on it. There is a high potential for currently unrecorded buried archaeological remains of prehistoric and later date to lie within the area of cutting and the south-western edge of the excavated material stockpile. There is also the potential for the preservation of buried soils beneath the existing earthwork and possibly palaeo-environmental remains. An area of sustainable placement will be located immediately to the east of the scheduled monument. This will incorporate planting to highlight sympathetically the alignment of the monument at its north-eastern end; however, there will be a high adverse impact and a major adverse effect.

6.4.19 Land will be required for the construction of the Proposed Scheme from Jones' Hill Wood (DWH030), ancient woodland of high value. The South Heath cutting will pass through the south-western corner of the woodland. This will result in the removal of approximately 0.9 ha of the existing woodland. New woodland planting on the south-eastern edge of Jones' Hill Wood will offset the loss of ancient woodland to an extent; however, there will remain an impact of high magnitude resulting in a major adverse effect.

6.4.20 Disturbance of potential archaeological remains of high value on land east of Wellwick Farm and north of Coneycroft Farm (DWH111). The Proposed Scheme will be in the Wendover green tunnel as it passes Wendover from the south exiting into the Wendover north cutting, and continuing north-westwards as it passes approximately 450m to the north-east of this site. Extensive landscaping and excavated material stockpiling will be undertaken on the western side of the route extending to within 250m from the farm. Metal detector rallies and fieldwalking on this land have yielded evidence of a possible Romano-British villa site, and include the discovery of a human cremation of Roman date. The Proposed Scheme has the potential to remove buried remains of the possible villa and associated settlement remains that will cause a medium adverse impact and a major adverse effect.

6.4.21 The Proposed Scheme will cause disturbance of potential archaeological remains of low value on land on the west side of Hunt's Green Farm (DWH014). The Proposed Scheme will be in the South Heath cutting approximately 500m to the west of Hunt's Green Farm and landscaping works will extend to within 100m. Metal detector rallies have yielded a small assemblage of metal finds of Roman, medieval and post-medieval date. At Hunt's Green approximately 200m further east limited fieldwalking yielded a small assemblage of flint artefacts of Mesolithic to Bronze Age date (DWH162). This suggests a very limited potential for finds of similar date on the west side of Hunt's Green Farm. The very low levels of recovered artefacts suggest this is an asset of low value. Landscape earthworks will, however, result in damage or removal of the majority of the land associated with these finds. This will result in a high adverse impact and a moderate adverse effect.

6.4.22 The Proposed Scheme will cause disturbance of potential archaeological remains of moderate value on land around Upper Wendoverdean Farm, Wendover Dean Farm and Manor Farm (DWH042). The Proposed Scheme will be in the South Heath cutting to the south-east of Wendover Dean Farm (DWH045), Upper Wendoverdean Farm (DWH053) and Manor Farmhouse (DWH043) but will then be elevated on the Wendover Dean viaduct as it passes Wendover Dean Farm and Upper Wendoverdean Farm at a distance of approximately 300m, then moving onto the Wendover Dean north embankment and the Rocky Lane cutting. Landscape earthworks, temporary earthworks stockpiling, the Wendover Dean viaduct satellite compound and the provision of balancing ponds will also be required up to 150m away from both asset groups. Metal detector rallies in the fields surrounding these farms yielded a range of multi-period finds which may be associated with buried archaeological remains of Roman to medieval date. Construction works will remove approximately 40% of the land associated with these finds. This will cause a medium adverse impact and a moderate adverse effect.

6.4.23 The Proposed Scheme will require the demolition of non-designated buildings of at least 19th century date, each of which is of low value. These comprise farm complexes at Durham Farm (DWH044) north-west of Jones' Hill Wood; Road Barn Farm (DWH082) east of Coxgrove Wood; a railway overbridge (DWH151) just north of Road Barn Farm; and Numbers 30-40 Ellesborough Road (DWH096). There will be high adverse impacts on each of these assets, each resulting in a moderate adverse effect.

6.4.24 The Proposed Scheme will cause disturbance of potential archaeological remains of moderate value on land between Bacombe Lane and Ellesborough Road (DWH116). Construction of the Proposed Scheme in the Wendover green tunnel and the location of extensive excavated material stockpiles between Bacombe Lane and Ellesborough Road will be located in an area where cropmarks have been identified which could be of medieval to post-medieval date. There is a very limited potential for the site to represent the remains of the medieval chantry chapel and hospital of St John the Baptist. There is a much greater likelihood that these cropmarks represent the remains of field boundaries and enclosures associated with agricultural practices. On that basis the site is considered to be of moderate value. Approximately 50% of the site will be removed. This will cause a medium adverse impact resulting in a moderate adverse effect.

6.4.25 Construction of the Proposed Scheme on the Stoke Mandeville south embankment and the establishment of landscaping and a new footbridge will remove approximately 65% of a field of degraded ridge and furrow earthworks to the east of Stoke Grove Farm (DWH143). This is an asset of low value. There will be a high adverse impact resulting in a moderate adverse effect.

6.4.26 Construction of the Proposed Scheme in the Wendover North cutting and the establishment of landscaping and realignment of the Nash Lee Road will remove approximately 45% of a field of degraded ridge and furrow earthworks just south of Nash Lee Road (DWH153). This is an asset of low value. There will be a high adverse impact resulting in a moderate adverse effect.

6.4.27 Construction of the Proposed Scheme will require the removal of sections of 16 hedgerows of moderate value which are considered to be historically important under the Hedgerow Regulations 1997 criteria for archaeology and history (DWH001, 002, 003, 004, 005, 009, 010, 011, 012, 013, 026, 027, 029, 031, 037 and 142). These are hedgerows that lie along parish boundaries and / or can be shown to pre-date Parliamentary Enclosure and / or form a constituent part of a feature mapped by the HER. This will constitute a medium adverse impact and a moderate adverse effect.

Impacts on the setting of heritage assets

6.4.28 There will be an adverse effect on the character and setting of Grim's Ditch scheduled monument (DWH008). The Proposed Scheme will be in the South Heath cutting passing through Grim's Ditch scheduled monument, a prehistoric earthwork bank and ditch of high value. An area of sustainable placement will be located immediately to the east of the scheduled monument. The setting of the surviving elements of Grim's Ditch comprising its earthworks and the surrounding rural landscape will be severed. This change will totally alter the setting of the monument, severely reducing opportunity to understand and appreciate the resource in its historical context and setting. This will cause a high adverse impact and a major adverse effect.

6.4.29 There will be an adverse effect on the character and setting of a group of four Grade II listed buildings at Wendover Dean Farm (DWH045) and a group of two Grade II listed buildings at Upper Wendoverdean Farm (DWH053), each of moderate value. Construction of the Proposed Scheme will be on the Wendover Dean viaduct, with associated overhead structures, landscaping and balancing ponds as the route passes approximately 150m to the east of these two farmstead groups. The rural, agricultural character of the asset groups' setting, rising to the east on the edge of the Misbourne Valley will be altered by the proximity of associated landscaping and infrastructure and have views toward the east changed by the insertion of the viaduct into the agricultural landscape to the extent that their value is noticeably affected. This will cause a medium adverse impact resulting in a moderate adverse effect.

6.4.30 There will be an adverse effect on the character and setting of a farmstead group at Wellwick Farm comprising the Grade II* Wellwick Manor, of high value and two associated Grade II listed barns (DWH109). The Proposed Scheme will run in the Wendover green tunnel as it passes Wendover from the south exiting into the Wendover north cutting approximately 450m to the north-east of the farm complex. The farm is set within relatively flat-lying, large open agricultural fields. Within this

setting there is minimal existing sound intrusion arising from traffic on the A413 Nash Lee Road and from the Marylebone to Aylesbury Line, however, this does not impinge on the rural quality of the farm group's setting. Views to the north and east towards Wendover and Nash Lee are open and relatively uninterrupted. This relatively open rural, agricultural setting contributes to the farmstead's value and will be slightly altered by the insertion of the cutting into the existing landscape to the north-east of the asset group. This will cause a low adverse impact resulting in a moderate adverse effect.

Permanent cumulative effects

6.4.31 There are no effects from committed development considered to be of specific relevance to the cultural heritage topic.

Other mitigation measures

6.4.32 Refinements to the mitigation measures incorporated into the design of the Proposed Scheme or included in the draft CoCP will be considered during detailed design to reduce further the significant effects described above. These refinements will include:

- the sustainable placement area to the east of Grim's Ditch will be designed to incorporate a depression to reflect the former line of the monument;
- the identification of suitable locations for advance planting, to reduce impacts on the setting of assets; and
- the identification of locations where the physical impact on below ground assets can be reduced through the design of earthworks.

Summary of likely residual significant effects

6.4.33 A range of archaeological assets will be permanently lost due to the construction of the Proposed Scheme; these assets include: earthwork and buried archaeological remains of prehistoric date associated with Grim's Ditch scheduled monument (DWH008), buried archaeological remains of likely prehistoric, Roman and medieval date on land to the east of Wellwick Farm and north of Coneycroft Farm (DWH111), buried archaeological remains of likely prehistoric, Roman and medieval date on land on the west side of Hunt's Green Farm (DWH014), buried archaeological remains of likely prehistoric, Roman and medieval date on land around Upper Wendoverdean Farm, Wendover Dean Farm and Manor Farm (DWH042), buried archaeological remains of possible medieval to post-medieval date on land between Bacombe Lane and Ellesborough Road (DWH116), earthwork and buried remains of ridge and furrow of likely medieval date east of Stoke Grove Farm (DWH143) and earthwork and buried remains of ridge and furrow of likely medieval date just south of Nash Lee Road (DWH153). A programme of archaeological works will be prepared to investigate, analyse, report and archive these assets.

6.4.34 The Proposed Scheme will result in the demolition of Durham Farm a non-designated farm complex on Bowood Lane (DWH044), Road Barn Farm a non-designated farm complex east of Coxgrove Wood (DWH082), a railway overbridge just north of Road Barn Farm (DWH0151) and numbers 30-36 Bacombe Terrace, Ellesborough Road, and

numbers 38-40 Ellesborough Road (DWH096). A programme of built heritage works will be prepared to investigate, analyse, report and archive these assets.

6.4.35 The setting of several historic settlements and buildings will be affected by the presence of the constructed Scheme, including landscaping, overbridges and other associated infrastructure. This presence will affect these assets through physical loss or severance of landscape elements or disruption of landscape associations that contribute to their value. These include: the surviving remains of Grim's Ditch scheduled monument (DWH008), the ancient woodland of Jones' Hill Wood (DWH030), Wendover Dean Farm (DWH045), Upper Wendoverdean Farm (DWH053), Wellwick Farm (DWH109) and Wendover southern focus (DWH117). Sections of 16 historically important hedgerows will also be removed (DWH 001, 002, 003, 004, 005, 009, 010, 011, 012, 013, 026, 027, 029, 031, 037 and 142).

6.5 Effects arising from operation

Avoidance and mitigation measures

6.5.1 The following measures have been incorporated into the design of the Proposed Scheme to reduce the impacts and effects on assets:

- noise mitigation measures have been included within the Proposed Scheme design to reduce potential impacts derived from changes to the setting of identified assets; and
- landscape planting will increasingly reduce the potential impacts derived from changes to the setting of identified assets within the study area as it matures during the operational phase.

Assessment of impacts and effects

6.5.2 The assessment considers the Proposed Scheme once operational and all effects are considered to be permanent. There will be no physical impacts on buried archaeological remains or other heritage assets arising from the operation of the Proposed Scheme. Impacts on the setting of heritage assets arising from the physical presence of the Proposed Scheme are described as permanent occurring within the construction phase and are not repeated in detail here, albeit that they will endure through the operation of the Proposed Scheme. Where there is a combined effect on the setting of an asset from the presence of the constructed Scheme and its operation, this is reported in the assessment of operation.

6.5.3 Wendover southern focus, comprising the southern part of the Wendover Conservation Area including two Grade II* listed buildings, the Church of St Mary and its lychgate and churchyard walls and three Grade II buildings associated with Wendover House School (DWH117), will experience a change in their setting caused by increased noise. This will constitute a medium adverse impact resulting in a major adverse effect. In combination with the presence of the Proposed Scheme, this will result in a medium adverse impact resulting in a major adverse effect.

6.5.4 Wendover Dean Farm, a group of four Grade II listed farm buildings on Bowood Lane, Wendover Dean (DWH045), will experience a change in its setting caused by the movement of trains and the associated increase in noise. This will constitute a

medium adverse impact resulting in a moderate adverse effect. In combination with the presence of the Proposed Scheme, this will result in a medium adverse impact resulting in a moderate adverse effect.

6.5.5 Upper Wendoverdean Farm, a group of two Grade II listed farm buildings north of Bowood Lane, Wendover Dean (DWH053). The asset will experience a change in its setting caused by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact resulting in a moderate adverse effect. In combination with the presence of the Proposed Scheme, this will result in a medium adverse impact resulting in a moderate adverse effect.

6.5.6 Old Mill House is a Grade II listed building of moderate value (DWH118). The asset will experience a change in its setting caused by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact resulting in a moderate adverse effect. In combination with the presence of the Proposed Scheme, this will result in a medium adverse impact resulting in a moderate adverse effect.

Cumulative effects

6.5.7 Assessment of inter-project effects on cultural heritage assets arising from the interaction of the Proposed Scheme with cumulative development projects has been undertaken. These developments are listed in Volume 5: CT-004-000 and shown on Maps CT-13-019 to CT-13-021 (Volume 5, Cross Topic Appendix 1 Map Book). No significant cumulative effects have been identified in relation to cultural heritage.

Other mitigation measures

6.5.8 The Proposed Scheme includes a number of design measures to address potential impacts and significant effects. No additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified.

Summary of likely residual significant effects

6.5.9 The setting of several historic settlements, buildings and landscapes will be affected visually and by noise once the Proposed Scheme becomes operational. This includes: Wendover southern focus (DWH117), Wendover Dean Farm (DWH045), Upper Wendoverdean Farm (DWH053) and Old Mill House (DWH118). In due course, visual effects will reduce as planting matures and the new railway integrates into the landscape.

7 Ecology

7.1 Introduction

7.1.1 This section describes the ecological baseline and identifies likely impacts and significant ecological effects that will arise from the construction and operation of the Proposed Scheme. These include impacts on species, habitats and sites designated for their importance for nature conservation.

7.1.2 The principal ecological issues in this area are the loss of ancient woodland habitat from Jones' Hill Wood and the loss of breeding barn owl territories as a consequence of the operation of the Proposed Scheme.

7.1.3 Volume 5 of the ES contains supporting information to the ecological assessment reported in this section, including:

- ecological baseline data (Volume 5: Appendices EC-001-002, EC-002-002 EC-003-002, and EC-004-002); and
- a register of local/parish level effects, which are not described individually in Volume 2 (Appendix EC-005-002).

7.1.4 As well as survey data, the assessment draws on existing information gathered from national organisations and from regional and local sources including: Buckinghamshire and Milton Keynes Environmental Records Centre; Berkshire; Buckinghamshire and Oxfordshire Wildlife Trust; Chilterns Conservation Board; North Bucks Bat Group; Berkshire and South Buckinghamshire Bat Group; Buckinghamshire Bird Club; and Buckinghamshire Amphibian and Reptile Group.

7.2 Scope, assumptions and limitations

7.2.1 The scope and methodology of the ecological assessment are introduced in the SMR (Volume 5: Appendix CT-001-000/1) and SMR Addendum (Volume 5: Appendix 001-000/2). Further detail, including the study area for individual surveys, is provided within the SMR Addendum (Volume 5: Appendix CT-001-000/2). The assessment methodology is summarised in Section 8 of Volume 1, along with route-wide assumptions and limitations. Limitations associated with particular surveys are reported in Volume 5: Appendices EC-001-002, EC-002-002, EC-003-002, and EC-004-002.

7.2.2 A Water Framework Directive assessment has been undertaken in conjunction with the environmental assessment. Details of this assessment are presented in Volume 5: Appendix WR-001-000.

7.2.3 Access was not obtained to all of the land area where general habitat survey (Phase 1 habitat survey) was proposed. Locations with the potential to support key ecological receptors where access could not be gained for survey include large areas of farmland at Wendover Dean and south-east of Wendover, and several fields north of Nash Lee Road. In addition, access was not secured for Springfield Farm, Chapel Farm and Hunt's Green Farm until June 2013 thus limiting survey work in this area. Further

details are provided in Volume 5: EC-001-002, EC-002-002, EC-003-002, and EC-004-002.

7.2.4 Where data are limited, a precautionary baseline has been built up according to the guidance provided in Volume 5: Appendix CT-001-000/2. This constitutes a 'reasonable worst case' basis for the subsequent assessment.

7.2.5 A precautionary approach to the assessment has been adopted to identify the likely significant ecological effects of the Proposed Scheme.

7.3 Environmental baseline

Existing baseline

7.3.1 This section describes the ecological baseline relevant to the assessment: the designated sites, habitats and species recorded in this area. Further details are provided in the reports and maps presented in Volume 5: EC-001-002, EC-002-002, EC-003-002 and to EC-004-002 and Map Series EC-01 to EC-12 (Volume 5, Ecology Map Book CFA10). Statutory and non-statutory designated sites are shown on Volume 5, Maps EC-01-019 to EC-01-021.

7.3.2 Land required for the construction of the Proposed Scheme and that adjacent to it consists of farmland (predominantly arable with some pasture) with species-rich intact hedgerows. There are woodland blocks and chalk hillsides in the wider area, and the land required for the construction of the Proposed Scheme passes through a valley between these features. Wendover is located adjacent to the route to the north-east of the area, where the land drops from the Chiltern Hills to the lowlands of the Vale of Aylesbury. Farm buildings and residential development are scattered throughout.

Designated sites

7.3.3 There are two statutory designated sites within 500m of the land required for the construction of the Proposed Scheme. They are:

- Bacombe and Coombe Hills Site of Special Scientific Interest (SSSI) (76.9ha) - is at its nearest point 25m south-west of land required for the construction of the Proposed Scheme, south-west of Wendover. It is designated for species-rich lowland calcareous grassland, which is a habitat of principal importance as identified in Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)[33] and a local Biodiversity Action Plan (BAP) habitat[34]. The SSSI is also designated for its population of fringed gentian, which represents the entire UK population of this plant, which was only recently discovered in the UK. Areas of juniper scrub, lowland mixed deciduous woodland (a habitat of principal importance), hazel coppice and some terrestrial invertebrates (e.g. the chalkhill blue and brown argus butterflies) are also listed on its citation. It is of national value; and
- Bacombe Hill Local Nature Reserve (LNR) (25ha) - the northern part of the

33 Natural Environment and Rural Communities Act 2006 (Chapter 16).London. Her Majesty's Stationery Office.
34 Buckinghamshire and Milton Keynes Biodiversity Partnership. Available online at http://www.buckinghamshirepartnership.gov.uk/biodiversity/biodiversity-action-plan/lowland-calcareous-grassland/#.UmK2W9xwadI. Accessed September 2013.

Bacombe Hills SSSI is also designated as a LNR, which is therefore also 25m from the land required for the construction of the Proposed Scheme. It is principally designated for its chalk grassland and woodland. As with all LNRs the provision of public access is important to the designation of this site. It is of district/borough value.

7.3.4 There are two Biological Notification Sites (BNS) relevant to the assessment in this area. Both are of county/metropolitan value. They are:

- The Wendover Rifle Range BNS (1.8ha) - an old gravel pit, which now supports species-rich grassland that has developed on a well-drained substrate. The boundary of the site comprises woodland and its southern edge is within the land required for the Proposed Scheme; and
- Grassland at North Lee BNS (15.2ha) - a former agricultural research centre designated for semi-improved neutral grassland. There are approximately 20 disused buildings throughout the grassland. The BNS crosses the boundary between this area and the Stoke Mandeville and Aylesbury area (CFA11). The larger part of the BNS is in the Dunsmore, Wendover and Halton area (CFA10), but the land required for the construction of the Proposed Scheme crosses a part of the BNS that is within CFA 11.

7.3.5 In addition, there are two areas of ancient semi-natural broadleaved woodland, within or immediately adjacent to the land required for the construction of the Proposed Scheme; Jones' Hill Wood (1.8ha) and Rushmoor Wood (2.1ha), both north-west of Hunt's Green. These ancient woodlands represent an irreplaceable resource.

Habitats

7.3.6 Habitats which are relevant to this assessment are as follows:

Woodland

7.3.7 The semi-natural broadleaved woodland and hazel coppice within Bacombe and Coombe Hills SSSI and Bacombe Hill LNR (both described in the designated sites section) are not a principal reason for the site designation. Beech, whitebeam and ash predominate on the slopes with pedunculate oak and birch on higher ground. The woodland at the base of the Hill consists of hazel with birch and ash. It is likely to be of up to county/metropolitan value.

7.3.8 Jones' Hill Wood is within land required for the construction of the Proposed Scheme and Rushmoor Wood is outside but within 20m of it. Both sites are semi-natural broadleaved woodland with the desk study records indicate the presence of bluebell, primrose and early-dog violet. Both areas qualify as lowland mixed deciduous woodland, a habitat of principal importance. Ancient woodland is rare and in decline but these woodlands are small and isolated from the extensive semi-natural broadleaved woodland that is present throughout the wider landscape. Individually each is of district/borough value.

7.3.9 An un-named wood that could not be surveyed due to access restrictions is located between Jones' Hill Wood and Rushmoor Wood and is adjacent to the land required for construction of the Proposed Scheme. It is not ancient woodland but provides a

stepping stone for species movement between these ancient woodlands. It is up to local/parish value.

Hedgerows

7.3.10 There are 22km of hedgerows in the land required for construction of the Proposed Scheme in the Dunsmore, Wendover and Halton area. The densest area of hedgerows is around Wendover Dean. Of those surveyed at least 2.5km were found to qualify as important hedgerows (under the Hedgerows Regulations 1997)[35]. The important hedgerows are rich in woody species among which hawthorn, elder, field maple and blackthorn are dominant, and rose is frequent. The important hedgerows are concentrated to the south-east and north-west of Wendover, particularly to the north of Wellwick Farm. All the hedgerows surveyed qualify as a habitat of principal importance. Due to the large number of established and important hedgerows, and to the habitat connectivity that they provide in an arable-dominated landscape, the hedgerow network is of district/borough value.

Watercourses

7.3.11 There are several watercourses that drain the area but a southern branch of the Stoke Brook is the only one that will be crossed by the land required for the construction of the Proposed Scheme. It flows north-west along the boundary with the Stoke Mandeville and Aylesbury area (CFA 11) and converges with three other branches to form the Stoke Brook. This watercourse is discussed further in CFA 11 where the Proposed Scheme crosses it.

Grassland

7.3.12 Unimproved calcareous grassland and a mosaic of acid grassland and dry heath is present in Bacombe and Coombe Hills SSSI and Bacombe Hill LNR (described in the designated sites section). The lowland calcareous grassland, a habitat of principal importance and the principal reason for designation, supports species-rich turf of sheep's fescue with characteristic downland plants such as horseshoe vetch, autumn gentian, devil's-bit and the nationally scarce chalk eyebright. The acid grassland and dry heath occupies the higher grounds, with wavy hair-grass, heath bedstraw, heather and early hair-grass. These grasslands areas are of national value.

7.3.13 There are six blocks of semi-improved neutral grassland in the area:

- with no access and therefore little data on the quality of the habitat in the Grassland at North Lee BNS and the Wendover Rifle Range BNS, it is assumed the grassland is species-rich as this is the principal reason for the site's designation. As part of a precautionary assessment, each grassland is therefore considered to be up to county/metropolitan value;
- the remaining four blocks of grassland within this area have relatively low botanical interest. They are located east and north of Wendover Dean (11ha and 0.6ha respectively), north-west of Wendover (0.3ha) and on the verges of

[35] The Hedgerows Regulations 1997 (1997 No. 1160). London. Her Majesty's Stationery Office. The Hedgerows Regulations 1997 set out two criteria for determining whether a hedgerow is important or unimportant: Wildlife and Landscape, and Archaeology and History. The Ecology Chapter and the Technical Appendix for hedgerows refer to the Wildlife and Landscape criteria. Therefore it is likely that there will be differences between the total number of important hedgerows in the Ecology and the Cultural Heritage chapters of the ES.

Chesham Lane (0.1ha). These areas are predominantly agriculturally improved and species-poor. Each is of local/parish value.

Ponds

7.3.14 Four ponds are relevant to the assessment; three within, and one adjacent to the land required for the construction of the Proposed Scheme. The two ponds that were surveyed had limited plant diversity and were typical of the lowland arable landscape. Although one pond supports great crested newts and so qualifies as a habitat of principal importance, both are of local/parish value.

7.3.15 For the purpose of this assessment and as they are in similar habitat to the ponds that were surveyed, the two ponds where access was unavailable are considered to be of up to local/parish value.

Orchard

7.3.16 A 9.5ha traditional orchard, which is located to the north of Nash Lee Road, is partially within the land required for the construction of the Proposed Scheme. It is no longer maintained as an orchard, the majority of its trees are dead, and grass and scrub habitat is developing. Although it is recognised as a habitat of principal importance and a local BAP habitat, there are few viable fruiting trees. It is of district/borough value.

7.3.17 A second smaller orchard is entirely within the land required for the construction of the Proposed Scheme at Road Barn Farm. It is 0.5ha in area and is a local BAP habitat. It is of local/parish value.

Other Habitats

7.3.18 Other habitats recorded in this area include juniper scrub in Bacombe and Coombe Hills SSSI. This is a lowland habitat and nationally rare. As a principal reason for designation it is of national value.

7.3.19 There is extensive arable and cultivated land and areas of parkland to the north of the area. None is greater than local/parish value.

Protected and/or notable species

7.3.20 A summary of the species relevant to the assessment is provided in Table 8.

Table 8: Protected and/or notable species

Species / species group	Value	Receptor	Baseline and rationale for valuation
Terrestrial invertebrates	County / metropolitan	Invertebrate assemblage at the orchard north of Nash Lee Road	Five notable species were recorded, all with nationally scarce: *Prionychus ater*, *Ischnomera cyanea*, *Ampedus elongantulus*, which are all dependant on dead wood and heartwood decay, *Rhinocyllus conicus*, which is dependent on mosaic grassland and *Fannia nidica*, which is dependent on birds' nests. This assemblage meets the threshold for county importance.
Bats	Up to county / metropolitan	Brown long-eared bat population associated with habitats around	Field surveys at buildings at Grove Farm recorded the presence of between 10-15 brown long-eared bats (estimated from droppings). Adjacent

Species / species group	Value	Receptor	Baseline and rationale for valuation
		Grove Farm.	hedgerows connect the roost to the woodland at Bacombe Hills, which is suitable foraging habitat. As part of the precautionary approach and due to the number of bats recorded emerging from the building, it is assumed that the brown long-eared bat roost is a maternity roost. These are uncommon and necessary to maintain populations over wide areas. Brown long-eared bats are a species of principal importance.
	Up to county / metropolitan	Bat assemblage using mature hedges, trees and tree-lined lanes for foraging and commuting at Rocky lane, Bowood lane, Kings lane and Leather Lane	Driven and walked activity transects in the southern and central part of this area recorded five species; common pipistrelle and soprano pipistrelle (in low to moderate numbers) with occasional passes of *Myotis* species, noctules and serotine bats. The activity indicates that this habitat is likely to be used for foraging and commuting between roosts and other foraging sites. In addition to the species listed above, the desk study indicates the presence of four brown long-eared roosts and a common pipistrelle roost within 1km of the land required for the proposed scheme. The hedgerows are the only connectivity between the large areas of woodland to the east and west of the land required. Noctule bats and soprano pipistrelle bats are species of principal importance.
	District/borough	Whiskered bat population near Ellesborough Road	A whiskered bat roost was recorded in a residential building. The low number of droppings (5-10) suggest the roost is used by a single bat (or low numbers). Static monitoring and activity surveys recorded low levels of activity. The network of established hedgerows and watercourses provide good commuting habitat for bats, linking the roost with the foraging sites along the Stoke Brook, the orchard (north of Nash Lee Road), Wellwick Farm and Bacombe Hills. Whiskered bats are rare[36] and have a restricted distribution.
	District/borough	Brown long-eared bat population at Ellesborough Road	A brown long-eared bat roost was recorded in a residential building. The low numbers of droppings (approximately 30) suggest the roost is used by a low number of bats (likely to be five or less). The network of established hedgerows provide good commuting habitat for bats, linking the roost with the woodland at Bacombe Hills and other foraging sites including the orchard (north of North Lee Road) and Wellwick Farm.
	District/borough	Noctule bat population at the orchard, north of Nash Lee Road	A noctule bat was recorded emerging from a tree near the eastern corner of the orchard. Noctule bats were also recorded foraging and commuting in the wider area, particularly to the south-east towards

[36] Bat Conservation Trust (2012). The state of the UK's bats: National Bat Monitoring Programme Population Trends 2012. BCT. London

Species / species group	Value	Receptor	Baseline and rationale for valuation
			the Bacombe Hills. This timing of the activity and numbers recorded indicates that other small roosts are likely to be present close by. The noctule bat population and range is restricted within Buckinghamshire and roosts of any size are uncommon and important to the survival of the population. Noctule bats were also recorded flying and foraging close to the orchard).
	District/borough	Common pipistrelle population west of Wendover	Three common pipistrelle bats were recorded emerging from a roost in a tree near Wellwick Farm. T from it. Two further roosts with one and two bats respectively were recorded at the orchard north of Nash Lee Road. Static monitoring and activity surveys recorded moderate numbers of common (and soprano pipistrelles) here. The network of established hedgerows and watercourses provide good commuting habitat for bats, linking the roost described above with the established foraging grounds in the area (the Stoke Brook, the orchard, Wellwick Farm and Bacombe Hills). The number of bats recorded indicates there are likely to be other roosts nearby.
	District/borough	Bat assemblage associated habitat west of Wendover	In addition to the bat species recorded between Ellesborough Road and the orchard (to the north of Nash Lee Road) field surveys recorded low numbers of serotine bats and the rarer nathusius pipistrelle bats. Both were foraging along the hedgerow network and commuting to and from the Bacombe Hills.
	Local/parish	Brown long eared population associated with habitat at Hartley Farm.	Low numbers (1-5 individuals) of brown long-eared bats were recorded emerging from two separate summer/transient building roosts. Similar sized roosting sites are likely to be abundant in this part of Buckinghamshire. The roosts are unlikely to be maternity roosts.
	Local/parish	Soprano pipistrelle bat population associated with habitats around Grove Farm.	Field surveys recorded one soprano pipistrelle emerging from a building at Grove Farm. Adjacent hedgerows connect the roost to the woodland at Bacombe Hills, which is suitable foraging habitat.
Birds	County / metropolitan	Barn owl pair south-west of Wendover	Three barn owl territories were recorded south-west of Wendover. This is more than 1% of the county population.
	District/borough	Barn owl population west of Wendover	A single barn owl nest represents 0.5% of the county population and will therefore not be of county importance.
	District/borough	Red kite population near Wendover	Two red kite nests were recorded at this location. This population will not meet the threshold for county importance (less than 1% of the county population).
	District/borough	Breeding bird	Field surveys recorded 53 bird species. Notable

Species / species group	Value	Receptor	Baseline and rationale for valuation
		assemblage associated with habitats south-west of Wendover	species included single breeding territories for grey partridge (a species of principal importance) and kestrel, and four lapwing nesting sites. Desk study records also include spotted flycatcher, firecrest and cuckoo, although these could not be confirmed as breeding.
	District/borough	Breeding bird assemblage associated with habitats north-west of Wendover	Field surveys recorded 55 bird species although most were recorded in low numbers and not breeding on site. Notable species included three lapwing nest sites, and a corn bunting territory (but not confirmed as breeding), neither of which reach county importance but are both species of principal importance. Other records included common and widespread breeding bird species typical of open countryside and woodland. Desk study records in the area include gadwall, kingfisher, little grebe, pochard and grasshopper warbler, although these could not be confirmed as breeding.
	Up to district/borough	Breeding bird assemblage associated with habitats south-east of Wendover	A lack of access permission prevented surveys here. The land is dominated by arable fields interspersed by hedgerows, and scattered with woodland. As a precaution it is assumed that it supports a diverse assemblage of farmland species. Based on the species recorded in the surrounding habitat the assemblage is unlikely to be county importance.
	Local/parish	Breeding bird assemblage associated with habitats west of Wendover	Field surveys recorded 39 bird species. Notable species include kestrel (one territory). Desk study records also include common crossbill, grey wagtail, hobby and lesser spotted woodpecker (a species of principal importance), although these could not be confirmed as breeding.
	Local/parish	Wintering bird assemblage associated with habitats throughout the area	Field surveys recorded 46 bird species in this area. The few notable species recorded included low numbers of red kite and two grey partridge. Other records were for common and widespread wintering bird species, in low numbers and typical of open countryside and woodland.
Amphibians	County / metropolitan	Great crested newt population at Wellwick Farm	Of the three ponds surveyed at this location, one had great crested newts with a peak count of 15 individuals (a medium population size class). The ponds are isolated from other water bodies but surrounded by grassland and woodland suitable for this species during its terrestrial phase. This population is unlikely to exceed county importance.
	Up to country / metropolitan	Potential great crested newt population between Hunts Green and Strawberry Hill Farm	There are six ponds at this location, five of which are within 250m of land required for the construction of the Proposed Scheme. Woodland and grassland suitable for this species during its terrestrial phase are well connected by intact hedgerows. The ponds were not surveyed due to restricted access. As part of the precautionary assessment it is assumed all of the ponds that were not surveyed support a sustainable breeding population that could form a meta-population and

Species / species group	Value	Receptor	Baseline and rationale for valuation
			may qualify as being of county importance. Great crested newts are a species of principal importance.
	Up to county / metropolitan	Potential great crested newt population north-west of Wendover	A single pond south of Nash Lee Road is in the land required and two ponds, one east of the A413 and one north of Nash Lee Lane, are within 250m of the land required for the construction of the Proposed Scheme. The ponds were not surveyed due to restricted access. As part of the precautionary assessment however, it is assumed each has a sustainable breeding population and together qualify as being of county importance.
	Local/parish	Great crested newt population at Hartley Farm	A small population size class (peak count four individuals) of great crested news and several eggs were recorded at the only pond present here. This population is isolated from other possible breeding ponds and thus unlikely to qualify as a notable site for this species.
Plants	District/borough	Native black poplar at and near the southern branch of the Stoke Brook	Field surveys recorded up to 20 native black poplars within six sites along the Stoke Brook and the hedgerows to the south of Wendover. Desk study records indicate up to 40 trees within 1km of the land required for the construction of the Proposed Scheme. Native black poplars are rare.[37] However, this area is in the UK stronghold for this tree and numbers here are unlikely to be greater than 1% of the Aylesbury Vale population. Water vole are a species of principal importance.
Otter	District/borough	Otter population along the southern branch of the Stoke Brook	A single otter spraint was found on the northern edge of the area (on the boundary with CFA11), near the orchard north of Nash Lee Road. No evidence of otter holts was recorded. There are few recent desk study records to the north of Wendover (approximately 200m away). Extensive suitable habitat exists to the north in CFA 11. Otter are present in the area but are unlikely to be breeding and therefore will not meet the threshold for county importance. Otter are a species of principal importance.
Reptiles	Up to county / metropolitan	Reptile population land within and around Wendover Rifle Ranges BNS	Grassland at Wendover Rifle Ranges BNS may be suitable for reptiles. It is partly in land required for the construction of the Proposed Scheme but could not be surveyed. If a population of adder or a population containing high numbers of grass snake, common lizard or slow worm is present, the site could be of county importance. All common reptile species are species of principal importance.
	Local/parish	A grass snake population at the orchard north of Nash	No reptiles were recorded during refugia surveys but one grass snake was recorded during other ecology field surveys at this location. There are three desk study records within 1km of the land

[37] Forestry Commission. Information on the conservation of Black Poplar Populus nigra L. Available online at: http://www.forestry.gov.uk/pdf/fcin057.pdf/$FILE/fcin057.pdf (Visited September 2013).

Species / species group	Value	Receptor	Baseline and rationale for valuation
		Lee Road	required. Despite the wider habitat being suitable, this population is likely to move through this site to access other habitats or the population is very low.
Badger	Local/parish	Setts near Wendover Dean	Field surveys did not record any main setts. Of seven setts recorded only two were within the land required for the Proposed Scheme. Desk study records indicate that badgers are present throughout the area. Badgers are common and widespread animals in lowland Britain, and populations are not threatened or thought to be vulnerable at present.
Aquatic invertebrates	Local/parish	The southern branch of the Stoke Brook	Field surveys recorded a moderate diversity of species including fresh water shrimp, riffle beetle and mayfly. Results were consistent with 'Fair' water quality.
Fish	Up to local/parish	Fish populations within the Stoke Brook and its tributaries	No fish were recorded in the branch of the Stoke Brook and 3-spined stickleback were recorded in a tributary. No desk study records were received. Rare or important assemblages are unlikely to be present in this area.
Hazel dormice	Negligible	The hedgerow network around Wendover Rifle Range and Wendover Dean	Field surveys recorded no evidence in the woodland or the hedgerow network within this area. Desk study data indicated the presence of a single dormouse about 2.5km east from land required for construction of the Proposed Scheme within Wendover Woods in 2004. Hazel dormice are therefore unlikely to be present.
Water vole	Negligible	Southern branch of the Stoke Brook	The Stoke Brook is suitable for this species but surveys recorded no evidence. All desk study records were from the Grand Union Canal Wendover Arm, which at 0.75km from the land required for the construction of the Proposed Scheme will not be affected. Water vole are unlikely to be present.
White-clawed crayfish	Negligible	Southern branch of the Stoke Brook	The land required does not cross or affect any watercourses suitable for this species. Field surveys in a section of the Stoke Brook further north of this area (Stoke Mandeville and Aylesbury, CFA11) confirmed the presence of signal crayfish. White-clawed crayfish are unlikely to be present.

Future baseline

Construction (2017)

7.3.21 A summary of the known developments which are assumed to be mostly built and occupied prior to construction of the Proposed Scheme is provided in Section 2.1, with further details provided in Volume 5: Appendix CT-004-000/1. There are no known proposed developments anticipated during the construction phase that are likely to alter the current baseline.

Operation (2026)

7.3.22 There are no known committed developments or changes to management in this area that will affect the operational ecological baseline.

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 and avoid or reduce impacts to features of ecological value:

- reducing the extent of land required for the construction of the Proposed Scheme at Jones' Hill Wood will avoid the complete loss of the ancient woodland;
- limiting the extent of land required for the construction of the Proposed Scheme at Wendover Rifle Range BNS to reduce habitat disturbance;
- limiting the extent of land required for the construction of the Proposed Scheme at the traditional orchard north of Nash Lee Road to reduce the loss of this habitat; and
- limiting the extent of land required for the construction of the Proposed Scheme at Boswell's Farm to reduce the loss of mature trees.

7.4.2 The assessment also assumes implementation of the measures set out within the draft CoCP (CT-003-000), which includes translocation of protected species where appropriate.

Assessment of impacts and effects

Designated sites

7.4.3 The construction of a new buried drain and the connection to an existing sewer pipe along the northern edge of the A413 London Road, south of Wendover will result in the loss of habitat from the Wendover Rifle Range BNS. Construction will result in the loss of approximately 0.1ha of woodland (6.5% of the BNS) from the western boundary of the site but the grassland for which the site is principally designated will remain unaffected. The trees within the BNS will be permanently removed but this impact will not result in a significant adverse effect on the integrity of the site.

7.4.4 Bacombe and Coombe Hills SSSI and the Bacombe Hill LNR will be within 25m of the temporary road diversion that will link Bacombe Lane with Ellesborough Road. There will be no significant increases in air pollution (dust deposition) that could affect the habitats for which both sites are designated. Therefore the integrity of the both sites will remain unaffected.

7.4.5 Any potential significant effects on the Grassland at North Lee BNS are discussed in the Stoke Mandeville and Aylesbury area (CFA11) Volume 2 CFA report.

Habitats

7.4.6 As an uncommon habitat, the extent of the ancient woodland at Jones' Hill is important to its conservation status. Construction of the South Heath cutting will

remove approximately 1ha (57%) of this woodland. Loss and fragmentation of this extent will result in a permanent adverse effect on the conservation status of this woodland that will be significant at district/borough level.

7.4.7 Hedgerows will be affected during construction, particularly the dense network around Wendover Dean. The extent of hedgerows in the area, the proportion of important hedgerows and the role this network of hedgerows play in providing a continuous wildlife corridor are important factors in maintaining their conservation status. During construction approximately 22km of hedgerow habitat will be removed by the Proposed Scheme in CFA 10, of which at least 2.5km qualifies as an important hedgerow. As part of the precautionary assessment it is assumed that further important and species-rich hedgerows will be lost from land that it was not possible to survey. The remaining important hedgerows that were surveyed are outside the land required and will remain unaffected.

7.4.8 The loss of hedgerows will result in the fragmentation of the network. This will be particularly important to the south of South Heath (at Leather Lane, Bowood Lane and Rocky Lane) and north of Wellwick Farm where hedgerows provide the main connectivity across the arable landscape. Loss and fragmentation of this extent will result in a permanent adverse effect on the conservation status of hedgerows that is significant at the district/borough level.

7.4.9 The grassland at Wendover Rifle Range BNS is unlikely to be affected. As described, little of this habitat will be directly affected and any temporary indirect disturbances (such as an increase in light or dust deposition) will not be of a sufficient magnitude to affect the conservation status of the grassland. Therefore, no significant adverse effect is expected.

7.4.10 It is considered unlikely that any other effects on habitat receptors at more than the local/parish level will occur. Local/parish level effects are listed in Volume 5: Appendix EC-005-002.

Species

7.4.11 Barn owl could be affected by the construction of the Proposed Scheme. Nesting sites are re-used annually and are therefore important to the conservation status of this species. One nest is in land required for the construction of the Wendover north cutting and will be removed. Much of the surrounding habitat suitable for foraging will also be removed. As a scarce and vulnerable species, which is still in decline the loss of this individual nesting site will result in a permanent adverse effect on its conservation status that is significant at the district/borough level. It is unlikely that the other territories will be subject to any more than minor temporary disturbances as the extent of habitat loss is small given the abundance of suitable habitat that will be retained.

7.4.12 With the implementation of the draft CoCP any increased disturbances (light, noise and movement) during construction are unlikely to adversely affect the conservation status of red kite, and the general breeding bird assemblages present. The loss of habitat is also unlikely to be significant due to an abundance of alternative and suitable nesting and foraging habitat throughout the wider landscape and the temporary (up to four years) nature of the construction works.

7.4.13 If present in the area, reptiles within and around the Wendover Rifle Range BNS would be adversely affected. Loss of grassland, scrub, road verges and scattered trees to the construction of the Proposed Scheme will directly reduce the extent of habitat available for reptiles. The direct loss of populations or a large reduction and fragmentation of habitat would render any populations non-viable in the long-term. These impacts could therefore result in a permanent adverse effect on the conservation status of reptile populations that could be significant at up to the county/metropolitan level.

7.4.14 As part of a precautionary assessment, it is assumed that a medium population size class of great crested newts will be affected when a pond is removed to the north-west of Wendover. The conservation status of great crested newt is dependent on such ponds for breeding. Loss of this pond would result in an adverse effect on conservation status of this population that is significant at up to the county/metropolitan level.

7.4.15 No significant effects are expected on the terrestrial invertebrate assemblage at the orchard north of Nash Lee Road. There are few trees and little suitable deadwood habitat for notable invertebrates in the 0.8ha (8%) of the orchard that will be removed.

7.4.16 The removal or disturbance of habitat features that are used by bats during breeding and hibernation, or migrating between roosts, is considered to have the potential to result in adverse effects on the bat populations and species assemblages during construction. However, the point at which such impacts are considered likely to result in a significant adverse effect on conservation status will differ according to the species concerned.

7.4.17 No significant effects are expected on the small whiskered bat roost and the small brown long-eared bat roost at Ellesborough Road. The demolition of two residential buildings during the construction of the Wendover green tunnel will remove these roosts. However, both are used by low numbers of bats, are unlikely to be maternity roosts, the wider landscape provides an abundance of possible alternative roosting locations and these species utilise several such roosts within their range.

7.4.18 Loss of other habitat within the land required for the construction of the Proposed Scheme may require some bats to travel further, and expend more energy during foraging and movement throughout their home range for the duration of construction. However, the loss of habitat is considered unlikely to result in sufficient disturbance of the populations concerned to result in an adverse effect on their conservation status.

7.4.19 No significant effects are expected on the bat assemblage associated with mature hedges, trees and tree-lined lanes at the southern end of the area. The construction of the South Heath cutting, the Rocky Lane south cutting and the Small Dean viaduct southern approach embankment will remove mature hedges, trees and tree-lined lanes, particularly from Rocky Lane, Bowood Lane, King's Lane and Leather Lane. These features are used by common and soprano pipistrelles, a Myotis species, noctules and serotines. The width of the land required for the construction of the Proposed Scheme (that ranges between 60m and 550m) is therefore likely to reduce

the frequency with which this assemblage crosses the land required for the construction of the Proposed Scheme. However, no known roosts will be removed and extensive foraging sites (predominantly woodland) will be retained on either side of the route, as such loss of habitat is unlikely to result in an adverse effect on the assemblages' conservation status.

7.4.20 No significant effects are expected on the noctule population at the orchard north of Nash Lee Road and the common pipistrelle population west of Wendover as no roosts will be lost and extensive foraging habitat will remain outside of land required for construction of the Proposed Scheme for these populations to use.

7.4.21 The other known bat roosts will be retained, and will remain connected to suitable foraging habitat sites. Therefore, no significant adverse effects are expected.

7.4.22 No significant effects are expected on the great crested newt populations at Wellwick Farm. The breeding pond will not be removed and the temporary removal of less than 1ha of grassland (for up to three years) within an area of extensive suitable habitat to the north of the farm will not affect the viability of the population. The conservation status of this population will therefore remain unaffected.

7.4.23 No significant effects are expected on the potential population of great crested newts near Strawberry Hill Farm as the ponds will remain and little or no terrestrial habitat will be removed.

7.4.24 No significant effects are expected on the native black poplar population. As so few trees (less than 0.5% of the Aylesbury Vale population) will be removed the conservation status of the local population is likely to remain unaffected.

7.4.25 No impacts are expected on otter because the southern branch of the Stoke Brook, which the species utilises, will not be affected. Disturbance of otter in the northern reaches of the Stoke Brook is described in the Volume 2 CFA report for the Stoke Mandeville and Aylesbury area (CFA11).

7.4.26 It is considered unlikely that any other effects on species at more than the local/parish level will occur. Local/parish level effects are reported in Volume 5: Appendix EC-005-002.

Other mitigation measures

7.4.27 This section describes additional measures designed to reduce or compensate for significant ecological effects. These include habitat creation, linking existing habitats and providing crossing points to enable bats to cross the Proposed Scheme.

7.4.28 Four ecological compensation areas have been incorporated into the land required for construction of the Proposed Scheme, these are:

- land to the east of Jones' Hill Wood adjacent to Bowood Lane (approximately 5ha) will consist of mainly of woodland;
- land west of Jones' Hill Wood (approximately 2.0ha) will consist of grassland with scrub and trees;
- land to the south of the orchard at Nash Lee Road (approximately 2ha) will

consist of grassland with scrub; and

- land to the north of orchard at Nash Lee Road (approximately 1ha) will consist of grassland with scrub.

7.4.29 Other habitat will be created primarily for landscape screening or compensation. It is likely that these measures will indirectly provide ecological benefits, for example foraging and sheltering opportunities for wildlife.

7.4.30 Ancient woodland is irreplaceable. However, the loss of 1ha of ancient woodland from Jones' Hill Wood will be compensated through a range of measures. Ancient woodland soil with its associated seed bank will be salvaged and translocated to the ecological compensation area east of Jones' Hill Wood and planted with broad-leaved trees so as to increase the extent of woodland and increase connectivity across the landscape. This new planting will provide connection between Jones' Hill Wood, and the un-named wood 180m to the south-east. In turn, this will provide a good habitat connection between Jones' Hill Wood and Rushmoor Wood, the ancient woodlands in this district. Other measures such as planting native tree and shrub species of local provenance and translocation of coppice stools and dead wood will be undertaken in accordance with the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2).

7.4.31 After the translocation of ancient woodland soils the ecological compensation area east of Jones' Hill Wood will be planted with approximately 5ha of lowland mixed deciduous woodland (a habitat of principal importance). The new woodland will include rides and glades to help maintain the identity of the adjacent retained woodland. While not fully replicating the ancient woodland that will be lost, the large increase in woodland extent will maintain the conservation status of woodland in the area, and when mature (approximately 50 years) it will result in a separate beneficial effect that is significant at the district/borough level.

7.4.32 New hedgerow creation will be undertaken and connected habitat is provided within the landscape scheme to compensate for losses of wildlife corridors that hedgerows provide. The species composition of the new hedges will be tailored to match that of those in the surrounding area and planting will be in accordance with the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2). There will be temporary adverse effects whilst the new hedges become established and mature. Following establishment and maturation of planting it is anticipated that any adverse impacts on hedgerows and the wildlife corridors they create will be reduced to a level which will not result in any significant effect on the conservation status.

7.4.33 Although no significant effects are expected the landscape planting at the South Heath Cutting, Small Dean Viaduct Southern Approach Embankment and the Wendover North Cutting will encourage bats away from the route (particularly north of Upper Wendoverdean Farm and north of Wellwick Farm). The covering of the Wendover Green Tunnel will also provide continuous habitat between Wendover and the foraging sites in and around the Bacombe Hill SSSI. In addition, the Wendover Dean Viaduct and the Small Dean Viaduct will provide opportunity for bats to fly under the route, particularly the brown longed-bat population at Grove Farm.

7.4.34 Planting on the embankments of the over- and underbridges at Leather Lane, the footpath leading to King's Lane (TLE/2), and the Nash Lee Orchard footpath will be designed to encourage bats to fly at a safe height over the Proposed Scheme, thus reducing any severance created during construction. The planting on the embankments of Bowood Lane will be important in linking the existing woodland at and around Jones' Hill Wood with the new precautionary ecological compensation area on the western side of the route, thus connecting the locally available foraging habitat across the route. The planting around the Nash Lee Road diversion will be important in maintaining connectivity between the nearby orchard and the Stoke Brook to the north, Wellwick Farm and the foraging habitat at Bacombe Hill to the south.

7.4.35 Although no significant adverse effects are expected on any bat population due to the loss of two bat roosts at Ellesborough Lane, they will be compensated for through the provision of new artificial roosts in accordance with the ecological principles of mitigation provided in Volume 5: Appendix CT-001-000/2.

7.4.36 There will be an adverse effect on the conservation status of barn owl at the district/borough level due to loss of one territory. To offset the likely loss of barn owls from the vicinity of the Proposed Scheme, opportunities to provide barn owl nesting boxes in areas greater than 1.5 km from the route will be explored with local landowners. As the availability of nesting sites is a limiting factor for this species the implementation of these measures would be likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

7.4.37 If the presence of reptiles is confirmed during surveys to be conducted prior to construction then they will be moved to one of the ecological compensation areas. All such areas will comprise terrestrial habitat suitable for breeding and hibernating reptiles, and will be created and managed in accordance with the ecological principles of mitigation provided Volume 5: Appendix CT-001-000/2. These measures will ensure the anticipated effects on the reptile population concerned to a level where they are not expected to be significant.

7.4.38 If the presence of great crested newts is confirmed during surveys to be conducted prior to construction then mitigation will be provided in line with the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2) and the animals will be translocated to one of the nearby ecological compensation areas. This will include the provision of replacement ponds and terrestrial habitat sufficient to ensure that the favourable conservation status of this species is maintained.

7.4.39 Terrestrial invertebrates associated with dead-wood and mosaic grassland will not be significantly affected. However, habitat suitable for these species, such as dead wood or mosaic grasslands will be provided in accordance with the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2).

7.4.40 Although no significant effects are expected and where reasonably practicable, cuttings will be taken from native black poplar trees that are to be felled and used to propagate and plant new trees throughout the area. This planting will compensate for the loss of this species and as such there will be no significant ecological effects to native black poplar trees.

Summary of likely residual significant effects

7.4.41 Taking into account mitigation, compensation and enhancement proposed, anticipated significant residual ecological effects during construction are:

- the permanent loss of approximately 1ha of ancient woodland from Jones' Hill wood, which is irreplaceable;
- when mature, there will be a separate beneficial increase in the extent of semi-natural broadleaved woodland; and
- the permanent loss of one barn owl territory represents a residual significant effect. However, if the proposed mitigation measures for barn owl are implemented through liaison with landowners, the residual effect on barn owl would be reduced to a level that is not significant.

7.5 Effects arising from operation

Avoidance and mitigation measures

7.5.1 The following measures have been included as part of the design of the Proposed Scheme and avoid or reduce impacts on features of ecological value:

- the Wendover green tunnel will allow bats and other animals to safely pass over the Proposed Scheme;
- the creation of planted embankments either side of roads, footpaths and access crossing points, as discussed in the construction mitigation section will encourage bats to fly at a safe height over the Proposed Scheme (particularly at Leather Lane, the footpath leading to King's Lane (TLE/2), Bowood Lane, along several mature hedgerows north of Upper Wendoverdean Farm, Nash Lee Road and the Nash Lee Orchard footpath; and
- the Small Dean viaduct will allow bats and other animals to safely pass under the Proposed Scheme.

Assessment of impacts and effects

7.5.2 The operation of the Proposed Scheme has the potential to result in a variety of impacts on bat populations including those as a result of collision with passing trains, turbulence and noise. The point at which such impacts are considered to result in a significant adverse effect on the conservation status of the population concerned will differ between species. As a consequence, the following assessment of operational impacts takes into account the differing character and nature of the bat populations and/or assemblages concerned in determining the likely effects of the Proposed Scheme on each of these receptors.

7.5.3 Noise, vibration and lighting from passing trains have the potential to disturb bat species foraging and commuting within habitats close to the Proposed Scheme. Understanding of the impact of noise on bats caused by passing trains is limited. There is some evidence to suggest that gleaning bats, such as brown long-eared, will have reduced foraging success within areas where there is persistent noise from busy

roads. However, noise generated from passing trains will be regular but temporary and as such will differ from that resulting from a busy road.

7.5.4 Where the route of the Proposed Scheme bisects, or is located in close proximity to existing features known to be used regularly by foraging or commuting bats, there is an increased risk that bats could be killed or injured as a result of collisions with passing trains or associated turbulence. The significance of any such effect will be dependent on both the flight habitat of the species or species concerned and the vertical alignment of the Proposed Scheme (i.e. is the railway in cutting, on embankment, on a viaduct, or at grade) at the point the impact occurs.

7.5.5 No significant effects are expected on the brown long-eared bat population at Grove Farm. With little woodland suitable for foraging near the roost the population is likely to fly west to the abundant woodland of the Bacombe Hills, which will remain unaffected. Should bats fly east towards the route, the adjacent landscape planting will provide habitat corridors that will encourage bats towards safe crossing points; the Small Dean viaduct to the south and the Wendover green tunnel to the north.

7.5.6 The levels of bat activity along hedgerows and road verges to the south of Wendover and along the hedgerows to the north of Wellwick Farm demonstrated that bats cross the Proposed Scheme and could be at risk of mortality due to collision with trains. However, any adverse effects will be reduced to a level that is not significant by the avoidance and mitigation measures described previously.

7.5.7 The noise made by passing trains has the potential to disturb birds within habitats close to the Proposed Scheme. Birds habituate to loud noises that they hear regularly and frequently, and hence it is considered that this will not generally cause significant effects. There is some evidence to suggest that breeding bird densities can be reduced where there is persistent noise from busy roads due to birds being unable to hear each other's songs. However, this is not expected to occur with the Proposed Scheme as trains will pass quickly. The effect of train noise on breeding birds is therefore not considered to be significant.

7.5.8 The majority of other bird species that are known to be present in the area are not considered to be particularly vulnerable to collision with trains. However, barn owls are often killed by cars and trains. This is because they hunt low over the rough grassland habitats that are associated with road verges and railway embankments and are slow moving. The land required for the operation of the Proposed Scheme in this area includes wide cuttings and embankments that will be colonised by vegetation that may be suitable for foraging barn owl, and may therefore increase their risk of mortality from contact with trains. Two pairs that nest to the south-west of Wendover are likely to forage along or cross the route to access foraging sites to the north, thus increasing the risk of train strike. The loss of these breeding pairs would result in a permanent adverse effect on the conservation status of this species at the county/metropolitan level.

7.5.9 It is considered unlikely that any other effects on species receptors at more than the local/parish level will occur. Local/parish level effects are listed in Volume 5: Appendix EC-005-002.

Other mitigation measures

7.5.10 This section describes additional elements designed to reduce or compensate for significant ecological effects.

7.5.11 Train strike is likely to result in the loss of barn owls which nest close to the route. As part of the precautionary assessment adverse effects are likely to remain significant at the county/metropolitan level. To offset these impacts opportunities to provide barn owl nesting boxes in areas greater than 1.5km from the route will be explored with local landowners. As the availability of nesting sites is a limiting factor for this species the implementation of these measures is likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

Summary of likely residual significant effects

7.5.12 The mitigation, compensation and enhancement measures described above reduce the residual ecological effects during operation to a level that is not significant, except for barn owl. Train strike is likely to result in the loss of barn owls that nest close to the route resulting in a residual significant effect. However, if the proposed mitigation measures for barn owl are implemented through liaison with landowners, the residual effect on barn owl would be reduced to a level that is not significant.

8 Land quality

8.1 Introduction

8.1.1 This section of the report presents the baseline conditions that exist along the proposed route in relation to land quality, followed by a summary of the likely impacts and any significant effects as a result of the 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, mining or mineral resources point of view, including: geological sites of special scientific interest (SSSI), local geological sites (LGS), areas of current underground or opencast mining and areas of designated mineral resources. Mitigation measures are presented and any residual effects are summarised.

8.1.2 Potentially contaminated areas of land have been identified that could affect, or be affected by, the construction of the Proposed Scheme (for example contaminated soils may need to be removed or the 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. In addition, a review has been undertaken to establish whether the operation of the Proposed Scheme will lead to contamination of its surrounding environment and what needs to be done to prevent such contamination.

8.1.3 The main environmental features relevant to land quality include the underlying Chalk Principal aquifer; the existing Marylebone to Aylesbury Line; and Bacombe and Coombe Hills SSSI.

8.1.4 The land quality issues in this area include:

- the existing Marylebone to Aylesbury Line in the area;
- two petrol stations on A413 London Road and at the southern end of Wendover;
- the inert landfill at Bacombe Lane (south of Wendover) as shown on Map LQ-01-020, D6 (Volume 5, Land Quality Map Book); and
- a partially infilled pond at Hunt's Green Farm.

8.1.5 Details of baseline information and the land quality assessment methodology are outlined in the following appendices (presented in Volume 5):

- Appendix CT-001-000/1: the SMR and Appendix CT-001-000/2: the SMR Addendum; and
- Appendix LQ-001-010 : Land quality appendix.

8.1.6 Land contamination issues are closely linked with those involving water resources and waste. Issues regarding groundwater resources are addressed in Section 13. Issues regarding the disposal of waste materials, including contaminated soils, are addressed in Volume 3 Section 16.

8.1.7 Engagement has been undertaken with Chiltern District Council, Aylesbury Vale District Council and Wycombe District Council, the Environment Agency and the Petroleum Officer regarding land contamination, and Buckinghamshire County Council with regards to mineral policy and data. Information has been received on potential land contamination and mineral extraction and mineral safeguarding areas (MSA).

8.2 Scope, assumptions and limitations

8.2.1 The assessment scope, key assumptions and limitations for the land quality assessment are set out in Volume 1 and in the SMR and its addendum presented in Volume 5 (Appendices CT-001-000/1 and 2). This section follows the standard assessment methodology.

8.2.2 Baseline data were reviewed for the area of land required to construct the Proposed Scheme, excluding utility works on the highway, together with a buffer extending out for a minimum of 250m, but in the case of groundwater data up to 1km. This is defined as the study area. With respect to land quality issues, utility works within the highway are a low risk construction activity, as most of the excavation works will be within the highway construction layers, and re-instatement will be made with highway construction materials

8.2.3 Site visits to the study area were made in July 2012 where the location of the Proposed Scheme was viewed from points of public access only. Due to access constraints not all sites considered to have the greatest potential for contamination were visited. However, the purpose of site visits is to verify desktop information and the lack of complete site walkovers is considered unlikely to have substantially affected the land quality assessment.

8.3 Environmental baseline

Existing baseline

8.3.1 Unless otherwise stated, all features described in this section are presented in Maps LQ-01-019 to LQ-01-021a (Volume 5, Land Quality Map Book).

Geology

8.3.2 This section describes the underlying ground conditions within the study area. It first describes any made ground present, followed by near surface superficial deposits and lastly describes the deeper bedrock geology. The geological mapping is illustrated on Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

8.3.3 The Proposed Scheme in this study area mostly crosses agricultural land. However, a cover of made ground may be present in built up areas of the study area as a result of previous cycles of development.

8.3.4 Superficial deposits are absent over the majority of the route section with the exception of Clay-with-Flints at the start of the study area and Head deposits of clay, silt, sand and gravel following a valley through which the A413 road runs. The Proposed Scheme crosses this valley just south of Wendover.

8.3.5 The bedrock geology of the area comprises Cretaceous White Chalk (a soft limestone with nodular flint beds). The detailed Chalk formations outcrop progressively along the route, but generally comprise marly chalk with flints.

8.3.6 From Nash Lee Road to the northern end of the study area, the bedrock comprises the Cretaceous Gault and Upper Greensand Formations consisting of mudstone, sandstone and limestone which underlie the Chalk to the south.

Groundwater

8.3.7 The Chalk has been designated as a Principal aquifer by the Environment Agency. The Gault and Upper Greensand Formations have been designated as unproductive strata. The head deposits have been designated as Secondary (undifferentiated) aquifer and the superficial Clay-with-Flints designated as unproductive strata.

8.3.8 The southernmost 3km of this route section are located within a groundwater source protection zones (SPZ) consisting of a Zone 2 outer protection zone (SPZ2) and Zone 3 total catchment zone (SPZ3) as shown on Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

8.3.9 A search for groundwater abstractions confirmed that there are three public water supply abstractions (PWS) and five licensed abstractions (excluding PWS) that abstract from the Chalk aquifer within 1km of the route in this study area.

8.3.10 Further detail on the groundwater beneath the Proposed Scheme can be found in Section 13.

Surface waters

8.3.11 The only significant water bodies in the study area are a number of small ponds, a drain and the Stoke Brook at the northern end of the study area.

8.3.12 There are no surface water abstractions within 1km of the route.

8.3.13 Further information on surface waters is provided in Section 13.

Current and historical land use

8.3.14 Current potentially contaminative land uses include

- the existing Marylebone to Aylesbury Line in the area (Map LQ-01-020, D5, Volume 5 Land Quality Map Book); and
- two petrol stations on London Road and at the southern end of Wendover (Map LQ-01-020, H7 and C5, Volume 5, Land Quality Map Book).

8.3.15 The principal historical potentially contaminative land uses include:

- the inert landfill at Bacombe Lane (south of Wendover) shown on Map LQ-01-020, D6 (Volume 5, Land Quality Map Book); and
- a partially infilled pond at Hunt's Green Farm.

8.3.16 Contaminants commonly associated with these uses could include metals, semi-metals, asbestos, organic and inorganic compounds. Infilled pits could also give rise to landfill gases such as methane, carbon dioxide or volatile organic compounds (VOC).

Other regulatory data

8.3.17 Regulatory data reviewed include pollution incidents, radioactive and hazardous substances consents and environmental permits (previously landfill, Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) licences). Notable data are as follows:

- one current Aylesbury Vale District Council Air Pollution Control for petrol filling station, area reference 10-9, Map LQ-01-020, H7 (Volume 5, Land Quality Map Book); and
- three substantiated pollution incidents for fly tipping.

Mining/mineral resources

8.3.18 The Buckinghamshire Minerals and Waste Core Strategy DPD[38] (adopted in November 2012), Policy CS1 states that development proposals in this area, other than those involving minerals extraction, will need to demonstrate that they will not sterilise any mineral resources, or that consideration has been given to prior extraction of the protected mineral or that the need for the proposed development outweighs the economic value of the mineral resource.

8.3.19 Wendover Gravel Pit has been identified as a location where historical sand and gravel extraction has taken place.

8.3.20 Bacombe Hill has also been identified for historical sand and gravel extraction. It is also identified on historical maps as the site of an old chalk pit in 1961.

8.3.21 No mineral consultation/safeguarding areas, preferred mineral sites or current extractions have been identified within the study area.

Geo-conservation resources

8.3.22 There are no geological conservation resources identified within the study area.

Receptors

8.3.23 The sensitive receptors that have been identified within this study area are summarised in Table 9.

Table 9: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land Contamination	People	Residents in existing properties	High
		Workers e.g. farms and existing railway	Moderate
	Controlled Waters	Principal aquifer of the Chalk	High
		Secondary undifferentiated aquifer of the head deposits	Moderate
	Natural Environment	Bacombe Hill SSSI	High

[38] Buckinghamshire County Council (2012), *Minerals and Waste Core Strategy Development Plan Document.*

Issue	Receptor type	Receptor description	Receptor sensitivity
	Built Environment	Buildings and property	Low to high
		Underground structures and services	Low

Future baseline

8.3.24 There are currently no identified committed development sites within the study area which are likely to change the land quality baseline during either construction or operation of the Proposed Scheme. The sites identified are all located outside of the area required to construct the Proposed Scheme, and are not close to sites with contaminative potential. On this basis, they are considered unlikely to be able to affect land quality within the Proposed Scheme.

8.4 Effects arising during construction

Avoidance and mitigation measures

8.4.1 The construction assessment takes into account the mitigation measures contained within the draft CoCP (Volume 5: Appendix CT-003-000). The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme. Its requirements in relation to work in contaminated areas will ensure the effective management and control of the work. Such requirements include:

- methods to control noise, waste, dust, odour, gases and vapours (draft CoCP, Sections 5, 7, 13 and 15);
- methods to control spillage and prevent contamination of adjacent areas (draft CoCP, Section 5);
- the management of human exposure for both construction workers and people living and working nearby (draft CoCP, Section 11);
- methods for the storage and handling of excavated materials (both contaminated and uncontaminated) (draft CoCP, Sections 7 and 15);
- management of any unexpected contamination found during construction (draft CoCP, Section 11);
- a post remediation permit to work system (draft CoCP, Section 11);
- storage requirements for hazardous substances such as oil (draft CoCP, Section 16);
- traffic management to ensure that there is a network of designated haul roads to minimise compaction/degradation of soils (draft CoCP, Section 7); and
- methods to monitor and manage flood risk and other extreme weather events which may affect land quality during construction (draft CoCP, Section 16).

8.4.2 The draft CoCP requires that a programme of ground investigation will take place prior to construction to confirm areas of contamination and a risk assessment

undertaken to determine what, if any, site specific remediation measures will be required to allow the Proposed Scheme to be constructed safely and to prevent harmful future migration of contaminants (draft CoCP, Section 11). The investigation and assessment of potentially contaminated sites will be undertaken in accordance with:

- Environment Agency CLR11 Model Procedures for the Management of Land Contamination (2004)[39]; and
- British Standard BS10175 Investigation of Potentially Contaminated Sites (2011)[40].

8.4.3 Where significant contamination is encountered, a remedial options appraisal will be undertaken to define the most appropriate remediation techniques. This appraisal will be undertaken based on multi-criteria attribute analysis that considers environmental, resource, social and economic factors in line with Sustainable Remediation Forum UK's publication A Framework for Assessing the Sustainability of Soil and Groundwater Remediation (2010)[41]. The preferred option will then be developed into a remediation strategy, in consultation with regulatory authorities prior to implementation.

8.4.4 Contaminated soils excavated from the site, wherever feasible, will be treated as necessary to remove or render any contamination inactive and reused within the Proposed Scheme where needed and suitable for use. Techniques are likely to include stabilisation methods, soil washing and bio-remediation to remove oil contaminants. Contaminated soil disposed of off-site will be taken to a soil treatment facility, another construction site (for treatment, as necessary, and re-use) or to an appropriately permitted landfill.

Assessment of impacts and effects

8.4.5 The scheme elements that are particularly relevant to land quality are described in this section.

8.4.6 In this area, the route will start in cutting, transitioning to embankment up to Wendover Dean viaduct. The route will then transition between embankment and cutting before rising via embankment to a second viaduct (Small Dean) and back onto embankment. The route will then enter the portal for the Wendover green tunnel to the west of Wendover, which the route will follow for approximately 1.2km with most of the remaining 500m of this length of the route in cutting.

8.4.7 Two auto-transformer stations are proposed in this area: Wendover (approximately 180m south of Rocky Lane) and Stoke Grove (approximately 100m north of the B4009 Nash Lee Lane).

8.4.8 In the Dunsmore, Wendover and Halton area there will be one main compound (Small Dean viaduct main compound) and eight civil engineering satellite compounds and three railway installation satellite compounds.

[39] Environment Agency (2004), *CLR11 Model Procedures for the Management of Land Contamination.*
[40] *British Standard* (2011), *Investigation of Potentially Contaminated Sites, BS10175.*
[41] Sustainable Remediation Forum UK (2010), *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation.*

Land contamination

8.4.9 In line with the assessment methodology, as set out in the SMR, SMR Addendum and its appendices, an initial screening process was undertaken (identified in the methodology as Stages A and B) 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. In total, 14 areas were considered during this screening process; six of these areas were taken forward to more detailed risk assessments (Stages C and D), in which the potential risks were assessed more fully. All areas assessed are shown on Maps LQ-01-019 to 021a (Volume 5, Land Quality Map Book) and those considered as potentially posing a risk are labelled with a reference number.

8.4.10 Conceptual site models (CSM) have been produced for the six areas taken to Stage C and D assessments. The detailed CSM are provided in Volume 5: Appendix LQ-001-010, Section 3 and the results of the baseline risk assessments are summarised in this section. Potentially contaminated areas have been grouped and considered together, where appropriate. The following factors have determined the need for Stage C and D assessments:

- whether the area is on or off the Proposed Scheme or associated offline works; e.g. roads;
- the vertical alignment, i.e. whether the Proposed Scheme is in cutting or on embankment;
- the presence of underlying Principal or Secondary A aquifers or nearby watercourses; and
- the presence of adjacent residential properties or sensitive ecological receptors.

8.4.11 A summary of the baseline CSM is provided in Table 10. The impacts and baseline risks quoted are 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, it is based on precautionary, worst case assumptions and may therefore report a higher risk than that which actually exists.

Table 10: Summary of baseline CSM for sites that may pose a contaminative risk for the Proposed Scheme

Area reference (1)	**Area name**	**Main potential impacts**	**Main baseline risk** (2), (3)
10-1 and 10-13	Existing mainline railway and historical rail spur (Area reference 10-1, Map LQ-01-020, D5); and (Area reference 10-13, Map LQ-01-020, A6)	Exposure of off-site human (commercial and residential) receptors to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of off-site human (commercial and residential) receptors by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure of the Principal Chalk aquifer to leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater.	Moderate

Area reference [1]	Area name	Main potential impacts	Main baseline risk [2], [3]
		Exposure of off-site properties to direct contact of property with contaminants in soil and groundwater.	Very low
		Exposure of off-site properties to lateral migration and build-up of asphyxiative or explosive gases.	Moderate/low
10-7	Partially infilled pond (Map LQ-01-019, H5)	Exposure of off-site human (commercial and residential) receptors to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of off-site human (commercial and residential) receptors by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure of off-site human (commercial and residential) human receptor to asphyxiative or explosive gases.	Moderate
		Exposure of off-site properties to lateral migration and build-up of asphyxiative or explosive gases.	Moderate
		Exposure of off-site properties to direct contact of property with contaminants in soil and groundwater.	Very low
10-9	Petrol filling station and vehicle repair garage (Map LQ-01-020, H7)	Exposure of on-site (commercial) and off-site (residential) human receptors to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Low
10-11	Petrol filling station and tanks (Map LQ-01-020, C5)	Exposure of on-site (commercial) and off-site (residential) human receptors to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Low
		Exposure of on-site (commercial) and off-site (residential) receptors by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate
		Exposure of on-site (commercial) and off-site (residential) to asphyxiative or explosive gases.	High
		Exposure of Principal Chalk aquifer to leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater .	Moderate
		Exposure of on-site properties to lateral migration and build-up of asphyxiative or explosive gases.	High
		Exposure of on-site properties to direct contact with contaminants in soil and groundwater.	Moderate
		Exposure of off-site properties to lateral migration and build-up of asphyxiative or explosive gases.	High
		Exposure of off-site properties direct contact with contaminants in soil and groundwater.	Moderate/low
10-14	Inert landfill adjacent to	Exposure of off-site (residential) human receptors to contamination by direct contact, ingestion and inhalation of	Low

Area reference [1]	Area name	Main potential impacts	Main baseline risk [2], [3]
	Bacombe Lane (Map LQ-01-020, D6)	contaminants in soil and soil-derived dust.	
		Exposure of off-site human (residential) receptors by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure of off-site human receptor (residential) to asphyxiative or explosive gases.	Moderate/low
		Exposure of Principal Chalk aquifer to leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater.	Very low
		Exposure of off-site properties to lateral migration and build-up of asphyxiative or explosive gases.	Moderate/low

(1) Each area is assigned a unique identification number (See Volume 5: Appendix LQ-001-010)
(2) CSMs have been prepared as part of the detailed land contamination methodology (refer to Volume 5) for baseline, construction and post-construction
(3)The moderate or high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high or moderate existing baseline risk in the absence of site investigation a precautionary, worst case risk is reported in the table.

Temporary effects

8.4.12 An assessment of the effects of contamination has been undertaken by comparing the CSM developed for potential contaminated areas at baseline, construction and post construction stages. The baseline and construction CSM have been compared to assess effects at the construction stage.

8.4.13 Table 11 presents the summary of the construction effects obtained from a comparison of the baseline and construction impacts. The construction risk assessment takes into account the implementation of the mitigation measures set out within the draft CoCP. The details of these comparisons are presented in Volume 5: Appendix LQ-001-010.

8.4.14 The baseline and construction CSM have been compared to determine the change in level of risk to receptors during the construction stage, and thus to define the level of effect at the construction stage. 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 assessed to remain as high. This will be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the construction boundary.

Table 11: Summary of temporary (construction) effects

Area reference	Area name	Main baseline risk	Main construction Risk [1], [2]	Temporary effect (and significance)
10-1 and 10-13	Existing mainline railway and historical rail spur (Area reference 10-1, Map LQ-01-020, D5); and (Area reference 10-13, Map LQ-01-020,	Very low to moderate	Very low to moderate/low	Negligible - not significant

Area reference	Area name	Main baseline risk	Main construction Risk (1), (2)	Temporary effect (and significance)
	A6)			
10-7	Partially infilled pond (Map LQ-01-019, H5)	Very low to moderate	Very low to moderate	Negligible - not significant
10-9	Petrol filling station and vehicle repair garage (Map LQ-01-020, H7)	Low to high	Low to high	Negligible - not significant
10-11	Petrol filling station and tanks (Map LQ-01-020, C5)	Low to high	Low to high	Negligible -not significant
10-14	Inert landfill adjacent to Bacombe Lane (Map LQ-01-020, D6)	Very low to moderate	Very low to moderate/low	Negligible - not significant

(1) The low/moderate main construction risk identified in the above table does not necessarily imply an unacceptable risk. Application of the processes and measures within the CoCP will ensure that site risks during the construction stage are controlled.
(2) The high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high risk in the absence of site investigation a precautionary, worst case risk is reported in the table. Application of the processes and measures within the CoCP will ensure that site risks during the construction stage are controlled.

8.4.15 Table 11 indicates that, based upon the assessment, the construction period is expected to have a negligible effect on the receptors overall and is not considered to be significant in relation to potential land contamination. The main construction risk is the risk from the construction of the Proposed Scheme assuming that any mitigation measures as set out in the draft CoCP have been implemented. The temporary effect and significance has been determined by calculating the change in risk between the main baseline risk and the main construction risk. Therefore, 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.

8.4.16 Construction site compounds located in this area will include the storage of potentially hazardous substances, such as fuels and lubricating oils and may also be used for temporary storage of potentially contaminated soils. Implementation of the measures outlined in the draft CoCP will manage risks from the storage of such materials.

Cumulative temporary effects

8.4.17 There are anticipated to be no significant cumulative temporary effects from construction.

Permanent effects

8.4.18 Baseline and post-construction CSM have been compared to assess the permanent (post-construction) effects. The post-construction CSM assumes that all the required remediation has been carried out and validated.

8.4.19 Table 12 includes the summary of the permanent (post-construction) effects obtained from a comparison of the baseline and post-construction impacts and whether these

are significant. The details of these comparisons are presented in Volume 5: Appendix LQ-001-010.

Table 12: Summary of permanent (post-construction) effects

Area ref	Area name	Main baseline risk	Main post-construction Risk (1), (2)	Post -construction effect and significance
10-1 and 10-13	Existing mainline railway and historical rail spur (CFA10-1, Map LQ-01-020, D5); and (CFA10-13, Map LQ-01-020, A6)	Very low to moderate	Very low to moderate/low	Negligible - not significant
10-7	Partially infilled pond (Map LQ-01-019, H5)	Very low to moderate	Very low to moderate	Negligible - not significant
10-9	Petrol filling station and vehicle repair garage (Map LQ-01-020, H7)	Low to high	Low to high	Negligible - not significant
10-11	Petrol filling station and tanks (Map LQ-01-020, C5)	Low to high	Low to high	Negligible - not significant
10-14	Inert landfill adjacent to Bacombe Lane (Map LQ-01-020, D6)	Very low to moderate/low	Very low to moderate/low	Negligible - not significant

(1) The low/moderate main construction risk identified in the above table does not necessarily imply an unacceptable risk. Application of the processes and measures within the CoCP will ensure that site risks during the construction stage are controlled within acceptable limits as agreed with the appropriate regulator.
(2) The high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high risk in the absence of site investigation a precautionary, worst case risk is reported in the table. Application of the processes and measures within the CoCP will ensure that site risks during the construction stage are controlled.

8.4.20 The magnitude of the permanent effects and their significance have been determined by calculating 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 will be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the construction boundary.

8.4.21 Table 12 shows that the Proposed Scheme results in no change in the level of risk already existing at each site for both on site and off site receptors. None of the post-construction effects of land contamination impacts predicted are significant.

Cumulative permanent effects

8.4.22 There are anticipated to be no significant cumulative permanent effects.

Mining/mineral resources

8.4.23 Construction of the Proposed Scheme has the potential to impact existing mineral resources and proposed areas of mineral exploitation. This could occur by sterilisation of the resource, direct excavation during construction of the Proposed Scheme or through temporary and/or permanent severance[42] that may occur during the construction period of the Proposed Scheme, possibly continuing through to the operation.

8.4.24 There are no areas in this part of the route that are currently being worked or that have planning permission. In addition this area will not cross a preferred mineral site, a mineral safeguarding area or a mineral consultation area.

8.4.25 There are anticipated to be no significant cumulative permanent effects from construction.

Geo-conservation sites

8.4.26 There are no geological conservation resources identified within the study area.

Other mitigation measures

8.4.27 At this stage, no additional mitigation measures are considered necessary to mitigate risks from land contamination at construction period beyond those set out in the draft CoCP and instigated as part of required remediation strategies. In addition to the excavation and treatment of contaminated soils, it may also be necessary to install ground (landfill) gas and leachate control systems within affected old backfilled sites, on a temporary or permanent basis, to ensure that ground (landfill) gas and leachate migration pathways are controlled and do not adversely affect the Proposed Scheme or the wider environment as a consequence of the Proposed Scheme.

Summary of likely significant residual effects

8.4.28 No likely significant adverse effects are anticipated with the application of the mitigation measures detailed above.

8.5 Effects arising from operation

8.5.1 Users of the Proposed Scheme (i.e. rail passengers), whilst within trains, are at all routine times within a controlled environment, and have therefore been scoped out of the assessment.

Avoidance and mitigation measures

8.5.2 Maintenance and operation of the Proposed Scheme will be in accordance with environmental legislation and good practice whereby appropriate spillage and pollution response procedures will be established and followed.

Assessment of impacts and effects

8.5.3 There will be two auto-transformer stations in this study area, at Wendover and Stoke Grove. An auto-transformer station can, in principle, be a source of contamination

[42] 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.

through accidental discharge or leaks of coolant. However, the proposed auto-transformer station, in common with other modern substations, will use secondary containment appropriate to the level of risk.

8.5.4 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.

8.5.5 It is unlikely that there will be any cumulative effects on land quality or in-combination effects on receptors because of the environmental controls that will be placed on operational procedures.

Other mitigation measures

8.5.6 No other mitigation measures will be required beyond what has already been outlined relating to land quality in the Dunsmore, Wendover and Halton study area.

8.5.7 There may be ongoing monitoring requirements following remediation works carried out during construction. Such monitoring, including monitoring of groundwater quality or ground gas, could extend into the operational phase of the Proposed Scheme.

Summary of likely significant residual effects

8.5.8 No significant residual effects are anticipated associated with operation of the Proposed Scheme.

9 Landscape and visual assessment

9.1 Introduction

9.1.1 This section reports the assessment of the likely significant landscape and visual effects. It starts by summarising the baseline conditions found within and around the route of the Proposed Scheme and goes on to describe the significant effects that will arise during construction and operation on landscape character areas (LCA) and visual receptors.

9.1.2 In this section, the operational assessment section refers not just to the running of the trains but also the presence of the new permanent infrastructure associated with the Proposed Scheme.

9.1.3 Principal landscape and visual issues in the area include:

- temporary effects to LCA and visual receptors during construction arising from the presence of construction plant and worksites, removal of existing vegetation and severance of agricultural land; and
- permanent landscape and visual effects during operation arising from the presence of new engineered landforms cutting across the existing landscape, new viaducts, tunnel portals, noise fence barriers, highway and rail infrastructure, overhead line equipment, balancing ponds and regular passing of high speed trains. Permanent effects will reduce over time as planting established as part of the Proposed Scheme matures.

9.1.4 An assessment of effects on the character of the Chilterns AONB is presented in Volume 3, Section 2.

9.1.5 A separate but related assessment of effects on the setting of heritage assets is included in Section 6. Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in Volume 5: Appendix LV-001-010, which comprises the following:

- Part 1 Engagement with technical stakeholders;
- Part 2 Environmental baseline report;
- Part 3 Assessment matrices; and
- Part 4 Schedule of not significant effects.

9.1.6 The extent of the landscape and visual study area, the distribution of visual receptor viewpoints and the location of verifiable photomontages has been discussed with Buckinghamshire County Council, Chiltern District Council, Wycombe District Council, Aylesbury Vale District Council, National Trust and the Chilterns Conservation Board. Summer field surveys, including photographic studies of LCA and visual assessment of viewpoints, were undertaken from July to October 2012 and from May to June 2013. Winter surveys were undertaken from January to March 2013.

9.2 Scope, assumptions and limitations

9.2.1 The assessment scope, key assumptions and limitations for the landscape and visual assessment are set out in Volume 1, the SMR (Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

9.2.2 The study area has been informed by the construction and operational phase zones of theoretical visibility (ZTV) that are shown in Maps LV-07-035 to LV-07-038 and LV-08-035 to LV-08-038 (Volume 5, Landscape and Visual Assessment Map Book). The ZTV has been produced in line with the methodology described in the SMR Addendum (Volume 5: Appendix CT-001-000/2), and is an indication of the visibility of the Proposed Scheme. In some locations, extensive vegetation cover will mean the actual visibility is substantially less than that shown in the ZTV. Tall construction plant (e.g. cranes and piling rigs) are excluded from the ZTV for the construction phase and overhead line equipment is excluded from the ZTV for the operational phase, but these are described and taken in to account in the assessment of effects on LCA and visual receptors.

9.2.3 LCA and visual receptors within approximately 1km of the Proposed Scheme have been assessed. Long distance views of up to 2km have been considered at locations such as Hampdenleaf Wood, Boddington Hill and Coombe Hill from public rights of way (PRoW).

Limitations

9.2.4 During the baseline survey there were some areas which were inaccessible (such as private land, commercial premises and residential buildings). In these instances, professional judgement has been used to approximate the likely views from these locations.

9.2.5 Viewpoints which do not have a representative photograph for both the winter and summer months include viewpoint 097.2.003: view south-east from Upper Wendoverdean Farm; and viewpoint 101.2.003: view east from dwellings on London Road, Small Dean.

9.3 Environmental baseline

Existing baseline

Landscape baseline

9.3.1 A dry valley bottom is framed by steep chalk slopes orientated broadly north-east to south-west, that forms part of the wider chalk dip slope Chilterns Escarpment. The settlement of Wendover lies to the north-west of the escarpment where the valley bottom, the broad Aylesbury Vale and the dramatic north-western face of the Chilterns Escarpment meet. Settlement is otherwise dispersed throughout this landscape. Arable farmland is principally found on the lower slopes with smaller fields of pasture on the steeper upper slopes. Woodland is a key feature on higher ground, including expanses of ancient woodland that extend down the upper slopes of the valley. This provides a sense of enclosure and seclusion in the more densely wooded areas. Other vegetation largely consists of low cut or managed hedgerows with

occasional hedgerow trees on the valley slopes and in the valley bottom. The majority of the Dunsmore, Wendover and Halton area lies within the designated Chilterns AONB.

9.3.2 The area is rich in monuments that are commonly found in elevated locations. Those of particular note include Grim's Ditch near Woodlands Park, the Coombe Hill war memorial monument, and the Boddington Camps (Boddington Banks) Hillfort. The A413, the primary road in the study area, generally follows the course of the Marylebone to Aylesbury Line along the length of the valley bottom. Also running broadly parallel or perpendicular to the A413, a network of lanes and PRoW provide access to the countryside and are considered to be valued recreational resources including the following:

- Ridgeway National Trail;
- South Bucks Way;
- Chiltern Link;
- Chiltern Way;
- Aylesbury Ring; and
- Icknield Way Trail.

9.3.3 The LCA have been determined with reference to the Landscape Plan for Buckinghamshire[43], the Aylesbury Vale LCA[44], the Chiltern District LCA[45], and the Wycombe District LCA[46], and refined where applicable.

9.3.4 Descriptions of all LCA are provided in Volume 5: Appendix LV-001-010, Part 2. For the purposes of this assessment the study area has been sub-divided into 13 discrete LCA, nine of which are most likely to be affected. A summary of these LCA is provided below. The LCA are shown in Maps LV-02-035 to LV-02-038 (Volume 5, Landscape and Visual Assessment Map Book).

The Lee Undulating Valley Slopes LCA

9.3.5 This LCA lies within the Chilterns AONB and as such is considered to be of national value. A number of narrow winding roads and sunken lanes, which are often lined with dense mature trees and hedgerows, traverse this elevated transitional landscape between the low-lying Wendover Gap valley and the higher plateau to the east. The settlement of The Lee, comprising architecture built in the local vernacular of brick and flint, is located to the east of this LCA. Land use generally comprises a mix of large arable fields and comparatively small fields of pasture, interspersed with regular blocks of woodland, some of which are classified as ancient woodland. The components within the landscape are generally well-maintained, therefore the condition is considered to be good. The level of tranquillity in the area is considered to

[43] Buckinghamshire County Council (2001) *Landscape Plan for Buckinghamshire Part 1: Landscape Character Assessment*
[44] Jacobs (2008) *Aylesbury Vale Landscape Character Assessment: Prepared for Buckinghamshire County Council and Aylesbury Vale District Council*
[45] Land Use Consultants (2011) *Chiltern District Landscape Character Assessment:* Prepared for Buckinghamshire County Council and Chiltern District Council
[46] Land Use Consultants (2011*) Wycombe District Landscape Character Assessment*: Prepared for Buckinghamshire County Council and Wycombe District Council

be high owing to the absence of busy transport routes and the sense of seclusion afforded by woodland cover. Therefore, this area has a high sensitivity to change.

Wendover Gap LCA

9.3.6 This well-defined, steep sided valley is nestled at the foot of two areas of elevated chalk escarpment. It represents one of the characteristic valleys of the Chilterns AONB and as such is considered to be of national value. The valley is a key communications corridor, featuring the A413, the Marylebone to Aylesbury Line and a National Grid overhead power line. Minor roads frequently run perpendicular to the A413, climbing the valley slopes. Arable land occupies the valley bottom with pasture more commonly located on the higher slopes. The farmland is broken up by areas of predominantly deciduous woodland, some of which is ancient woodland such as Jones' Hill Wood, and dispersed farmsteads. Although the area has a low level of tranquillity, primarily due to the presence of busy road and rail routes in the valley bottom, the landscape is generally well maintained and in a good condition. Therefore, this area has a high sensitivity to change.

Settlement (Wendover) LCA

9.3.7 Wendover is a historically important small market town nestled in a gap between two areas of elevated chalk escarpment, with the settlement a distinctive component of the region's character, and as such the value of this LCA is considered to be regional. The linear form of the historic core of Wendover is clearly identifiable, not least due to the large number of historic buildings which creates a strong sense of unity and enclosure. However, busy roads which pass through the area reduce the overall level of tranquillity to medium. Land use is predominantly residential, with pockets of high quality open space. The buildings, public realm and pockets of vegetation within the area are also well maintained and as such provide a generally strong sense of cohesion. Therefore the condition of the landscape is considered to be good. Overall, this area has a high sensitivity to change.

Chiltern Scarp (Wendover West) LCA

9.3.8 This elevated landscape is located to the west of Wendover. It features the prominent steep-sided ridge of Bacombe Hill (at a height of approximately 200m AOD) which forms part of the chalk escarpment of the Chilterns AONB and as such is considered to be of national value. Overall the condition of the landscape is good, with extensive woodland cover, some of which is ancient woodland. The woodland confers a strong unity to the escarpment in the wider area. The sense of enclosure here is broken up by and contrasts with the more open areas of downland pasture which afford far-reaching views across the lower-lying landscape. Detracting features in the lower-lying wider landscape affect the setting of this LCA, and whilst there is some intervisibility with these features, they are generally perceived as being detached from the elevated Chiltern Scarp (Wendover West) LCA due to their distance, therefore the level of tranquillity is still considered to be high. Given the above this area has a high sensitivity to change.

Chiltern Scarp (Coombe Hill) LCA

9.3.9 The summit of this steep-sided wooded escarpment is identified by the prominent Second Boer War memorial monument. The lower slopes are densely wooded and

enclosed, whilst the hill summit comprises open calcareous grassland with panoramic views afforded across the lower-lying landscape. This lower-lying landscape includes the A413, the Marylebone to Aylesbury Line, electricity pylons and the urban edge of Aylesbury, all visual detractors which affect the setting of this LCA. These open far-reaching views attainable from the summit of Coombe Hill are recognised as a special quality of the Chilterns AONB. Overall the condition of the landscape is good, with the extensive well-maintained wooded cover of the escarpment a distinctive feature, underlining a strong continuity with the wider chalk escarpment. Tranquillity is high owing to the enclosed nature of the wooded areas on the lower slopes and the sense of separation on the more open summit from the visual detractors in the lower-lying vale. As the Chiltern Scarp (Coombe Hill) LCA lies within the Chilterns AONB, the landscape is considered to be of national value. Therefore, this area has a high sensitivity to change.

Wendover Foothills (West) LCA

9.3.10 This transitional landscape between the flat Aylesbury vale and the steep chalk escarpment comprises for the most part a gently sloping and open farmed landscape. Land use is predominantly a mix of large scale pasture and arable fields with the occasional isolated dwelling. The A413 and the Marylebone to Aylesbury Line pass through the area to the east, as do a series of electricity pylons which are a prominent feature in the landscape. Overall the condition of the landscape is considered to be good due to its well-maintained components such as hedgerows. However, visually detracting features including the electricity pylons and the proximity of the relatively busy settlement of Wendover diminish the level of tranquillity to low. As the LCA lies within the Chilterns AONB it is considered to be of national value. Therefore, this area has a medium sensitivity to change.

Risborough Foothills LCA

9.3.11 A pattern of large-scale pasture and arable fields bounded by trimmed hedgerows overlays the relatively flat to gently rolling landform. There is a high degree of intervisibility with surrounding areas from the open fields of this sloping landscape. Intervisibility with visual detractors, including the edge of the settlement of Wendover, electricity pylons and the transport network, exert their influence over a wide area. Components within the landscape are generally well maintained, however intervisibility with visual detractors such as the A413 and electricity pylons are commonplace within the landscape and are features in the wider landscape setting. Therefore the condition is considered to be fair and the level of tranquillity is considered to be low. However, the Risborough Foothills LCA does lie within the Chilterns AONB and is consequently of national value. Given the above this area has a medium sensitivity to change.

Longwick Vale LCA

9.3.12 Strongly defined thickets of mature dense hedgerow vegetation bound the pasture and arable fields in this flat landscape. The network of hedgerows creates a strong sense of enclosure and unity throughout the LCA. Linear shelter belts of tall poplar trees are commonly located in proximity to farmsteads. Within the LCA the absence of woodland is notable, however woodland cover is commonplace in the wider landscape, particularly that in the vicinity of the chalk escarpment which often forms

the backdrop to views and emphasises the sense of place and association with the Chilterns AONB. The buildings, surface treatments and vegetation within the area are generally well maintained, therefore the overall condition of the landscape is considered to be good. The rural setting, scarcity of built development, sense of enclosure and unity contribute to a high level of tranquillity. The landscape is of local value. Therefore, this area has a medium sensitivity to change.

Southern Vale LCA

9.3.13 This LCA comprises a low-lying vale landscape with limited topographic variation flanked by a wooded chalk escarpment to the south. It is crossed by busy transport corridors and includes the settled area of World's End. The rural character of the area is eroded due to the intervisibility with the urban edge of Aylesbury to the north, across the open landscape. Outside of the areas of settlement, which often comprises ribbon development, the land use predominantly comprises large scale arable farmland with pockets of small paddocks and grazing parcels located on the fringe of settlements. The pattern of elements in the landscape is interrupted by the ribbon development and transport corridors and as such the landscape is considered to be in a poor condition with a low level of tranquillity. The LCA lies partly within the Chilterns AONB and as such is considered to be of national value. Despite this, the area has a low sensitivity to change.

Visual baseline

9.3.14 Descriptions of the identified representative viewpoints are provided in Volume 5: Appendix LV-001-010, Part 2. A summary description of the distribution and types of receptors most likely to be affected is provided in this section. The viewpoints are shown in Maps LV-03-035 to LV-03-038 and LV-04-035 to LV-04-038 (Volume 2, CFA10 Map Book). In each case, the middle number (xxx.**x**.xxx) identifies the type of receptor that is present in this area - 2: Residential, 3: Recreational, 4: Transport, 5: Hotels/Healthcare Institutions, 7: Active Sports.

9.3.15 No protected views have been identified within the study area.

9.3.16 Residential receptors have a high sensitivity to change and are generally located on the periphery of Wendover, Dunsmore and Kingsash, in addition to isolated farmsteads throughout the study area and groupings of properties on the higher ground between Wendover and Halton. Views are typically rural across agricultural fields interspersed with blocks of woodland with the rooflines of buildings and infrastructure in the valley bottom visible through dense vegetation. Successive belts of mature vegetation bordering fields generally limit the extent of views afforded, although there are occasional panoramic views from the upper slopes of the valley.

9.3.17 Recreational receptors, also with a high sensitivity to change, are located on PRoW throughout the study area, including the Ridgeway National Trail, the South Buckinghamshire Way, the Chiltern Link, the Chiltern Way, the Aylesbury Ring and the Icknield Way Trail. The viewpoints are typically located in rural agricultural locations, with arable fields in the foreground and wooded skylines or planted field boundaries forming some degree of enclosure.

9.3.18 Viewpoints from users travelling along scenic roads are commonly located on lanes on the upper slopes of the valley which run both parallel and perpendicular to the main road in the study area, the A413, and have a medium sensitivity to change. Views from users travelling on the A413 have a low sensitivity to change. These views are characterised by pockets of development, agricultural land and hedgerow vegetation with wooded backdrops on the higher ground.

9.3.19 Hotel and healthcare institution receptors, generally located in the vicinity of the main road network in the study area, have a medium sensitivity to change.

Future baseline

9.3.20 A summary of the committed developments which are assumed to be built and occupied prior to either the construction or operation of the Proposed Scheme is provided below, along with the consequential effect on the character of LCA and nature of views. Developments which will introduce new visual receptors which may be significantly affected are also described. These developments are shown in Maps CT-13-019 to CT-13-021 (Volume 5, Cross Topic Appendix 1 Map Book).

Construction (2017)

9.3.21 The Chiltern Way Federation development will include the demolition and subsequent replacement of an existing sports hall and multi-utility games area and the construction of new teaching and vocational blocks, soft and hard landscaping and reconfigured access off London Road. The development will introduce new buildings and new tree planting within the Settlement (Wendover) LCA. However, due to the relatively small scale of the development in a well enclosed area the sensitivity of this LCA will be unchanged for the assessment of effects during construction.

9.3.22 Views from residences and users of the PRoW and road network in the vicinity of Church Lane in Wendover will be further restricted by the Chiltern Way Federation development. No new receptors will be introduced by the Chiltern Way Federation development in Wendover.

Operation (2026)

9.3.23 By 2026, the tree planting established by the Chiltern Way Federation development will have matured although it will not alter the character of the Settlement (Wendover) LCA. The sensitivity of this area will remain as high during year 1 of operation.

9.3.24 Views from residences and users of the PRoW and road network in the vicinity of Church Lane in Wendover will be further restricted by the Chiltern Way Federation development as a result of maturing vegetation.

9.4 Temporary effects arising during construction

9.4.1 As is commonplace with major infrastructure works, the scale of the construction activities means that works will be visible in many locations and will have the potential to give rise to significant temporary effects which cannot be mitigated practicably. Such effects 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 civil engineering works will take place, including establishment of compounds, main earthworks and structure works. The effects associated with the peak construction phase in this area will generally be considered to be long term given the construction programme (see Section 2.3). Overall, civil engineering works in this area will be undertaken between the start of 2018 and the end of 2021. The Small Dean viaduct main compound will be in place for approximately four years. Satellite compounds will be in place for between approximately one and a half years and four years. The civil engineering works at most individual sites along the route in this area will occur for a period of between approximately two and three years. Effects during other phases of works are likely to be lesser due to less construction equipment being required at the time and a reduced intensity of construction activity. The permanent effects of the presence of the Proposed Scheme are described in the operational assessment section.

9.4.2 The construction works that have been taken into account in determining the effects on landscape and visual receptors includes:

- construction of the Leather Lane overbridge;
- construction of the sustainable placement area at Hunt's Green, a parcel of agricultural land immediately adjacent to the South Heath cutting, 5m high, 1.3km long and up to 450m wide as described in Section 2.2.6;
- construction of the Bowood Lane overbridge;
- construction of the Wendover Dean viaduct;
- construction of the Rocky Lane underbridge;
- construction of the Small Dean viaduct;
- construction of the Wendover green tunnel;
- presence of the Nash Lee Road roadhead and associated vehicular movements;
- construction of the Nash Lee Road overbridge;
- general realignment and construction of temporary and permanent utility connections; and
- general earthworks including temporary material stockpiles up to 5m in height along the Proposed Scheme requiring cut/fill, vegetation removal, modification of landform, temporary closures and the presence of construction plant and worksites.

Avoidance and mitigation measures

9.4.3 Measures that have been incorporated into the draft CoCP to avoid or reduce landscape and visual effects during construction include the following (see Volume 5: Appendix CT-003-000):

- designing lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses (draft CoCP, Section 5);

- use of well-maintained hoardings and fencing (draft CoCP, Section 5);
- a requirement for contractors to pay due consideration to the impacts of extreme weather events and related conditions that may affect landscape and visual resources during construction (draft CoCP, Section 5);
- maximising the retention and protection of existing trees and vegetation where possible (draft CoCP, Section 12);
- replacement of any trees intended to be retained which may be accidentally felled or die as a consequence of construction works (draft CoCP, Section 12); and
- appropriate maintenance of planting and seeding works and implementation of management measures, to continue through the construction period as landscape works are completed (draft CoCP, Section 12).

9.4.4 These measures have been taken account of in the assessment of the construction effects below.

Assessment of temporary impacts and effects

9.4.5 The most apparent changes to landscape character and views during construction will relate to the temporary presence of construction plant, the demolition of properties, the removal of existing landscape elements, such as trees, hedges and agricultural land and the emergence of new features including the construction of the sustainable placement area in the landscape. Changes will be most notable in the vicinity of Wendover Dean and Small Dean, where construction of two new viaducts will affect the setting of the landscape, as well as in the landscape to the west of Wendover where construction of a green tunnel will similarly affect the setting.

9.4.6 The height of the construction plant and the proximity of construction activities to viewpoints, coupled with intermittent intervening screening (apart from the site hoardings) will result in significant visual effects during construction. The topography in certain locations and the retention of intervening hedgerows and trees will partially screen ground level construction activity including from some long-distance elevated locations.

Landscape assessment

9.4.7 The following section describes the likely significant effects on LCA during construction. All LCA within the study area considered to experience an effect that is not significant (minor or negligible) are described in Volume 5: Appendix LV-001-010 Part 4.

The Lee Undulating Valley Slopes LCA

9.4.8 Construction activities will include the formation of a 15m deep cutting, the construction of the Leather Lane overbridge realignment, the crossing of two dry valleys and the realignment of two PRoW. The formation of the sustainable placement area will also necessitate the removal of hedgerow vegetation. Ground levels will be raised by up to 6m, with intensive vehicular movements associated with the sustainable placement area also directly affecting this LCA. Furthermore, an

approximately 150m long stretch of the Grim's Ditch scheduled monument and associated mature vegetation will be removed. The Leather Lane overbridge satellite compound will be located adjacent to Leather Lane and the Wendover Dean viaduct satellite compound will be located adjacent to Bowood Lane. Temporary material stockpiles will also be present in the landscape. Impacts will arise as a result of these activities occurring in the landscape, such as the alterations to the landform, the removal of vegetation and introduction of plant and machinery in the landscape.

9.4.9 In the immediate vicinity of the Proposed Scheme, the presence of construction activities will noticeably reduce tranquillity. However, this will dissipate over the wider landscape with increasing distance from the Proposed Scheme. This is due in part to the enclosure provided by woodland cover in the landscape and the orientation of the landform.

9.4.10 Across the LCA the key characteristics will for the most part be retained, with the nearby settlement of The Lee unaffected. The introduction of construction activities into this LCA will be at variance with the character of the area given that the only notable urban influences and intensive vehicular movements exist in the valley floor below. Screening afforded by vegetation in the surrounding landscape, including the extensive Rushmoor Wood, will limit the visibility of the construction activities in the wider landscape. However, worksites and ancillary structures introduced into the landscape will be prominent and will result in the loss and severance of agricultural land and hedgerows, whilst indirectly impacting the wider landscape setting. On the basis of the above, the magnitude of change is considered to be medium.

9.4.11 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect.

Wendover Gap LCA

9.4.12 Construction activities will include the formation of cuttings up to approximately 15m depth and embankments up to approximately 10m in height and 500m long. The Wendover Dean viaduct, the Small Dean viaduct and part of the Wendover green tunnel will also be constructed within this LCA. Other construction activities will include the realignment of Bowood Lane, Rocky Lane and various PRoW, and the construction of the Wendover auto-transformer station. Facilitating these construction activities a number of satellite compounds and one main compound will be established. The Wendover Dean viaduct satellite compound will be located adjacent to Bowood Lane and the Wendover Dean viaduct launch satellite compound will be located in proximity to Upper Wendoverdean Farm. The Rocky Lane underbridge satellite compound will be located adjacent to Rocky Lane. The Small Dean viaduct launch satellite compound will be located adjacent to the A413 London Road. The Small Dean viaduct main construction compound (approximately 15,000m2) will be located in proximity to Grove Farm and the Wendover green tunnel (south) satellite compound will be located in proximity to Bacombe Lane. As a result of the introduction of the above into the landscape, agricultural land, woodland and hedgerow vegetation will be severed and noticeably disrupt the pattern of characteristic landscape elements. However, these impacts will be in the context of a valley bottom already disrupted by transport development. Temporary material stockpiles will also be introduced into the landscape along the length of the route.

9.4.13 The visual interference of these activities and emergence of new structures such as the Wendover Dean viaduct in combination will further reduce the level of tranquillity in the LCA.

9.4.14 Direct impacts on landscape components will occur across a large extent of this LCA along the length of the Proposed Scheme. The removal of hedgerows and hedgerow trees will disrupt the vegetation pattern in the valley bottom and reduce the unity in the landscape. Some woodland will also be lost, including a large proportion of Jones' Hill Wood, an area defined as ancient woodland. Where not enclosed by woodland, intervisibility with construction activities in this predominantly farmed landscape will be noticeably out of character. Given the extensive loss of existing landscape features including mature vegetation, the emergence of new structures and the perceptible reduced tranquillity, the magnitude of change is considered to be high.

9.4.15 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect.

Settlement (Wendover) LCA

9.4.16 The route of the Proposed Scheme will lie outside of this LCA. However, the construction boundary will coincide with the western edge of this LCA along sections of the A413 for approximately 650m. Construction activities which will directly impact this LCA will include site clearance and earthworks activities along the A413 and the Marylebone to Aylesbury Line. Construction activities in the adjacent LCA will also indirectly affect the setting of this LCA, in particular the presence and operation of tall plant and machinery associated with the Small Dean viaduct and main construction compound in proximity to Grove Farm, the Wendover green tunnel and the temporary realignment of Ellesborough Road. This will also noticeably reduce tranquillity in the western parts of Wendover through visual and acoustic intrusion. However, towards the historic core, the sense of enclosure afforded from the surrounding development and vegetation will limit intervisibility with construction activities and the level of tranquillity will not perceptibly reduce.

9.4.17 Direct impacts will be localised to the western fringe of this LCA where vegetation removal will be required. There will also be limited indirect impacts on tranquillity as a result of intervisibility with construction activities. Overall therefore, the magnitude of change is considered to be low.

9.4.18 The low magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect.

Chiltern Scarp (Wendover West) LCA

9.4.19 The Proposed Scheme will lie outside this LCA and therefore no landscape elements within the LCA will be directly impacted. The Proposed Scheme will run through the valley to the east of this LCA between the settlement of Wendover and Bacombe Hill at a distance of approximately 200m at its nearest point. Bacombe Hill sits above the lower-lying landscape within which the construction activities will occur and the woodland on the slopes of the hill will partially restrict intervisibility with the lower-lying landscape.

9.4.20 The activities associated with the construction of the green tunnel will result in indirect impacts on the setting of the LCA through the intervisibility of these construction works in combination with the Small Dean viaduct main construction compound, the B4009 Nash Lee Road overbridge satellite compound and the maintenance loop. Within the grassland landscape these impacts will be more apparent due to the open nature of views afforded of the construction activities in the lower-lying landscape at the foot of the hill and also further afield to the north towards the Aylesbury vale where a cutting will be formed. Despite the wider landscape context containing existing infrastructure development, the presence of the plant and machinery in the lower-lying landscape will appear as additional features in the lower-lying landscape. The loss and severance of agricultural land and hedgerow vegetation will also be perceptible in characteristic long-distance views in this LCA and will indirectly reduce tranquillity.

9.4.21 Extensive indirect impacts on setting, together with a perceptible reduction in the level of tranquillity, will result in a medium magnitude of change.

9.4.22 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect.

Chiltern Scarp (Coombe Hill) LCA

9.4.23 The Proposed Scheme will lie outside this LCA and therefore no landscape elements within the LCA will be directly impacted. Given its elevation and proximity to the route, construction activities in the valley landscape below will be noticeable including earthworks (cuttings up to approximately 15m depth and embankments up to approximately 10m height), PRoW realignments and works associated with new features, the most prominent of which will be the Small Dean viaduct, the Wendover green tunnel and the B4009 Nash Lee Road realignment. Other emerging new features which will affect the setting of this LCA will include the Bowood Lane realignment, the Wendover Dean viaduct, the Wendover auto-transformer station, the Rocky Lane realignment, the Stoke Grove auto-transformer station, the maintenance loop and the new A4010 Stoke Mandeville bypass (discussed in CFA11). Emerging features and construction activities in the lower-lying landscape will appear as additional features in the landscape although screening afforded by woodland on the slopes of the LCA will also help to reduce the perception of construction activities. The long-distance views afforded from this elevated area, a key characteristic of the landscape, will be directly impacted as the construction activities will be visible alongside existing infrastructure development.

9.4.24 Construction activities will be seen against a backdrop of electricity pylons, road infrastructure and the urban edge of Aylesbury. The setting of this LCA which is characterised by its open views, will be indirectly impacted whereby there will be a noticeable, albeit localised reduction in tranquillity at the summit of Coombe Hill due to the intervisibility with construction activities in the lower-lying landscape.

9.4.25 Given the above and that direct impacts will not occur to landscape components within the LCA, the magnitude of change is considered to be medium.

9.4.26 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect.

Wendover Foothills (West) LCA

9.4.27 Direct impacts, through the removal of vegetation and the severance of agricultural land, will arise as a result of the construction of a green tunnel and associated portal and the realignment of Ellesborough Road. Further direct impacts will arise from the formation of cuttings of up to 10m deep in the north of this LCA in the vicinity of the A413 roundabout. Site clearance will require the removal of existing vegetation and earthworks will alter the topography locally. The impacts on the landscape on the eastern side of the Proposed Scheme will be less pronounced due to the intervening transport corridors and linear vegetation. Temporary material stockpiles will also be introduced into the landscape.

9.4.28 The construction works associated with the Proposed Scheme will contribute to a further noticeable reduction in tranquillity due to the introduction of new components as visual detractors incongruous with the existing landscape setting.

9.4.29 The construction activities will directly affect the character of the flat open farmed landscape, where the presence of construction plant and emerging structures will substantially alter the landscape through the removal and severance of existing landscape features such as hedgerow vegetation and agricultural land. The changes noted above will be incongruous within the predominantly farmed landscape. Taking the above into account, the magnitude of change is considered to be high.

9.4.30 The high magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a major adverse effect.

Risborough Foothills LCA

9.4.31 The formation of an approximately 6m deep cutting and the realignment of the B4009 Nash Lee Road will directly affect this landscape through the removal of vegetation and severance of agricultural land, with the Nash Lee Road overbridge satellite compound facilitating these works. Temporary material stockpiles will also be introduced into the landscape. The visual disturbance and noise of construction activities in the adjacent areas will indirectly affect the setting of this LCA.

9.4.32 Construction activities will bring about noticeable reduction in tranquillity, especially to the farmed landscape on the south-western side of the Proposed Scheme. There will be a barely perceptible change in tranquillity within the landscape to the north-east due to the influence of the existing transport infrastructure.

9.4.33 The construction activities will bring about a discernible change in the character of this open farmland landscape. Limited vegetation removal will be required within this landscape, with some alterations in the landform occurring to accommodate the Proposed Scheme in cutting and the B4009 Nash Lee Road overbridge. Construction will take place in the context of an existing busy transport corridor. On this basis, the magnitude of change is considered to be medium.

9.4.34 The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect.

Longwick Vale LCA

9.4.35 Construction activities within this LCA will include the formation of cuttings up to 4m deep, the construction of the Stoke Grove auto-transformer station, the realignment of the B4009 Nash Lee Road, the construction of the maintenance loop, the construction of the new A4010 Stoke Mandeville bypass (described within CFA11) and the realignment of a PRoW. Temporary material stockpiles will also be introduced into the landscape. This will require the removal of vegetation and the severance of agricultural land. Facilitating the construction activities, the B4009 Nash Lee Road overbridge satellite compound in the adjacent LCA will affect the setting of this LCA. Construction will bring about a marked reduction in tranquillity as a result of the operation of plant and machinery associated with earthworks and crossings along the Proposed Scheme and the removal of vegetation.

9.4.36 Construction will bring about a noticeable change to the character of this LCA through the removal of vegetation, changes to the existing hedgerow pattern, an increase in openness and a marked reduction in tranquillity. Taking the above into account, the magnitude of change is considered to be high.

9.4.37 The high magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a major adverse effect.

Southern Vale LCA

9.4.38 Construction of the Proposed Scheme will directly affect the south-western edge of this LCA from Nash Lee Lane towards the site of the former St Mary's Church and cemetery (within CFA11) for approximately 380m. Construction activities will include earthworks and the realignment of the B4009 Nash Lee Road. Direct impacts will result from the removal of sections of hedgerow, although this will not disrupt the overall pattern of vegetation within the LCA. Temporary material stockpiles will also be introduced into the landscape resulting in the temporary loss and severance of agricultural land. The introduction of construction activities within this farmed landscape will be prominent and noticeably out of character.

9.4.39 The construction activities will bring about a noticeable reduction in tranquillity in the more rural areas of this landscape which are remote from the settled areas of Wendover and World's End. Given the removal of existing vegetation, localised changes in topography and a noticeable reduction in tranquillity, the magnitude of change is considered to be medium.

9.4.40 The medium magnitude of change, assessed alongside the low sensitivity of the character area, will result in a moderate adverse effect.

Visual assessment

9.4.41 The following section describes the likely significant effects on visual receptors during construction. The construction assessment has been undertaken during winter, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of construction activities may be reduced during summer when vegetation, if present in a view, will be in leaf. Where residential receptors and hotel/healthcare institution receptors experience significant effects at night-time arising from additional lighting, these are also presented in this section. Representative viewpoints

within the study area considered to experience an effect that is not significant (minor or negligible) are described in Volume 5: Appendix LV-001-010, Part 4.

9.4.42 The number identifies the viewpoint locations which are shown on Maps LV-03-035 to LV-03-038 (Volume 2, CFA10 Map Book). In each case, the middle number (xxx.**x**.xxx) identifies the type of receptor that is present in this area - 2: Residential, 3: Recreational, 4: Transport, 5: Hotels/Healthcare Institutions, 7: Active Sports.

9.4.43 Where a viewpoint may represent multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with a lower sensitivity may be lower than those reported.

Viewpoint 095.2.002: View east from dwellings on London Road, Wendover Dean

9.4.44 Construction activities will be visible in the background of this view (approximately 700m from the viewer). Plant and machinery associated with the Cottage Farm accommodation overbridge and the Footpath TLE/2 (that becomes WEN/38 west of the route) and South Heath cutting will be apparent on the crest of the slope. The block of woodland in the middle ground will partially screen construction activities associated with the cutting, although this and the overbridge works will be clearly visible in proximity to the electricity pylon approximately 800m away. The provision of the sustainable placement area will be visible in the background of the view, resulting in the alteration of the existing landform. Oblique views of construction activities to the left of the view associated with the Bowood Lane realignment will also be attainable. Woodland to the right of the view in the middle ground will restrict long-distance views and will screen views of construction activities. Given the extent and scale of works visible and the introduction of new components incongruous with the existing view, the magnitude of change is considered to be high.

9.4.45 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.46 Lighting associated with the Leather Lane overbridge satellite compound will increase the extent of lighting in the background of the view, when compared to the dimly lit rural landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 095.3.001: View east from the PRoW (Footpath WEN/38) near Wendover Dean

9.4.47 There will be open views of plant and machinery forming the South Heath cutting and sustainable placement area near Hunt's Green Farm across the middle ground of this view (approximately 50m away). The construction of the Footpath TLE/2 accommodation overbridge will also be visible in the immediate foreground. The realignment of Bowood Lane and the Wendover Dean viaduct satellite compound will be clearly visible to the left of the view in front of the electricity pylon. Temporary material stockpiles will also be visible from this location. Given the substantial changes across the field of view which will occur in close proximity to the viewpoint, the magnitude of change is considered to be high.

9.4.48 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 095.3.002: View east from the South Bucks Way PRoW (Bridleway WEN/45) near Cockshoots Wood

9.4.49 The majority of construction activities visible will relate to the formation of the South Heath cutting (approximately 1.5km away) and the Wendover Dean viaduct (approximately 1.7km away), although plant and machinery will be partially screened by the large blocks of woodland in the background of this view. The construction of elevated structures such as PRoW crossings and the Bowood Lane realignment will also be apparent in the centre of the view, as will the removal of vegetation. The Wendover Dean viaduct satellite compound will be visible in proximity to a large area of vegetation which will be partly removed. To the left of the view, the construction of the Wendover Dean viaduct will be partially screened by the hedgerow in the middle ground, although taller construction plant and machinery will be visible above. To the right of the view, the construction activities associated with the formation of the sustainable placement area near Hunt's Green Farm will be apparent. Temporary material stockpiles will also be visible in the left of the view between Bowood Lane and Rocky Lane. Despite the distance, incongruous construction activities will be partially visible across the extent of this panoramic view. On the basis of the above, the magnitude of change is considered to be high.

9.4.50 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 096.3.002: View west from the PRoW (Footpath TLE/2) off King's Lane

9.4.51 The construction of the South Heath cutting and the sustainable placement area near Hunt's Green Farm will be prominent in this view. There will be open views of construction activities associated with the elevation of the PRoW in the centre of the view. To the right, the construction works associated with the realignment of Bowood Lane and the Wendover Dean viaduct satellite compound will be clearly visible. Plant and machinery will also intrude upon views beyond to the other side of the valley. Given the substantial changes in the direct field of view and in proximity to the receptor, the magnitude of change is considered to be high.

9.4.52 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 096.4.002: View west from King's Lane near Potter Row

9.4.53 The Leather Lane satellite compound and plant and machinery will be clearly visible in the agricultural field in the foreground in the left of this view (approximately 250m away). The removal of vegetation along the length of Leather Lane and in the farmed landscape in the foreground will also be clearly visible, altering the composition of the view by opening up views beyond. Large scale plant and machinery associated with the formation of the sustainable placement area extending towards Hunt's Green Farm from the Proposed Scheme will be clearly visible in the foreground and will necessitate the removal of hedgerow vegetation. These works will break the

predominantly open skyline which forms the backdrop of the view. Given the openness of views of construction activity visible in close proximity to the viewpoint, the magnitude of change will be high.

9.4.54 The high magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 097.2.001: View east from dwellings on Bowood Lane, Wendover Dean

9.4.55 The construction of the Wendover Dean viaduct will be clearly visible in the middle ground and background of this view (approximately 350m away). In addition, vegetation removal and the subsequent excavation of the cutting in the background of the view will also be clearly visible. Temporary material stockpiles will be visible from this location in front of Jones' Hill Wood. Longer distance views to the left will be screened by the vegetation in the middle ground. To the right of the view, construction activities associated with the Bowood Lane realignment will be visible although partly screened by the mature trees in the foreground. Construction activities will substantially alter the composition of the view. Taking the above into account, the magnitude of change is considered to be high.

9.4.56 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.57 Lighting associated with the Wendover Dean viaduct satellite compound will increase the extent of lighting in the background of the view, when compared to the dimly lit rural landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 097.2.003: View south-east from Upper Wendoverdean Farm

9.4.58 Construction activities will be visible across the extent of the view in between the middle ground and background. Large scale plant and machinery associated with the construction of the Wendover Dean viaduct and the demolition of Durham Farm will be prominent in the centre middle ground of the view (approximately 400m away) and will break the skyline. To the right of the view in the background, the removal of a large proportion of Jones' Hill Wood ancient woodland will also be clearly visible. To the left of the view, the Wendover Dean viaduct satellite compound will be for the most part screened by the hedgerow running perpendicular from the viewpoint in the foreground. The formation of balancing ponds will be visible in the grassed fields in the middle ground, in front of the construction activities associated with the viaduct. The presence of the viaduct will become more apparent as the construction period progresses. The changes outlined above will result in a substantial alteration in the composition of this view. Taking the above into account, the magnitude of change is considered to be high.

9.4.59 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.60 Lighting associated with the Wendover Dean viaduct satellite compound and the Wendover Dean viaduct launch satellite compound will noticeably increase the extent

of lighting in the view as additional sky glow, when compared to the dimly lit rural landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 097.3.001: View east from the PRoW (Footpath WEN/37) on Bowood Lane

9.4.61 The construction of the Bowood Lane overbridge will dominate this view in the foreground and middle ground immediately adjacent to the viewpoint, where the presence of plant and machinery and the removal of vegetation will be prominent. The loss of a large proportion of Jones' Hill Wood (approximately 140m away), which is classified as ancient woodland, will be apparent in the background of the view. The Wendover Dean viaduct satellite compound and temporary material stockpiles will also be visible in the background. Given these substantial changes in close proximity to the viewpoint, the magnitude of change is considered to be high.

9.4.62 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 097.4.001: View north-east from Cobblershill Lane

9.4.63 The majority of construction activities visible will relate to the removal of vegetation and the plant and machinery forming earthworks where the Proposed Scheme will traverse the west-facing valley slopes. However the construction activities will occur broadly parallel to the line of electricity pylons visible in the background of this view, partially screened by intervening vegetation in the foreground and middle ground. In addition, the construction of the Wendover Dean viaduct and the Wendover Dean viaduct launch satellite compound, behind Upper Wendoverdean Farm, will be apparent (approximately 1.4km away). The removal of a large proportion of Jones' Hill Wood on the skyline, an area classified as ancient woodland, will also be apparent. The construction of the Rocky Lane underbridge, the Rocky Lane underbridge satellite compound and the Wendover auto-transformer station to the left of the view will be partially screened by the intervening vegetation in the foreground and will be barely visible in the background beyond. Temporary material stockpiles will be visible across the view. The composition of the view will be markedly altered as a result of the construction activities, but given the context of the view from an existing transport route these changes will be less incongruous and the magnitude of change will be medium.

9.4.64 The medium magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 098.2.001: View west from Strawberry Hill Cottage, King's Lane

9.4.65 Construction activities will be visible across the extent of this panoramic view in the middle ground. The realignment of Bowood Lane and the Wendover Dean viaduct satellite compound will be visible between Strawberry Hill Farm and the block of woodland to the left. The removal of a small proportion of this woodland to accommodate the Proposed Scheme in a cutting will be visible. However, the remaining woodland will partially screen construction activities. The construction of

the Wendover Dean viaduct will be visible lower down in the valley in the centre of the view (approximately 500m away). As the route traverses the landscape to the right of the view, plant and machinery associated with vegetation removal and earthworks will be clearly visible in the middle ground, as will the Wendover Dean viaduct satellite compound. Woodland to the far right of the view will screen more distant views. Temporary material stockpiles will also be visible to the receptor from this location. These construction activities will be clearly visible in the view and will partially alter the composition of the view. Taking the above into account, the magnitude of change is considered to be medium.

9.4.66 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

9.4.67 Lighting associated with the Wendover Dean viaduct satellite compound and the Wendover Dean viaduct launch satellite compound will noticeably increase the extent of lighting in the view, when compared to the dimly lit rural landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 098.3.001: View west from the PRoW (Footpath TLE/3) on Bowood Lane

9.4.68 The construction of the Bowood Lane overbridge will be prominent in the foreground and middle ground of this view (approximately 80m away), where plant and machinery and vegetation removal will be apparent. The Wendover Dean viaduct satellite compound and temporary material stockpiles will be clearly visible in the middle ground behind which the loss of a large proportion of Jones' Hill Wood will also be apparent. Given the substantial changes in close proximity to the receptor, the magnitude of change is considered to be high.

9.4.69 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 098.3.003: View north-west from the PRoW (Footpath TLE/5) near Kingsash

9.4.70 The view of the Proposed Scheme from this location during construction is illustrated on the photomontage shown in Figure LV-01-189 (Volume 2, CFA10 Map Book).

9.4.71 The construction of the Wendover Dean viaduct will be dominant in the middle ground (approximately 250m away) in the rolling farmed landscape and set against the backdrop of the opposing valley slopes. A temporary construction access road provided from the embankment down into the valley and the demolition of Durham Farm will be clearly visible. Large areas of earthworks and associated vegetation removal will be apparent, including the loss of part of Jones' Hill Wood. Temporary material stockpiles will also be visible from this location in the distance beyond the Wendover Dean construction activities. Given the substantial changes in proximity to this viewpoint, the magnitude of change is considered to be high.

9.4.72 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 099.2.001: View north-east from The Laurels, Rocky Lane

9.4.73 The realignment of Rocky Lane will dominate the immediate foreground of this view. Plant and machinery forming an embankment extending across the existing alignment of Rocky Lane to the right of the view will be clearly visible (approximately 90m away). Furthermore, the removal of hedgerows and trees adjacent to the existing Rocky Lane will open up views to construction activities extending across the farmed landscape. Earthworks will also be apparent, as will temporary material stockpiles. Given the substantial changes which will occur in proximity to the receptor within the direct field of view, the magnitude of change is considered to be high.

9.4.74 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

9.4.75 Lighting associated with the Small Dean viaduct launch satellite compound will increase the extent of lighting in the background of the view which will otherwise be largely un-lit. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 099.3.001: View east from the PRoW (Bridleway GLH/46) at Hampdenleaf Wood near Little Hampden

9.4.76 The majority of construction activities visible will relate to earthworks and vegetation removal. The Proposed Scheme will traverse the valley slopes, broadly following the alignment of the electricity pylons visible in the background and will be partially screened by intervening vegetation. The construction of the Wendover Dean viaduct (approximately 1.9km away) and the Wendover Dean viaduct launch satellite compound will be partially screened by Upper Wendoverdean Farm. Construction of the Rocky Lane underbridge, Rocky Lane underbridge satellite compound and the Wendover auto-transformer station will be visible to the left in proximity to Hartley Farm. Temporary material stockpiles will also be visible in the background. Overall, the composition of the view will be partially altered and the magnitude of change will therefore be medium.

9.4.77 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 099.4.001: View east from Cobblershill Lane

9.4.78 Views of the construction of the Wendover Dean viaduct (approximately 650m away) and the extensive area of earthworks to the north of the viaduct will be partially screened by intervening vegetation in the middle ground. Vegetation removal, topsoil stripping and earthworks will be clearly visible across the scene. Temporary material stockpiles will also be visible, as will the construction of the Wendover auto-transformer station. The realignment of Rocky Lane and the Rocky Lane underbridge satellite compound will be partially screened by vegetation, in particular alongside the A413 London Road, to the left of the view. Given these substantial changes, the magnitude of change is considered to be high.

9.4.79 The high magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 099.5.001: View east from the Firecrest public house

9.4.80 Construction activities will be visible across the breadth of this view in the middle ground, albeit partially screened by the vegetation extending along the length of the A413 London Road (the nearest works will be approximately 350m away and comprise mitigation earthworks). The construction of the Wendover Dean viaduct, together with the Wendover Dean viaduct satellite compound and Wendover Dean viaduct launch satellite compound will be visible to the right of the view. However these components will not be immediately apparent; neither will the removal of a large proportion of Jones' Hill Wood, due to the screening in the foreground of the view. Similarly to the left of the view the construction of the Rocky Lane underbridge, the Rocky Lane underbridge satellite compound and the Wendover auto-transformer station will be visible, but will not be immediately apparent as they will be partially screened by the intervening vegetation. Given the extent of change in this view, the magnitude of change is considered to be medium.

9.4.81 The medium magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

9.4.82 Additional sky glow associated with the compounds discussed above will increase the extent of lighting in the view, albeit in the context of a foreground that is occasionally lit but often dark. On the basis of the above, the magnitude of change at night is considered to be low, resulting in a moderate adverse effect.

Viewpoint 100.2.001: View south-west from dwellings at the junction of King's Lane and Rocky Lane, Kingsash

9.4.83 Construction activities will be clearly visible in the valley floor to the left and centre and within the background of this view. The construction of the Wendover Dean viaduct, the nearest visible element to the viewpoint approximately 700m away, will appear in the centre of the view, albeit partly screened by vegetation in the middle ground on the crest of the slope. The realignment of Bowood Lane will be clearly visible to the left of the view, as will the Wendover Dean viaduct satellite compound at Bowood Lane. Intervening landform in the middle ground will screen construction activities to the right of the view. Temporary material stockpiles will also be visible from this location in the vicinity of Jones' Hill Wood. Construction activities will be incongruous with the existing view and the magnitude of change is considered to be high.

9.4.84 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

9.4.85 Lighting associated with the Wendover Dean viaduct satellite compound and the Wendover Dean viaduct launch satellite compound will substantially increase the extent of lighting in the view, when compared to the dimly lit rural landscape. On this basis, the magnitude of change at night is considered to be high, resulting in a major adverse effect.

Viewpoint 100.2.002: View north from Hartley Farm, Rocky Lane

9.4.86 Construction activities will be clearly visible within the middle ground in the vicinity of the existing alignment of Rocky Lane to the left of the view. The plant and machinery

associated with the realignment of Rocky Lane will be prominent (approximately 50m away), as will the removal of vegetation to accommodate the realignment of Rocky Lane. This will open up views across the farmed landscape towards the Small Dean viaduct launch satellite compound. The addition of these new components will be incongruous with the existing view and given their proximity will result in a magnitude of change considered to be medium.

9.4.87 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a moderate adverse effect.

9.4.88 Lighting associated with the Small Dean viaduct launch satellite compound will perceptibly increase the extent of lighting in the view as distant sky glow in the background, when compared to the dimly lit rural landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be low, resulting in a moderate adverse effect.

Viewpoint 100.4.001: View south-west from Rocky Lane, near Kingsash

9.4.89 Construction activities will be visible in the middle ground, with those associated with the Wendover Dean viaduct most apparent (approximately 650m away). Plant and machinery associated with the construction of elevated features including the Bowood Lane realignment and Wendover Dean viaduct will be clearly visible in the view. Vegetation removal and earthworks along the length of the route will be visible intermittently through gaps in the blocks of woodland and pockets of mature vegetation in the middle ground. Temporary material stockpiles will also be intermittently visible from this location, partially screened by the intervening hedgerow vegetation. The rising landform to the right of the view will screen construction activities in this area. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.90 The medium magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 101.2.002: View east from dwellings near Little London, Dunsmore

9.4.91 Construction activities will be visible in the background of this view, extending further up the valley side in the right of the view. The plant and machinery associated with the realignment of Rocky Lane (approximately 900m away) and the construction of the Wendover Dean viaduct (approximately 1.4km away), in addition to a PRoW crossing and the realignment of Bowood Lane further in the distance will all be clearly visible in the view. The Wendover Dean viaduct satellite compound and the Rocky Lane underbridge satellite compound will also be apparent. Plant and machinery associated with vegetation removal and earthworks will be partially screened by intervening vegetation in the middle ground and background of the view. Temporary material stockpiles will also be visible from this location in front of the earthworks construction activities. Construction will substantially alter the composition of the view. On this basis, the magnitude of change is considered to be high.

9.4.92 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.93 Lighting associated with the construction compounds described above will substantially increase the extent of lighting in the view, when compared to the dimly lit rural landscape. The magnitude of change to this receptor at night is considered to be high, resulting in a major adverse effect.

Viewpoint 101.2.003: View east from dwellings on London Road, Small Dean

9.4.94 Construction activities will be prominent across the breadth of this view in the foreground and will for the most part not be screened by the intervening hedgerow vegetation. The plant and machinery associated with the mitigation earthworks, creation of the balancing pond and vegetation removal in the centre of the view will dominate the view, whilst the activities associated with the Rocky Lane realignment (approximately 400m away), to the right of the view will be less apparent. Furthermore, the removal of vegetation to the left of the view will open views towards the Small Dean viaduct launch satellite compound. Given the substantial changes which will occur in this view, the magnitude of change will be high.

9.4.95 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.96 Lighting associated with the Small Dean viaduct launch satellite compound will perceptibly increase the extent of lighting to the left of the view. On this basis, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 101.2.004: View east from dwellings on Small Dean Lane

9.4.97 Construction activities in the background of this view will be partially screened by the hedgerows and mature trees in the middle ground and background. The ground level of the Wendover Dean viaduct satellite compound will be screened by a block of woodland although tall plant and machinery will be visible above the woodland, breaking the skyline. The construction of the Wendover Dean viaduct will be clearly visible in front and to the left of this block of woodland broadly following the alignment of the existing electricity pylons. The Rocky Lane underbridge satellite compound and the realignment of Rocky Lane will also be clearly visible in the immediate foreground (approximately 650m away). There will be open views of plant and machinery associated with earthworks and vegetation removal along the length of the route in the context of the existing electricity pylons. To the far right of the view, the realignment of Bowood Lane will also be visible to the right of a large block of woodland in proximity to an electricity pylon. Temporary material stockpiles will be visible from this location in front of the earthworks construction activities to the right of Rocky Lane. Given the substantial changes described above, the magnitude of change will be high.

9.4.98 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.99 Lighting associated with the Wendover Dean viaduct satellite compound, the Wendover Dean viaduct launch satellite compound and the Rocky Lane underbridge satellite compound will substantially increase the extent of lighting in the view, when compared to the dimly lit rural landscape. On the basis of the above, the magnitude of change at night is considered to be high, resulting in a major adverse effect.

Viewpoint 101.2.005: View east from dwellings on Rocky Lane

9.4.100 Construction activities associated with the realignment of Rocky Lane will be clearly visible in this view (approximately 100m away). Construction activities associated with the removal of vegetation in the background of the view will open up views beyond, which will result in tall plant and machinery related to the realignment of Rocky Lane being more visible. The construction of a new access route off Rocky Lane in the middle ground on the right side of the road will be the most apparent activity in the view due to its close proximity. Tall plant and machinery associated with the Rocky Lane underbridge satellite compound will be visible to the right of the view behind the electricity pylons in the background. Activities at ground level will be partially screened by intervening vegetation and a fence in the foreground. Given the partial alteration in the composition of the view, the magnitude of change will be medium.

9.4.101 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

9.4.102 Lighting associated with the Rocky Lane underbridge satellite compound will increase the extent of lighting in the view, when compared to the dimly lit rural landscape. On this basis, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 101.2.006: View north-west from dwellings on London Road, Small Dean

9.4.103 Construction activities will be clearly visible in the foreground, including the demolition of Road Barn Farm and the removal of vegetation in order to accommodate the Small Dean viaduct launch satellite compound. Plant and machinery associated with the construction of the Small Dean viaduct will be apparent in the middle ground, approximately 150m away. The removal of vegetation and subsequent construction of a new access track for Boswells Farm to the right of the A413 London Road will also be visible in the middle ground between the viewpoint and the Small Dean viaduct crossing location. Given the substantial changes which will occur in this view, the magnitude of change will be high.

9.4.104 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.105 Lighting associated with the Small Dean viaduct launch satellite compound will markedly increase the extent of lighting in the view, which is currently only intermittently lit by passing vehicles on the A413 London Road. On this basis, the magnitude of change to this receptor at night is considered to be high, resulting in a major adverse effect.

Viewpoint 101.3.001: View east from a restricted bridleway off the Icknield Way Trail PRoW (Bridleway WEN/13)

9.4.106 Plant and machinery associated with the construction of the Small Dean viaduct will be clearly visible at the end of the vista in the background of this view (approximately 30m away). Vegetation removal will also be apparent in the background of the view adjacent to the A413, partially opening up views towards the construction activities. Mature vegetation in the foreground and middle ground restricts views either side of this narrow vista, limiting the extent of construction activities visible. Overall, the magnitude of change is considered to be medium.

9.4.107 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 101.4.001: View south-east from Dunsmore Lane

9.4.108 Construction activities along the length of the route will be visible, albeit partly screened by vegetation in the foreground, middle ground and background of the view. The construction of the Wendover Dean viaduct and earthworks to the north of this emerging structure will be visible in the centre of the view against a wooded backdrop. The realignment of Bowood Lane will also be visible in the centre of the view on the higher ground, where earthworks, road construction, and vegetation removal will be clearly visible on the skyline, albeit at some distance from the viewpoint (approximately 530m). The Rocky Lane underbridge satellite compound will be visible to the left of the view behind the visually prominent electricity pylon. Temporary material stockpiles will also be visible in front of the earthworks construction activities between the Wendover Dean viaduct works and Rocky Lane. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.109 The medium magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 101.4.002: View east from Small Dean Lane

9.4.110 Plant and machinery associated with the construction of the Small Dean viaduct will be clearly visible in the background of this view (approximately 620m away), although activities at ground level will be partially screened by retained woodland. Tall plant and machinery at the Small Dean viaduct main construction compound will be visible to the left of the view in the background in proximity to an existing electricity pylon. This will be partially screened by vegetation in the middle ground. Given the substantial changes across the view, the magnitude of change is considered to be high.

9.4.111 The high magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 102.3.001: View south-west from the Ridgeway and the Chiltern Link PRoW (Bridleway WEN/46) on Hogtrough Lane

9.4.112 The construction of the Small Dean viaduct and Small Dean viaduct launch satellite will be visible in the centre and to the right in the background of this view

(approximately 500m away), although partially screened by the intervening vegetation in the foreground. In front of these activities, the removal of beech trees at the end of the tree avenue will be apparent, where construction of the Small Dean viaduct will necessitate the realignment of the Boswells Farm access track. To the left of the view, plant and machinery associated with the Rocky Lane underbridge will be barely perceptible in the background of the view. The presence of construction activities will substantially alter the composition of the view. On this basis, the magnitude of change is considered to be high.

9.4.113 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 103.2.001: View south-east from dwellings on Ellesborough Road, Wendover

9.4.114 Construction activities will extend from the foreground to the background of this view (approximately 50m away). Construction of the Wendover green tunnel will necessitate the removal of vegetation and the realignment of Ellesborough Road to the left of the view, opening up views across a grassed landscape. The construction of a temporary link road to the right of the view will also be apparent. Given the substantial alteration in the composition of the view, the magnitude of change is considered to be high.

9.4.115 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.116 Lighting associated with the construction of the Wendover green tunnel will noticeably increase the extent of lighting in the view, when compared to the partially lit semi-urban landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium resulting in a moderate adverse effect.

Viewpoint 103.3.001: View north from the PRoW (Footpath WEN/13A) off Bacombe Lane

9.4.117 The construction of the Wendover green tunnel and Ellesborough Road temporary diversion will be clearly visible in this view (approximately 50m away at the nearest point). Large scale plant and machinery associated with earthworks, topsoil stripping and installation of new structures will be visible in the middle ground across the extent of the view, altering the character of the view and obscuring views beyond towards the wooded background. Temporary material stockpiles will also be visible. The intervening rising topography to the left of the view will partially screen the construction activities associated with a new temporary link road tie-in. Given the substantial changes in close proximity and in the direct field of view, the magnitude of change is considered to be high.

9.4.118 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 104.3.002: View south-west from the PRoW (Bridleway WEN/14) on Bacombe Lane, Wendover

9.4.119 The construction of the Wendover green tunnel (approximately 100m away) and Bacombe Lane road tie-in will be clearly visible in the middle ground of this view. To the left of the view, plant and machinery will be visible extending across the grassland in front of Grove Farm, leading towards the Wendover green tunnel (south) satellite compound behind the existing electricity pylon. Construction activities at ground level and temporary material stockpiles to the right of the view will be screened by vegetation in the foreground, although large scale plant and machinery will be visible above the intervening vegetation. On the basis of the above the character of the view will be substantially altered which will result in a high magnitude of change.

9.4.120 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 105.2.001: View north from dwellings on Ellesborough Road, Wendover

9.4.121 The view of the Proposed Scheme from this location during construction is illustrated on the photomontage shown in Figure LV-01-190 (Volume 2, CFA10 Map Book).

9.4.122 Construction activities associated with the Wendover green tunnel will be clearly visible in the middle ground of this view (approximately 200m away) to the right and centre. Property demolition, vegetation removal, topsoil stripping and earthworks will also be clearly visible. The temporary diversion of Ellesborough Road will be clearly visible in the foreground. To the centre and left of the view, plant and machinery will be visible across the arable field, with cranes associated with the Wendover green tunnel portal clearly visible. This will partially obstruct views towards the wooded background. Further left in the view, the realignment of B4009 Nash Lee Road will be visible in the background, as will the B4009 Nash Lee Road overbridge satellite compound. A large temporary material stockpile will also be visible in the foreground, the nearest component to the viewpoint. Given the substantial changes in this view, the magnitude of change is considered to be high.

9.4.123 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.124 Lighting associated with the construction of the Wendover green tunnel in the middle ground and the B4009 Nash Lee Road overbridge satellite compound in the background will increase the extent of lighting in the view, when compared to the partially lit peri-urban landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 105.2.002: View east from Wellwick Farm, Wendover

9.4.125 The construction of the B4009 Nash Lee Road overbridge will be apparent in the middle ground (approximately 800m away), as will the B4009 Nash Lee Road overbridge satellite compound, although these elements will be partially screened by the existing sparse hedgerows and mature hedgerow trees in the view. Earthworks and vegetation removal will be discernible in some areas of the view. In addition,

buildings to the right of the view will screen views towards the construction activities associated with the Wendover green tunnel (approximately 700m away). All construction activities will be seen in the context of existing electricity pylons, telegraph poles and the Triangle Business Park. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.126 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

9.4.127 Additional lighting associated with construction of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 105.3.001: View north-east from the summit of Coombe Hill on the PRoW (Footpath ELL/64)

9.4.128 Construction activities will be visible in the middle ground and background of this view in the context of an expansive relatively flat farmed landscape with areas of settlement. Temporary material stockpiles will also be visible. To the right of the view plant and machinery will be visible in the arable fields in front of the A413 Nash Lee Road associated with the Wendover green tunnel and cutting (approximately 1.6km away). To the left of these activities, the process of realigning of the B4009 Nash Lee Road will be clearly visible in combination with the B4009 Nash Lee Road overbridge satellite compound behind the line of electricity pylons. To the left, plant and machinery associated with two PRoW overbridges will be visible, as will the plant and machinery required to remove vegetation, strip soil and create embankments. Beyond this point further construction activities will be indistinct due to the increasing distance and partial screening afforded by vegetation. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.129 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 105.3.002: View north-east from the Aylesbury Ring PRoW (Footpath WEN/6), west of Wendover

9.4.130 Construction activities associated with the Wendover green tunnel will be clearly visible in the foreground and middle ground of this view (approximately 100m away) to the right and centre within the arable field. The demolition of buildings, the removal of vegetation from the boundaries of Ellesborough Road and the cricket ground will be clearly visible, as will plant and machinery associated with the stripping of topsoil and earthworks across the view. To the centre left of the view, plant and machinery associated with the Wendover green tunnel portal will be clearly visible, with earthworks activities and the emergence of the tunnel portal (approximately 250m away) evident. Further left in the view, the formation of the cutting will be visible in the middle ground. Views to the wooded background will be partially screened by plant and machinery in the foreground and middle ground across the length of the view. A large temporary material stockpile will also be visible in the foreground. Given the substantial changes which will occur in the direct field of this view, the magnitude of change is considered to be high.

9.4.131 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 105.3.003: View east from the summit of Bacombe Hill on the PRoW (Footpath WEN/15C)

9.4.132 Construction activities will be visible in the middle ground of this view in the context of a generally flat farmed landscape with areas of settlement to the east. Temporary material stockpiles will also be visible. To the centre and right of the view, plant and machinery will be partly screened by the intervening landform and extensive woodland in the foreground of the view. Only the taller plant and machinery associated with the Wendover green tunnel will be visible (approximately 500m away). To the left of the view the formation of the cutting will be visible. Further left, the realignment of the B4009 Nash Lee Road will be clearly visible in combination with the B4009 Nash Lee Road overbridge satellite compound behind the line of electricity pylons. In the far distance, plant and machinery associated with two PRoW overbridges will be visible, as will the plant and machinery required to remove vegetation, strip soil and create an embankment for the Proposed Scheme, albeit these activities will be less apparent due to the distance away. Given the substantial changes which will occur across this panoramic view, the magnitude of change is considered to be high.

9.4.133 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

Viewpoint 106.3.001: View south-west from the PRoW (Footpath WEN/54) to the west of Wendover

9.4.134 Tall plant and machinery associated with the Wendover green tunnel and tunnel portal will be visible in the background, breaking the skyline of this view (approximately 110m away). However, these construction activities will be seen in the context of electricity pylons on the skyline with an existing rail line in the middle ground to the right of the view. Vegetation in the foreground will partially screen construction activities, particularly at ground level. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.135 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 107.2.002: View south-east from dwellings on Nash Lee Road, Nash Lee

9.4.136 Construction activities will be clearly visible in the foreground, middle ground and background of this view, where plant and machinery associated with the construction of the B4009 Nash Lee Road realignment will be most prominent. Vegetation removal as a result of this realignment will also be apparent. In the background construction activities associated with the route crossing (at approximately 350m away) will be less discernible due to distance, although they will still be apparent. To the right of the view the B4009 Nash Lee Road overbridge satellite compound will be partially visible beyond the hedgerow running alongside the existing road alignment. The increase of vehicular movements associated with the B4009 Nash Lee Road roadhead will also be

apparent. Given the substantial changes which will occur in the direct field of view, the magnitude of change is considered to be high.

9.4.137 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.138 Lighting associated with the B4009 Nash Lee Road overbridge satellite compound in the view will markedly increase the extent of lighting, when compared to the partially lit peri-urban landscape. On the basis of the above, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 108.2.001: View south-west from dwellings on Nash Lee Lane, Wendover

9.4.139 Construction activities will be clearly visible in both the left and right of this view, with some screening in the centre of the view in the middle ground. To the left, plant and machinery associated with the realignment of the B4009 Nash Lee Road (approximately 80m away) will be clearly visible in the foreground. Plant and machinery associated with vegetation removal and earthworks will similarly be clearly visible in the middle ground. To the right of the view, vegetation removal and earthworks associated with the cutting will be clearly visible in the middle ground and will open up longer views towards the background, where plant and machinery associated with the B4009 Nash Lee Road realignment construction activities will be clearly visible. In the centre of the view in the foreground, activities associated with the creation of a balancing pond will be apparent. To the right the B4009 Nash Lee Road overbridge satellite compound will also be partially visible. Given the substantial changes which will occur in the direct field of view, the magnitude of change is considered to be high.

9.4.140 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.141 Lighting associated with the B4009 Nash Lee Road overbridge satellite compound in the middle ground of the view will substantially increase the extent of lighting in the view, when compared to the partially lit peri-urban landscape. On this basis, the magnitude of change to this receptor at night is considered to be high, resulting in a major adverse effect.

Viewpoint 108.4.001: View south-west from the A413 Wendover Road

9.4.142 Large scale plant and machinery will be clearly visible in this view associated with the realignment of the B4009 Nash Lee Road behind the vegetation in the foreground (approximately 100m away). Plant and machinery associated with the formation of the approximately 6.5m deep cutting will be visible beyond the vegetation in the middle ground and above the A413 roundabout. Given the substantial changes which will occur in the direct field of view, the magnitude of change is considered to be high.

9.4.143 The high magnitude of change, assessed alongside the low sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 109.2.001: View east from dwellings on Risborough Road

9.4.144 Views of construction activities at ground level will be partially obscured by the hedgerow in the foreground. However more open views may be attained from first floor windows towards the construction activities located approximately 700m away. Plant and machinery associated with the removal of vegetation, topsoil stripping and earthworks associated with the Proposed Scheme and maintenance loop will be visible within the middle ground. This will be viewed alongside other built elements such as electricity pylons and the buildings of the Triangle Business Park. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.145 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

9.4.146 Additional lighting associated with construction of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 109.4.001: View east from the B4009 Nash Lee Road

9.4.147 Construction activities will be partially screened by vegetation in the foreground and middle ground. Beyond the cluster of properties to the right of the view, plant and machinery associated with vegetation removal and the creation of an approximately 2.5m deep cutting will be visible (approximately 550m away). Between the buildings to the right and the isolated property in the centre of the view, plant and machinery will be visible in the background, where the construction works will be at grade. Behind the isolated property, plant and machinery associated with the elevation of a PRoW will be visible, as will the construction of an approximately 3m high embankment. Further left, vegetation in the foreground and middle ground will obscure views towards the construction activities. Given the partial alteration in the composition of the view, the magnitude of change is considered to be medium.

9.4.148 The medium magnitude of change, assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect.

Cumulative effects

9.4.149 Section 2.1 and Volume 5: Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the construction of the Proposed Scheme. There are no known developments which are assumed to be under construction at the same time as the Proposed Scheme which will result in a consequential cumulative effect on LCA or visual receptors. Cumulative developments which have been considered in the assessment are shown on Maps CT-13-019 to CT-13-021 (Volume 5, Cross Topic Appendix 1 Map Book).

Other mitigation measures

9.4.150 To further reduce the significant effects described above, consideration of where planting can be established early in the construction programme will be given during the detail design stage. This may include consideration of 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 practicably mitigated due to the visibility of construction activity and the sensitivity of surrounding receptors. Therefore, no other mitigation measures are considered practicable during construction.

Summary of likely significant residual effects

9.4.151 These effects will be temporary and reversible in nature lasting only for the duration of the construction works. Any residual effects will generally arise from the widespread presence of construction activity and construction plant within the landscape and viewed from surrounding residential receptors, and users of PRoW and main roads within the study area.

9.5 Permanent effects arising during operation

9.5.1 Specific elements of the Proposed Scheme that have been taken into account in determining the effects on landscape and visual receptors includes, ordered from south to north:

- the Leather Lane overbridge;
- the sustainable placement area;
- the loss of part of Grim's Ditch Scheduled Monument;
- the Bowood Lane overbridge;
- the loss of part of Jones' Hill Wood, an area classified as ancient woodland;
- the Wendover Dean viaduct;
- the Rocky Lane underbridge;
- the Small Dean viaduct;
- the Wendover green tunnel portals;
- the B4009 Nash Lee Road overbridge;
- the A4010 Stoke Mandeville bypass (described in CFA11);
- the presence of earthworks along the Proposed Scheme requiring cut/fill, vegetation removal, noise fence barriers, balancing ponds and modifications to the landform; and
- the presence of high speeding trains and overhead line equipment.

Avoidance and mitigation measures

9.5.2 The operational assessment of impacts and effects is based on year 1 (2026), year 15 (2041) and year 60 (2086) of the Proposed Scheme. A process of iterative design and assessment has been employed to avoid or reduce adverse effects during the operation of the Proposed Scheme. Measures that have been incorporated into the design of the Proposed Scheme include:

- embankments and cuttings, both for the route of the Proposed Scheme and highway realignments, have been shaped so as to integrate the Proposed Scheme into the character of the surrounding landscape. Planting will reflect tree and shrub species native to the landscape;
- where it is considered that a noise fence barrier would create a visual impact on neighbouring residential properties a landscape bund will be provided where reasonably practicable;
- balancing ponds will be integrated into the landscape to alleviate flooding and also provide opportunities for biodiversity; and
- planting, including native broad-leaved woodland, shrub and hedgerows will be implemented along various sections of the Proposed Scheme to screen the high speed passing trains from neighbouring residential properties and users of adjacent PRoW and to aid integration of the Proposed Scheme into the landscape. Selection of species will take into account possible climate change impacts associated with the quality and availability of water and the potential increase in pests and diseases.

9.5.3 These avoidance and mitigation measures have been taken account within the assessment of the operational effects below.

Assessment of impacts and effects

9.5.4 The likely significant effects on the landscape character and viewpoints in operation will arise from:

- new engineered landforms cutting across the existing landscape;
- the presence of new viaducts of approximately 18m height with associated infrastructure;
- the presence of noise fence barriers that will create a manmade linear feature;
- the permanent severance of land;
- the presence of highway and rail infrastructure in the rural environment, including road bridges;
- the presence of overhead line equipment; and
- the presence of regular high speed trains.

9.5.5 At a number of locations, views of the Proposed Scheme will be obscured by the intervening topography, intervening hedgerows and trees and the screening effects achieved by the Proposed Scheme in cutting and mitigation earthworks. Effects will be further reduced over time as the mitigation planting matures.

Landscape assessment

9.5.6 This section describes the significant effects on LCA during year 1, year 15 and year 60 of operation. Effects that are not significant effects for LCA are presented in Volume 5: Appendix LV-001-010, Part 4.

9.5.7 The assessment of effects in year 15 assume proposed planting has grown by approximately 450mm a year (i.e. trees will be 7-7.5m high). The assessment of effects in year 60 assumes all planting has reached its fully mature height.

Wendover Gap LCA

9.5.8 The Proposed Scheme will pass through this LCA between Woodlands Park and Ellesborough Road. The presence of the Proposed Scheme and associated road and PRoW realignments will directly affect this landscape in year 1 of operation. Landscape impacts of the Proposed Scheme will include:

- engineered landforms comprising steep slopes cutting across the natural landform, incongruous in the context of the adjacent landscape;
- presence of overhead line equipment and regular trains visible which, although already presently associated with the Marylebone to Aylesbury Line, introduces additional infrastructure within a largely rural landscape context;
- presence of an approximately 18m high and 500m long viaduct in the vicinity of Wendover Dean and an approximately 14m high and 500m long viaduct in the vicinity of Small Dean;
- presence of the Bowood Lane overbridge;
- presence of the Rocky Lane underbridge;
- presence of PRoW crossings;
- presence of noise fence barriers as a distinct linear feature, contrasting with the natural landscape; and
- presence of the sustainable placement area near Hunt's Green Farm, which comprises farmland at an altered height of up to 5m, approximately 1.3km long and up to 450m wide.

9.5.9 As a result of the presence and visibility of the Proposed Scheme on viaduct or embankment, there will be a noticeable reduction in tranquillity as the Proposed Scheme passes through the farmed landscape in the vicinity of Bowood Lane, Wendover Dean and Kingsash. In other locations the Proposed Scheme will largely be in cutting and any deterioration in the level of tranquillity will be largely derived from the changes associated with vegetation losses and the introduction of overhead line equipment and overbridges will reduce the sense of seclusion in the landscape.

9.5.10 Therefore due to these changes which will be incongruous with the character of the area, the magnitude of change is considered to be medium in year 1 of operation.

9.5.11 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

9.5.12 By year 15 of operation, farming activities will have become well established on land previously used for construction activities to the extent that this land will be indistinguishable from the adjacent wider farmland. Localised changes in topography associated with mitigation earthworks will blend in with the existing surrounding

landscape. Furthermore, planting will have established sufficiently to achieve greater landscape integration of the scheme into the rural landscape, including through:

- reducing the influence of engineered landforms;
- better integrating the Bowood Lane and Rocky Lane road realignments;
- providing increased connectivity in the landscape as hedgerow previously reinstated mature;
- partially screening the overhead line equipment, noise fence barriers and trains on the stretches of embankment either side of the Small Dean viaduct; and
- partially screening the Wendover green tunnel south portal.

9.5.13 However, due to the presence of both the Wendover Dean viaduct and the Small Dean viaduct, which will remain highly apparent, and the consequent changes to the tranquillity of the area and impact upon the setting of the landscape, the magnitude of change will remain medium in year 15 of operation.

9.5.14 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect in year 15 of operation.

9.5.15 By year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming not significant. This is reported in Volume 5: Appendix LV-001-010, Part 4.

Wendover Foothills (West) LCA

9.5.16 The Proposed Scheme will pass through the Wendover Foothills (West) LCA to the west of Wendover and will either be in tunnel or cutting. A notable degree of change in landscape character in the immediate vicinity of the Proposed Scheme will arise as the setting will be impacted through the introduction of additional infrastructure. Landscape impacts of the Proposed Scheme will include:

- engineered landforms comprising steep slopes cutting across the natural landform, incongruous in the context of the wider landscape;
- presence of overhead line equipment and regular trains visible, which although already present within the context of the Marylebone to Aylesbury Line, introduces additional infrastructure within a largely rural landscape context;
- presence of a green tunnel and an associated tunnel portal;
- presence of the B4009 Nash Lee Road overbridge; and
- presence of noise fence barriers as a distinct linear feature, contrasting with the natural landscape.

9.5.17 The operation of the Proposed Scheme in year 1 will discernibly reduce the level of tranquillity, particularly in the vicinity of the B4009 Nash Lee Road realignment. Although the B4009 Nash Lee Road realignment will largely be at grade, this structure will be within an open setting as a result of the loss of vegetation during construction.

Planting proposals at this stage will not provide any integration of the Proposed Scheme.

9.5.18 Therefore, due to these changes which will be incongruous with the character of the area, the magnitude of change is considered to be medium in year 1 of operation.

9.5.19 The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

9.5.20 By year 15 of operation, farming activities will have become well established on land previously used for construction activities to the extent that this land will be indistinguishable from the adjacent wider farmland. Localised changes in topography associated with mitigation earthworks measures will be noticeable but will blend in with the existing surrounding landscape in terms of landform and farming practices. Furthermore, planting will have established sufficiently to achieve greater landscape integration of the scheme into the rural landscape, through the following:

- reducing the influence of engineered landforms;
- better integrating the B4009 Nash Lee Road realignment;
- partially screening the overhead line equipment, noise fence barriers and trains on the stretch in cutting; and
- partially enclosing the Wendover green tunnel portal.

9.5.21 However, due to the continued presence of new landscape components such as the Wendover green tunnel portal and the Proposed Scheme in cutting, the alterations to the landform and the changes to the tranquillity of the area which affect the setting of the landscape, the magnitude of change will remain medium in year 15 of operation.

9.5.22 The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect in year 15 of operation.

9.5.23 By year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming not significant. This is reported in Volume 5: Appendix LV-001-010, Part 4.

Longwick Vale LCA

9.5.24 The Proposed Scheme will pass through the Longwick Vale LCA from B4009 Nash Lee Road towards the site of St. Mary's Church and cemetery (within CFA11). The presence of the Proposed Scheme, in particular the section of the route on an embankment, will affect the character of this area. Landscape impacts of the Proposed Scheme will include:

- engineered landforms comprising steep slopes cutting across the natural landform, incongruous in the context of the wider landscape;
- presence of overhead line equipment and regular trains visible, which although already present within the context of the Marylebone to Aylesbury Line, introduces additional infrastructure within a largely rural landscape context;
- presence of the B4009 Nash Lee Road overbridge;

- presence of the maintenance loop;
- presence of noise fence barriers as a distinct linear feature, contrasting with the natural landscape; and
- presence of the A4010 Stoke Mandeville bypass (described in CFA11).

9.5.25 The tranquillity of this farmed landscape will be noticeably reduced during year 1 of operation of the Proposed Scheme. Direct impacts will arise from the presence of engineered structures along the route such as earthworks and embankments and the increased openness as a result of vegetation losses during the construction period. Therefore, the magnitude of change is considered to be medium in year 1 of operation.

9.5.26 The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

9.5.27 By year 15 and beyond to year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming not significant. This is reported in Volume 5: Appendix LV-001-010, Part 4.

Visual assessment

9.5.28 This section describes the significant effects on visual receptors during year 1, year 15 and year 60 of operation. Effects that are considered to not be significant on visual receptors are presented in Volume 5: Appendix LV-001-010, Part 4.

9.5.29 For each viewpoint the following assessments have been undertaken:

- effects during winter of year 1 of operation;
- effects during summer of year 1 of operation;
- effects during summer of year 15 of operation; and
- effects during summer of year 60 of operation.

9.5.30 Where significant effects have been identified, an assessment of effects at night-time arising from additional lighting has also been undertaken.

9.5.31 The number identifies the viewpoint locations which are shown in Maps LV-04-035 to LV-04-038 (Volume 2, CFA10 Map Book). In each case, the middle number (xxx.**x**.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport, 5: Hotels/Healthcare Institutions, 7: Active Sports.

9.5.32 Where a viewpoint may represent multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with a lower sensitivity may be lower than those reported.

9.5.33 The view of the Proposed Scheme from viewpoint 105.2.002 (illustrated in the photomontage shown in Figure LV-01-053) and viewpoint 105.3.002 (illustrated in the photomontage shown in Figure LV-01-055) (Volume 2, CFA10 Map Book), will not be significantly affected as the Proposed Scheme will be partially screened by the

intervening vegetation and landform from these location, or will be in the Wendover green tunnel.

Viewpoint 095.2.002: View east from dwellings on London Road, Wendover Dean

9.5.34 The overhead line equipment will be visible along the crest of the slope, except where a block of woodland in the middle ground screens this element. The PRoW overbridge realignment to the centre left of this view (approximately 700m away) will be screened by the block of woodland in the middle ground. At this location the Proposed Scheme will be in cutting with no views of the track level of the route. Given the addition of these new features, which will be incongruous with the existing view, the magnitude of change is considered to be medium.

9.5.35 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.36 During summer, mature trees in the middle ground will provide additional screening of the Proposed Scheme in the centre of the view. However, this will not be sufficient to reduce the magnitude of change. Taking the above into account, there will be no change to the assessment during summer.

9.5.37 By year 15 and beyond to year 60 of operation, planting established on the crest of the slope will have matured, providing additional screening to the elements of the Proposed Scheme. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.38 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 095.3.001: View east from the PRoW (Footpath WEN/38) near Wendover Dean

9.5.39 As the Proposed Scheme will be in cutting, the overhead line equipment will be the main visible element (approximately 70m away) across the middle ground and background. The realignment of Bowood Lane will be clearly visible in the background to the left, with vegetation losses apparent. The PRoW in the centre of the view in the foreground and middle ground will be noticeable as a new elevated feature in the landscape. To the right of the view the block of woodland in the middle ground will partially screen the Proposed Scheme. Mitigation planting will not provide any additional screening towards the route at this stage. Given the addition of these new features in the view, the magnitude of change is considered to be medium.

9.5.40 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.41 During summer, mature trees in the middle ground will provide some degree of screening of the overhead line equipment. However given the extent of the Proposed Scheme visible across the view and the presence of a new elevated feature in the foreground and middle ground of the view, the magnitude of change will remain as

medium. Taking the above into account, there will be no change to the assessment during summer.

9.5.42 By year 15 of operation although planting established will have matured, providing some additional screening and improving connectivity in the landscape, elements of the Proposed Scheme will remain visible. Therefore effects will be unchanged.

9.5.43 By year 60, planting will have matured further and will provide additional screening and better integrate the Proposed Scheme into the landscape. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 095.3.002: View east from the South Bucks Way PRoW (Bridleway WEN/45) near Cockshoots Wood

9.5.44 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-044 (Volume 2, CFA10 Map Book).

9.5.45 Views of the route at track level will for the most part be screened by landform where the route will be in cutting. Woodland to the centre and right in the background of this view will also provide extensive visual screening, limiting views to intermittent glimpses of the overhead line equipment. Elevated features such as the Bowood Lane realignment (approximately 1.6km away), PRoW overbridges and the Wendover Dean viaduct (approximately 1.7km away) will be recognisable as new features in the landscape and will be visible to the left of this panoramic view. Vegetation losses associated with the construction period will still be apparent and mitigation planting will not yet provide any additional screening towards the Proposed Scheme. The sustainable placement area at Hunt's Green Farm will be indiscernible to the existing farmland. Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be medium.

9.5.46 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.47 Woodland in the background and the hedgerow vegetation in the middle ground of the view will provide some additional screening towards the Proposed Scheme, although it will not be sufficient to alter the magnitude of change. Taking the above into account, there will be no change to the assessment during summer.

9.5.48 The view of the Proposed Scheme from this location during year 15 of operation is illustrated on the photomontage shown in Figure LV-01-233 (Volume 2, CFA10 Map Book).

9.5.49 By year 15, planting will have established and provide some additional degree of screening, however elements of the Proposed Scheme will still remain visible within this panoramic view. Therefore the magnitude of change is considered to be low, giving rise to a moderate adverse effect.

9.5.50 By year 60, planting will have matured further and will provide additional screening and better integrate the Proposed Scheme into the landscape. This will result in

effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 096.3.002: View west from the PRoW (Footpath TLE/2) off King's Lane

9.5.51 This view will be substantially altered by changes to the natural topography as a result of earthworks associated with the Proposed Scheme in the immediate vicinity of the receptor, including the sustainable placement area at Hunt's Green Farm. Vegetation loss associated with the construction period will still be apparent and reinstated and proposed planting will not yet provide any additional screening towards the Proposed Scheme. In the left and centre of the view, the Proposed Scheme will be in cutting with the overhead line equipment the main visible component (approximately 220m away). To the right, the Proposed Scheme will also be in cutting but the Bowood Lane realignment will be clearly visible at a higher elevation and will be the main visible component. Therefore the magnitude of change is considered to be high.

9.5.52 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.53 In summer of year 1 of operation, effects will be unchanged.

9.5.54 By year 15, although planting will have established and provide some degree of screening, the overhead line equipment will still be visible across a large extent of this panoramic view. Therefore the effects will be unchanged.

9.5.55 By year 60, planting will have matured further and will provide additional screening, better integrating the Proposed Scheme into the landscape. Therefore, the magnitude of change is considered to be medium, giving rise to a moderate adverse effect in the summer of year 60 of operation.

Viewpoint 096.4.002: View west from King's Lane near Potter Row

9.5.56 To the left of this view the Leather Lane overbridge will be clearly visible as a new elevated feature in the landscape (approximately 450m away). The Proposed Scheme at track level will be partially screened by the intervening altered landform associated with the sustainable placement area near Hunt's Green Farm in combination with the reinstated hedgerow bounding the grassed field in the middle ground of the view. There will be glimpsed views of the overhead line equipment along the length of the Proposed Scheme in the view, breaking the predominantly open skyline in the background. Vegetation lost during construction will still be apparent in the view. Given the discernible alteration in the composition of the view, the magnitude of change will be medium.

9.5.57 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.58 In summer of year 1 of operation, effects will be unchanged.

9.5.59 By year 15 and beyond to year 60 of operation, reinstated and proposed planting will have matured, providing some additional screening. This will result in effects that are

not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 097.2.001: View east from dwellings on Bowood Lane, Wendover Dean

9.5.60 The Wendover Dean viaduct will be clearly visible in the middle ground and background of this view (approximately 350m away). Where the Proposed Scheme is in cutting, there will be no views of the track level. Views of the overhead line equipment will also be partially screened by vegetation in the middle ground and foreground of the view. The Bowood Lane realignment will be for the most part screened by vegetation in the foreground, to the right of the view. Mitigation planting connecting two isolated areas of woodland in the background of the view will not yet be mature and vegetation removed during construction will be apparent. Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be high.

9.5.61 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.62 Woodland in the background of the view and the hedgerow vegetation in the middle ground of the view will provide some additional screening towards the Wendover Dean viaduct during the summer of year 1 of operation and the magnitude of change will be medium. Taking the above into account, there will be a moderate adverse effect in summer of year 1 of operation.

9.5.63 By year 15 and beyond to year 60 of operation, planting established will have matured, providing some additional screening and improving connectivity in the landscape. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.64 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 097.2.003: View south-east from Upper Wendoverdean Farm

9.5.65 The Wendover Dean viaduct will be dominant in the middle ground of this view (approximately 400m away), with the overhead line equipment clearly visible along the length of the view, even where the route will be in cutting to the right. Vegetation loss during construction will still be apparent, in particular the loss of a large proportion of Jones' Hill Wood. Mitigation earthworks to the south of the Wendover Dean viaduct will also visibly alter the natural topography. Given the addition of these new features which will be incongruous with the existing view, including a large scale feature in the direct field of view in an AONB setting, the magnitude of change is considered to be high.

9.5.66 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.67 In summer of year 1 of operation, effects will be unchanged.

9.5.68 By year 15 and beyond to year 60 of operation, the lack of intervening planting means effects will remain unchanged.

9.5.69 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 097.3.001: View east from the PRoW (Footpath WEN/37) on Bowood Lane

9.5.70 The Bowood Lane overbridge will be visually prominent to the right of the view in the foreground and middle ground in the immediate vicinity of the receptor. The absence of vegetation, removed during construction, will be conspicuous including that along Bowood Lane in the right of the view, and a large proportion of Jones' Hill Wood to the left of the view in the background. Given these substantial changes in the direct field of this view, the magnitude of change is considered to be high.

9.5.71 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.72 In summer of year 1 of operation, effects will be unchanged.

9.5.73 By year 15 and beyond to year 60 of operation, planting established adjacent to Bowood Lane will have matured and will entirely screen views of the Proposed Scheme and will introduce a new woodland feature which will restrict open views towards the elevated plateau. However, woodland enclosing views in the vicinity of sunken laneways is a common characteristic of the wider Chilterns AONB landscape. The magnitude of change is considered to be medium. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 097.4.001: View north-east from Cobblershill Lane

9.5.74 The Wendover Dean viaduct will be clearly visible in the background of this view (approximately 1.4km away) to the right of Upper Wendoverdean Farm in the distance. To the left of this new elevated feature, the Proposed Scheme will be visible traversing the west-facing valley slopes, broadly following the alignment of the existing electricity pylons. The loss of vegetation, removed during construction will be apparent including the loss of a large proportion of Jones' Hill Wood. In some cases, views of the track level of the Proposed Scheme will be screened by the intervening vegetation, although the overhead line equipment will be visible across the whole of this view. The Rocky Lane underbridge and Wendover auto-transformer station to the left of the view will be screened by the intervening vegetation in the foreground. On the basis of the above the composition of the view will be altered, therefore the magnitude of change will be medium.

9.5.75 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.76 In summer of year 1 of operation, screening afforded by the intervening vegetation will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.77 By year 15 and beyond to year 60 of operation, farming activities in the background of the view will have resumed, largely restoring the appearance of the existing landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 098.2.001: View west from Strawberry Hill Cottage, King's Lane

9.5.78 The Wendover Dean viaduct will be visible in the middle ground of this view (approximately 520m away) against a backdrop of farmland interspersed with blocks of woodland on the opposing side of the valley. To the left the Bowood Lane overbridge realignment will be visible between Strawberry Hill Farm and Jones' Hill Wood in the middle ground with vegetation loss during construction still apparent. In the centre left of the view, the Proposed Scheme will be partially screened by the woodland and intervening landform before leading to the Wendover Dean viaduct. As the route runs across the right of the view it will be visible, albeit with some vegetation in the middle ground providing screening. Mitigation planting to the left of the view connecting together areas of existing woodland will not yet provide any additional screening or improve the composition of the view. Given the addition of these new features in the view, the magnitude of change is considered to be medium.

9.5.79 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.80 During summer, mature trees in the middle ground of the view will provide some degree of screening towards the Proposed Scheme; however this will not be sufficient to alter the magnitude of change. Taking the above into account, there will be no change to the assessment during the summer.

9.5.81 By year 15 and beyond to year 60 of operation, established planting will have matured and will slightly improve the composition of the view, however the effects will remain unaltered.

9.5.82 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 098.3.001: View west from the PRoW (Footpath TLE/3) on Bowood Lane

9.5.83 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-045 (Volume 2, CFA10 Map Book).

9.5.84 The vegetation lost during construction will still be apparent, including a large proportion of Jones' Hill Wood to the right of the view in the middle ground. The mitigation planting will be visually prominent to the right of the view in the foreground and middle ground in the immediate vicinity of the receptor. Given these changes in the view, the magnitude of change is considered to be medium.

9.5.85 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.86 In summer of year 1 of operation, effects will be unchanged.

9.5.87 By year 15 and beyond to year 60 of operation, planting established adjacent to Bowood Lane will have matured and will entirely screen views of the Proposed Scheme and will introduce a new woodland feature which will restrict open views across the valley. However, woodland enclosing views in the vicinity of sunken laneways is a common characteristic of the wider Chilterns AONB landscape. The magnitude of change is considered to be medium. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 098.3.003: View north-west from the PRoW (Footpath TLE/5) near Kingsash

9.5.88 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-046 (Volume 2, CFA10 Map Book).

9.5.89 The Wendover Dean viaduct will be a dominant new feature within the landscape in the middle ground, intruding upon views to the background beyond. The removal of vegetation and the demolition of Durham Farm during construction will be conspicuous (approximately 300m away). Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be high.

9.5.90 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.91 In summer of year 1 of operation, effects will be unchanged due to the open nature of the view.

9.5.92 By year 15 the lack of intervening planting means effects will remain unchanged. By year 60 the Wendover Dean viaduct will have weathered and in combination with mature reinstated planting, the Proposed Scheme will be better integrated into the landscape. The effects however will remain unchanged and will be significant.

Viewpoint 099.2.001: View north-east from The Laurels, Rocky Lane

9.5.93 The realignment of Rocky Lane will be clearly visible, although earthworks designed to blend in with the landform in the adjoining farmland will provide some degree of integration into the landscape in the middle ground in the immediate vicinity of the receptor. However the overhead line equipment will be clearly visible. Vegetation loss during construction will result in more open views. Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be high.

9.5.94 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.95 In summer of year 1 of operation, effects will be unchanged.

9.5.96 By year 15 of operation, reinstated planting will have matured and will better integrate the Rocky Lane realignment into the landscape. Therefore the magnitude of

change is considered to be medium, giving rise to a moderate adverse effect in the summer of year 15.

9.5.97 By year 60 of operation, proposed planting will have further matured and better integrate the Rocky Lane realignment and route of the Proposed Scheme into the landscape. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.98 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 099.3.001: View east from the PRoW (Bridleway GLH/46) at Hampdenleaf Wood near Little Hampden

9.5.99 The Proposed Scheme and overhead line equipment will be visible in the background of this view. It will appear to traverse the west-facing valley slopes broadly following the alignment of the electricity pylons, first in cutting and then on an embankment, with the overhead line equipment apparent along its length. The Wendover Dean viaduct will be visible as a new elevated structure within the Chilterns AONB to the right of this view (approximately 1.9km away). To the left the Rocky Lane underbridge will be visible in the distance, although this new feature will be relatively inconspicuous. Vegetation loss will however still be apparent. On the basis of the above the composition of the view will be distinctly altered, therefore the magnitude of change will be medium.

9.5.100 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.101 In summer of year 1 of operation, effects will be unchanged.

9.5.102 By year 15 and beyond to year 60 of operation, reinstated planting will have matured and provide partial screening whilst the landscape will have largely taken on the appearance of agricultural fields. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 099.4.001: View east from Cobblershill Lane

9.5.103 To the right of this view (approximately 650m away) the Wendover Dean viaduct will be screened by vegetation in the foreground and middle ground of the view. As the route traverses the landscape, views of the tracks will be screened where the route is in cutting; however the overhead line equipment will be visible above the mitigation earthworks. The Wendover auto-transformer station will be partially screened by the earthworks associated with the Proposed Scheme. To the left of the view, the Rocky Lane realignment will be screened by vegetation in the foreground and middle ground. Hedgerow loss will be apparent across the length of the route. Taking the above into account, the magnitude of change is considered to be medium.

9.5.104 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.105 In summer of year 1 of operation, the screening afforded by vegetation in the view will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.106 By year 15 and beyond to year 60 of operation, reinstated planting will slightly improve the composition of the view although effects will remain unchanged from the summer of year 1 of operation and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 100.2.001: View south-west from dwellings at the junction of King's Lane and Rocky Lane, Kingsash

9.5.107 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-048 (Volume 2, CFA10 Map Book).

9.5.108 The Wendover Dean viaduct will be visible in the centre of this view (approximately 750m away) against a partially wooded backdrop in the background of the view. The elevated Bowood Lane realignment will be screened by vegetation in the middle ground and background to the left. As it traverses the landscape, the route will be partially screened by earthworks in the background and vegetation in the middle ground. To the right of the view the Proposed Scheme will be screened by intervening landform in the middle ground. Given the addition of these new features which will be filtered by the intervening vegetation and landform, the magnitude of change is considered to be medium.

9.5.109 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.110 In summer of year 1 of operation, effects will be unchanged.

9.5.111 By year 15 and beyond to year 60 of operation, reinstated and proposed planting will have matured and will slightly improve the composition of the view, however the effects will remain unaltered.

9.5.112 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 100.4.001: View south-west from Rocky Lane, near Kingsash

9.5.113 Elevated features including the Bowood Lane realignment (approximately 1.4km away) and Wendover Dean viaduct (approximately 700m away) will be visible in this view. The absence of vegetation, removed to facilitate construction of the Proposed Scheme, will still be apparent and will partially open up views. The Proposed Scheme will be partially screened by earthworks, designed to blend in with the landscape, and blocks of woodland and pockets of mature vegetation in the middle ground. There will be intermittent, glimpsed views of the overhead line equipment. The rising landform to the right of the view will screen views towards the Proposed Scheme. Mitigation planting in the middle ground in proximity to the Bowood Lane realignment will not

be sufficiently mature to provide any visual screening. Taking the above into account, the magnitude of change is considered to be medium.

9.5.114 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.115 In summer of year 1 of operation, effects will be unchanged.

9.5.116 By year 15 and beyond to year 60 of operation, reinstated and proposed planting will have matured and will slightly improve the composition of the view, however the effects will remain unaltered.

Viewpoint 101.2.002: View east from dwellings near Little London, Dunsmore

9.5.117 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-049 (Volume 2, CFA10 Map Book).

9.5.118 A number of new elevated features will be clearly visible in year 1 of operation, including the Wendover Dean viaduct (approximately 1.4km away), the Bowood Lane realignment and a PRoW overbridge in the background of the view on the other side of the valley. Vegetation loss at these locations and along the length of the route will be apparent in the view. The Proposed Scheme will however for the most part be in a cutting and will therefore be screened. To the left of the view, the Proposed Scheme, including noise fence barriers and overhead line equipment, will be visible at it transitions from cutting to an embankment. Given the addition of these new features in the view, the magnitude of change is considered to be medium.

9.5.119 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.120 During summer mature trees in the middle ground and background of the view will further screen views towards the Proposed Scheme. However, the extent of additional screening will not be sufficient to alter the magnitude of change experienced during winter. Taking the above into account, there will be no change to the assessment during summer.

9.5.121 By year 15 of operation, reinstated and proposed planting will have matured and will further integrate the Proposed Scheme into the landscape. However the magnitude of change is considered to remain medium, giving rise to a moderate adverse effect in the summer of year 15.

9.5.122 By year 60 of operation, proposed planting will have further matured and better integrate the Proposed Scheme into the landscape. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.123 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 101.2.003: View east from dwellings on London Road, Small Dean

9.5.124 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-050 (Volume 2, CFA10 Map Book).

9.5.125 The Proposed Scheme will be prominent across the breadth of this view in the foreground on an embankment, partially restricting views towards the wooded backdrop of the Chilterns Escarpment. Towards the centre right of the view, passing high speed trains will be intermittently visible where not screened by the mitigation earthworks. In this location, the overhead line equipment will also be partially visible, as will a balancing pond in the immediate vicinity of the viewpoint. The absence of vegetation, removed during the construction period, will still be apparent. Mitigation planting will not be sufficiently mature to provide any visual screening nor will it integrate the Proposed Scheme into the landscape at this stage. Given the changes which will occur in this view, the magnitude of change will be high.

9.5.126 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.127 In summer of year 1 of operation, effects will be unchanged.

9.5.128 By year 15 of operation, the lack of intervening planting means effects will remain unchanged.

9.5.129 By year 60 of operation however the proposed planting will soften the appearance of the Proposed Scheme. This will reduce the magnitude of change to medium, giving rise to a moderate adverse effect during the summer of year 60 of operation.

9.5.130 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 101.2.004: View east from dwellings on Small Dean Lane

9.5.131 The Proposed Scheme will be visible extending across farmland on the opposite side of the valley in the context of an expansive landscape. The Wendover Dean viaduct will form a prominent new feature in the view (approximately 1.5km away). The Rocky Lane realignment to the centre left of the view will be visible due to the extent of vegetation loss during construction (approximately 800m away). The Bowood Lane realignment will also be distinguishable in the far right of the view. In the centre of the view, the Wendover auto-transformer station will be largely screened by earthworks. The majority of the route itself will be in a cutting. Vegetation lost during construction will be apparent. Although areas of retained vegetation in the background will provide a degree of softening to the Proposed Scheme, it will be recognisable as a new linear feature in the landscape. Overall, the magnitude of change is considered to be medium.

9.5.132 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.133 In summer of year 1 of operation, effects will be unchanged.

9.5.134 By the summer of year 15 of operation reinstated and proposed planting will have matured further screening the Proposed Scheme. Where the landform has been altered, farming practices will have become well established and the appearance of the land will have been largely restored. However, effects will remain unchanged.

9.5.135 By year 60 of operation reinstated and proposed planting will have further matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.136 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 101.2.005: View east from dwellings on Rocky Lane

9.5.137 The Rocky Lane realignment will be partially screened by vegetation in the foreground and middle ground of this view (approximately 250m away), although some vegetation lost during construction will be apparent against the wooded backdrop of Kingsash. A break in vegetation on the right side of Rocky Lane will be just distinguishable where a new track will lead to the Wendover auto-transformer station. The Proposed Scheme will for the most part be screened by vegetation in the foreground, middle ground and background of the view, although there will be occasional glimpsed views of the overhead line equipment where the Proposed Scheme is on an embankment. Overall, the magnitude of change is considered to be medium.

9.5.138 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.139 In summer of year 1 of operation, effects will be unchanged.

9.5.140 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.141 No significant effects at night-time arising from additional lighting have been identified.

Viewpoint 101.2.006: View north-west from dwellings on London Road, Small Dean

9.5.142 The Small Dean viaduct will be dominant in the middle ground of this mid-distance view (approximately 250m away). Vegetation along the A413 London Road lost during construction will still be apparent in the foreground, partially opening up views. As a consequence, the magnitude of change is considered to be high.

9.5.143 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.144 In summer of year 1 of operation, effects will be unchanged.

9.5.145 By year 15 of operation, the lack of intervening planting means effects will remain unchanged.

9.5.146 By year 60 of operation however the proposed planting will soften the appearance of the Proposed Scheme. This will reduce the magnitude of change to medium, giving rise to a moderate adverse effect during the summer of year 60 of operation.

9.5.147 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 101.3.001: View east from a restricted bridleway off the Icknield Way Trail PRoW (Bridleway WEN/13)

9.5.148 The Small Dean viaduct will be visible at the end of the vista in the background of this view (approximately 30m away). The loss of vegetation as a result of construction will also be apparent. However, mature vegetation in the foreground and middle ground of the view will partially screen views of the along and either side of this narrow vista, limiting the extent of the Proposed Scheme visible. Given the addition of this new feature which will be filtered in the view, the magnitude of change is considered to be medium.

9.5.149 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.150 In summer of year 1 of operation, the screening afforded by vegetation in the view will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.151 By year 15 and beyond to year 60 of operation, effects will remain unchanged from the summer of year 1 of operation and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 101.4.001: View south-east from Dunsmore Lane

9.5.152 The realignment of Bowood Lane will be visible on the higher ground where vegetation losses will be apparent in the centre of this view, albeit at a considerable distance (approximately 2km away) away and will be seen in the context of an expansive view. The Wendover Dean viaduct will also be visible against a wooded backdrop. Views of the track level will be screened by earthworks and/or vegetation in the foreground, middle ground or background for the majority of its length. The nearest point of the Proposed Scheme visible will be approximately 500m away. Taking the above into account, the magnitude of change is considered to be medium.

9.5.153 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.154 In summer of year 1 of operation, effects will be unchanged.

9.5.155 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and

will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 101.4.002: View east from Small Dean Lane

9.5.156 The Small Dean viaduct will be clearly visible against a backdrop of an extensive wooded skyline (approximately 620m away). The loss of some vegetation during construction will be apparent in the background of the view. Woodland in the background will partially screen views of the Proposed Scheme and overhead line equipment. Overall, the magnitude of change is considered to be high.

9.5.157 The high magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.158 In summer of year 1 of operation, effects will be unchanged.

9.5.159 By year 15 and beyond to year 60 of operation, the composition of the view will remain unaltered therefore the effects will be unchanged.

Viewpoint 102.3.001: View south-west from the Ridgeway and the Chiltern Link PRoW (Bridleway WEN/46) on Hogtrough Lane

9.5.160 The Small Dean viaduct will form a focal point in the background of this view (approximately 570m away) at the end of the Beech tree avenue. The loss of some vegetation removed during construction will be apparent due to the realignment of the Boswells Farm access track. To the left of the view the Proposed Scheme and overhead line equipment will be intermittently visible in the background of the view, partially screened by vegetation in the foreground. On the basis of the above, the magnitude of change is considered to be medium.

9.5.161 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.162 In summer of year 1 of operation, the screening afforded by vegetation in the view will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.163 By year 15 and beyond to year 60 of operation, reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 103.2.001: View south-east from dwellings on Ellesborough Road, Wendover

9.5.164 There will be more open views across the landscape during year 1 of operation as a consequence of vegetation losses during construction. To the centre of this view (approximately 50m away), Bacombe Lane will be visible in the background across the now open grassed landscape, whilst similarly to the left, Wendover will be visible. The reinstatement of Ellesborough Road immediately adjacent to the receptor will appear as a new feature in the landscape as the road surface will be contemporary and reinstated planting will be immature, opening up views towards Bacombe Lane. Given

the addition of these new features which will substantially alter the composition of the view close to the viewpoint, the magnitude of change is considered to be high.

9.5.165 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.166 In summer of year 1 of operation, effects will be unchanged.

9.5.167 By year 15 and beyond to year 60 of operation, reinstated hedgerow planting will screen views towards Bacombe Lane. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.168 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 104.3.002: View south-west from the PRoW (Bridleway WEN/14) on Bacombe Lane, Wendover

9.5.169 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-051 (Volume 2, CFA10 Map Book).

9.5.170 To the left of this view, the Proposed Scheme will be dominant in the view, visible extending across the pasture in front of Grove Farm and leading towards the Wendover green tunnel portal which will be located in the centre of the view (approximately 100m away). The Bacombe Lane road realignment will be screened by the Wendover green tunnel portal and intervening vegetation and landform. Vegetation lost during construction will still be apparent, in particular opening up views towards the Wendover green tunnel portal. On the basis of the above, the magnitude of change considered to be high.

9.5.171 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.172 In summer of year 1 of operation, effects will be unchanged.

9.5.173 The view of the Proposed Scheme from this location during year 15 of operation is illustrated on the photomontage shown in Figure LV-01-235 (Volume 2, CFA10 Map Book).

9.5.174 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 105.2.001: View north from dwellings on Ellesborough Road, Wendover

9.5.175 The changes in landform and loss of vegetation and demolition of buildings associated with the Wendover green tunnel will be visible across this panoramic view in the middle ground (approximately 220m away). To the centre left of the view, the overhead line equipment will be partially visible where the route is in cutting to the

left of the Wendover green tunnel portal (approximately 800m away). To the left of the view, the B4009 Nash Lee Road realignment will be visible as a new feature in the background of the view. Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be medium.

9.5.176 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.177 In summer of year 1 of operation, effects will be unchanged.

9.5.178 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape in combination with farming activities resuming and taking on the appearance of that formerly. This will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.179 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 105.3.001: View north-east from the summit of Coombe Hill on the PRoW (Footpath ELL/64)

9.5.180 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-054 (Volume 2, CFA10 Map Book).

9.5.181 Overall the Proposed Scheme will comprise a small element in the context of this panoramic view. To the right the top of the Wendover green tunnel portal will be visible in the context of an agricultural landscape adjacent to the A413 Nash Lee Road, where the route will be seen extending left in the view whilst in cutting (approximately 1.6km away). Further left the B4009 Nash Lee Road realignment will be clearly visible as a new feature in the landscape, as will two further PRoW overbridges. Although visible, the new A4010 Stoke Mandeville bypass (described within CFA11) will be inconspicuous due to the considerable distance (approximately 3km away). Beyond this distance the Proposed Scheme will be barely perceptible, in part due to the increasing distance but also the extent of screening afforded by vegetation. The route will be visible across the extent of this expansive view, therefore the magnitude of change is considered to be medium.

9.5.182 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.183 In summer of year 1 of operation, the screening afforded by vegetation in the view will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.184 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 105.3.003: View east from the summit of Bacombe Hill on the PRoW (Footpath WEN/15C)

9.5.185 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-056 (Volume 2, CFA10 Map Book).

9.5.186 To the left of this view, the B4009 Nash Lee Road realignment will be visible as a new feature in the landscape (approximately 1.8km away), as will two further PRoW overbridges. Although visible, the new A4010 Stoke Mandeville bypass (described within CFA11) to the left of these PRoW overbridges will be relatively inconspicuous. To the right of the view the Proposed Scheme (approximately 750m away) will be screened by extensive woodland in the foreground. In the centre of the view, vegetation in the foreground will partially screen views of the green tunnel, with the landscape reinstated to its former agricultural use. Taking the above into account, the magnitude of change is considered to be medium.

9.5.187 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.188 In summer of year 1 of operation, the screening effects of vegetation in the view will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.189 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape in combination with farming activities resuming and taking on the appearance of that formerly and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 107.2.002: View south-east from dwellings on Nash Lee Road, Nash Lee

9.5.190 The crossing point of the B4009 Nash Lee Road overbridge will be visible in the middle ground and background of this view (approximately 250m away), with the realignment of B4009 Nash Lee Road in the foreground of the view also clearly visible. Vegetation losses associated with the construction period will still be apparent resulting in partial visibility of the overhead line equipment which will be recognisable as a new feature in the landscape. As a consequence, the magnitude of change is considered to be high.

9.5.191 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.192 In summer of year 1 of operation, effects will be unchanged.

9.5.193 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.194 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 108.2.001: View south-west from dwellings on Nash Lee Lane, Wendover

9.5.195 The view of the Proposed Scheme from this location during the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-058 (Volume 2, CFA10 Map Book).

9.5.196 To the left of this view (approximately 90m away) the B4009 Nash Lee Road realignment will be clearly visible as a new feature in the landscape, above the route in cutting, in the centre of the view and extending into the background. To the right of the view only the overhead line equipment will be visible. Vegetation lost during construction will result in more open views in the middle ground. Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be high.

9.5.197 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect in the winter of year 1 of operation.

9.5.198 In summer of year 1 of operation, effects will be unchanged.

9.5.199 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.200 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 109.2.001: View east from dwellings on Risborough Road

9.5.201 Towards the centre and right of this mid-distance view, open views of the route, both of the overhead line equipment and at track level, will be obtained, particularly from first floor levels. The Footpath ELL/20 overbridge (approximately 800m away) elevated above the route will be prominent within a predominantly flat middle and foreground, despite landform alterations. In the middle ground to the left of this view, views of the Proposed Scheme will be partially obstructed by Stoke Grove Farm and its associated vegetation in the foreground. Although the Proposed Scheme will not break the horizon line of the wooded hills in the background, vegetation loss in the middle ground will be noticeable, opening up views towards the Triangle Business Park in the distance. Given the addition of these new features which will be incongruous with the existing view, the magnitude of change is considered to be medium.

9.5.202 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.203 In summer of year 1 of operation, the view towards the Proposed Scheme will be similar to the winter view as it will be across and open arable field, particularly from first floor levels. Taking the above into account, effects will be unchanged.

9.5.204 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.205 Additional lighting associated with operation of the Proposed Scheme will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Viewpoint 109.4.001: View east from the B4009 Nash Lee Road

9.5.206 The Proposed Scheme will be partially screened by vegetation in the foreground and middle ground. Beyond the cluster of properties to the right of the view, the overhead line equipment will be partially visible where the route is in an approximately 2.5m deep cutting (approximately 530m away). Between the cluster of properties to the right of the view and the isolated Flint Cottage in the centre, the Proposed Scheme and overhead line equipment will be visible in the background, where the route will be at grade. At this distance however the Proposed Scheme will be relatively inconspicuous. Behind Flint Cottage, the Footpath ELL/20 overbridge (approximately 600m away) will be visible, as will the approximately 3m high embankment. Further left, vegetation in the foreground and middle ground will obscure views towards the route. Taking the above into account, the magnitude of change is considered to be medium.

9.5.207 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.208 In summer of year 1 of operation, the screening afforded by vegetation in the view will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

9.5.209 By year 15 and beyond to year 60 of operation reinstated and proposed planting will have matured and will better integrate the Proposed Scheme into the landscape and will result in effects that are not considered to be significant. These are reported in Volume 5: Appendix LV-001-010, Part 4.

Cumulative effects

9.5.210 There are no known developments which are assumed to be under construction or operation at the same time as the Proposed Scheme which will result in a consequential cumulative effect on LCA or visual receptors. Cumulative developments which have been considered in the assessment are shown on Maps CT-13-019 to CT-13-021 (Volume 5, Cross Topic Appendix 1 Map Book).

Other mitigation measures

9.5.211 The permanent effects of the Proposed Scheme on landscape and visual receptors have been substantially reduced through incorporation of the measures described previously. Effects in year 1 of operation may be further reduced by establishing

planting early in the construction programme, which will be considered during the detail design stage. This would provide additional screening and greater integration of the Proposed Scheme into the landscape. However, no other mitigation measures are considered practicable due to the high visibility of elements of the Proposed Scheme and the sensitivity of the surrounding receptors.

Summary of likely significant residual effects

9.5.212 In most cases, significant effects will reduce over time as the proposed mitigation planting matures and reaches its designed intention. However, the following residual effects will remain following year 15 of operation:

- moderate adverse effects, which will be at variance with the existing character of the Wendover Gap LCA and the Wendover Foothills (West) LCA, due to the influence engineered landforms and different elements of the Proposed Scheme including viaducts, tunnel portals, trains, noise fence barriers and overhead line equipment will have on the rural landscape. The changes that will occur will not be wholly compatible in the local environment during year 15 of operation. However these effects will dissipate to minor adverse by year 60 of operation, following greater maturity of the proposed planting, and will therefore not be considered significant;
- moderate beneficial effects which will result in a noticeable improvement in the existing views from users of the PRoW network along Bowood Lane (097.3.001 and 098.3.001) as the proposed planting visible will introduce new features into the landscape which are considered to be a special quality of the Chilterns AONB;
- major and moderate adverse effects which will result in a deterioration in the existing views from dwellings and users of PRoW in the vicinity of Wendover Dean, Kingsash and Cockshoots Wood (095.3.001, 095.3.002, 096.3.002, 097.2.003, 098.2.001, 098.3.003, 100.2.001 and 100.4.001), arising from visibility of different elements of the Proposed Scheme including the Wendover Dean viaduct, trains, noise fence barriers and overhead line equipment. However at viewpoints 095.3.001 and 095.3.002, the effects will reduce to minor adverse by year 60 of operation and are considered to not be significant; and
- moderate adverse effects which will result in a deterioration in the existing views from residences in the vicinity of Small Dean on Rocky Lane and off Small Dean Lane (e.g. 099.2.001, 101.2.002, 101.2.004 and 101.4.002) and major adverse effects which will result in a marked deterioration in the existing views from residences on London Road (101.2.003 and 101.2.006) arising from visibility of different elements of the Proposed Scheme including the Small Dean viaduct, the Rocky Lane underbridge, trains, noise fence barriers and overhead line equipment. With the exception of viewpoints 101.2.003 and 101.2.006, by year 60 of operation the effects will not be considered significant.

10 Socio-economics

10.1 Introduction

10.1.1 This section reports the likely significant economic and employment effects during the construction and operation of the Proposed Scheme.

10.1.2 The need for a socio-economic assessment results from the potential for the Proposed Scheme to affect:

- existing businesses and community organisations and thus the amount of local employment;
- local economies, including employment; and
- planned growth and development.

10.1.3 The beneficial and adverse socio-economic effects of the Proposed Scheme are reported at two different levels: route-wide; and CFA. Effects on levels of employment are reported at a route-wide level in Volume 3. Localised effects on businesses and observations on potential local economic effects are reported within each CFA report.

Construction

10.1.4 The proposed construction works will have relevance in terms of socio-economics in relation to the potential employment opportunities arising from construction in the local area (including in adjacent CFA).

Operation

10.1.5 The operation of the Proposed Scheme will have relevance in terms of socio-economics, in relation to the potential employment opportunities created by new business opportunities.

10.2 Scope, assumptions and limitations

10.2.1 The assessment scope, key assumptions and limitations for the socio-economics assessment are set out in Volume 1 and in the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

10.2.2 There have been no variations to the socio-economic assessment methodology arising from engagement with stakeholders and community organisations.

10.3 Environmental baseline

Existing baseline

Study area description

10.3.1 Section 2.1 of this report provides a general overview of the Dunsmore, Wendover and Halton area that includes data of specific relevance to socio-economics notably demographic and employment data. The following section provides a brief overview

in terms of employment, economic structure, labour market, and business premises availability within the area[47].

10.3.2 The route in the area crosses three local authority boundaries, straddling the Chiltern District that includes the largest portion of the area, Aylesbury Vale District and Wycombe District.

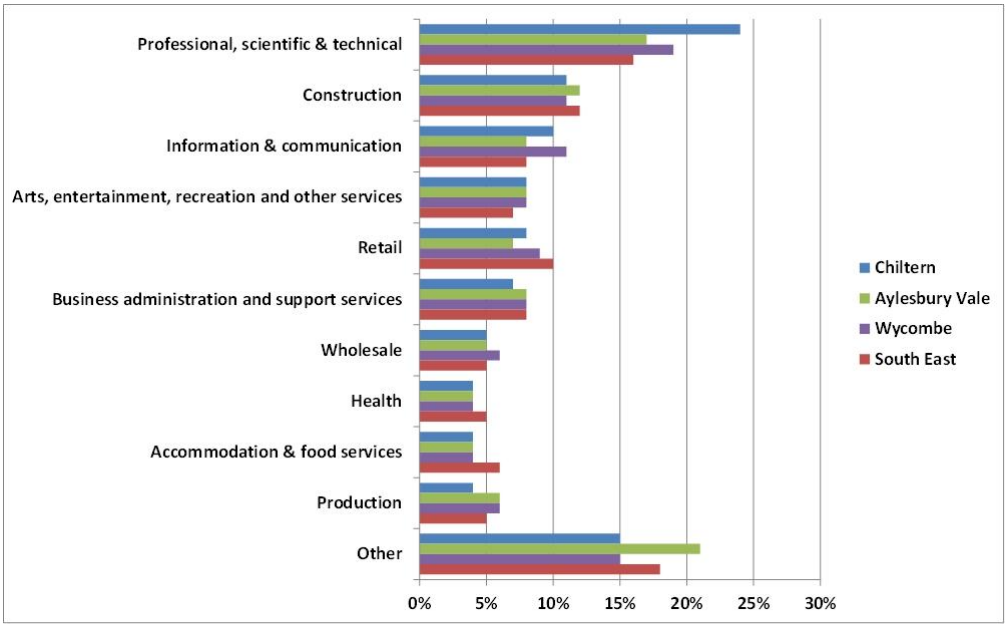
10.3.3 Where possible, baseline data has been gathered on demographic character areas (DCA)[48] to provide a profile of local communities. Map SE-02-011 (Volume 5, Socio-economics Map Book) shows the location of the DCA. The area contains: Wendover Dean; Hunt's Green, Kingsash and Lee Common; Dunsmore; Nash Lee and North Lee; and Wendover DCA.

Business and labour market

10.3.4 Within Chiltern District there is a wide variety of business types reflecting a diverse range of commercial services. The professional, scientific and technical services sector accounts for the largest proportion of businesses (24%), with the construction (11%), information and communication (10%), and arts, entertainment, recreation and other services (8%) sectors also accounting for relatively large numbers of businesses within the district. Within both Aylesbury Vale District and Wycombe District the professional, scientific and technical services sector accounts for the largest proportion of businesses (17% and 19% respectively), with the construction (both 12%), and information and communication (8% and 11% respectively) sectors also accounting for large numbers of businesses within both of districts. This is shown in Figure 6[49]. For comparison, within the South East region, the professional, scientific and technical services sector also accounts for the largest number of businesses (16%), with construction (12%), retail (10%) and information and communication and business administration and support services (both 8%) sectors also accounting for relatively large numbers of businesses within the region[50].

[47] Further information on the socio-economics baseline, with regard to business and labour market profile, within the area are contained in the Volume 5: Appendix SE-001-000.
[48] DCA have been determined through an understanding of local context and aim to be aligned as closely as possible to groups of lower super output areas (LSOAs).
[49] The Figure presents the proportion of businesses within each business sector in the borough but not the proportion of employment by sector
[50] ONS (2012), *UK Business: Activity, Size and Location 2011*, ONS, London. Please note 2011 data has been presented to provide an appropriate comparison with 2011 Census data.

Figure 6: Business sector composition in Chiltern, Aylesbury Vale, and Wycombe Districts and the South East [51] [52]



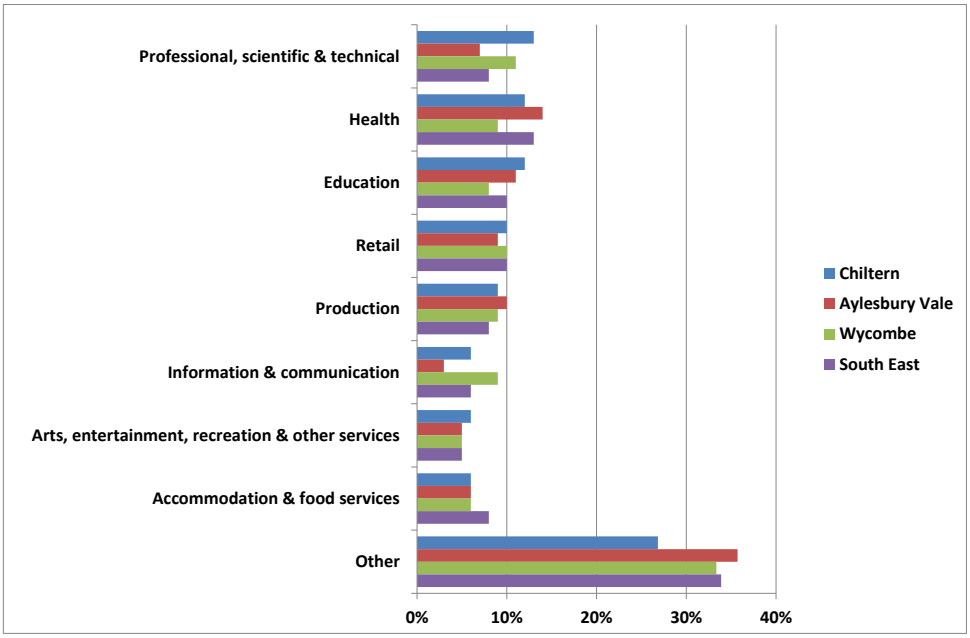
10.3.5 Approximately 31,000 people worked in Chiltern District, 66,000 in Aylesbury Vale and 78,000 in Wycombe while 100 people worked within both Dunsmore and Wendover Dean DCA, 200 within both Nash Lee and North Lee and Hunt's Green, Kingsash and Lee Common DCA and 2,300 in Wendover DCA[53].

10.3.6 According to the ONS Business Register and Employment Survey 201153, the sector with the highest proportion of employment in Chiltern and Wycombe Districts is professional, scientific and technical (14% and 12% respectively). These levels are higher than that recorded across both the South East and England as a whole (both 8%). There is also a high proportion of employment in health in Chiltern District (12%) and in Aylesbury Vale District (14%), that is in line with regional and national levels (both 12%). This is shown in Figure 7.

10.3.7 Key sectors for Wendover Dean DCA are retail (22%), health (20%), accommodation and food services (11%) and arts, entertainment, recreation and other services (10%). For Hunt's Green, Kingsash and Lee Common, key sectors are business administration and support services (15%), retail (12%) and construction (12%). Key sectors within Dunsmore and Nash Lee and North Lee are accommodation and food services (16%), construction (11%), professional, scientific and technical (10%) and education (10%). Within Wendover health (20%) and accommodation and food services (12%) are key sectors.

[51] 'Other' includes agriculture, forestry and fishing, motor trades, transport and storage (including postal), financial and insurance, property, education, and public administration and defence.
[52] ONS (2012), *UK Business: Activity, Size and Location 2011*, ONS, London.
[53] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London.

Figure 7: Proportion of employment by industrial sector in Chiltern, Aylesbury Vale, and Wycombe Districts and the South East[54] [55]



10.3.8 According to the 2011 Census[56], the employment rate[57] within Chiltern District was 69% (that represents 45,000 people). For Aylesbury Vale District the employment rate was 72% (that represents 91,000 people) and for Wycombe District it was 70% (that represents 86,000 people). The rate for each district is higher than both the South East (68%) and England (65%). The employment rate in the Wendover Dean DCA was 64%, 63% in Hunt's Green, Kingsash and Lee Common DCA, 68% in Dunsmore DCA, 67% in Nash Lee and North Lee DCA and 71% in Wendover DCA.

10.3.9 In 2011, the unemployment rates for Chiltern, Aylesbury Vale and Wycombe Districts stood at 4%, 5% and 5% respectively, compared to the England average of 7%. The unemployment rate in the Wendover Dean, Hunt's Green, Kingsash and Lee Common DCA was 5% in each, with 1% recorded in Dunsmore, 2% in Nash Lee and North Lee and 4% in Wendover Dean[58].

10.3.10 According to the 2011 Census 41% of Chiltern District residents, 32% of Aylesbury Vale District residents, and 34% of Wycombe District residents aged 16 and over were qualified to National Vocational Qualification Level 4 (NVQ4), compared to 30% in the South East and 27% in England. Around 15%, 17% and 17% respectively of Chiltern, Aylesbury Vale and Wycombe Districts' residents had no qualifications which is lower than that recorded both for South East (19%) and England (23%).

[55] 'Other' includes agriculture, forestry and fishing, construction, motor trades, wholesale, transport and storage (including postal), financial and insurance, property, business administration and support services and public administration and defence.
[56] ONS (2012), *Census 2011*, ONS, London.
[57] The proportion of working age (16-74 years) residents in employment. Employment comprises the proportion of the total resident population who are 'in employment' and includes full-time students who are employed.
[58] Unemployment figures have been rounded to the nearest whole number. DCA unemployment rates are presented for each DCA in this section while in Section 2 they are shown in aggregate.

10.3.11 According to the 2011 Census, 48% of both Wendover Dean DCA and Hunt's Green, Kingsash and Lee Common DCA residents aged 16 and over were qualified to NVQ4 level, compared to 52% in Dunsmore DCA, 47% in Nash Lee and North Lee DCA and 39% in Wendover DCA. The proportion of residents with no qualifications was 11% in Wendover Dean DCA, 10% in Hunt's Green, Kingsash and Lee Common DCA, 11% in Dunsmore DCA, 12% in Nash Lee and North Lee DCA and 15% in Wendover DCA.

10.3.12 The five DCA are residential areas, set within a predominantly rural and agricultural area, recording high rates of employment, low unemployment and high qualifications attainment.

Future baseline

Construction (2017)

10.3.13 Volume 5: Appendix CT-004-000 provides details of the developments that are assumed to have been implemented by 2017. There are no consents or allocations in this area which are expected to accommodate material additional employment by 2017.

Operation (2026)

10.3.14 Volume 5: Appendix CT-004-000 provides details of the developments that are assumed to have been implemented by 2026. There are no consents or allocations in this area which are expected to accommodate material additional employment between 2017 and 2026.

10.4 Effects arising during construction

Avoidance and mitigation measures

10.4.1 In order to avoid or minimise the environmental impacts during construction, the Proposed Scheme design includes provisions to maintain access to businesses during the construction period.

10.4.2 The draft CoCP (Volume 5: Appendix CT-003-000) includes a range of provisions that will help mitigate the socio-economic effects associated with construction within this local area including:

- 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 (draft CoCP, Section 5);
- reducing nuisance through sensitive layout of construction sites (draft CoCP, Section 5);
- applying best practicable means (BPM) during construction works to reduce noise (including vibration) at sensitive receptors (including local businesses) (draft CoCP, Section 13);
- requiring contractors to monitor and manage flood risk and other extreme weather events which may affect socioeconomic resources during construction (draft CoCP, Sections 5 and 16); and

- site specific traffic management measures including requirements relating to the movement of traffic from business and commercial operators of road vehicles, including goods vehicles (draft CoCP, Section 14).

Assessment of impacts and effects

Temporary effects

Change in business amenity value

10.4.3 No non-agricultural businesses[59] have been identified within the area that are expected to experience significant amenity effects as a result of the Proposed Scheme.

Isolation

10.4.4 No non-agricultural businesses have been identified within the area that are expected to experience significant isolation effects as a result of the Proposed Scheme.

Construction employment

10.4.5 A number of construction compounds for the Proposed Scheme will be located within the Dunsmore, Wendover and Halton area, and will include Small Dean viaduct main compound. These locations are set out in Section 2.3 of this report. The use of these sites will result in the creation of up to 1,600 person years of construction employment[60] opportunities , or approximately 160 full-time equivalent jobs[61], that, 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 assessed as part of the route-wide assessment (Volume 3).

10.4.6 Direct construction employment created by the Proposed Scheme will also lead to opportunities for local businesses to supply the project or to benefit from expenditure of construction workers. The impact of the indirect construction employment creation has been assessed as part of the route-wide assessment (Volume 3).

Cumulative effects

10.4.7 No committed (intra-project) developments have been identified that are considered to interact with the Proposed Scheme.

10.4.8 Cumulative effects arise in relation to the accumulation of individual resource based job displacement/losses on a local labour market. These effects are assessed as part of the route-wide assessment (Volume 3).

Permanent effects

Businesses

10.4.9 Businesses directly affected, i.e. those that lie within land required for the construction of the Proposed Scheme, are reported in groups where possible to form

[59] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level.
[60] 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.
[61] Based on the convention that 10 employment years is equivalent to one full time equivalent job.

defined resources, based on their location and operational characteristics. A group could contain either one or a number of businesses.

10.4.10 From an employment perspective, no significant direct effects on non-agricultural employment have been identified and the Proposed Scheme is not anticipated to result in the displacement or possible loss of jobs within this area.

Cumulative effects

10.4.11 No committed (intra-project) developments have been identified that are considered to interact with the Proposed Scheme.

10.4.12 Cumulative effects arise in relation to the accumulation of individual resource based job displacement/ losses on a local labour market. These effects are dealt with as part of the route-wide assessment (see Volume 3).

Other mitigation measures

10.4.13 The assessment has concluded that there are no significant adverse effects arising during construction in relation to businesses directly affected by the Proposed Scheme.

10.4.14 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the route in terms of supplying goods and services and obtaining employment. HS2 Ltd is committed to working with its suppliers to build a skilled workforce that fuels further economic growth across the UK.

Summary of likely residual significant effects

10.4.15 No residual significant socio-economic effects are likely to arise during construction of the Proposed Scheme.

10.5 Effects arising during operation

Avoidance and mitigation measures

10.5.1 No mitigation measures are required during operation within this area.

Assessment of impacts and effects

Resources with direct effects

10.5.2 There are no resources considered likely to experience significant direct effects during the operational phase of the project within this area.

Change in business amenity

10.5.3 No non-agricultural businesses have been identified within the area that are expected to experience significant amenity effects as a result of the Proposed Scheme.

Operational employment

10.5.4 Operational employment will be created at locations along the route including stations, train crew facilities and infrastructure/maintenance depots that are considered unlikely to be accessed by residents of the area.

10.5.5 Direct operational employment created by the Proposed Scheme could also lead to indirect employment opportunities for local businesses in terms of supplying the project or benefiting from expenditure of directly employed workers on goods and services.

10.5.6 The impact of operational employment creation has been assessed as part of the route-wide assessment (see Volume 3).

Cumulative effects

10.5.7 No committed developments have been identified that are considered to interact with the Proposed Scheme.

Other mitigation measures

10.5.8 The assessment has concluded that operational effects within this section of the route will be either negligible or beneficial and therefore mitigation is not required.

Summary of likely residual significant effects

10.5.9 No residual significant socio-economic effects are likely to arise during operation of the Proposed Scheme.

11 Sound, noise and vibration

11.1 Introduction

11.1.1 This section reports the assessment of the likely noise and vibration significant effects arising from the construction and operation of the Proposed Scheme for the Dunsmore, Wendover and Halton area on:

- people, primarily where they live ('residential receptors') in terms of a) individual dwellings and b) on a wider community basis, including any shared community open areas[62]; and
- community facilities such as schools, hospitals, places of worship, and also commercial properties such as offices and hotels, collectively described as 'non-residential receptors' and 'quiet areas'[63].

11.1.2 The assessment of likely significant effects from noise and vibration on agricultural, community, cultural heritage or ecological receptors and the assessment of tranquillity are presented in Sections 3, 5, 6, 7 and 9 of this report respectively.

11.1.3 In this assessment 'sound' is used to describe the acoustic conditions which people experience as a part of their everyday lives. The assessment considers how those conditions may change through time and how sound levels and the acoustic character of community areas is likely to be modified through the introduction of the Proposed Scheme. Noise is taken as unwanted sound and hence adverse effects are noise effects and mitigation is, for example, by noise barriers.

11.1.4 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 e.g. resulting from changes in traffic patterns on existing roads or railways that result from the construction or operation of the Proposed Scheme.

11.1.5 This section sets out the means to avoid or reduce the adverse effects that may occur.

11.1.6 The approaches to assessing sound, noise and vibration and appropriate mitigation are outlined in Volume 1 and scope and methodology are defined in the following documents:

- Scope and Methodology Report (SMR) (Appendix CT-001-000/1); and
- SMR Addendum (Appendix CT-001-000/2).

11.1.7 More detailed information and mapping regarding the sound, noise and vibration assessment for Dunsmore, Wendover and Halton is available in the relevant appendices in Volume 5:

[62] 'shared community open areas' are those that the emerging National Planning Practice Guidance identifies may partially offset a noise effect experienced by residents at their dwellings and are either a) relatively quiet nearby external amenity spaces for sole use by a limited group of residents as part of the amenity of their dwellings or b) a relatively quiet external publicly accessible amenity space (e.g. park to local green space) that is nearby.

[63] Quiet areas are defined in the Scope and Methodology Report as either Quiet Areas as identified under the Environmental Noise Regulations or are resources which are prized for providing tranquillity (further information is provided in Volume 5: Appendix SV-001-000).

- sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000);
- sound, noise and vibration baseline (Appendix SV-002-010);
- sound, noise and vibration construction assessment (Appendix SV-003-010);
- sound, noise and vibration operation assessment (Appendix SV-004-010); and
- Map Series SV-01, SV-02, SV-03 and SV-04 (Volume 5, Sound, Noise and Vibration Map Book).

11.2 Environmental baseline

Existing baseline

11.2.1 The existing baseline sound environment for this area is moderately varied, reflecting the context of a mixture of small towns, villages, hamlets and isolated properties in a largely rural setting.

11.2.2 The largest settlement in the area is Wendover. Transport infrastructure through Wendover includes road links and the Marylebone to Aylesbury line. The main roads connecting Wendover to neighbouring towns include the A413 Nash Lee Road, the B4009 Aylesbury Road/Tring Road, and Ellesborough Road. Traffic on these main roads forms the dominant sound source for much of Wendover. Daytime sound levels in locations close to busy roads are typically 55 to 60dB[64]. In addition to the road traffic, other sound sources in the area include trains on the Marylebone to Aylesbury line and intermittent over-flying aircraft. Away from busy roads, the sound environment is still generally dominated by road traffic, but daytime sound levels are typically around 50dB.

11.2.3 Sound levels are lower at night as traffic flows reduce, typically 50 to 55dB[65] in locations close to busier roads and around 45dB away from these roads.

11.2.4 In some of the outlying areas of Wendover, whilst road traffic on the main roads remains the dominant sound source, this is perceived as being 'distant' and natural and agricultural sounds are more prevalent. Daytime sound levels in these areas are typically 45 to 50dB, dropping to around 40dB overnight.

11.2.5 In the rural areas further away, from Wendover, the acoustic character generally includes the sound of distant road traffic and, in some locations, agricultural activities and natural sounds. Sound levels can vary considerably, dependent on the proximity of local roads, but daytime levels are typically 45 to 50dB and night-time around 40dB. RAF Halton lies to the north east of Wendover and military helicopters are occasionally heard.

11.2.6 Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for this area in Volume 5: Appendix SV-002-010.

[64] Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,\ 16hr.}$

[65] Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,\ 8hr.}$

11.2.7 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[66]. Vibration at all receptors from the Proposed Scheme has therefore been assessed using specific thresholds, below which receptors will not be affected by vibration. Further information is provided in Volume 1, Section 8.

Future baseline

11.2.8 Without the Proposed Scheme, existing sound levels in this area are likely to increase slowly over time. This is primarily due to road traffic growth with growth also planned on the Marylebone to Aylesbury line. Changes in car technology may offset some of the expected sound level increases due to traffic growth on low speed roads. On higher speed roads[67], tyre sound dominates and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

Construction (2017)

11.2.9 The assessment of noise from construction activities assumes a baseline year of 2017 which represents the period immediately prior to the start of the construction period. As a reasonable worst case, it has been assumed that no change in baseline sound levels will occur between the existing baseline (2012/13) and the future baseline year of 2017. The assessment of noise from construction traffic assumes a baseline year of 2021, representative of the middle of the construction period when the construction traffic flows are expected to be at their peak. Further information can be found in the Traffic and Transport assessment in Section 12.

Operation (2026)

11.2.10 The assessment is based upon the predicted change in sound levels that result from the Proposed Scheme. The assessment initially considered a worst case (that would overestimate the change in levels) by assuming that sound levels would not change from the existing baseline year of 2012/2013. Where significant effects were identified on this basis, the effects have been assessed using a baseline year of 2026 to coincide with the proposed start of passenger services. The future baseline is for the sound environment that would exist in 2026 without the Proposed Scheme.

11.3 Effects arising during construction

Local assumptions and limitations

Local assumptions

11.3.1 The construction arrangements that form the basis of the assessment are presented in Section 2.3 of this report.

11.3.2 Although it is anticipated that there may be some short term night-time working during road and rail possession periods, it is expected that the noise effects would be limited in duration and hence are not considered to be significant.

[66] Further information is available in the Volume 5: Appendix SV-001-000, the SMR and its Addendum.

[67] Tyre noise typically becomes the dominant sound source for steady road traffic at speeds above approximately 30mph

11.3.3 The assessment takes account of people's perception of noise throughout the day. More stringent criteria are applied during evening and night-time periods, when people are more sensitive to noise, compared to the busier and more active daytime period.

Local limitations

11.3.4 In this area, there are a number of locations where the land or property owners did not permit baseline sound level monitoring to be undertaken at their premises. However, sufficient information has been obtained to undertake the assessment. Further information is provided in Volume 5: Appendix SV-002-010.

Avoidance and mitigation measures

11.3.5 The assessment assumes the implementation of the principles and management processes set out in the draft CoCP which are:

- Best Practicable Means (BPM) as defined by the Control of Pollution Act 1974 (CoPA) and Environmental Protection Act 1990 (EPA) will be applied during construction activities to minimise noise (including vibration) at neighbouring residential properties;
- as part of BPM, mitigation measures are applied in the following order:
  - noise and vibration control at source: for example the selection of quiet and low vibration equipment, review of construction methodology to consider quieter methods, location of equipment on site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings[68];and then
  - screening: for example local screening of equipment or perimeter hoarding;
- where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary re-housing will be offered in accordance with the draft CoCP noise insulation and temporary re-housing policy;
- lead contractors will seek to obtain prior consent from the relevant local authority under Section 61 of CoPA for the proposed construction works. The consent application will set out BPM measures to minimise construction noise, including control of working hours, and provide a further assessment of construction noise and vibration including confirmation of noise insulation / temporary re-housing provision;
- contractors will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to and be reviewed by the Nominated Undertaker and will be made available to the local authorities; and
- contractors will be required to comply with the terms of the CoCP and

[68] Warning signals that consist of bursts of noise

appropriate action will be taken by the Nominated Undertaker as required to ensure compliance.

11.3.6 In addition to this mitigation, taller screening as described in the draft CoCP[69] has been assumed along edge of the construction site boundary adjacent to the residential communities along Nash Lee Road and, to the south west of Wendover, Ellesborough Road and Bacombe Lane.

11.3.7 Noise insulation will be offered for qualifying buildings as defined in the draft CoCP noise insulation and temporary re-housing policy. Noise insulation or ultimately temporary re-housing will avoid residents being significantly affected[70] by levels of construction noise inside their dwellings. The assessment reported in this section provides an estimate of the buildings that are likely to qualify for such measures.

11.3.8 Qualification for noise insulation and temporary re-housing will be identified as part of seeking prior consent from the local authorities under Section 61 of the CoPA. Qualifying buildings will be identified early enough so that noise insulation can be installed, or temporary re-housing provided, before the start of the works predicted to exceed noise insulation or temporary re-housing criteria. Noise insulation, where required, will be installed as early as possible to reduce internal sound levels from construction activities and also when the Proposed Scheme comes into operation.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.3.9 Taking account of the avoidance and mitigation measures set out in the previous paragraphs, the three residential buildings on Bacombe Lane and approximately 10 residential buildings on Ellesborough Road that are closest to the construction boundary are forecast to experience noise levels higher than the noise insulation trigger levels as defined in the draft CoCP. For daytime construction the trigger level is 75dB[71] measured outdoors.

11.3.10 The mitigation measures, including noise insulation, will reduce noise inside all dwellings, including those mentioned in the previous paragraph, such that it does not reach a level where it would significantly affect70 residents.

Residential receptors: direct effects –communities

11.3.11 The avoidance and mitigation measures in this area will avoid airborne construction noise adverse effects70 on the majority of receptors and communities. Residual temporary noise or vibration effects are identified later in this section.

11.3.12 With regard to noise outside dwellings, the assessment of temporary effects takes account of construction noise relative to existing sound levels.

11.3.13 In locations with lower existing sound levels[72], construction noise effects70 are likely to be caused by changes to noise levels outside dwellings. These may be considered

[69] As described in the draft CoCP, provided as necessary by solid temporary hoarding, temporary earth stockpiles, and screening close to the activities or other means to provide equivalent noise reduction.
[70] Information is provided in the emerging National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk.
[71] $L_{pAeq,0800\text{-}1800}$ measured at the facade
[72] Further information is provided in Volume 5: Appendix SV-001-000.

by the local community as an effect on the acoustic character of the area and hence be perceived as a change in the quality of life. These effects are considered to be significant when assessed on a community basis taking account of the local context[73] as identified in Table 13.

Table 13: Direct adverse effects on residential communities and shared open areas that are considered to be significant on a community basis

Significant effect number (see Volume 5 Appendix SV-003-010)	Type of significant effect	Time of day	Location	Cause (construction activities)	Assumed approximate duration of impact
CSV10-C01	Noise	Daytime	Wendover: approximately 5 dwellings on Bacombe Lane	Wendover green tunnel construction, earthworks with typical and highest monthly noise levels of around 70dB and 75dB	16 months
CSV10-C02	Noise	Daytime	Wendover: approximately 20 dwellings on Ellesborough Road	Wendover green tunnel, earthworks and Ellesborough Road, earthworks with typical and highest monthly noise levels of 60-70dB and 65-80dB	–up to 15 months

Residential receptors: indirect effects

11.3.14 Significant noise effects on residential receptors arising from construction traffic are unlikely to occur in this area.

Non-residential receptors: direct effects

11.3.15 Significant construction noise or vibration effects have been identified on a reasonable worst case basis on the following non-residential receptors:

- Chiltern Way Federation School, Wendover Campus, Wendover (CSV10-N01). Significant noise effects[74] have been identified during the daytime with noise levels rising at times to 60dB[75] during the construction of the Wendover Green Tunnel;
- St Mary's Church, Wendover (CSV10-N02). Significant noise effects have been identified during the daytime with noise levels rising at times to 60dB during the construction of the Wendover Green Tunnel; and
- Community Hall, Witchell Road, Wendover (CSV10-N03). Significant noise effects have been identified during the daytime with noise levels rising at times to 60dB during the construction of the Wendover Green Tunnel.

[73] Further information is provided in SV-001-000 and SV-003-010.
[74] Activity disturbance, especially for activities that require good conditions for verbal communication
[75] Equivalent continuous sound level at the facade, $L_{pAeq, 0700-1900}$.

Non-residential receptors: indirect effects

11.3.16 Significant noise effects on non-residential receptors arising from construction traffic are unlikely to occur in this area.

Cumulative effects from the Proposed Scheme and other committed development

11.3.17 This assessment has considered the potential cumulative construction noise effects of the Proposed Scheme and other committed developments[76]. In this area, planning consent has been approved for a construction project at Chiltern Way Federation School, Wendover Campus, Church Lane, Wendover that may be built at the same time as the Proposed Scheme. If the construction at the school coincides with that of the Proposed Scheme then adverse noise effects may be prolonged or increased in magnitude at the following non-residential receptors:

- Chiltern Way Federation School, Wendover Campus on Church Lane, (CSV10-No1); and
- St Mary's Church on Church Lane (CSV10-No2).

Summary of likely residual significant effects

11.3.18 The avoidance and mitigation measures reduce noise inside all dwellings from the construction activities such that it is does not reach a level where it would significantly affect70 residents.

11.3.19 The measures reduce any adverse effects from construction noise outdoors on the majority of residential communities such that they are not considered significant except at the residential communities along Ellesborough Road and Bacombe Lane on the edge of Wendover that are closest to the works.

11.3.20 On a reasonable worst case basis, noise from specific construction activities has been identified as resulting in significant residual temporary effects on the following non-residential properties in Wendover:

- Chiltern Way Federation School, Wendover Campus;
- St Mary's Church; and
- Community Hall, Witchell Road.

11.3.21 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 receptor, its use and the benefit of the measures. The outcome of these activities will be reflected in the Environmental Minimum Requirements.

[76] Refer to Volume 5: Appendix CT-004-000.

11.4 Effects arising during operation

Local assumptions and limitations

Local assumptions - service pattern

11.4.1 The effects of noise and vibration from the operation of the Proposed Scheme have been assessed based on the highest likely train flows, including the Phase Two services. Trains are expected to be 400m long during peak hours and a mix of 200m and 400m long trains at other times.

11.4.2 The expected passenger service frequency for both Phase One, and Phase One with Phase Two services are described in Volume 1[77]. As a reasonable worst case, this assessment is based upon the service pattern for Monday to Saturday including Phase Two services. Passenger services will start at or after 05:00 from the terminal stations and in this area will progressively increase to the number of trains per hour in each direction on the main lines set out in Table 14. This number of services is assumed to operate every hour from 07:00 to 21:00. The number of services will progressively decrease after 21:00 and the last service will arrive at terminal stations by 24:00. Train speeds are shown in Table 14.

Table 14: Train flows and speeds

Description of line	Time period for peak daytime flows	Number of trains per hour in each direction with Phase Two services (Phase One only trains per hour in each direction is set out in brackets)	Speed
Main line between London and the north	0700 - 2100 hours	18 (14)	330kph for timetabled trains (assumed 90% of services), and 360kph for 10% of services

Local assumptions - tunnelled sections

11.4.3 Tunnel portals are likely to include mechanical ventilation equipment. It is likely that this equipment will only operate for limited testing periods during the daytime[78], or in the event of an emergency.

Avoidance and mitigation measures

11.4.4 The development of the Proposed Scheme has, as far as reasonably practicable, kept the alignment away from main communities and low in the ground. These avoidance measures have protected many communities from likely significant noise or vibration effects.

Airborne noise

11.4.5 HS2 trains will be quieter than the relevant current European Union specifications. 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. The track will be specified to reduce noise, as

[77] The change in noise and vibration effects between the different passenger services is assessed in Volume 1
[78] For example, HS1 vent shaft fans are tested monthly.

will the maintenance regime. Overall these measures would reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on the new track. Further information is provided in Volume 5: Appendix SV-001-000.

11.4.6 To avoid or reduce significant airborne noise effects, the Proposed Scheme incorporates noise barriers in the form of engineering cuttings, landscape earthworks, noise fence barriers and / or 'low-level' barriers on underbridges and viaducts. Noise barrier locations are shown on Map Series SV-05 (Volume 2, CFA10 Map Book).

11.4.7 Generally, the assessment has been based on noise barriers having a noise reduction performance equivalent to a noise fence barrier with a top level 3m above the top of the rail, which is acoustically absorbent on the railway side, and which is located 5m to the side of the outer rail. In practice, barriers may differ from this description, but will provide the same acoustic performance. For example, where noise barriers are in the form of landscape earthworks they will need to be higher above rail level to achieve similar noise attenuation to a 3m barrier because the crest of the earthwork will be further than 5m from the outer rail.

11.4.8 The Proposed Scheme incorporates 'low-level' barriers into the design of viaducts. Where needed to avoid or reduce significant airborne noise effects, these barriers feature and absorptive lining on the rail side and are designed to provide noise reduction that is equivalent to a 2m high absorptive noise barrier located on the parapet of the viaduct. Locating these 'low-level' barriers close to the rail also reduces visual impact and limits the mass of the viaduct itself.

11.4.9 Taller noise barriers (4m above rail) have been incorporated in to the scheme on the approach to the southern portal of the Wendover green tunnel. This is to further reduce the adverse noise effects on the south-western edge of the settlement.

11.4.10 Noise effects are reduced in other locations along the line by landscape earthworks provided to avoid or reduce significant visual effects and engineering structures such as cuttings and safety fences on viaducts (where noise barriers are not required). The location of these barriers is shown on Map Series SV-05 (Volume 2, CFA10 Map Book).

11.4.11 The Proposed Scheme also includes a green tunnel at Wendover. Tunnel portals will be designed to avoid any significant airborne noise effects caused by the trains entering the tunnel.

11.4.12 Significant noise effects from the operational static sources such as mechanical ventilation at tunnel portals and line-side equipment will be avoided through their design and the specification of noise emission requirements (for further information please see Volume 5: Appendix SV-001-000).

11.4.13 Noise insulation measures will be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996[79] (the Regulations). The assessment reported in this section provides an estimate of the buildings that are likely to qualify under the Regulations. Qualification for noise

[79] Her Majesty's Stationery Office (1996), The Noise Insulation (Railways and Other Guided Transport Systems) Regulations, London.

insulation under the Regulations will be identified and noise insulation offered at the time that the Proposed Scheme becomes operational.

11.4.14 Where required, as well as improvements to noise insulation of windows facing the railway, ventilation will be provided so that windows can be kept closed to protect internal sound levels.

11.4.15 Following Government's emerging National Planning Practice Guidance[80], where the noise from the use of the Proposed Scheme measured outside a dwelling exceeds the Interim Target defined by the WHO Night Noise Guidelines for Europe[81], residents are considered to be significantly affected by the resulting noise inside their dwelling. The effect on people at night due to the maximum sound level as each train passes has also been assessed[82]. The Interim Target is a lower level of noise exposure than the Regulations trigger threshold for night noise. In these particular circumstances, where night-time noise levels for the use of new or additional railways authorised by the Bill are predicted following the methodology set out in the Regulations to exceed 55dB[83], or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion82, noise insulation will be offered for these additional buildings.

Ground-borne noise and vibration

11.4.16 Significant ground-borne noise or vibration effects will be avoided or reduced through the design of the track and track-bed.

Assessment of impacts and effects

Residential receptors: direct effects –individual dwellings

11.4.17 The assessment has identified a number of residential buildings close to the Proposed Scheme where the daytime forecast noise level does not exceed the threshold set in the Regulations but the forecast night-time noise level would exceed the World Health Organization's Interim Target of 55dB[81], or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion[82]. It is estimated that these buildings will also be offered noise insulation as described previously in the Avoidance and mitigation measures section. These buildings are indicated on Map Series SV-05 (Volume 2, CFA10 Map Book):

- Hartley Farm, Rocky Lane;
- Larkfield, Bacombe Lane, Wendover;
- Long Meadow, Bacombe Lane, Wendover; and
- Cobwebs, Bacombe Lane, Wendover.

11.4.18 These properties are also identified as being likely to qualify for noise insulation as a consequence of construction noise as described earlier in this section.

[80] National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk.
[81] World Health Organization, Night-time Noise Guidelines for Europe, 2010.
[82] During the night (2300-0700) a significant effect is also identified where the Proposed Scheme results in a maximum sound level at the façade of a building at or above: 85 dB L_{pAFmax} (where the number of train pass-bys exceeding this value is less than or equal to 20); or 80 dB L_{pAFmax} (where the number of train pass-bys exceeding this value is greater than 20).
[83] Equivalent continuous level, $L_{pAeq,\ 23:00\text{-}07:00}$ measured without reflection from the front of buildings.

11.4.19 The mitigation measures including noise insulation will reduce noise inside all dwellings such that it will not reach a level where it would significantly affect residents.

Residential receptors: direct effects –communities

11.4.20 The mitigation measures in this area will avoid airborne noise adverse effects on the majority of receptors, and at the following communities:

- Hunt's Green;
- Wendover Dean (except as identified in Table 15);
- Kingsash;
- Wendover (except as identified in Table 15); and
- Nash Lee (except as identified in Table 15).

11.4.21 Taking account of the envisaged mitigation, Map Series SV-05 (Volume 2, CFA10 Map Book) shows the long term 40dB[84] night-time sound level contour from the operation of trains on the Proposed Scheme. The extent of the 40dB night-time sound level contour is equivalent to, or slightly larger than, the 50dB daytime contour[85]. In general, below these levels adverse effects are not expected.

11.4.22 Above 40dB during the night and 50dB during the day the effect of noise is dependent on the baseline sound levels in that area and the change in sound level (magnitude of effect) brought about by the Proposed Scheme. The airborne noise impacts and effects forecast for the operation of the scheme are presented on Map Series SV-05 (Volume 2, CFA10 Map Book).

11.4.23 The changes in noise levels are likely to affect the acoustic character of the area such that there is a perceived change in the quality of life and are considered to be significant when assessed on a community basis[86] taking account of the local context[87] as identified in Table 15.

Table 15: Direct adverse effects on residential communities and shared open areas that are considered significant on a community basis

Significant effect number (see Map series SV-05)	Source of significant effect	Time of day	Location and details
OSV10-C01	Airborne noise increase from new train services	Daytime and night-time	Wendover Dean south. Approximately 10 dwellings in the vicinity of Bowood Lane and London Road. Forecast increases in sound from the railway are likely to cause a moderate adverse effect on the acoustic character of the area around the properties. There are no shared open spaces identified as being affected in this community area.
OSV10-C02	Airborne noise increase	Daytime and night-	Wendover Dean north. Approximately 15 dwellings in the vicinity of Rocky Lane and Chesham Lane. Forecast increases

[84] Defined as the equivalent continuous sound level from 23:00 to 07:00 or $L_{pAeq, night}$).
[85] With the train flows described in the assumptions section of this CFA Report, the daytime sound level (defined as the equivalent continuous sound level from 07:00 to 23:00 or $L_{pAeq, day}$) from the Proposed Scheme would be approximately 10dB higher than the night-time sound level. The 40dB contour therefore indicates the distance from the Proposed Scheme at which the daytime sound level would be 50dB.
[86] Further information is contained in Volume 1.
[87] Further information is provided in SV-001-000 and SV-004-010.

Significant effect number (see Map series SV-05)	Source of significant effect	Time of day	Location and details
	from new train services	time	in sound from the railway are likely to cause a major adverse effect on the acoustic character of the area around the very closest properties to the Proposed Scheme reducing to a minor effect at those furthest away. There are no shared open spaces identified as being affected in this community area.
OSV10-C03	Airborne noise increase from new train services	Daytime and night-time	Wendover south. Approximately 10 dwellings in the vicinity of Bacombe Lane. Forecast increases in sound from the railway are likely to cause a major adverse effect on the acoustic character of the area around the three very closest properties to the Proposed Scheme reducing to a minor effect at those furthest away. There are no shared open spaces identified as being affected in this community area.
OSV10-C04	Airborne noise increase from new train services	Daytime and night-time	Nash Lee. Approximately 20 dwellings in the vicinity of Nash Lee Lane. Forecast increases in sound from the railway are likely to cause a moderate adverse effect on the acoustic character of the area around these properties. No shared open spaces have been identified as being affected in this community area.

Residential receptors: indirect effects

11.4.24 The assessment of operational noise and vibration indicates that significant indirect effects on residential receptors are unlikely to occur in this area.

Non-residential receptors: direct effects

11.4.25 The assessment of operational noise and vibration indicates that significant effects are likely on the non-residential receptors identified in Table 16.

11.4.26 The assessment of effects on non-residential receptors has been undertaken on a worst case basis taking account of publicly available information about each receptor. Further information can be found in Volume 5: Appendix SV-004-010.

Table 16: Likely significant noise or vibration effects on non-residential receptors arising from operation of the Proposed Scheme

Significant effect number (see Map series SV-05)	Type of significant effect and source	Time of day	Location and details
OSV10-N01	Minor airborne noise effect on the acoustic character around the church and on a worst case basis there is a risk of disturbing activities inside church buildings due to the operation of train services.	Daytime and night-time	St. Mary's Church, Wendover, which is also used for live music performance.

11.4.27 The assessment of adverse any adverse effect of noise inside St. Mary's Church is on a worst case basis. It assumes that any activities that are more sensitive to noise take place in the internal areas of the church that have windows doors or other openings (for example on the bell tower) on the façade facing the route, that little sound

insulation is provided by the windows, doors or other openings and that there is no disturbance from existing sound sources.

Non-residential receptors: indirect effects

11.4.28 The assessment of operational noise and vibration indicates that significant indirect effects are unlikely to occur on non-residential receptors in this area.

Summary of likely significant residual effects

11.4.29 The mitigation measures reduce noise inside all dwellings such that it does not reach a level where it would significantly affect70 residents.

11.4.30 Taking account of the mitigation measures and the local context, the residual adverse noise effects70 on the acoustic character around the residential communities at Wendover Dean south (in the vicinity of Bowood Lane and London Road), Wendover Dean north (in the vicinity of Rocky Lane and Cheshunt Lane), Wendover south (in the vicinity of Bacombe Lane) and Nash Lee (in the vicinity of Nash Lee Lane and Nash Lee Road) are considered significant on a community basis.

11.4.31 On a reasonable worst case basis a significant noise effect has been identified on St. Mary's Church, Wendover.

11.4.32 HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid these significant effects. In doing so HS2 Ltd will continue to engage with stakeholders to fully understand the receptor, its use and the benefit of the measures. The outcome of these activities will be reflected in the Environmental Minimum Requirements.

12 Traffic and transport

12.1 Introduction

12.1.1 This section describes the likely impacts on all forms of transport and the consequential effects on transport users arising from the construction and operation of the Proposed Scheme through the Dunsmore, Wendover and Halton area.

12.1.2 With regards to traffic and transport, the main issues as a result of construction of the Proposed Scheme are traffic generated during construction and the closures of both roads and PRoW, either temporarily or in some cases permanently, with associated diversions.

12.1.3 The effects on traffic and transport have been assessed quantitatively, based on baseline conditions and future projection scenarios.

12.1.4 A detailed report on traffic and transport and surveys undertaken within the area is contained in the Volume 5: Appendix TR-001-000, Transport Assessment.

12.1.5 Figure 2 shows the location of the key infrastructure in this area.

12.1.6 Engagement has been undertaken with the transport authority Buckinghamshire County Council (BCC).

12.2 Scope, assumptions and limitations

12.2.1 The assessment scope, key assumptions and limitations for the traffic and transport assessment are set out in Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5 CT-001-000/2). This report follows the standard methodology.

12.2.2 The study area includes the A413 London Road / Nash Lee Road, A4010 Risborough Road, B4009 Nash Lee Road and local roads that and local roads that are affected by the Proposed Scheme.

12.2.3 A number of transport modelling tools have been used to inform the assessment including the Department for Transport's traffic forecasting tool, Trip End Model Presentation Program (TEMPRO), for future forecasting of road traffic growth in the area. The assessment covers morning (08:00 to 09:00) and evening (17:00 to 18:00) peak periods for an average weekday.

12.2.4 It has been assumed that bus services for the future years of assessment will be the same as those currently operating, since it is not possible to forecast how services may change in the future.

12.2.5 Forecast future year traffic flows with and without the Proposed Scheme have been based on an approach that does not take account of wider effects such as the redistribution and reassignment of traffic, modal shift and peak spreading. As a consequence, adverse transport effects may be over-stated.

12.3 Environmental baseline

Existing baseline

12.3.1 Existing conditions in the Dunsmore, Wendover and Halton area have been determined through site visits, specially commissioned transport surveys, and liaison with relevant transport authorities and stakeholders to source traffic data, information on public transport, PRoW and accident data.

12.3.2 Traffic surveys were undertaken to establish current traffic flows on the road network subject to assessment during September 2012 and February 2013. The surveys comprised of automatic traffic counts, junction turning counts and queue surveys. This was supplemented by traffic and transport data obtained from other sources where available, including from BCC.

12.3.3 PRoW surveys were undertaken in August and September 2012 to establish the nature of the PRoW and their usage by pedestrians, cyclists and equestrians (non-motorised users). The surveys included all PRoW and roads that will cross the Proposed Scheme, and any additional PRoW that will be affected by the Proposed Scheme. The surveys indicated that the majority of PRoW are used by no more than 40 people per day apart from a crossing on Ellesborough Road, which was used by no more than 120 people per day. The Proposed Scheme affects 18 PRoW in the Dunsmore, Wendover and Halton area and crosses 14 of these. In addition to the 14 PRoW the Proposed Scheme also crosses seven roads with potential for use by non-motorised users.

12.3.4 The main strategic roads and local roads affected by the Proposed Scheme are A413 London Road / Nash Lee Road, A4010 Risborough Road, B4009 Nash Lee Road, Small Dean Lane, Rocky Lane (also known as Chesham Lane), Bowood Lane, Bacombe Lane, Nash Lee Lane, North Lee Lane, South Street, and Pond Street/Ellesborough Road.

12.3.5 Relevant accident data for the road network subject to assessment has been obtained from BCC for the three year period of 2009 to 2011 for the road network subject to assessment. This has been assessed and no accident clusters have been identified in this area.

12.3.6 The following bus services operate along roads that were subject to traffic and transport assessment:

- Route 55 – connecting Aylesbury to Amersham and serving Stoke Mandeville, Wendover, Great Missenden, Chesham, and Chesham Bois;
- Route 21A – connecting St Bernards School to Aylesbury and serving Stoke Mandeville and Princes Risborough; and
- Route 300 – connecting Aylesbury to High Wycombe and serving Stoke Mandeville, Princes Risborough, Lacey Green, Walters Ash, Naphill, and Hughenden Valley.

12.3.7 Two of these services operate along the B4009 Nash Lee Road, with a combined peak frequency of up to four buses an hour. Route 55 operates along the A413 London Road at a peak frequency of up to one bus an hour.

12.3.8 Frequent passenger railway services operate along the Marylebone to Aylesbury Line serving Wendover station within the area.

12.3.9 The Proposed scheme does not affect any waterways in this area that are frequently used by waterborne craft and consequently these are not considered further in this assessment.

Future baseline

12.3.10 The future baseline traffic volumes have been calculated by applying growth factors derived from TEMPRO for the future years of 2021, 2026 and extrapolation to 2041. The factors have been derived for the individual road types and relevant wards.

12.3.11 No other changes to the traffic and transport baseline are anticipated in this area.

Construction

12.3.12 Construction activities have been assessed against 2021 baseline traffic flows, irrespective of when they occur during the construction period. Future baseline traffic volumes in the peak hours in this area are forecast to grow by between approximately 8% and 9% by 2021 compared to 2012 depending on road type.

Operation (2026)

12.3.13 Future baseline traffic volumes in the peak hours in this area are forecast to grow by between approximately 15% and 17% by 2026 compared to 2012 depending on road type.

Operation (2041)

12.3.14 Future baseline traffic volumes in the peak hours in this area are forecast to grow by between approximately 30% and 33% by 2041 compared to 2012 depending on road type.

12.4 Effects arising during construction

Avoidance and mitigation measures

12.4.1 The following measures (as described in Section 2) have been included as part of the engineering design of the Proposed Scheme and will avoid or reduce effects on transport users:

- transporting construction materials and equipment within and along haul roads adjacent to the Proposed Scheme alignment where reasonably practicable to reduce lorry movements on the public highway;
- the majority of roads crossing the Proposed Scheme will be kept open during construction, resulting in reduced diversions of traffic onto alternative routes;
- provision of temporary alternative routes and/or building structures early to maintain connectivity for PRoW closed during construction to reduce loss of amenity;
- HGV routed as far as reasonably practicable along the strategic road network, using designated routes for access, as shown in Map TR-03 -054 (Volume 5, Traffic and Transport Map Book); and

- providing on-site accommodation and welfare facilities to reduce daily travel by site workers.

12.4.2 The draft CoCP (see Volume 5: Appendix CT-003-000) includes measures which seek to reduce the impacts and effects of deliveries of construction materials and equipment, including reducing construction lorry trips, during peak background traffic periods. The draft CoCP includes HGV management and control measures.

12.4.3 Where reasonably practicable, the number of private car trips to and from the site (both workforce and visitors) will be reduced by encouraging alternative modes of transport or vehicle sharing. This will be supported by an overarching framework travel plan[88] that will require travel plans to be used, along with a range of potential measures to mitigate the impacts of traffic and transport movements associated with construction of the Proposed Scheme. As part of this, a construction workforce travel plan will be put into operation with the aim of reducing workforce commuting by private car, especially sole occupancy car travel. Where reasonably practicable in the rural context, this will encourage the use of sustainable modes of transport or vehicle sharing.

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

12.4.5 Specific measures will include:

- core site operating hours will be 08:00 to 18:00 on weekdays and 08:00 to 13:00 on Saturdays. Therefore site staff and workers will generally arrive before the morning peak hour and depart after the evening peak hour (although assessment has assumed that some of work journeys to the construction sites take place within the morning and evening peak hours to reflect a reasonable worst case scenario (draft CoCP, Section 5); and
- excavated material will be reused where reasonably practicable along the alignment of the Proposed Scheme which will reduce the effects of construction vehicles on the public highway (draft CoCP, Section 15).

Assessment of impacts and effects

Temporary Effects

12.4.6 The following section considers the impacts on traffic and transport and the consequential effects resulting from construction of the proposed scheme.

12.4.7 The temporary traffic and transport impacts within the area will be:

[88] Construction and operational travel plans will promote the use of sustainable transport modes as appropriate to the location and types of trip. They will include measures such as: provision of information on and promotion of public transport services; provision of good cycle and pedestrian facilities; liaison with public transport operators; promotion of car sharing; and the appointment of a travel plan coordinator to ensure suitable measures are in place and are effective.

- construction vehicle movements to/from the construction compounds;
- road closures and associated diversions; and
- PRoW closures and associated diversions.

12.4.8 Construction vehicle movements required to construct the Proposed Scheme include the delivery of plant and materials, movement of excavated materials and site worker trips.

12.4.9 Details of construction compounds along with planned construction routes are provided in Section 2. The duration of when there will be busy transport activity at each site is shown in Table 17. This represents the periods when the construction traffic flows will be greater than 50% of the peak flows. Also shown is the estimated number of daily vehicle trips during the peak month of activity. The lower end of the range shows the average number of trips in the busy period and the upper end the average during the peak month.

Table 17: Typical vehicle trip generation for construction site compounds in this area

Compound Type	Location	Access to/from compound	Indicative start/set up date	Estimated duration of use (years)	Estimated duration with busy vehicle movements (Months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/ LGV	HGV
Main	Small Dean viaduct	Small Dean Lane and A413	2017	Four years and three months	42 months	120-150	10-20
Satellite	Leather Lane overbridge	Leather Lane , Potter Row, King's Lane, B485 Chesham Road and A413	2017	One year and three months	14 months	100-130	<10
Satellite	Bowood Lane overbridge	The haul road from Leather Lane, Potter Road, King's Lane, B485 Chesham Road and A413	2018	Two years	18 months	100-130	20-30
Satellite	Wendover Dean viaduct	Via the haul road from Rocky Lane and A413	2018	Two years	19 months	40-50	20-30
Satellite	Rocky Lane underbridge/Wendover auto-transformer station	Rocky Lane and A413	2018	Six years and nine months	19 months	50-60	<10
Satellite	Small Dean	The haul road	2018	Two years	22 months	90-100	20-30

Compound Type	Location	Access to/from compound	Indicative start/set up date	Estimated duration of use (years)	Estimated duration with busy vehicle movements (Months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/ LGV	HGV
	viaduct launch	from Rocky Lane and A413					
Satellite	Wendover Green (south)	The haul road from Small Dean viaduct main compound, Small Dean Lane and A413	2017	Two years and nine months	32 months	80-100	40-50
Satellite	Wendover green tunnel (south portal) (rail systems)		2023	One year and three months			
Satellite	Wendover green tunnel (north)	The haul road from Small Dean viaduct main compound and A413	2018	Two years and six months	26 months	70-90	40-50
Satellite	B4009 Nash Lee Road overbridge	B4009 Nash Lee Road and A413 or A4010	2018	Seven years	40 months	50-110	40-90

12.4.10 Information on the indicative construction programme and methodology is provided in Section 2.3 which illustrates how the phasing of activities at different compounds will generally be staggered and that construction activities at individual compounds may not occur over the whole duration presented in Table 17. Consequently the peak traffic movements will not generally occur at the same time, although in some instances there may be some overlap.

12.4.11 Where construction routes service more than one construction compound, the combined vehicle movements have been assessed.

12.4.12 Construction of the Proposed Scheme is forecast to result in changes in daily traffic flows due to works and construction vehicles accessing worksites and also temporary road closures and diversions.

12.4.13 These changes in traffic flows will lead to significant increases in delays to vehicle users and congestion[89] at the following junctions:

[89] In assessing significant effects of traffic changes on congestion and delays, a major adverse effect occurs where traffic flows at a junction will be beyond or very close to capacity with the Proposed Scheme and the increases in traffic due to the Proposed Scheme will be such as to substantially increase queues and delays on a routine basis at peak times. A moderate adverse effect will occur when traffic flows at a junction will be approaching or at capacity with the Proposed Scheme and modest increases in traffic will increase the frequency of queues and more substantial

- A4010 Risborough Road with B4009 Nash Lee Road (major adverse effect);
- A413 Nash Lee Road with B4009 Nash Lee Road (moderate adverse effect);
- A413 Nash Lee Road with Small Dean Lane (major adverse effect);
- A413 London Road with Rocky Lane (also known as Chesham Lane) (major adverse effect);
- A413 London Road with Dunsmore Lane (major adverse effect); and
- A413 London Road with Bowood Lane (major adverse effect).

12.4.14 Road closures and associated diversions will result in the following effects for traffic due to increased travel distance:

- temporary closure (up to approximately one year) of Bacombe Lane requiring a traffic diversion of approximately 1.5km, via South Street, Pound Street, Ellesborough Road and a temporary link road between Ellesborough Road and Bacombe Lane, resulting in a minor adverse effect; and
- temporary closure (up to approximately nine months) of Small Dean Lane requiring a traffic diversion of approximately 2.7km, via the A413 London Road and Dunsmore Lane, resulting in a moderate adverse effect.

12.4.15 Construction of the Proposed Scheme will result in substantial increases in traffic flows (i.e. more than 30% for HGV or all vehicles) and these will cause a significant increase in traffic related severance[90] for non-motorised users in the following locations:

- A4010 Aylesbury Road / Risborough Road between A4129 Longwick Road and the Proposed Scheme (major adverse effect) due to an increase in HGV flow;
- B4009 Nash Lee Road (major adverse effect) due to an increase in HGV flow;
- Small Dean Lane, between A413 and Small Dean viaduct main compound (moderate adverse effect) due to an increase in HGV flow as well as all traffic flow;
- A413 London Road/ Nash Lee Road, south east of B4009 Nash Lee Road (major adverse effect) due to an increase in HGV flow;
- Rocky Lane (also known as Chesham Lane) between A413 London Road and Rocky Lane underbridge satellite compound (moderate adverse effect) due to an increase in HGV flow;
- Bowood Lane, between Bowood Lane overbridge satellite compound and King's Lane (moderate adverse effect) due to an increase in all traffic flow; and

delays. A minor adverse effect occurs when traffic flows at a junction are not generally exceeding capacity with the Proposed Scheme but the increase in flows will result in occasional queues and delays or small increases in existing delays.

[90] In the context of this traffic and transport section, Severance is used to relate to a change in ease of non-motorised users due to, for example, a change in travel distance or travel time or a change in traffic levels on a route that makes it harder for non-motorised users to cross. A reference to severance does not imply a route is closed to access

- King's Lane between Rocky Lane (also known as Chesham Lane) and Bowood Lane (minor adverse effect) due to an increase in all traffic flow.

12.4.16 These traffic flow increases will not result in increases in congestion and significant delays except for those locations identified above.

12.4.17 Utilities works, including diversions, have been assessed in detail where they are major and where the traffic and transport impacts from the works separately, or in combination with other works, will be greater than other construction activities arising within the area. More minor utility works are expected to result in only localised traffic and pedestrian diversions, which will be of short term duration. No additional significant effects are expected due to utilities works.

12.4.18 No significant effects on parking or loading have been identified during construction in this area.

12.4.19 The effect on accident and safety risks is not significant as there are no locations where there are both accident clusters and substantial increases in traffic during construction.

12.4.20 There will be minor adverse effects on non-motorised users due to increased travel distance from 11 of the PRoW and two road diversions, at WEN/55 (Footpath), WEN/15A - Ridgeway Trail (Footpath), WEN/6, WEN/11, WEN/6 - Aylesbury Ring Trail (Footpath), WEN/11 (Two Footpaths), Ellesborough Road, WEN/13A (Footpath), WEN/39 (Footpath), WEN/36 - Chiltern Way trails (Footpath), TLE/5 (Footpath), Bowood Lane, and TLE/3 (Footpath), with eight of the PRoW diversions and one road diversion will be between 100 and 300 metres in length. The diversion at TLE/3 (Footpath) and Bowood Lane will be approximately 550m and the diversions at WEN 6 and WEN6 Aylesbury Ring will be approximately 800m in length. There will be a moderate adverse effect due to the diversion of WEN/57 - Icknield Way trail (Bridleway) by approximately 2.2km.

12.4.21 Apart from general congestion, there will be no effect on bus services, or disruption at stations or interchanges that will result from construction of the Proposed Scheme.

12.4.22 The construction of the Proposed Scheme will require temporary rail possessions on the Princes Risborough to Aylesbury Line and Marylebone to Aylesbury Line which will affect some users of passenger services stopping at Wendover. The possessions will be short-term and generally take place during mid-week nights or weekends. Therefore the effects of these possessions on rail users in this area will not be significant.

Cumulative effects

12.4.23 The assessment includes the cumulative effects of planned development during construction by taking this into account within the background traffic growth.

12.4.24 The assessment also takes into account construction traffic and transport impacts of works being undertaken in neighbouring study areas. From the areas to the south including Central Chilterns (CFA9) and the Chalfonts and Amersham (CFA8) areas the cumulative construction traffic flows of approximately 120 cars/ light goods vehicles

(LGV) per day (two-way) and 30 HGV per day (two-way) have been included in the assessment for this area.

12.4.25 From the north, including Stoke Mandeville and Aylesbury area (CFA11), the cumulative construction traffic flows of approximately 70 cars per day (two-way) and 10 HGV (two-way) have been included in the assessment for this area.

Permanent effects

12.4.26 Any permanent effects of construction have been considered in operations assessments for traffic and transport in 12.5. This is because the impacts and effects of the forecast increases in travel demand and the wider impacts and effects of operations need to be considered together.

Other mitigation measures

12.4.27 The implementation of the draft CoCP (Volume 5: Appendix CT-003-000) in combination with the framework travel plan and the construction workforce travel plan will, to some degree, mitigate the transport related effects during construction of the Proposed Scheme. The reductions in effects arising from the travel plan measures have not been included in the assessment, which will mean that the adverse effects may be over-stated.

12.4.28 Where reasonably practicable rail possessions will be scheduled to coincide with other planned rail possessions for engineering and maintenance works on the same line to minimise additional disruption to rail users. Rail replacement services will be provided where necessary when rail possessions are in place.

12.4.29 No further traffic and transport mitigation measures during construction of the Proposed Scheme are considered necessary based on the outcome of this assessment.

Summary of likely significant residual effects

12.4.30 Increased traffic during the most intensive periods of construction, particularly HGV traffic, will affect non-motorised users crossing and using; A4010 Aylesbury Road/Risborough Road; B4009 Nash Lee Road; Small Dean Lane, between A413 and Small Dean viaduct main compound; A413 London Road/ Nash Lee Road, south east of B4009 Nash Lee Road; Rocky Lane between A413 and Rocky Lane underbridge satellite compound; Bowood Lane, north east of Bowood Lane overbridge satellite compound; and King's Lane between Rocky Lane and Bowood Lane.

12.4.31 Increased traffic during the most intensive periods of construction will also potentially cause additional traffic congestion and delays at a number of junctions in the area; A4010 Risborough Road with B4009 Nash Lee Road; A413 Nash Lee Road with B4009 Nash Lee Road; A413 Nash Lee Road with Small Dean Lane; A413 London Road with Rocky Lane; A413 London Road with Dunsmore Lane; and A413 London Road with Bowood Lane.

12.4.32 Temporary closure of Bacombe Lane and Small Dean Lane during construction will cause some additional delays for users of these roads due to the additional travel distance required by the associated diversions whilst in operation.

12.4.33 Temporary closure and associated diversion of 12 PRoW and two roads (WEN/55/1; WEN/15A/2; WEN/6/2; WEN/11/1; WEN/6/3; WEN/11/2; Ellesborough Road; WEN/13A/1; WEN/57/1; WEN/39/2; WEN/36/1; TLE/5/2; Bowood Lane; and TLE/3/1), during construction will affect non-motorised users due to the increased travel distances required by associated diversions.

12.4.34 The significant effects that result from the construction of the Proposed Scheme are shown in Map TR-03-054 (Volume 5, Traffic and Transport Map Book).

12.5 Effects arising from operation

Avoidance and mitigation measures

12.5.1 The following measures have been included as part of the design of the Proposed Scheme and will avoid or reduce impacts on transport users:

- retaining the majority of roads crossing the Proposed Scheme in, or very close to, their current location resulting in no diversions of traffic onto alternative routes; and
- retaining all PRoW crossing the Proposed Scheme, with localised realignments.

Assessment of impacts and effects

12.5.2 The following section considers the impacts on traffic and transport and the consequential effects resulting from the operational phase of the Proposed Scheme (as described in Section 2.4).

12.5.3 The operational traffic and transport impacts within this area arise from the realignment of PRoW.

12.5.4 In 2041, traffic flows with the Proposed Scheme are expected to be similar to those forecast without the Proposed Scheme. The only changes to traffic will be occasional traffic that may access areas of the Proposed Scheme for maintenance purposes. However, these infrequent vehicle movements are expected to be very low and will have no significant effect, including no effects on travel times or non-motorised users.

12.5.5 The effect on accident and safety risks is not significant as there are no increases in traffic during operation.

12.5.6 No significant effects on parking and loading will result from the operation of the Proposed Scheme in this area.

12.5.7 It is not expected that the operation of the Proposed Scheme will require any bus route diversions and there will be no impacts on rail services in the area. Consequently, there will be no effects on public transport users during operation of the Proposed Scheme.

12.5.8 There will be minor adverse effects on non-motorised users as a result of increased travel distance due to two PRoW realignments at ELL/25 (Footpath) and WEN/14 (Bridleway), and the realignment of one road at Bacombe Lane. The length of the Bacombe Lane and ELL/25 (Footpath) realignments are approximately 200m and the WEN/14 (Bridleway) realignment is approximately 600m. There will be a moderate

adverse effect due to the permanent closure of the old link road between Small Dean Lane and A413 London Road, with the alternative route being approximately an additional 800 metres.

12.5.9 The impacts and consequential effects of the operation of the Proposed Scheme in 2041 will be the same as described for 2026, having taken account of the increased background traffic growth.

Cumulative effects

12.5.10 The assessment includes cumulative effects of planned development during operation by taking this into account within the background traffic growth.

12.5.11 There will be no additional traffic in this area resulting from the operation of the Proposed Scheme in neighbouring areas.

Other mitigation measures

12.5.12 No other mitigation measures during operation of the Proposed Scheme are considered necessary based on the outcome of this assessment.

Summary of likely significant residual effects

12.5.13 Permanent realignment of three PRoW and one road (ELL/25/1, WEN/14/4, old link road between Small Dean Lane and A413, and Bacombe Lane) will affect non-motorised users due to increased travel distances.

12.5.14 The significant effects that result from the operation of the Proposed Scheme are shown in Map TR-04-065 (Volume 5, Traffic and Transport Map Book).

13 Water resources and flood risk assessment

13.1 Introduction

13.1.1 This section provides a description of the current baseline for water resources including surface water, groundwater and the baseline conditions for flood risk. It then reports the likely impacts and significant effects on these aspects as a result of the construction and operation of the Proposed Scheme.

13.1.2 The main environmental features of relevance to water resources and flood risk include:

- the dry valley of the upper River Misbourne and dry valleys of the Chalk scarp at Wendover;
- the Wendover Brook and its tributary watercourses including the Church Lane drain and Castle Park Stream, the Stoke Brook which rises at World's End north of Wendover and its largest tributary the Chalkshire Stream;
- the Wendover Arm feeder of the Grand Union Canal which starts within 1km of the route at Wharf Road Wendover;
- numerous identifiable ponds and drains located outside the route alignment but within 1km of the route;
- three public water supply abstractions and a number of private groundwater abstractions; and
- Weston Turville Reservoir Site of Special Scientific Interest (SSSI) is approximately 1.3km north of the route. The reservoir itself is situated in the Stoke Mandeville and Aylesbury area (CFA11) but its source catchment is within this area.

13.1.3 Key environmental issues relating to water resources and flood risk include:

- the potential impact on groundwater quality and groundwater abstractions in Wendover and Wendover Dean;
- the potential impact from the Wendover green tunnel on groundwater flow and water dependent habitats, particularly groundwater flow towards the Weston Turville Reservoir SSSI and the Stoke Brook; and
- potential flooding at construction areas and in dry valleys such as Small Dean and Wendover where the construction of viaducts and cuttings are proposed.

13.1.4 Volume 5: Appendix WR-001-000 contains a report on the route-wide effects including:

- generic assessments on a route-wide basis;
- stakeholder engagement;

- in combination effects;
- a draft operation and maintenance plan for water resources and flood risk;
- a Water Framework Directive[91] (WFD) compliance assessment; and
- a route-wide Flood Risk Assessment (FRA).

13.1.5 Detailed reports on water resources and flood risk within this area are also contained in the Volume 5 appendices. These include:

- Appendix WR-002-010: Water Resources Assessment report; and
- Appendix WR-003-010: Flood Risk Assessment.

13.1.6 Map Series WR-01 to WR-03 (Volume 5, Water Resources and Floor Risk Assessment Map Book) show some of the details, environmental baseline and design features referred to in this report. Discussions have been held with the Environment Agency, Buckinghamshire County Council (BCC), Wycombe District Council (WDC), Chiltern District Council (CDC) and Aylesbury Vale District Council (AVDC), the Canal and River Trust (formerly British Waterways), Thames Water Utilities Ltd and private holders of groundwater abstraction licences.

13.2 Scope, assumptions and limitations

13.2.1 The assessment scope, key assumptions and limitations for the water resources and flood risk assessment are set out in Volume 1 and in the SMR and its addendum, and appendices presented in Volume 5: Appendix CT-001-000 and Appendix CT-001-000/2. This report follows the standard assessment methodology.

13.2.2 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the centre line of the route, except where there is clearly no hydraulic connectivity. For surface water features in urban areas, the extent was reduced to 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at stations and depots, professional judgement has been used in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this spatial scope is defined as the study area.

13.2.3 Site visits have been carried out for the following locations along the route:

- the Weston Turville SSSI, with particular reference to its feeder streams; and
- numerous groundwater springs in and around Wendover.

13.2.4 WFD classification data has been made available by the Environment Agency. For water bodies that do not have a WFD status class shown in the relevant River Basin Management Plan (RBMP), the status class for those water courses has been taken as the status class for the first downstream water body for which a status class is

[91] Water Framework Directive - Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, Strasbourg, European Parliament and European Council.

reported. Where groundwater does not have a WFD status class shown in the relevant RBMP, these are referred to as 'not assessed by the Environment Agency'.

13.2.5 Limited monitoring data is available with regard to baseline groundwater levels, flows and quality. Available reports that provide measurements of groundwater strikes or rest water levels measured immediately following borehole excavation, have also been used to assess the likely position of the water table.

13.2.6 The only groundwater level contours available for this area are at 10m intervals for late 1976 as shown on the British Geological Survey (BGS) regional hydrogeology map[92]. Flow directions have been inferred from topography and potential connectivity to surface watercourses that cross the bedrock or superficial deposits.

13.2.7 The limitations associated with flood risk within this study area are described in detail in the flood risk assessment in Volume 5: Appendix WR-003-010.

13.3 Environmental baseline

Existing baseline - surface water resources

Surface water features

13.3.1 Most water bodies in the study area fall within the Thame and South Chilterns sub-catchment of the Thames River Basin District (RBD) as set out in the RBMP[93]. The south of the study area (the dry valley of the upper Misbourne) however falls within the Colne sub-catchment of the River Thames.

13.3.2 The route will not cross any watercourses or ponds in the study area.

13.3.3 Map WR-01-012 and Map WR-01-013 (Volume 5, Water Resources and Flood Risk Assessment Map Book) show the current surface water baseline and all surface water features within the study area are assessed within Volume 5: Appendix WR-002-010. Table 18 includes features potentially affected by the Proposed Scheme.

Table 18: Surface water features potentially affected by the Proposed Scheme

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book, map reference)	Watercourse classification[94]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[95]
Drain at Church Lane Wendover	Watercourse rises at Church Lane Wendover. At Wharf Road Wendover part becomes the canal feeder (see below) and	Main river	No status shown in RBMB - assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate

[92] British Geological Survey (1984), *Hydrogeological map of the area between Cambridge and Maidenhead including parts of hydrometric areas 33, 38 and 39.*
[93] Environment Agency (2009), *River Basin Management Plan*, Thames River Basin District.
[94] Water-feature classifications: Section 113 of the Water Resources Act 1991 defines a main river as a watercourse that is shown as such on a Main river map. Section 72 of the Land Drainage Act 1991 defines an ordinary watercourse as 'a watercourse that is not part of a main river'. Section 221 of the Water Resources Act 1991 defines a watercourse as including 'all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows'. Main rivers are larger rivers and streams designated by Defra on the main river map and are regulated by the Environment Agency.
[95] For examples of receptor value see Table 43 in the addendum to the SMR (see Volume 5, Appendix CT-001-000/2).

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book, map reference)	Watercourse classification[94]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[95]
	part becomes the Castle Park Stream. (WR-01-013, H6 to G4)				
Grand Union Canal (Wendover Arm)	Starts at Wharf Road Wendover and flows northwards through Wendover. (WR-01-013, G4 to F2)	Artificial	Grand Union Canal, Wendover Arm feeder (GB70610183) Good	Good potential (by 2015)	High
Castle Park Stream	Starts in culvert at Wharf Road Wendover and flows northwards through Wendover. (WR-01-013, G4 to F3)	Main river	No status shown in RBMB - assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Wendover Brook	East of the route flowing south to north through Wendover (WR-01-013, F5 to E2)	Main river	Bear Brook and Wendover Brook (GB106039030380) Moderate	Good potential	High
Stoke Brook	Rises at World's End and flows along the CFA10 and CFA11 boundary, north-east to south-west. (WR-01-013, E4 to D6)	Main river	Stoke Brook Aylesbury (GB106039030320) Moderate	Good status (by 2015)	High
Chalkshire Stream	Three tributaries and the Chalkshire Stream flow to the west of the route near North Lee. (WR-01-013, E7 to D6)	Main river	No status shown in RBMP - assumed status Moderate	No status shown in RBMP - assumed status Good status	Moderate
Numerous small ponds within 1km of the Proposed Scheme	Various locations (see Volume 5: Appendix WR-002-010 for further details)	Not applicable	Not applicable	Not applicable	Low

Water Framework Directive status

13.3.4 The Environment Agency states the current overall status, under the WFD, of the Wendover Brook as Moderate, the Stoke Brook as Moderate and Wendover Arm (Grand Union Canal) as Good. The objective for 2027 is Good Potential/Status for all of these water bodies.

Abstractions and permitted discharges

13.3.5 There are no licensed surface water abstractions within the study area[96]. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

13.3.6 The Environment Agency reports that there are 13 current consented surface water discharges within 1km of the route in the study area (details in Volume 5: Appendix WR-02-010).

Existing baseline – groundwater resources

Geology and hydrogeology

13.3.7 The geological formations and hydrogeology of the study area are described in this section, with additional details and a schematic geological cross-section included in Volume 5: Appendix WR-002-010. Descriptions of the geological formations are also provided in Section 8.

13.3.8 The location of abstractions, geological formations and indicative groundwater levels are shown in Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.9 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 19. Unless otherwise stated, the geological groups listed will be crossed by the route.

Table 19: Summary of geology and hydrogeology in the study area

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Superficial deposits						
Diamicton	South-eastern part of the CFA	Clay-with-Flints	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low
Head	Spatially limited thin band that runs from south to north and will be crossed by the route in the centre of the CFA	Clay, silt, sand and gravel	Secondary A	Not assessed by Environment Agency	Not assessed by Environment Agency	Moderate
Bedrock						
Lewes Nodular Chalk Formation (White Chalk	Outcrops in the Eastern and south-eastern part	Hard nodular chalk and hardground	Principal	Mid Chilterns Chalk (GB40601G601200) Poor	Good	High

[96] Surface water abstractions for public supply are not included.

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Subgroup)	of the CFA	s		Chiltern Chalk Scarp GB40601G604100 Poor	Good	High
New Pit Chalk Formation(White Chalk Subgroup)	Outcrops across the southern / eastern half of the CFA, replacing the Lewes Chalk Formation at outcrop	Blocky hard chalk with marls and marl seams	Principal	Mid Chilterns Chalk (GB40601G601200) Poor	Good	High
				Chiltern Chalk Scarp (GB40601G604100) Poor	Good	Moderate
Zig Zag Chalk Formation and West Melbury Marly Chalk Formation (Grey Chalk Subgroup)	Outcrops across the northern / western half of the CFA between the outcrops of the New Pit Chalk Formation and the Gault Clay Formation	Blocky chalk with marls, with occasional hard limestone	Principal	Chiltern Chalk Scarp (GB40601G604100) Poor	Good	Moderate (Secondary aquifers) Low (unproductive strata)
Upper Greensand Formation and Gault Clay Formation, undifferentiated (Selbourne Group)	Outcrops in the northern /western part of the CFA only, replacing the New Pit Chalk Formation at outcrop.	Fine grained sand and sandstone with silt (Upper Greensand Formation) Mudstone, siltstone and clay (Gault Clay Formation)	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low

Superficial deposits

13.3.10 There are no superficial drift deposits within the majority of the study area, with the exception of a small area of Clay-with-Flints (Diamicton) close to the boundary with Community Forum Area 9, Central Chilterns (CFA9), and a small area of Head Deposits comprising clay, silt, sand and gravel to the south of Wendover.

Bedrock aquifers

13.3.11 The bedrock geology of the majority of the study area comprises Cretaceous Chalk. The undifferentiated Cretaceous Gault and Upper Greensand Formation comprises mudstone, siltstone and sandstone underlying the Chalk and outcropping in the northern 1km of the Proposed Scheme in this study area.

13.3.12 The regional hydrogeological map shows that Chalk groundwater levels in autumn 1976 (known to represent very low groundwater levels in drought conditions) were 118m above Ordnance Datum (AOD) close to the CFA9/10 boundary, rising to a peak of approximately 125mAOD at the groundwater divide around Wendover Dean. Groundwater levels reduced to the north-west, to around 94mAOD at the edge of the Chalk outcrop, close to Wellwick Farm. The direction of groundwater flow in the vicinity of the route changes from a south-easterly direction to towards the north-west at the groundwater divide.

13.3.13 The Environment Agency borehole monitoring data indicates that maximum recorded groundwater levels in winter 2001/2 (representing high regional groundwater levels) were 135mAOD, i.e. approximately 1-2m below ground level (bgl) on the boundary with CFA9, approximately 670m south-west of the route, rising to 142mAOD, i.e. approximately 13mbgl, at Wendover Dean (approximately 600m south-west of the route). This suggests that groundwater levels will be below route elevation between the middle of the South Heath cutting in CFA9 to the Wendover Dean south embankment.

13.3.14 Groundwater level data is not currently available to the north-west of the Wendover Dean south embankment. In the vicinity of the Wendover green tunnel and Wendover north cutting, the relationship with existing springs, ground levels, and railway and road drainage is likely to be complex as discussed in Volume 5: Appendix WR-002-010 and shown on Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

Water Framework Directive status

13.3.15 No WFD classification has been given by the Environment Agency to the superficial deposits.

13.3.16 The study area is mainly within the Chiltern Chalk Scarp groundwater body. The current overall WFD status of groundwater in the study area is summarised in Table 19 and is largely classified as having 'Poor' status.

Abstractions and permitted discharges

13.3.17 The Environment Agency reports that there are three groundwater abstractions for public water supply (PWS) with groundwater source protection zones (SPZ) located within the study area. Two PWS sources are located to the south-west of the Proposed Scheme and one to the north-east. The closest PWS source is located 820m to the south-west of the route. SPZ2 and 3 for one of the PWS sources will be crossed by the route in the south-west of the area. Further details are given in Volume 5: Appendix WR-002-010 and on Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.18 There are five licensed abstractions (excluding PWS) within the study area that abstract from the Chalk aquifer, as shown on Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book). The SPZ2 for two of these groundwater abstractions will be intersected by the route. There are two reported private, unlicensed groundwater abstractions in this area as set out in Volume 5: Appendix WR-002-010. There is also the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

13.3.19 The Environment Agency reports that there are 30 current consented discharges to groundwater within 1km of the route through this study area. Details are provided in Volume 5: Appendix WR-002-010 and Map WR-02-010 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

Surface water/groundwater interaction

13.3.20 Review of the 1:25,000 Ordnance Survey maps indicates that there is a spring line forming the source of several watercourses on the scarp slope of the Chilterns at elevations of approximately 120mAOD. Comparison with the geological maps suggests this is on a formation boundary within the Grey Chalk Sub Group, possibly the Chiltern (Totternhoe) Stone at the boundary between the Zig Zag Chalk and West Melbury Marly Chalk Formations as shown on Map WR-02-010, D6 to D8 (Volume 5, Water Resources and Flood Risk Assessment Map Book). The Stoke Brook appears at a lower elevation at World's End and there may be a component of groundwater inflow from the Upper Greensand Formation which contributes to the stream. The Wendover Brook is likely to be fed by the Chalk. It rises within a residential area of Wendover and flows towards the Weston Turville Reservoir SSSI, before bypassing the reservoir and flowing towards the Bear Brook in Aylesbury.

Water dependent habitats

13.3.21 The route will not cross any areas with statutory ecological designations in relation to surface water.

13.3.22 The Weston Turville Reservoir is designated as an SSSI for reed beds and lowland fen, rare plants, wintering birds and aquatic invertebrates. The SSSI lies approximately 1.3km north-east of the route, to the north of Wendover as shown on Map WR-01-013, E3 (Volume 5, Water Resources and Flood Risk Assessment Map Book). Historically, Weston Turville Reservoir was built to mitigate for spring flows in the Wendover area that are captured for filling the Grand Union Canal via the artificial Wendover Arm feeder – the reservoir outlet discharges into the Wendover Brook. The reservoir is fed by a small number of streams that rise at springs within 1km of the route. It can also receive water released from the Wendover Arm feeder channel. The Wendover Brook rises at St Agnes Gate in Wendover (Map WR-01-013, F5) and has been diverted to flow around the western margin of the reservoir (see Volume 5: Appendix WR-002-010 for details).

13.3.23 The SSSI is underlain by the undifferentiated Gault Clay and Upper Greensand Formation and is largely dependent on spring fed surface water flows.

Existing baseline – flood risk

River flooding

13.3.24 The agreed data set for river flooding is the Environment Agency Flood Zone Mapping[97].

13.3.25 The Proposed Scheme will not cross any areas of historic river flooding or areas of Flood Zone 3. Flood Zone 3 of the Church Lane drain/Castle Park Stream commence to the south-east of Wendover within the study area, which continues in a north-westerly direction. The maximum extent of Flood Zone 3 is approximately 260m from the route in this location and is therefore not considered further. The risk of flooding upstream of the Environment Agency Flood Zones is considered further under the risk of surface water flooding.

Surface water flooding

13.3.26 The agreed dataset for surface water flooding is the Environment Agency Flood Map for Surface Water[98] (FMfSW), as shown on Maps WR-01-012 and WR-01-013 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.27 The Proposed Scheme will cross a number of dry valleys within the study area that are shown on the FMfSW to be at risk of surface water flooding.

13.3.28 The land surrounding the dry valley at Small Dean has had significant topographical modifications as a result of the construction of the Marylebone to Aylesbury Line and the A413 London Road.

13.3.29 The dry valley at Grove Farm forms part of the upper catchment of the Church Lane drain/Castle Park Stream which joins the Wendover Brook downstream of the Weston Turville Reservoir. At the location of the crossing there are existing embankments crossing this dry valley associated with the A413 London Road and the Marylebone to Aylesbury Line, which have resulted in a significantly increased risk of surface water flooding upstream. At this location, flood depths of greater than 0.3m are predicted for flood events up to an including the 1 in 200 year annual probability (0.5%) rainfall event.

13.3.30 Other dry valleys in the study area are located in the vicinity of Wendover Dean, south of Bacombe Lane, Ellesborough Road, Coneycroft Farm, and areas of ponding at Nash Lee Road and Nash Lee Lane. Predicted flood depths within these areas are generally less than 0.3m for flood events up to and including the 1 in 200 year annual probability (0.5%) rainfall event.

Sewer flooding

13.3.31 The agreed datasets for sewer flooding are the Buckinghamshire Preliminary Flood Risk Assessment[99] (PFRA) and local authority Strategic Flood Risk Assessment[100] (SFRA) reports.

[97] Environment Agency Flood maps, Available from: http://www.environment-agency.gov.uk/homeandleisure/37837.aspx. Accessed: September 2013.
[98] Environment Agency (2010), *Flood Map for Surface Water*, Available from: http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/dataLayers_FMSW.xml. Accessed: 1 February 2013.

13.3.32 The Buckinghamshire PFRA states that properties and infrastructure within the study area are at risk of flooding due to the surcharging of the underground sewer system which results in overland flow.

13.3.33 Thames Water Utilities Limited historical sewer flooding records show that there have been a very small number of sewer flooding incidents within this study area. Precise locations are not recorded within either the SFRA or PFRA reports; however the SFRA data indicate that only a few houses were flooded in each location. The Chiltern SFRA[101] [102] concludes that sewer flooding in the region appears to be sporadic and rare.

Artificial water bodies

13.3.34 Flooding from artificial water bodies, such as canals and reservoirs, although unlikely, may occur as a result of failure of a retaining structure that impounds water. The agreed dataset for flooding due to reservoir failure is the Environment Agency Reservoir Inundation Map.

13.3.35 The now disused Wendover Arm of the Grand Union Canal commences in the centre of Wendover approximately 850m to the north of the route within the study area.

13.3.36 The Weston Turville Reservoir lies to the north-west of Wendover. There is an area with a residual risk of flooding as a result of a failure of the reservoir. However, the area commences at the northern extent of the reservoir and continues to the north away from the Proposed Scheme.

13.3.37 The distances between the Proposed Scheme and these sources of flood risk are considered sufficient to not require further consideration.

Groundwater flooding

13.3.38 Agreed datasets for groundwater flooding include the Buckinghamshire PFRA, the Wycombe District SFRA[103], the Aylesbury Vale SFRA and the Chiltern District SFRA. The Wycombe District SFRA shows a large part of the study area to be at risk of groundwater emergence, based on mapping produced in 2004.

Future baseline

13.3.39 Appendix CT-004-000 identifies developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the operation of the Proposed Scheme. The potential cumulative effects arising from committed developments in relation to water resources and flood risk have been considered as part of this assessment of the construction and operation of the Proposed Scheme.

[99] Jacobs and BCC (2011), *Buckinghamshire County Council Preliminary Flood Risk Assessment.*
[100] Royal Haskoning and AVDC (2007), *Aylesbury Vale Strategic Flood Risk Assessment Level 1 Report.*
[101] Jacobs and CDC (2013), *Chiltern District Council SFRA Level 1 Update.*
[102] Jacobs and CDC (2008), *Chiltern District Council SFRA Level 2.*
[103] Jacobs and WDC (2007), *Wycombe District SFRA.*

13.3.40 Developments are required to comply with the National Planning Policy Framework[104] (NPPF), development plans and other legislation and guidance. As such committed developments should have a neutral effect on the water resources and flood risk baseline.

13.3.41 Water Framework Directive future status objectives are set out in Table 18 and Table 19. This potential change in baseline is not considered to result in the reported effects from the Proposed Scheme changing in significance.

Climate change

13.3.42 Current projections to the 2080s indicate that climate change may affect the future baseline against which the impacts of the Proposed Scheme on surface water and groundwater resources have been assessed. There may be changes in the flow and water quality characteristics of surface water and groundwater bodies as a result of changes in climate. However, except for flood flows described below, these changes are not considered likely to result in the reported effects from the Proposed Scheme changing in significance.

13.3.43 Current predictions indicate that there will be more frequent, higher intensity rainfall events in the future. The probability and severity of surface water flooding could therefore increase as surface water drainage systems fail to cope with more frequent, higher intensity storms. Peak river flows during flood events are expected to increase, potentially causing greater depths and extents of flooding.

13.3.44 When considering the influence that climate change may have on the future baseline, against which the impacts from the Proposed Scheme on flood risk have been evaluated, the assessment has used the recommended precautionary sensitivity ranges of key parameters, as given in Table 5 in the technical guidance to the NPPF. The sensitivity testing undertaken allows for variations in climate change factors included in other national guidance.

13.3.45 Further information on the potential additional impacts of climate change for water resources and flood risk is provided in Sections 7 and 8 of Volume 1 and Table 13 of Volume 5: Appendix CT-009-000.

13.4 Effects arising during construction

Avoidance and mitigation measures

13.4.1 The general approach to mitigation is set out in Volume 1, Section 9.

13.4.2 The following are examples of avoidance and mitigation measures that will reduce potential adverse effects on surface water and flood risk. Further details are given in Volume 5: Appendices WR-002-010 and WR-003-010.

13.4.3 With regard to surface water, sustainable drainage systems (SuDS), where appropriate, have been provided to encourage water to soak back into the ground such as near Grove Farm, Hartley Farm and the A413 London Road, and where drainage or cuttings intercept groundwater flow. The SuDS land drainage areas

[104] Department for Communities and Local Government (2012), *National Planning Policy Framework.*

provided in the current design are shown on Maps CT-06-035 to CT-06-040 (Volume 2, CFA10 Map Book). The presence of any SPZ has been taken into account to ensure that PWS will not be affected.

13.4.4 Drainage, including that from access roads and hard standings will discharge, where reasonably practicable, to SuDS balancing ponds, prior to subsequent discharge to watercourses or, if necessary, to sewer. The balancing ponds will provide mitigation to ensure that rainfall run-off from the route will be released in a controlled manner to the receiving watercourses reducing the potential for adverse impact on the water quality and flow of the receiving watercourse. The balancing ponds, shown on Maps CT-06-035 to CT-06-040 (Volume 2, CFA10 Map Book), will be designed where practicable to discharge at existing run-off rates and will accommodate for events up to and including the 1 in 100 annual probability (1%) including an allowance for climate change.

13.4.5 Highways works will include the temporary or permanent realignment of a number of minor roads and the B4009 Nash Lee Road. Appropriate mitigation will be provided to address the risks to water quality in the receiving water body for both flow and water quality during the detailed design of the Proposed Scheme using the Design Manual for Roads and Bridges[105] and CIRIA guidance[106]. The SuDS balancing ponds provided in the current design are shown on Maps CT-06-35 to CT-06-40 (Volume 2, CFA10 Map Book).

13.4.6 The following measures will reduce potential affects to groundwater that could arise from construction.

13.4.7 During construction of the Wendover green tunnel, the open cutting will intercept groundwater flow; however, this disruption will be limited due to the relatively shallow cutting. During dry periods when groundwater levels are low there will be little or no disturbance. Only during periods when groundwater levels are higher will there be a slight disturbance to flow. The elevation of the tunnel relative to the base of the Chalk and Upper Greensand aquifers is such that there will be a minimal change to spring fed streams located to the north of Wendover that feed Weston Turville SSSI. Only the stream rising in the west of Wendover (i.e. the Wendover Brook) and two drains near World's End, none of which contribute inflow to the SSSI, will have reduced baseflow from groundwater. Further detailed discussion is provided in Volume 5: Appendix WR-002-010.

13.4.8 The drainage of the Wendover green tunnel could intercept groundwater that would flow to these springs, resulting in moderate impacts and moderate effects which would be significant. This would only occur during construction as the green tunnel, when completed, should allow groundwater flow to return to pre-construction flow paths in this area.

13.4.9 The Wendover north cutting will be deeper and intersect more groundwater than the green tunnel. The two drains near World's End (i.e. the headwaters of the Stoke Brook)that flow across the cutting could be affected by reduced groundwater. The

[105] Department for Transport; Design Manual for Roads and Bridges; Volume 4, Section 2.
[106] Murname, E., Heap, A. and Swain, A., (2006), *C648 Control of Water Pollution from Linear Construction Sites*, CIRIA, London, UK.

Proposed Scheme will transfer any intercepted groundwater flow into the Stoke Brook, approximately 1km downstream of where the headwaters emerge to ensure that there will be minimal disruption to the majority of flow in the Stoke Brook.

13.4.10 The method of piling will be selected to avoid creating hydraulic pathways, such as cracks and cavities between the construction and the natural rock and will be selected to avoid creating pathways between the aquifer and shallower surface water and groundwater.

13.4.11 With regard to flood risk, the Proposed Scheme will cross a number of dry valleys that do not have permanent watercourses, but during peak rainfall events are shown to be at risk of surface water flooding. As described further in the flood risk assessment (Volume 5: Appendix WR-003-010) provisions will be made to attenuate surface water run-off and ensure conveyance is maintained to downstream catchments. Surface water flow in the dry valleys at Grove Farm and Small Dean will be conveyed beneath the route by culverts. To minimise potential adverse effects on flood risk all culverts will be designed to convey the 1 in 100 year annual probability (1%) flow including an allowance for climate change.

13.4.12 The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme (see Volume 5: Appendix CT-003-000). These will provide effective management and control of the impacts during the construction period.

13.4.13 The following examples illustrate how measures in the draft CoCP will reduce potentially adverse effects arising during construction on water resources and flood risk.

13.4.14 In accordance with draft CoCP, Section 16, monitoring will be undertaken in consultation with the Environment Agency prior to, during and post construction, if required, to establish baseline conditions for surface water and groundwater, including springs and spring fed watercourses near World's End, and to confirm the effectiveness of agreed temporary and permanent mitigation measures.

13.4.15 Groundwater contamination of the Chalk and Head deposits from surface infiltration at construction sites, such as the Small Dean viaduct launch satellite compound or the Wendover green tunnel satellite compound 1, will be minimised through the requirements of the draft CoCP, Section 16.

13.4.16 Mitigation measures set out in the draft CoCP require contractors to obtain the necessary approvals to enable discharge of dewatering and surface water run-off from construction sites to watercourses, to ground or to the public sewer network. The sites include the Small Dean viaduct launch area, Wendover green tunnel satellite compound 1 and B4009 Nash Lee Road overbridge satellite compound.

13.4.17 The Small Dean viaduct launch satellite compound, Wendover green tunnel satellite compound 1 and B4009 Nash Lee Road overbridge satellite compound will all lie within dry valleys at risk of flooding from surface water in times of heavy rainfall. The sites will be included in the site specific flood risk management plans prepared prior to construction, as stated in the measures set out within the draft CoCP.

Assessment of impacts and effects

13.4.18 This section describes the significant effects following the implementation of avoidance and mitigation measures.

13.4.19 Further details of the potential impacts that will not have significant effects are provided in the Water Resources Assessment report in Volume 5: Appendix WR-002-013 and Flood Risk Assessment in Volume 5: Appendix WR-003-013.

13.4.20 An assessment of the impact on the WFD status is detailed within the WFD Compliance Assessment, contained within the Route-wide Water Resources appendix (Volume 5: Appendix WR-001-000).

13.4.21 It is not considered that projected climate change effects, combined with the effects from the construction of the Proposed Scheme, will alter the significance of any of the reported effects on surface water and groundwater resources (see Volume 3: Route-wide Effects Assessment for further information).

Temporary effects

Surface water

13.4.22 The assessment shows that there will be no significant temporary adverse effects on surface water resources.

Groundwater

13.4.23 Construction such as piling or excavation of cuttings in the Chalk could have the potential to impact on groundwater quality due to the migration of fluids or suspended bedrock particles giving rise to raised turbidity. At the scale of the classified Mid Chilterns Chalk groundwater body any turbid groundwater will be attenuated within the Chalk and diluted in regional flow and the overall impact on the groundwater body as a whole is deemed to be negligible which for this high value receptor would be a neutral effect and therefore not significant.

13.4.24 Any migration of turbid groundwater to surface water is likely to be a slow process allowing natural attenuation within the chalk and dilution, to reduce turbidity to levels that are unlikely to significantly affect surface water quality. Therefore, the impact of any change in groundwater quality in the wider groundwater body on surface water and water dependent habitats will be negligible.

13.4.25 Although effects on wider water body receptors are considered to be neutral, if fissures connect the working area of the Proposed Scheme directly to high value receptors such as PWS or private boreholes for domestic use, the impact of even minor levels of turbidity will be large due to the high quality required to be met for potable use, resulting in a moderate and significant effect. In this area, no works below the water table will take place in SPZ1 and a limited amount of piling will take place in SPZ2. The PWS protected by these SPZ are also at least 850m from the Proposed Scheme and are not located directly down-gradient of the Proposed Scheme. As such, the risk of impacts on PWS is considered to be negligible and the effects are not significant.

13.4.26 There will however be a significant risk to private abstractions that are closer to the route. The private water abstractions are shown on Map WR-02-010, E5 (Volume 5, Water Resources and Flood Risk Assessment Map Book). Further mitigation for these private abstractions is discussed below in Other mitigation.

13.4.27 No other significant effects on groundwater resources or water dependent habitats have been identified within the assessment during the construction period.

Flood risk

13.4.28 The assessment has identified no significant increase in flood risk from all sources of flooding during the construction process and therefore no significant temporary effects.

Cumulative effects

13.4.29 There are no committed developments that have been identified which will result in significant cumulative temporary effects.

Permanent effects

Surface water

13.4.30 No anticipated permanent adverse effects on surface water features as a result of construction have been identified within the assessment, other than the redistribution of some of the flow in the spring fed head reach of the Stoke Brook as discussed below.

Groundwater

13.4.31 The Wendover north cutting has the potential to intercept some of the base flow to the headwaters of the Stoke Brook at World's End (Map WR-02-010, C5, Volume 5, Water Resources and Flood Risk Assessment Map Book). Although all this flow will be returned to the watercourse around 1km downstream of World's End, below the existing railway crossing at Hideaway Farm/Triangle Business Park, there could potentially be a reduction in flows in the upstream 1km of the watercourse. Should this occur, it would result in a localised minor impact with a moderate and therefore significant adverse effect. At the scale of the wider Stoke Brook the effect is considered neutral. Details of the assessment are provided in Volume 5: Appendix WR-002-010.

13.4.32 Any groundwater intercepted by the Wendover green tunnel will occur only during periods of high groundwater levels, when the groundwater contribution to flow in the Wendover Brook could be reduced, although this would be counterbalanced by the overall increase in water within the catchment. There will not be a significant effect to Weston Turville SSSI as a result of any changes to flow in the Wendover Brook. Further to this, the Wendover Brook bypasses the reservoir and is not normally in hydraulic connectivity with the SSSI. Detail is provided in Volume 5 Appendix: WR-002-010.

13.4.33 No other permanent significant adverse effects on groundwater resources have been identified within the assessment.

13.4.34 No permanent significant adverse effects to water dependent habitats, including those within the Weston Turville Reservoir SSSI, have been identified within the assessment (see Volume 5 Appendix WR-002-010).

Flood risk

13.4.35 The assessment shows there will be no significant permanent adverse effects on flood risk from all sources.

Cumulative effects

13.4.36 There are no committed developments that have been identified which will result in significant cumulative permanent effects.

Other mitigation measures

13.4.37 No other mitigation measures are envisaged for surface water.

13.4.38 At licensed private water abstractions where there is the potential for significant adverse effects on abstractions during construction, monitoring of groundwater turbidity will be used to verify if effects are occurring and provide evidence to justify further intervention, should that be required. Appropriate mitigation measures will be agreed with the owner in advance of construction commencing and may, for example, consist of the provision of a temporary alternative supply.

13.4.39 At the headwaters of the Stoke Brook, i.e. the upstream 1km near World's End, there is the potential for significant adverse effects on flow locally in this section of the brook. Specific monitoring of groundwater levels and watercourse flows will be used to verify the extent of the effect, if any. Discussions will be held with the Environment Agency on the results of the monitoring to determine if any further mitigation is required. Subject to monitoring outcomes, further mitigation options include measures to discharge intercepted groundwater via local infiltration on the northern side of the Wendover north cutting. With the implementation of such measures, if necessary, there will be no permanent significant effect on the Stoke Brook.

13.4.40 No other mitigation measures are envisaged for reducing flood risk.

Summary of likely significant residual effects

13.4.41 No significant residual effects on surface water and the Mid-Chilterns Chalk groundwater body, including PWS, have been identified within the assessment.

13.4.42 Following mitigation no other significant residual adverse effects to water resources and flood risk have been identified within the assessment.

13.5 Effects arising from operation

Avoidance and mitigation measures

13.5.1 Generic examples of design measures that will mitigate impacts so that there will be no significant adverse effects on the quality and flow characteristics of surface water courses and groundwater bodies during operation and management of the Proposed Scheme are described in Volume 1, Section 9.

13.5.2 Site specific examples of design measures that will mitigate impact include the drainage arrangements for the Proposed Scheme in the study area. This comprises balancing ponds for either railway or highway drainage. These ponds and their associated access tracks are shown in Maps CT-06-35 to CT-06-40a (Volume 2, CFA10 Map Book).

13.5.3 Generic examples of management measures during operation and management of the Proposed Scheme that will mitigate impacts so that there are no significant adverse effects on the quality and flow characteristics of surface water courses and groundwater bodies are described in Volume 1, Section 9, and in the draft operation and maintenance plan for water resources and flood risk included in Volume 5 Appendix WR-001-000.

13.5.4 Operation and management of the Proposed Scheme is not likely to have a significant adverse effect on flood risk anywhere in the catchments through which it passes. Generic examples of management measures that may mitigate flood risk are described in Volume 1, Section 9.

Assessment of impacts and effects

13.5.5 There are considered to be no significant adverse effects to surface water, groundwater or flood risk arising from operation of the proposed scheme.

Other mitigation measures

13.5.6 There are considered to be no further measures required to mitigate adverse effects on surface water resources or groundwater resources or flood risk.

14 References

Arup/URS (2013), *HS2 London - West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum*.

Aylesbury Vale District Council (2004) *Adopted Local Plan, Saved Policies*.

Aylesbury Vale District Council (2007), *Aylesbury Vale District Local Plan Written Statement 2004: Saved Policies*.

Aylesbury Vale District Council (2009), *Submission Core Strategy*.

Aylesbury Vale District Council (2013), *Vale of Aylesbury Plan Strategy 2011-2031*, Submission.

British Geological Survey (1984), *Hydrogeological map of the area between Cambridge and Maidenhead including parts of hydrometric areas 33, 38 and 39*.

British Standard (2011), *Investigation of Potentially Contaminated Sites*, BS10175.

Buckinghamshire and Milton Keynes Environmental Records Centre (2009), *Criteria for the Selection of Local Wildlife Site in Berkshire, Buckinghamshire and Oxfordshire*.

Buckinghamshire County Council (1991), *Buckinghamshire Structure Plan 1991-201, Saved Policies*.

Buckinghamshire County Council (2001), *Landscape Plan for Buckinghamshire Part 1: Landscape Character Assessment*.

Buckinghamshire County Council (2011), *Local Transport Plan 3 (2011-2016)*.

Buckinghamshire County Council (2012), *Minerals and Waste Core Strategy Development Plan Document*.

Chiltern District Council (2011), *Adopted Core Strategy*.

Chiltern district Council (2011), *Adopted Local Plan, Consolidated September 2007 and November 2011*.

Colin Plant Associates (2006), *Invertebrates and Ecological Assessment*. Unpublished Report to the Institute of Ecology and Environmental Management: Available on IEEM website.

Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale*. National Soil Resources Institute, Cranfield University, UK.

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

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

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

Defra (2010), *Defra background maps 2010*; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed: July 2013.

Defra (2011), *The Natural Choice: Securing the value of nature*.

Department for Communities and Local Government (2012), *National Planning Policy Framework*.

Department for Communities and Local Government (2012), *National Planning Policy Framework Technical Guidance*.

Department for Transport (DfT) *Design Manual for Roads and Bridges: Volume 11, Environmental Assessment, Section 3*. Available from: http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3/hd4509.pdf Accessed: September 2013.

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

Environment Agency (2009), *River Basin Management Plan, Thames River Basin District*.

Environment Agency (2010), *Flood Map for Surface Water*, Available from: http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/dataLayers_FMSW.xml. Accessed: 1 February 2013.

Environment Agency Flood maps, Available from: http://www.environment-agency.gov.uk/homeandleisure/37837.aspx. Accessed: September 2013.

IAQM (2012), *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance*.

Jacobs (2008), *Aylesbury Vale Landscape Character Assessment*: Prepared for Buckinghamshire County Council and Aylesbury Vale District Council.

Jacobs and BCC (2011), *Buckinghamshire County Council Preliminary Flood Risk Assessment*.

Jacobs and CDC (2008), *Chiltern District Council SFRA Level 2*.

Jacobs and CDC (2013), *Chiltern District Council SFRA Level 1 Update*.

Jacobs and WDC (2007), *Wycombe District SFRA*; Wycombe District Council.

Land Use Consultants (2011), *Chiltern District Landscape Character Assessment*: Prepared for Buckinghamshire County Council and Chiltern District Council.

Land Use Consultants (2011), *Wycombe District Landscape Character Assessment*: Prepared for Buckinghamshire County Council and Wycombe District Council.

Murname, E., Heap, A. and Swain, A. (2006), *C648 Control of Water Pollution from Linear Construction Sites*, CIRIA, London, UK.

Natural Environment and Rural Communities Act 2006 (2006), *Chapter 16, Natural England, London*: Her Majesty's Stationery Office.

Office for National Statistics (2011), *Census 2011*; http://www.ons.gov.uk/ons/guide-method/census/2011/index.html; Accessed: 1 February 2013

Office of National Statistics (2012), *Business Register and Employment Survey 2011*, ONS, London.

Office of National Statistics (2012), *UK Business: Activity, Size and Location 2011*, ONS, London.

Royal Haskoning and AVDC (2007), *Aylesbury Vale Strategic Flood Risk Assessment Level 1 Report*.

Soil Survey of England and Wales (1984), *Soils and Their Use in South East England*.

South East Regional Assembly (2009), *The South East Plan, Regional Spatial Strategy for the South East*.

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

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

Wycombe District Council (2008), *Adopted Core Strategy Development Plan Document*.

Wycombe District Council (2013), *Delivery and Site Allocations Plan for Town Centres and Managing Development*.