LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA13 | Calvert, Steeple Claydon, Twyford and Chetwode

November 2013

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Department for Transport

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

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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 local alternatives and the likely significant 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, these 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.

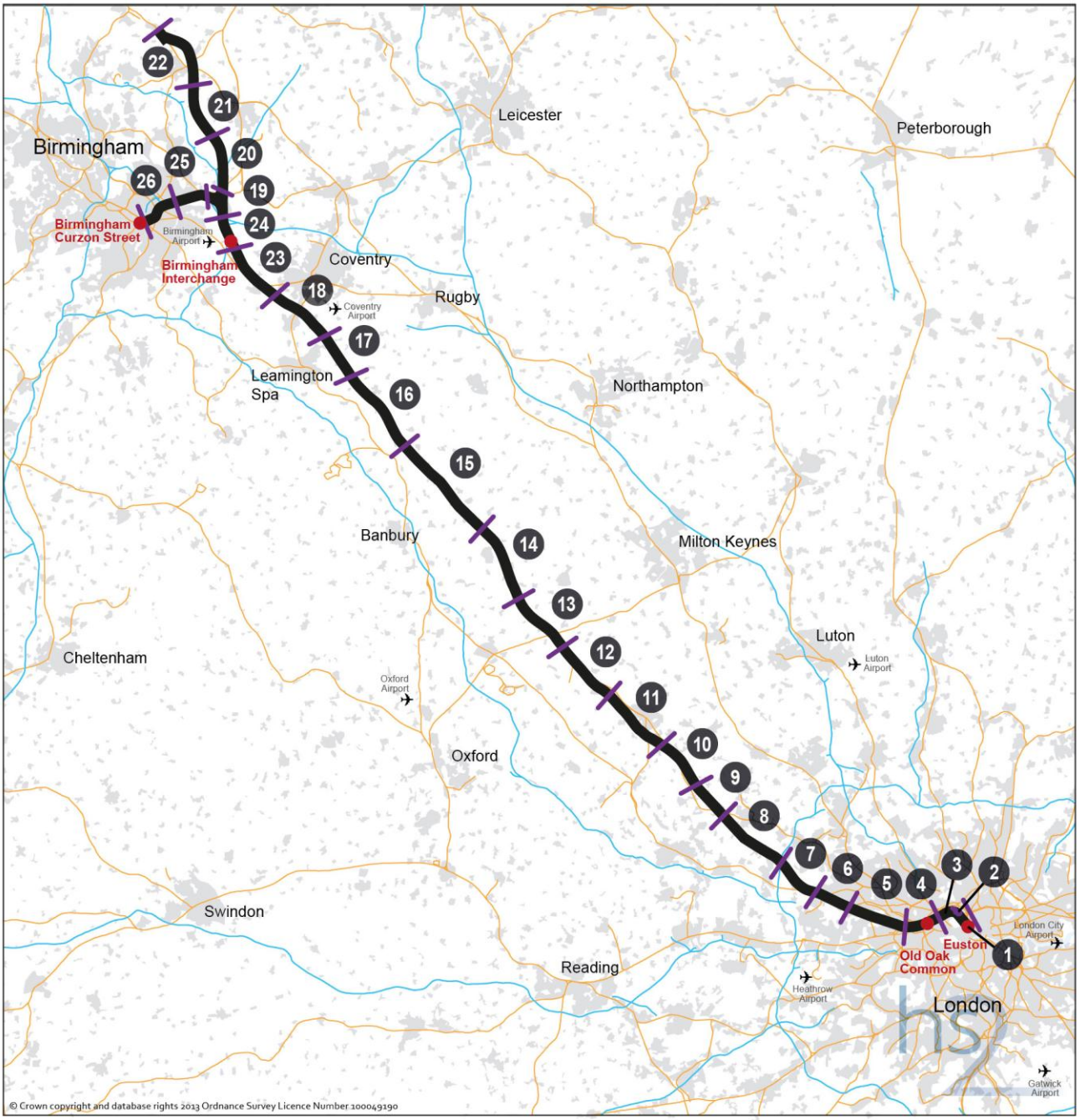
1.1.5 Section 4 of Volume 1 describes the anticipated operational characteristics of HS2, including the anticipated frequency of train services. As Volume 1 shows, the frequency of trains is expected to increase over time and to increase further upon opening of Phase Two. In assessing the environmental 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 Calvert, Steeple Claydon, Twyford and Chetwode area, 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

1.1.8 Figure 1. This has enabled wider public engagement on the scheme design and on the likely adverse and beneficial effects.

Figure 1: HS2 Phase One route and community forum areas



Community forum areas

1. Euston - Station and Approach
2. Camden Town and HS1 Link
3. Primrose Hill to Kilburn (Camden)
4. Kilburn (Brent) to Old Oak Common
5. Northolt Corridor
6. South Ruislip to Ickenham
7. Colne Valley
8. The Chalfonts and Amersham
9. Central Chilterns
10. Dunsmore, Wendover and Halton
11. Stoke Mandeville and Aylesbury
12. Waddesdon and Quainton
13. Calvert, Steeple Claydon, Twyford and Chetwode
14. Newton Purcell to Brackley
15. Greatworth to Lower Boddington
16. Ladbroke and Southam
17. Offchurch and Cubbington
18. Stoneleigh, Kenilworth and Burton Green
19. Coleshill Junction
20. Curdworth to Middleton
21. Drayton Bassett, Hints and Weeford
22. Whittington to Handsacre
23. Balsall Common and Hampton-in-Arden
24. Birmingham Interchange and Chelmsley Wood
25. Castle Bromwich and Bromford
26. Washwood Heath to Curzon Street

HS2 station
Proposed Phase One route
CFA boundary
Existing railways
Motorways
Airports

N

0 20 km approx

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 CFA13 (Calvert, Steeple Claydon, Twyford and Chetwode). 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 CFA13.

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 also include additional information about climate change adaptation and resilience.

1.3.5 The maps relevant to Calvert, Steeple Claydon, Twyford and Chetwode are provided in a separate corresponding document entitled Volume 2: CFA13 Map Book, which 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) and CT-06 (operation) (Volume 2, CFA13 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 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 Calvert, Steeple Claydon, Twyford and Chetwode area extends from the Calvert Green parish boundary in the south to the Barton Hartshorn parish boundary in the north, comprising approximately 10km of the Proposed Scheme.

2.1.2 The Infrastructure Maintenance Depot (IMD)[1] will be located between Calvert and Steeple Claydon. Approximately midway along the route, this location will allow for the efficient maintenance of the railway during its operation. Direct rail connections to the existing Bicester to Bletchley Line and Aylesbury Link railway line will also allow for the transfer of materials via rail, rather than road, during both construction and operation of the Proposed Scheme.

2.1.3 This area is largely within the county of Buckinghamshire, with an approximate 300m section of the route located in Oxfordshire. The area includes land within the parishes of Calvert Green, Steeple Claydon, Twyford, Chetwode, Preston Bissett, Godington and Barton Hartshorn.

2.1.4 The Newton Purcell to Brackley area (CFA14) lies to the north, with Waddesdon and Quainton area (CFA12) to the south, as shown in Figure 2.

Settlement, land use and topography

2.1.5 The topography is generally flat and becomes gently undulating in the north. The area is predominantly rural in character, with agriculture being the main land use, interspersed with small villages and a scattering of isolated residential properties and farmsteads. The Padbury Brook flows in a north-easterly direction, meandering between Twyford and Godington.

2.1.6 The area is dominated by arable farming, resulting in large field patterns with established hedgerow field margins. There is also some dairy farming, predominantly in the south of the area. The area is interspersed with some large pockets of ancient woodland, which are remnants of the Bernwood Forest.

2.1.7 There are a number of small settlements within the area, the largest being Steeple Claydon, to the east of the route and north of the proposed Calvert infrastructure maintenance depot (IMD) which is described in Section 2.1.

[1] The IMD will be responsible for management of the permanent railway excluding rolling stock, which will be maintained at the depot at Washwood Heath (see the CFA26 report).

Key transport infrastructure

2.1.8 The Proposed Scheme will run broadly parallel to the M40 motorway, which is approximately 10-15km to the west. The A421 Tingewick Road runs broadly east-west in the north of the area, connecting with the A413 London Road south of Buckingham in the east. The A41 runs roughly east-west to the south linking Bicester and Aylesbury. The remainder of the local road network consists of minor roads.

2.1.9 Two rail routes cross the area: the Bicester to Bletchley Line and the Aylesbury Link railway line (which runs from Steeple Claydon to Marylebone). The Aylesbury Link follows the line of the former Great Central Main Line and is operational as far as the intersection with the Bicester to Bletchley Line at Claydon Junction, but disused north of Calvert. The Aylesbury Link railway line and Bicester to Bletchley Line are connected by a short curved section of track to the north-east of Calvert. The operational sections of both lines are currently consigned to freight movements and comprise a single track running up to a total of four train movements a day across the two lines.

2.1.10 Network Rail (NR) is working with other consortium partners as part of the East West Rail project to improve the rail lines in this area. This will upgrade existing infrastructure on the Bicester to Bletchley Line and Aylesbury Link railway line, including enhanced rail freight and reinstated passenger services.

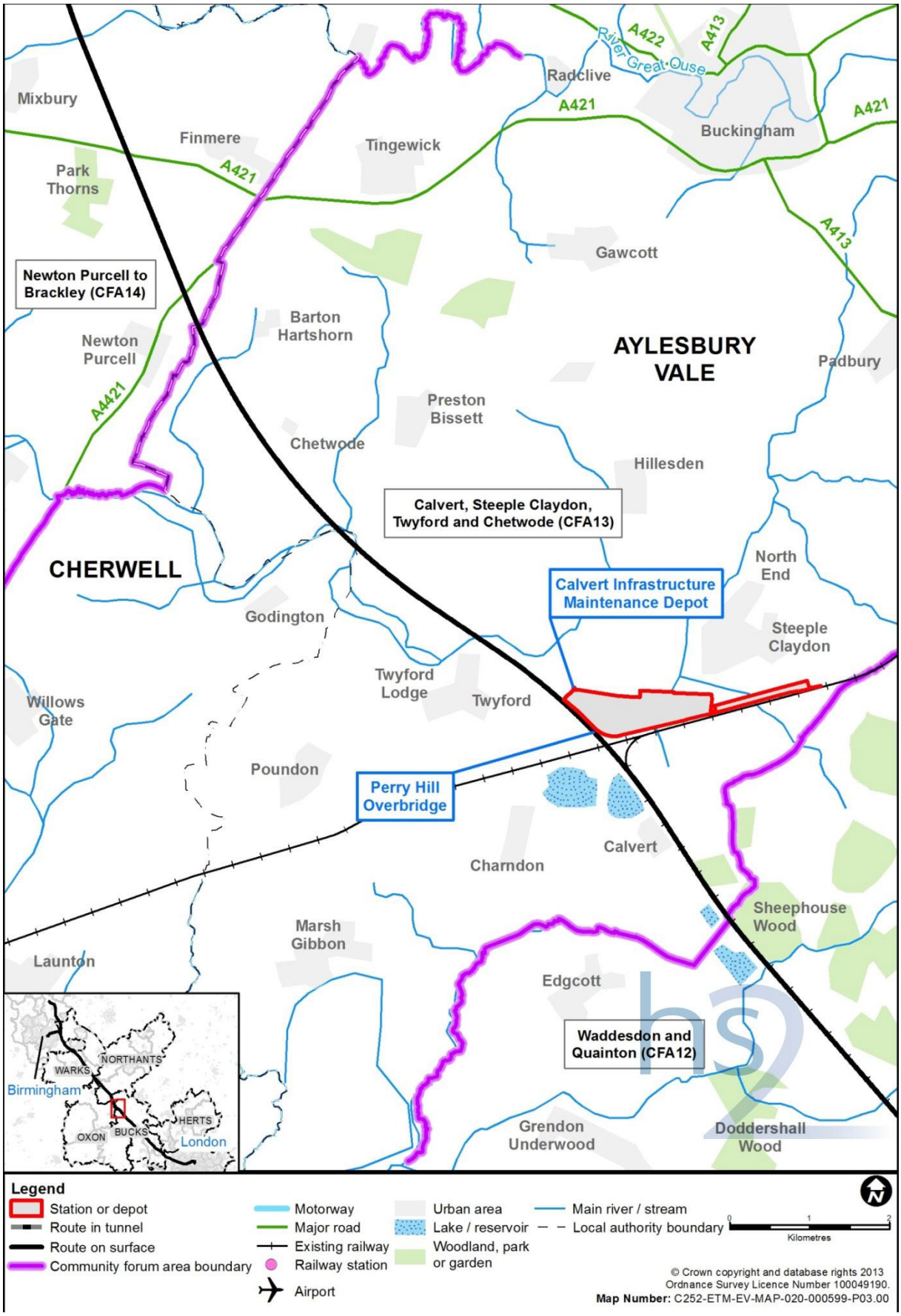
2.1.11 In addition to country lanes and other local roads, a well-established network of public footpaths, byways and bridleways provides connections between the villages in the area. Long distance public rights of way (PRoW) in the area include the Cross Bucks Way, Bernwood Forest route, Bernwood Jubilee Way and National Cycle Route 51.

Socio-economic profile

2.1.12 To provide a socio-economic context for the area, data for the following demographic character areas (DCA) are used: Steeple Claydon; Calvert and Charndon; Twyford and Poundon; Preston Bissett; Godington; Chetwode; and Barton Hartshorn[2]. In total, the population of the DCAs is approximately 4,700. The area's labour market outperforms England's as a whole; unemployment at 3.5% is lower than the national level of 7.4%, while 78.4% of the population aged 16-74 is economically active compared to the national figure of 69.9%[3]. There are approximately 700 people who work within the area[4].

[2] A DCA represents a community that, depending on the area, may consist of a local ward, neighbourhood or village(s).
[3] Data are taken from the Office for National Statistics (ONS), Population Census 2011.
[4] Data are taken from the ONS Business Register and Employment Survey 2011.

Figure 2: Area context map



Notable community facilities

2.1.13 The nearest villages to the route centre line are Calvert, Chetwode, Twyford and Steeple Claydon. The relatively limited range of facilities in the villages means that many residents are likely to be dependent upon travelling in order to access services. Buckingham to the north, Winslow to the east, and Bicester to the west (which are all approximately 7km from the route) are the nearest main centres for health care, shopping and leisure facilities, as well as nursery and secondary schools.

2.1.14 Calvert has a community hall and playground. Twyford has a village hall, a primary school, which caters for children aged 3 to 9, two churches, a village shop and a public house. Chetwode and Godington both have churches. The village of Steeple Claydon has a village shop, a primary school which caters for children aged 4 to 11, library, dental practice, three public houses and two churches.

Recreation, leisure and open space

2.1.15 There are some recreational facilities within the local area including Calvert Green which has a number of play areas. Twyford also has a recreation ground and pavilion, which is home to Twyford Cricket Club and Twyford United Football Club. Public houses and community halls provide a focus for social gatherings and for some village events. Informal open space is a widely used source of recreation in this area including Decoypond Wood, an approximately 9ha privately owned ancient semi-natural woodland and the nature reserve at Calvert Jubilee and Grebe Lake consisting of approximately 95ha just north of Calvert. The large number of PRoW in the area form a network of trails used for recreational purposes.

Policy and planning context

Planning framework

2.1.16 Given that the Proposed Scheme has been developed on a national basis and 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 development plans have been taken into account in relation to environmental topics.

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

- Buckinghamshire County Council Structure Plan[5];
- Buckinghamshire County Council Minerals and Waste Core Strategy DPD (2012)[6];
- Cherwell District Council Local Plan Saved Policies (2007)[7];

[5] Buckinghamshire County Council (1991), *Buckinghamshire Structure Plan 1991-2011: Saved Policies.*
[6] Buckinghamshire County Council (2012), Minerals and Waste Core Strategy Development Plan Document.
[7] Cherwell District Council (2007), Local Plan Saved Policies.

- Cherwell District Council Proposed Submission Local Plan (2012)[8];
- Cherwell District Council Proposed Focused Consultation (2013)[9];
- Aylesbury Vale District Council Vale of Aylesbury Plan Strategy 2011-2031 (2013)[10]; and
- Aylesbury Vale District Council Local Plan Saved Policies (2007)[11].

2.1.18 There are a number of key designations in the area, which include sites of special scientific interest (SSSI), local wildlife sites (LWS), conservation areas and listed buildings (Grades I and II*). These are shown on Maps CY-10-028b to CT-10-031a (Volume 2, CFA13 Map Book).

2.1.19 It is worth noting that although the Vale of Aylesbury Plan Strategy Document has been submitted to the Secretary of State until it is adopted, the 2007 Aylesbury Vale District Council Local Plan Saved Policies still has weight.

Local planning context

2.1.20 The Aylesbury Vale District Council Local Plan Saved Policies[11] does not allocate the IMD site at Calvert for any specific uses.

2.1.21 Policy GP17 of the Aylesbury Local Plan and Policy EMP5 of the Non-Statutory Cherwell Local Plan seeks to retain employment sites and uses. The Calvert Brickworks is designated in the Aylesbury Vale District Council Local Plan as a Major Development Area under Policy RA25 for mixed use housing and employment. The IMD does not affect these policies.

2.1.22 Policy GP25 of the Aylesbury Local Plan seeks to prevent development that might prejudice the use of the Bicester to Bletchley Line or the Aylesbury Link railway line. Linked to this, Policy GP26 seeks to prevent development that will prejudice station schemes or rail related transport proposals at Calvert. The proposed IMD will not affect these policies.

Committed development

2.1.23 Developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme, are shown on Maps CT-13-028 to CT-13-031 (Volume 5, Cross Topic Appendix 1 Map Book) and listed in Volume 5: Appendix CT-004-000/1 and CT-004-000/2. Except where noted otherwise in Appendix CT-004-000/1 and CT-004-000/2, it has been assumed that these developments will have been completed by 2017. These are termed 'committed developments' and have been taken into account for the purpose of assessing the likely significant environmental

[8] Cherwell District Council (2012), Proposed Submission Cherwell Local Plan.
[9] Cherwell District Council (2013), Proposed Submission Cherwell Local Plan, Focused Consultation.
[10] Aylesbury Vale District Council (2013), Vale Of Aylesbury Plan Strategy 2011-2031, Submission.
[11] Aylesbury Vale District Council (2007), Aylesbury Vale District Local Plan (Written Statement 2004 Saved Policies).

effects of 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. The following developments are relevant to several topics assessments in this area:

- East West Rail (EWR) is a strategic project to improve the railway from Oxford to Bicester (Phase 1) and Bicester to Bletchley railway line, including the Aylesbury Link railway line (Phase 2), onwards to East Anglia. The EWR project proposes to provide the upgrade of existing operational rail lines and reinstating sections of disused rail for the provision of new, fast passenger and freight services. A Transport and Works Act Order has been granted for Phase 1 and construction has commenced. Phase 2 will, where necessary, be subject to further planning applications and/or Transport and Works Act applications;
- planning Policy Reference RA/25 (Saved Aylesbury Vale District Local Plan, 2004) refers to a major development site, located on the former Calvert Brickworks on Brackley Lane adjacent to the land required to construct and operate the Proposed Scheme. This allocation includes 101 residential properties already existing and 199 planned developments assumed to be completed before 2017; and
- planning Reference 10/02571/App is located on Brickhill Way and Sandstone Close in Calvert Green and will include the erection of 98 residential properties, two retail units, public open space, car parking, roads and sewers.

2.1.24 However, where a committed development lies wholly or partly within the land required for the Proposed Scheme, it is assumed that the development will not be commenced or completed in its proposed form. Such developments are noted in Volume 5: Appendix CT-004-000/2.

2.1.25 No major developments, however, have been identified which are likely to have cumulative effects, when considered together with the Proposed Scheme within the Calvert, Steeple Claydon, Twyford and Chetwode area.

2.2 Description of the Proposed Scheme

2.2.1 The following section describes the main features of the Proposed Scheme in the Calvert, Steeple Claydon, Twyford and Chetwode 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 some land on a permanent basis, key features of which are illustrated on the operation Maps Series CT-06 (Volume 2, CFA13 Map Book). Land that will also be required, but only on a temporary basis for construction, 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 HS2).

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

- An area of sustainable on-site placement of excavated material has been incorporated adjacent to School Hill, the Aylesbury Link railway line and the Bicester to Bletchley Line;
- Perry Hill road re-alignment has been introduced;
- Twyford footbridge has been removed;
- additional landscaping and noise mitigation has been included in the vicinity of Twyford; and
- the accommodation and bridleway overbridge at Moat Farm has been removed.

Overview

2.2.5 The Proposed Scheme through this area will be approximately 10km in length. It will commence at the western edge of Sheephouse Wood, to the south of Calvert, and then proceed south-east to north-west parallel to the realigned Aylesbury Link railway line. It will pass to the east of Calvert, under the realigned Bicester to Bletchley Line, (which forms part of the East West Rail (EWR) project upgrades), then west of Steeple Claydon, broadly following the alignment of the disused Great Central Main Line (GCML).

2.2.6 The Calvert IMD will be located in the land adjacent to the route, north-east of the Bicester to Bletchley Line crossing, and the associated tracks will run west to east alongside the Bicester to Bletchley Line for approximately 3km, approximately 600m south of Steeple Claydon.

2.2.7 The route will continue from south-east to north-west and will pass to the east of Twyford, crossing the Padbury Brook three times before passing to the east of Godington. It will then pass to the west of Chetwode and on towards the county boundary between Buckinghamshire and Oxfordshire, to the west of Barton Hartshorn (see Maps CT-06-054 to CT-06-058-L1 Volume 2, CFA13 Map Book).

Calvert cutting and Aylesbury Link railway line realignment

2.2.8 The Proposed Scheme will leave the Waddesdon and Quainton area (CFA12) on an embankment. It will run parallel to, and to the west side of, the existing Aylesbury Link railway line which runs along the former Great Central Main Line corridor, with Sheephouse Wood located to the east and Calvert Landfill to the west. To accommodate the Proposed Scheme and the associated Sheephouse Wood mitigation structure (described below) in this area the Aylesbury Link railway line will be realigned by up to 3m eastwards between Sheephouse Wood and the Bicester to Bletchley Line. After the route passes under the Bicester to Bletchley Line, it will ascend and diverge from the former Great Central Main Line in cutting.

2.2.9 Through this section, the Proposed Scheme will run in the Calvert cutting, which is approximately 4.1km long. The cutting runs along the western side of the realigned Aylesbury Link railway line for approximately 2.2km, before continuing north-west parallel to the former Great Central Main Line rail corridor for approximately 1.8km. Key permanent features of the route in this section will include (see Maps Series CT-06-054 to CT-06-056 (Volume 2 CFA13 Map Book)):

- the HS2 tracks will run at approximately the same level as the Aylesbury Link railway line for approximately 200m just to the north of Sheephouse Wood, before descending into the Calvert cutting which will be retained on both sides to 600m north of School Hill, to reduce the extent of earthworks. North of this point the route will continue in a cutting, which will be retained only on the west side adjacent to the nature reserve at Calvert Jubilee lake;
- a green overbridge spanning the Aylesbury Link railway line and the Proposed Scheme, to provide a crossing for Footpath SCL/13 and to maintain existing habitat links across the route for bats and other wildlife. The overbridge will be up to 10m above existing ground level;
- areas of planting to maintain and enhance existing habitat corridors and links between woodland and the proposed green crossings. These planting areas have been purposefully set back at appropriate distances from the Proposed Scheme to encourage bats either towards the green crossings, or otherwise away from the Proposed Scheme;
- a Sheephouse Wood mitigation structure will be provided to avoid potential impacts on bats crossing the HS2 corridor adjacent to Sheephouse Wood. This will extend from the south of Sheephouse Wood to its northern extent at Footpath SCL/13 green overbridge, a distance of approximately 800m. The structure will provide a physical barrier to bats and for purposes of this ES has been assessed as a box shaped enclosure. This will be up to approximately 10m above rail level. If required to discourage bats from flying close to areas of wind turbulence around the structure lighting will be designed for minimal light spillage;
- removal of vegetation along sections of the eastern side of the Aylesbury Link railway line and on the western side of the HS2 tracks to maintain an open habitat to discourage bats from this area;
- Calvert green overbridge spanning the Aylesbury Link railway line and the Proposed Scheme, to provide an access road to the Calvert Landfill waste transfer sidings and maintain existing habitat links across the route for bats and other wildlife. The overbridge will be up to 6m above existing ground level. The approach embankments on the west side will incorporate additional earthworks to support the rerouted public Bridleway SCL/18 which runs approximately parallel to the Proposed Scheme;
- as described in the Aylesbury Link railway line realignment section, north of Calvert green overbridge HS2 will comprise a three track arrangement for about 1km, with two mainlines and a rail access spur which will run parallel to

the mainlines past School Hill before diverging to the east and connecting to the south side of the IMD. This southern rail access spur to the IMD will run in open cutting before passing under the Bicester to Bletchley Line and into the IMD;

- noise fence barriers on the west side of the Proposed Scheme on top of a retaining wall, approximately 1km in length and varying in height to provide a combined retaining wall and barrier height of 5m above rail level, continuing north up to School Hill green overbridge;
- a pumping station and associated access track from Brackley Lane, to convey a watercourse and land drainage area under the Proposed Scheme to an outlet at an existing watercourse on the east side;
- School Hill green overbridge spanning the Aylesbury Link railway line and the Proposed Scheme for the realignment of School Hill 25m to the east, and to maintain existing habitat links across the route for bats and other wildlife. The overbridge will be up to 7m above existing ground level;
- a sustainable placement area will be used to permanently deposit approximately 1,000,000m3 of surplus excavated materials. The area, which will be up to 800m long, up to 600m wide and up to 5m in height, will be located to the east of the Proposed Scheme, north of Calvert. The sides of the sustainable placement area will be designed to tie into the existing landform. On completion, hedgerows will be reinstated on their former position, modified land drainage will be provided and the land returned to agriculture;
- a pumping station and balancing pond for railway drainage to the east of the route and the Aylesbury Link railway line with associated access track from School Hill;
- an inverted siphon to convey an existing watercourse under the retained section of the Calvert cutting, with access tracks from School Hill;
- Portway Farm auto-transformer station[12] located to the west of the route on a section of railway corridor which will become redundant following the realignment of the Bicester to Bletchley Line;
- East West Rail overbridge to carry the realigned Bicester to Bletchley Line over the Proposed Scheme. The overbridge will beapproximately4m above existing ground level and the approach embankments and associated structures for this realignment are described in more detail in the next section;
- a balancing pond for IMD drainage to the east of the Proposed Scheme; and
- Perry Hill overbridge to take the realigned Perry Hill over the IMD northern access spur and to provide an accommodation access. The overbridge will be

[12] 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.

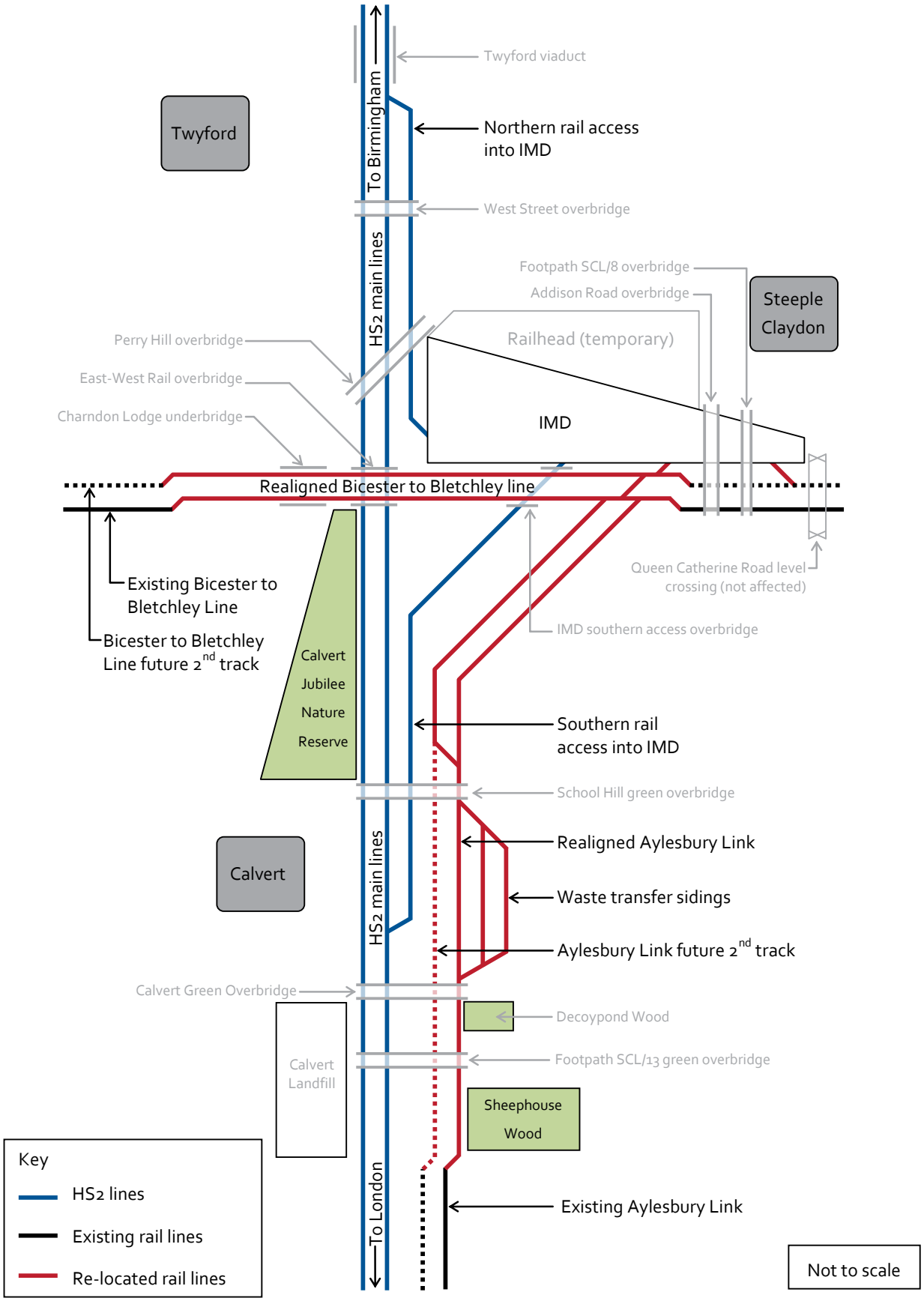
8m above existing ground level and will incorporate a separate farm accommodation track for Portway Farm on the north side of the highway.

2.2.10 The realignment of the Aylesbury Link railway line commences in the Waddesdon and Quainton area (CFA 12) and covers approximately 3.5km in total: 900m in the Waddesdon and Quainton area and 2.6km in the Calvert, Steeple Claydon, Twyford and Chetwode area. At the start of this section, the Proposed Scheme will run at the same height as the realigned Aylesbury Link railway line for approximately 200m before descending into a cutting, with the Aylesbury Link railway line remaining at approximately its existing level. Key permanent features of the realigned Aylesbury Link railway line, will include (see Figure 3):

- a single existing track realigned eastwards with the space for provision of an additional track in the future within NR boundaries. The track will be realigned by approximately 3m adjacent to Sheephouse Wood and up to 50m at School Hill. This will include a widened cutting for approximately 2km northwards from Sheephouse Wood;
- north of School Hill, the Aylesbury Link railway line will curve to the east on a new low embankment, approximately 650m long, to connect to the Bicester to Bletchley Line, passing through Shepherd's Furze Farm;
- adjacent to Sheephouse Wood, the railway corridor will comprise three lines – two lines for HS2 and one for the Aylesbury Link railway line with space to allow for its future twin tracking;
- between Calvert green overbridge and School Hill green overbridge, the railway corridor will comprise six lines – two for the waste transfer sidings, one for the Aylesbury Link railway line with space to allow for its future twin tracking, two lines for HS2 and one for the HS2 southern access spur into the IMD; and
- relocation of the existing Calvert Landfill waste transfer sidings and gantries[13] to the east side of the realigned Aylesbury Link railway line to the north of Decoypond Wood, to allow sufficient space for construction of the Proposed Scheme. These will provide train stabling and offloading facilities for Calvert Landfill site.

[13] The gantries are bridge-like frameworks used to support the overhead equipment for waste transfer between trains and HGVs within the Calvert Landfill site.

Figure 3: Permanent features of HS2 and the classic rail network at Calvert



Calvert Infrastructure Maintenance Depot (IMD) and Bicester to Bletchley Line realignment

2.2.11 The Calvert IMD will occupy land to the north-east of the intersection of the Proposed Scheme and the Bicester to Bletchley Line. The Bicester to Bletchley Line will be realigned up to 30m to the north and will run alongside the IMD, crossing over the Proposed Scheme at the western end (see Figure 3). The tracks within the IMD will run east-west, parallel to the Bicester to Bletchley Line for approximately 3km, extending from the East West Rail overbridge to west of the Queen Catherine Road level crossing. Rail access spurs will connect the Proposed Scheme to the IMD to the south and north. An aerial visualisation of the Calvert IMD at year 15 of operation (2041) is shown in Figure LV-15-004 (Volume 2 CFA13 Map Book).

2.2.12 Key features of the Proposed Scheme in this section, which is approximately 3.5km long, will include (see Maps CT-06-055 and CT-06-056 Volume 2, CFA13 Map Book):

- a pumping station, balancing pond and reed bed for highway drainage of Perry Hill to the north of the realigned Bicester to Bletchley Line, west of the mainline;
- Charndon Lodge underbridge to reinstate Perry Hill underneath the realigned Bicester to Bletchley Line. The realigned road will be up to 9m below existing ground level;
- relocation of a gas pumping station which currently occupies the area between the Bicester to Bletchley Line, the former GCML and Perry Hill, to the north of the IMD, 250m from the Proposed Scheme;
- realignment of the Bicester to Bletchley Line, which will run parallel to and to the north of the existing Bicester to Bletchley Line, will comprise:
  - an embankment to the north of the existing railway, beginning to the west of Addison Road and ascending westwards for approximately 1.1km at a height of up to 7m above existing ground level;
  - IMD southern access overbridge, at a height of approximately 7m above existing ground level, to take the Bicester to Bletchley Line over the southern rail access spur;
  - East West Rail overbridge to take the Bicester to Bletchley Line over the Proposed Scheme, which is in cutting below existing ground level. The overbridge will be up to 4m above existing ground level; and
  - an embankment descending from east to west for approximately 600m, with a maximum height of up to 3m, before re-joining the existing alignment.
- the Calvert IMD, a permanent maintenance depot covering approximately 37ha of land, extending 3km to the east of the Proposed Scheme. The depot will operate as a base for maintenance activities to support the railway infrastructure and will be approximately 350m wide at the western end and

100m wide at the eastern end. It will comprise:

- a depot building, to store and maintain maintenance vehicles, up to 13m high and with a covered roof area of approximately 6300m^2;
- a covered storage and light maintenance workshop area of approximately 5500m^2 and up to 13m high;
- accommodation and office buildings with an area of about 2500m^2 and up to 13m high, with parking for IMD staff;
- a main workshop building of approximately 2400m^2 and up to 13m high;
- a series of sidings to allow the handling and storage of rail infrastructure replacement materials and maintenance trains;
- rail access spurs from the IMD connecting to the HS2 lines to allow maintenance of the Proposed Scheme to the north and south of Calvert; and
- connections to the Bicester to Bletchley Line to allow maintenance materials to be delivered by rail.

- planted landscape earthworks up to 5m high on the north side for the full length of the IMD integrating the site into the landscape and providing visual screening. The earthworks will be installed at an early stage of construction to allow vegetation to establish;
- an approximately 200m long retaining wall to separate the through tracks from the southern access track to the IMD;
- a balancing pond for railway drainage to the south of the route with an access track from the existing Shepherd's Furze Farm accommodation access track off Addison Road;
- two pairs of parallel culverts, one on the west and one on the east of Addison Road carrying unnamed watercourses under the IMD. These culverts will be extensions of the existing culvert under the Bicester to Bletchley Line, 120m and 200m long respectively;
- re-location of an electricity sub-station to accommodate the IMD sidings;
- a new Addison Road overbridge, realigning the road to the east of its existing position. The new overbridge will span the Bicester to Bletchley Line and the IMD sidings at a height of around 9m above existing ground level;
- a footbridge to take Footpath SCL/8 and other PRoW south of Steeple Claydon across the realigned Bicester to Bletchley Line and the Calvert IMD sidings at a height of 7m above existing ground level;

- a replacement floodplain storage area to the north of the Calvert IMD, which will be excavated and regraded to approximately 1m below existing ground level[14]; and
- a land drainage area to the north of the IMD.

Twyford viaduct and adjacent earthworks

2.2.13 The Proposed Scheme will diverge eastwards away from the alignment of the former GCML, which is disused north of the crossing of the Bicester to Bletchley Line. The Proposed Scheme will continue south-east to north-west, rising out of a cutting north of West Street and onto an embankment, up to 4.5m high for approximately 2km, passing east of Twyford and crossing the Padbury Brook on a viaduct. The route will then descend into a cutting, up to 5m deep, for approximately 1km to the end of this section.

2.2.14 A third rail line, which provides access between the HS2 main lines and the IMD, extends northwards from the IMD for 1.3km along the eastern side of the HS2 main lines.

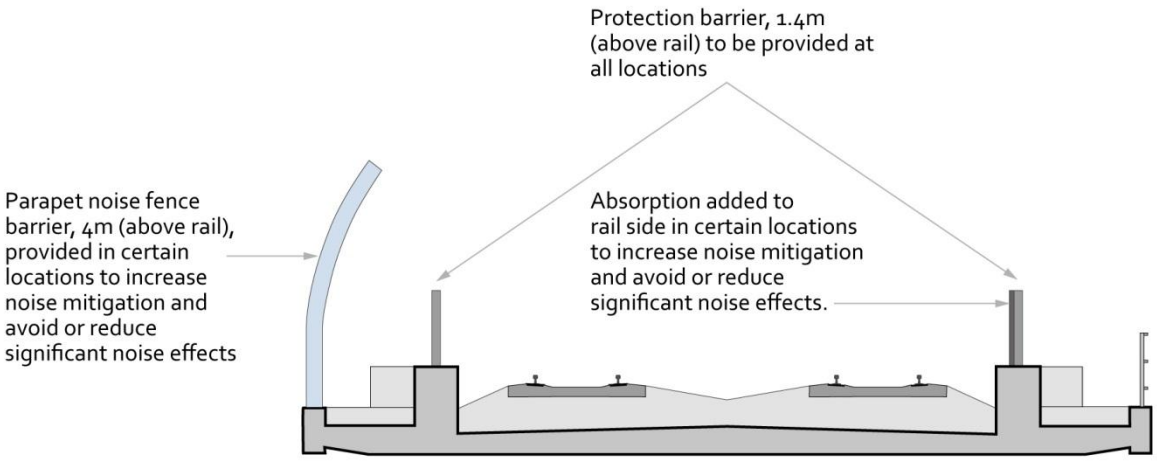
2.2.15 Key features of this section, which will be approximately 2.4km long, will include (see Maps CT-06-056 to CT-06-058-L1, Volume 2, CFA13 Map Book):

- landscape earthworks on the west side of the Proposed Scheme from the southern end of this section to the southern edge of the Padbury Brook floodplain, to integrate the embankment into the landscape and provide visual screening;
- a replacement floodplain storage area to the north-west of Perry Hill overbridge, excavated and regraded to approximately 1m below existing ground level;
- a balancing pond for highway drainage off the proposed West Street overbridge and associated access track between the former GCML and the Proposed Scheme;
- West Street overbridge to reinstate West Street up to 10m above existing ground level. The overbridge will be approximately 100m north-east of the existing bridge crossing the former GCML. The existing bridge will be retained in order to maintain farm access under West Street;
- retention and enhancement of existing vegetation along the former GCML corridor to provide visual screening;
- two replacement floodplain storage areas to the east between the Proposed Scheme and Perry Hill, which will be excavated and regraded to approximately 1m below existing ground level;

[14] All flood compensation areas will be regraded to tie back into existing ground level and returned to agriculture, wherever the farming practices are compatible with the land use.

- noise fence barriers up to 5m above rail height along the west side of the route past Twyford, for a distance of approximately 1.3km, except across the Twyford viaduct;
- a balancing pond for railway drainage to the east and a land drainage area to the west, adjacent to Twyford sewage treatment works;
- two replacement floodplain storage areas to the west of the Proposed Scheme, east of Twyford, which will be excavated and regraded to approximately 1m below existing ground level;
- a balancing pond for railway drainage to the east and a land drainage area on the west to the east of Twyford;
- Twyford viaduct to carry the Proposed Scheme over the Padbury Brook. The viaduct will be approximately 5m above existing ground level and will have a 1.4m high protection barrier adjacent to the tracks on each side. In addition, along the western edge of the viaduct there will be a 4m high noise fence barrier (see 4 for schematic of viaduct showing noise fence barrier on western side);
- areas of planting on both sides of the route within the Padbury Brook floodplain;
- a balancing pond for railway drainage to the east of the route;
- watercourse diversions at Mill Stream, under Twyford viaduct, and Cowley Old House;
- a replacement floodplain storage area to the west of the former GCML, which will be excavated and regraded to approximately 1m below existing ground level;
- landscape earthworks on the west side of the Proposed Scheme from the northern edge of the Padbury Brook floodplain, continuing north for approximately 400m, to provide noise mitigation. Tree planting along and to the north of the earthwork will also provide visual screening;
- an overbridge to provide farm access and Footpath PBI/5 connectivity over the Proposed Scheme;
- an overbridge to provide farm access and PRoW (restricted byway PBI/5A) connectivity over the Proposed Scheme; and
- an area of ecological mitigation to the west of the route to provide habitat compensation.

Figure 4: Schematic cross-section of Twyford viaduct illustrating 4m barrier along the western edge



Godington east and west viaducts and adjacent embankments

2.2.16 To the north of Godington, the Proposed Scheme will pass along a series of embankments and two viaducts as the route crosses a meander of the Padbury Brook into part of Oxfordshire and returns into Buckinghamshire. Key features of this section, which will be approximately 1.1km long, will include (see Map CT-06-058, Volume 2, CFA13 Map Book):

- retention and enhancement of existing vegetation along the former GCML corridor to provide visual screening;
- areas of woodland and hedgerow planting to the east of the route to provide visual screening;
- noise fence barriers up to 3m high will extend along the east side of the Proposed Scheme for the length of this section, up to the Godington east and west viaducts. These viaducts will span a meander of the Padbury Brook and floodplain. The viaducts will be approximately 5.5m 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 east side to also act as an absorptive noise fence barrier;
- two replacement floodplain storage areas on the west side of the Proposed Scheme adjacent to the Padbury Brook, which will be excavated and regraded to approximately 1m below existing ground level;
- a balancing pond for railway drainage to the north of Bridleway CHW/24. Maintenance access to the pond will be from the existing accommodation track; and
- an area of ecological mitigation to the east of the balancing pond to provide habitat compensation.

Chetwode cutting and Barton Hartshorn embankment

2.2.17 Gently curving to the north-west, the Proposed Scheme will pass to the west of Chetwode in a cutting approximately 1.9km long and up to 10.5m deep. The route will exit the cutting to re-join the route of the former GCML on embankment at the county boundary of Buckinghamshire and Oxfordshire, to the west of Barton Hartshorn. Key features of this section, which will be approximately 2.7km long, will include the following (see Maps CT-06-058 to CT-06-060, Volume 2, CFA13 Map Book):

- retention and enhancement of existing vegetation along the former GCML corridor to provide visual screening;
- an area of ecological mitigation to the west of the route to provide habitat compensation;
- landscape earthworks on the east side of the Proposed Scheme south of Rosehill Farm to integrate the cutting into the landscape and provide noise mitigation;
- a land drainage area to the east of the Proposed Scheme, south-east of Rosehill Farm;
- noise fence barriers along the east side of the Proposed Scheme at the bottom of the cutting approximately 1.2km in length and 4m high, continuing north past Chetwode;
- realignment of The Green (road) to accommodate the Proposed Scheme;
- Chetwode auto-transformer station to the west of the Proposed Scheme, south-east of Manthorn Farm;
- an overbridge to replace the private access to Manthorn Farm and take the realigned Footpath CHW/18 and maintenance access over the Proposed Scheme. The over bridge will be up to 3m above existing ground level;
- landscape earthworks on the east side of the Proposed Scheme from Sunflower Farm to the Hermitage, to integrate the cutting into the landscape and provide visual screening;
- landscape earthworks on the west side of the Proposed Scheme between Manthorn Farm and north of School End Road to integrate the cutting into the landscape and provide visual screening;
- a land drainage area and associated access track on the west side of the route north of Manthorn Farm;
- woodland planting between The Hermitage and the Proposed Scheme to provide visual screening;
- landscape earthworks on the east side of the Proposed Scheme between The Hermitage and north of School End Road to provide noise mitigation;

- School End overbridge for reinstatement of the existing road. The overbridge will also provide connectivity for Footpath CHW/11 over the Proposed Scheme. The overbridge will be up to 1m above existing ground level;
- an area of removed vegetation along the former GCML on the north side of School End to discourage wildlife away from the Proposed Scheme;
- a replacement floodplain storage area to the west of the route, which will be excavated and regraded to approximately 1m below existing ground level;
- three balancing ponds for railway drainage and two land drainage areas with associated access tracks from School End (on each side of the route);
- a replacement floodplain storage area to the east of the route, which will be excavated and regraded to approximately 1m below existing ground level;
- an area of ecological mitigation to the north of Barton Hartshorn Railway Wood LWS to provide woodland habitat compensation;
- landscape earthworks on the both sides of the Proposed Scheme to provide noise mitigation on the west side and visual screening on the east side of the route;
- land drainage areas on both sides of the route, with a reed bed adjacent to the land drainage area on the east side of the route; and
- an overbridge providing Footpath BHA/2 connectivity between Barton Hartshorn and Newton Purcell.

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the strategy for the construction of the Proposed Scheme in the Calvert, Steeple Claydon, Twyford and Chetwode 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
- construction programme.

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 Map Series CT-05 (Volume 2, CFA13 Map Book). Following construction works, land required

temporarily will be prepared for its eventual end use, which will include being returned to its pre-construction use wherever reasonably practicable.

Overview of the construction process

2.3.4 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, and preliminary enabling works;
- civil engineering works, including establishment of construction compounds, including establishment of the Calvert railhead, 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, reconfiguration of the railhead, establishment of the IMD, and removal of construction compounds including the railhead; and
- establishment of the Calvert IMD, system testing and commissioning.

Guide to general construction control provisions

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

- the approach to environmental management during construction and the role of the Code of Construction Practice (draft CoCP, Section 3);
- working hours (draft CoCP, Section 5.2);
- the management of construction traffic (draft CoCP, Section 14); and
- the handling of construction materials (draft CoCP, Section 16).

Advance works

2.3.6 General information about advance works can be found in Volume 1, Section 6.5. 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

2.3.7 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 and/or slab tracks and/or installing power supply and communications features.

2.3.8 The construction of the 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 worksites and the public highway, as well as performing other functions as described below. Compounds will either be main compounds or satellite compounds, which are generally smaller. Some compounds will be used for civil engineering works and others for railway installation works, and in some cases for both.

2.3.9 In the Calvert, Steeple Claydon, Twyford and Chetwode area there will be two main compounds and two civil engineering satellite compounds and five railway installation satellite compounds (of which one will continue to use a compound previously established for the civil engineering works).

2.3.10 Figure 5 shows the management relationship for civil engineering works compounds and Figure 6 for the railway installation works compounds. Details about individual compounds are provided in subsequent sections of this report.

Aylesbury Link railway line realignment

2.3.11 In this area, a single track of the Aylesbury Link railway line will be realigned eastwards, to make space provision for the addition of a second track in the future within NR boundaries, and provide working space to construct the Sheephouse Wood mitigation structure (see Section 2.2). The realignment is proposed to be carried out in the following five phases:

- Phase 1: Civil engineering enabling works, which will include the construction of access, construction compound establishment and site clearance. Works will be carried out during standard working hours plus some weekend possessions.
- Phase 2: Construction of earthworks and new waste transfer sidings, which will involve the clearance of the land and the construction of a low embankment to form the foundations for the new section of the Aylesbury Link railway line. There will be no disruption to existing train services, and work will be completed during standard working hours. During this phase, the land will be prepared and the foundations constructed for the new Calvert Landfill waste transfer sidings, while the existing waste transfer sidings remain in use.

- Phase 3: Installation of new track and railway systems, using the foundations created in Phase 2. The new waste transfer sidings will also be constructed, providing a similar facility to the existing Calvert Landfill waste transfer sidings, on the opposite side of the Aylesbury Link railway line. The majority of these works will take place during standard working hours, although some mid-week night possessions will be required for material delivery and preparation.
- Phase 4: Construction of connections to the new realigned section of the Aylesbury Link railway line and new waste transfer sidings. A short blockade, of approximately two weeks, will be required to connect the new sections of track into the existing, and to move the remaining track eastwards to provide space for HS2. The connections will be made in order that, at the end of the blockade, the operational rail traffic will use the new alignment following testing and commissioning.
- Phase 5: Follow up works and recovery of redundant track sections. Following the commissioning of the new section of track, some follow up works will be required during mid-week nights. This phase of works will also include recovery of the redundant track, which will be loaded on to rail vehicles for removal and disposal.

Bicester to Bletchley Line realignment

2.3.12 In this area the Bicester to Bletchley Line will be realigned 30m to the north as part of the works around the IMD and railhead. The realignment will be carried out in the following five phases:

- Phase 1: Civil engineering enabling works, which will include the construction of access, construction compound establishment and site clearance. Works will be carried out during standard working hours plus some weekend possessions.
- Phase 2: Construction of East West Rail overbridge, which will involve land clearance and the construction of approach embankments and a new bridge over HS2 onto which the Bicester to Bletchley Line will be diverted. The offline construction of the bridge will avoid prolonged disruption to existing train operations and there will be no disruption to existing train services during this phase. Works will be completed during standard working hours.
- Phase 3: Installation of new track and railway systems, comprising the installation of new track on the new alignment and the construction of the IMD reception sidings in conjunction with these works (see Calvert railhead main compound). The majority of these works will take place during standard working hours, although some mid-week night possessions will be required for material delivery and preparation.
- Phase 4: Construction of connections, where a series of weekend possessions will be required to connect the new sections of the track into the existing track. The connections will be made in order that at the end of the series of

possessions the operational rail traffic will use the new alignment, following testing and commissioning.

- Phase 5: Follow up works and recovery of redundant track sections. Following the commissioning of the new section of track, some follow up works will be required during mid-week nights. This phase of works will also include recovery of the redundant track, which will be loaded on to rail vehicles for removal and disposal.

2.3.13 All the works described above will adopt standard techniques and sequencing that are widely available and known in the UK for railway construction. The works will be carried out from the existing Network Rail system for construction of the connections.

General overview of construction compounds

2.3.14 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, which 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
- necessary operational parking.

2.3.15 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.

2.3.16 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 with the existing railway for the delivery of materials for the construction of the rail systems. In this section there will be one railhead within the Calvert main railhead compound;
- construction sidings will connect with the existing railway network to enable loading and unloading to and from trains delivering material to the HS2 site or removing excavated material, further details are provided in the relevant area reports;

- roadheads will require an area of land for the storage and loading and unloading of bulk earthworks materials which are moved to and from the site on public highways; and
- living accommodation for the construction workforce.

2.3.17 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.

2.3.18 Further information on the function of compounds, including general provisions for their operation, including security fencing, lighting, utilities supply, site drainage, codes of worker behaviour are set out in Volume 1, Section 6.6, and the draft CoCP, Section 5.6.

Construction traffic routes

2.3.19 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.

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

Figure 5: Schematic of construction compounds for civil engineering works

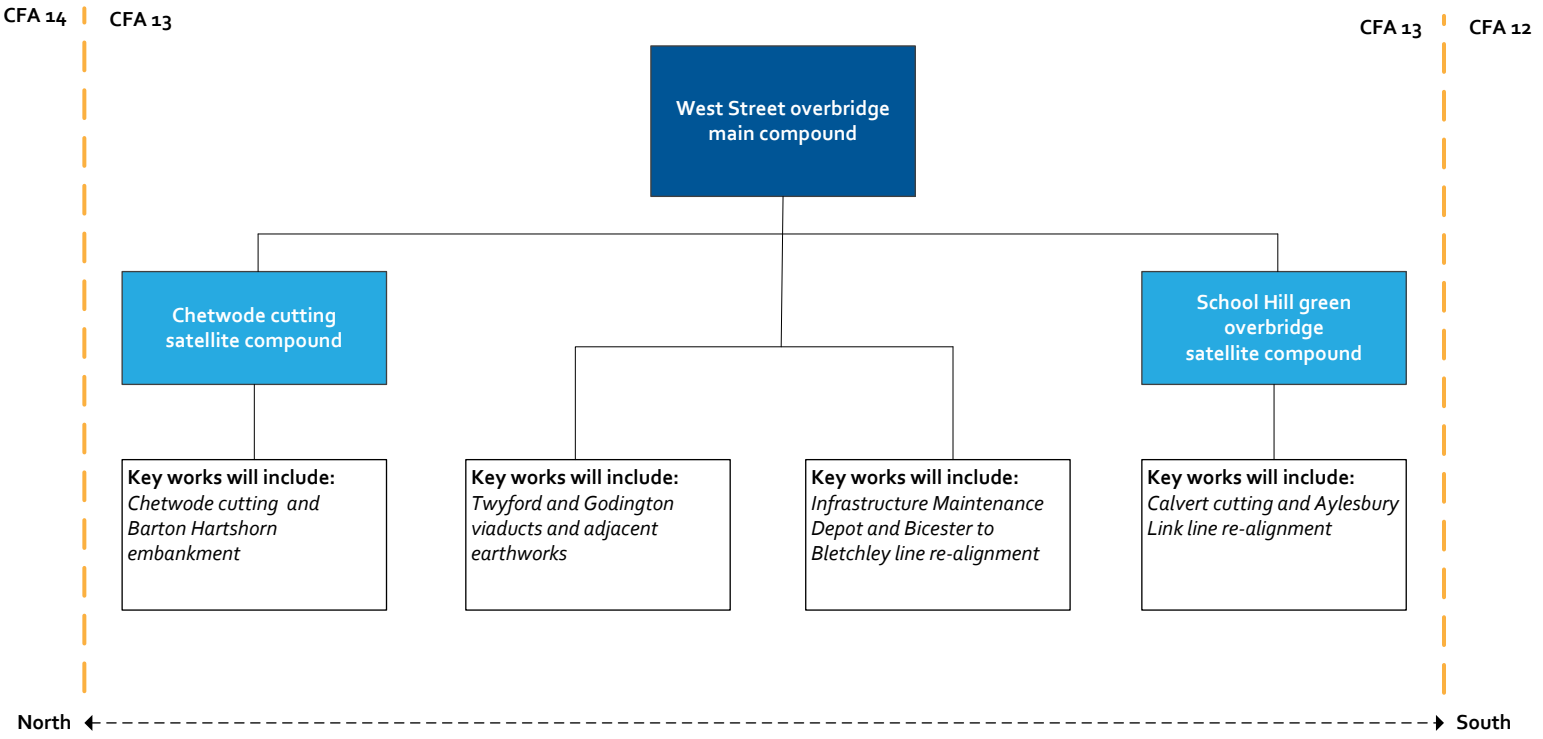
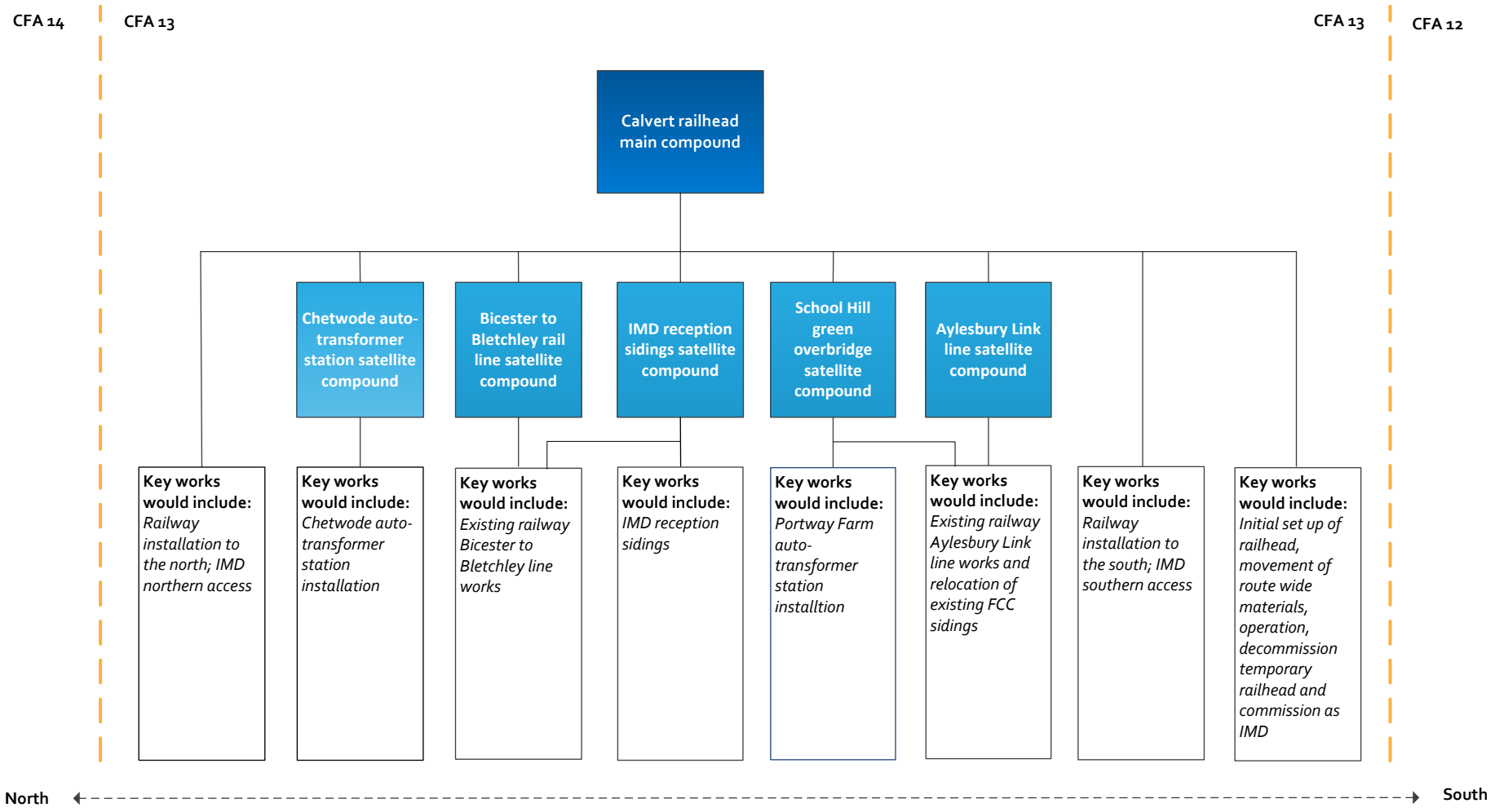


Figure 6: Schematic of construction compounds for railway installation works



West Street overbridge main compound

2.3.21 This construction compound will be used for civil engineering works only, between approximately Sheephouse Wood and Newton Purcell. The compound will:

- be operational for approximately six years and nine months, commencing in 2016;
- support approximately 130 workers each day throughout much of the civil engineering works period, but will increase to a maximum of 390 workers each day during the peak period of activity;
- provide living accommodation for approximately 65 workers for an estimated period of six years, increasing to 195 workers during the peak period of activity. The accommodation will occupy the eastern part of the construction site;
- be accessed via either:
  - the M40, A41, The Broadway, Edgcott Road, Grendon Road, Buckingham Road and Perry Hill and /or the M40, A41, A4421 and A421 and/or the M40, A43, A421, Gawcott Road, Hillesden Road and Perry Hill from the west; or
  - the M1, A421; and/or M1, A509, A4146, A421, Gawcott Road, Hillesden Road and Perry Hill from the east. Indivisible abnormal load transporters will need to access between the A421 and Gawcott Road via Radclive Road in lieu of Gawcott Road;
- provide support to two satellite compounds, as illustrated in Figure 5; and
- have an associated roadhead with access to/from Perry Hill for the receipt, storage and transfer of earthworks material route-wide (see Map CT-05-056, Volume 2, CFA13 Map Book).

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;
- building demolition;
- installation of culverts and drainage;
- establishment of a railhead;
- cutting, embankments and landscaping earthworks;
- construction of bridges, retaining walls and viaducts;
- highway and footpath construction and reinstatement;
- rail systems installations;
- erection of permanent fencing; and
- landscaping and planting.

2.3.23 The compound will be used to manage construction of the Bicester to Bletchley Line realignment and the Twyford and Godington viaducts and adjacent earthworks. The Bicester to Bletchley Line realignment will take approximately three years and six months to complete. The Twyford viaduct and adjacent earthworks will take approximately two years and six months to complete. The Godington viaducts and adjacent earthworks take approximately two years to complete. Volume 1, Section 5.9 describes a typical viaduct and Section 6.16 the associated construction activities.

2.3.24 The compound will also manage the initial set up of the Calvert railhead site (see Calvert railhead main compound for further information).

2.3.25 The compound will also manage the construction of the Sheephouse Wood mitigation structure which will be carried out in the following broad phases:

- foundation construction;
- assembly and erection of portal frames and bracing;
- installation of roof; and
- installation of mesh screens.

2.3.26 Demolitions at three properties and for seven structures will be required:

Table 1: Demolitions associated with construction works managed from West Street overbridge main compound

Description	Location
Residential property (Shepherd's Furze Farm (Grade II listed farmhouse)	Calvert
Commercial property (Nine Shepherd's Furze Farm buildings)	Calvert
Commercial outbuilding associated with Portway Farm	Perry Hill, Calvert
Pond Road overbridge crossing the Bicester to Bletchley Line	Addison Road, Steeple Claydon/Calvert
Western Power electrical sub-station	Addison Road, Calvert
Charndon Lane overbridge crossing the Bicester to Bletchley Line	Perry Hill, Calvert
Southern Gas network gas pumping station	North of Grebe Lake, Perry Hill, Calvert
Disused railway bridge over the former GCML	Church View Farm
Disused railway bridge over the former GCML	Twyford Mill

2.3.27 Diversion of three roads will be required:

- Addison Road will remain open during construction, and will then be permanently realigned, approximately 50m to the east over the new Addison Road overbridge;

- Perry Hill will remain open during construction, and will then be permanently realigned, approximately 120m to the west through the new Charndon Lodge underbridge; and
- a temporary closure of West Street during which there will be diversions via Perry Hill or School Hill, for a period of between one year and one year and six months, after which it will be permanently reinstated across the new West Street overbridge on its original alignment.

2.3.28 Alternative routes for 17 PRoW will be required:

- a temporary alternative route for public Footpath SCL/7, via SCL/8/2[15] and Addison Road for a period of between nine months and one year, adding approximately an additional 1.8km. It will then be permanently diverted approximately 320m to the west of its existing alignment across Footpath SCL/8 overbridge, adding an additional 1.0km;
- a temporary alternative route for public Footpath SCL/8, via SCL/8/2 and Addison Road for a period of between nine months and one year, adding approximately an additional 700m. It will then be permanently reinstated across Footpath SCL/8 overbridge along its existing alignment;
- a temporary alternative route for public Footpath SCL/9, via SCL/8/2 and Addison Road for a period of between nine months and one year, adding approximately an additional 1.8km. It will then be permanently diverted approximately 320m to the west of the existing alignment across Footpath SCL/8 overbridge, adding an additional 1km;
- a temporary alternative route for public Footpath TWY/4 around the Bicester to Bletchley rail line satellite compound for a period of between nine months and one year, adding approximately an additional 100m. It will then be permanently diverted along the northern edge of the Bicester to Bletchley line, adding an additional 50m;
- a temporary alternative route for public Footpath SCL/6 to the west for a period of one year, adding approximately an additional 1.5km. It will then be permanently diverted approximately 550m to the north of the existing alignment, adding an additional 1.2km;
- a temporary alternative route for public Footpath TWY/18, to the east for a period of between three to six months during construction of the flood compensation, adding approximately 150m. It will then be permanently diverted approximately 500m to the east across the new West Street overbridge and along the disused Great Central Main Line, adding approximately 650m;

[15] The Buckinghamshire County Council subsection reference has been provided in instances where different sections of the footpath will be realigned in different ways, in order to differentiate between these sections.

- a temporary alternative route for public Footpath TWY/19, to the east for a period of between three to six months, adding approximately 250m. It will then be permanently reinstated along its original alignment;
- public Footpath TWY/16 will remain open during construction. It will then be permanently diverted, approximately 250m to the west under Twyford viaduct, adding approximately 500m;
- public Footpath TWY/17 will remain open during construction. It will then be permanently diverted approximately 500m to the west under Twyford viaduct, adding approximately 800m;
- public Footpath PBI/5(F) will remain open during construction. It will then be permanently diverted approximately 200m to the east across Footpath PBI/5 accommodation overbridge, adding a negligible distance;
- public Footpath PBI/6/2 will remain open during construction. It will then be permanently diverted approximately 200m to the west across Footpath PBI/5 accommodation overbridge, adding approximately an additional 100m;
- public Footpath PBI/6/3 will remain open during construction. It will then be permanently diverted across Footpath PBI/5 accommodation overbridge, adding approximately an additional 100m;
- a temporary alternative route for public Footpath PBI/5A to the south, for a period of between nine months and one year, adding approximately an additional 800m. It will then be permanently reinstated along its existing alignment across Restricted Byway PBI/5A accommodation overbridge;
- a temporary alternative route for public Footpath PBI/9 to the east for a period of one year and six months, adding approximately an additional 50m. It will then be permanently diverted under Godington east viaduct, adding approximately an additional 300m;
- a temporary alternative route for public Footpath CHW/225/5 to the east for a period of between three to six months, adding approximately an additional 100m. It will then be permanently reinstated along its existing alignment;
- a temporary alternative route for public Footpath CHW/225/4 to the east for a period of between three to six months, adding approximately an additional 250m. It will then be permanently reinstated along its existing alignment; and
- a temporary alternative route for public Footpath CHW/24, to the west for a period of one year and six months, adding approximately an additional 200m. It will then be permanently reinstated along its existing alignment under Godington west viaduct.

2.3.29 Diversion of nine major utilities and the installation of four new major utilities will be required, the key ones being:

- permanent relocation of Southern Gas pumping station at Perry Hill, approximately 600m to the west of the existing location;

- permanent realignment of medium, intermediate and high pressure Southern Gas mains along the former GCML and Perry Hill to the relocated gas pumping station;
- permanent relocation of Western Power electricity sub-station at Addison Road, approximately 250m to the west of the existing location; and
- permanent new Western Power lines, connecting to Portway Farm auto-transformer station and the IMD.

2.3.30 Permanent realignment of four watercourses will be required at:

- Mill Stream (north of Padbury Brook), which will require a diversion of approximately 90m to the south;
- Cowley Old House, which will require a diversion of approximately250m to the east;
- Windmill Mound Dry Valley, which will require a diversion of approximately 1km to the south; and
- Padbury Brook, which will require a diversion of approximately 40m to the east under Godington west viaduct.

Calvert railhead main compound

2.3.31 This construction compound will be used for the movement of route wide earthworks by rail and railway installation works up to 40km south and 60km north of Calvert. The compound will occupy an area that includes the land required permanently for the IMD and temporarily for the Calvert railhead (see Figure 5), which is one of three such sites along the Proposed Scheme. The permanent infrastructure required for the IMD, including buildings and rail systems, will be partially built and operated initially as part of the railhead. The compound will:

- be established over approximately 2 years, starting in 2016;
- be operational for approximately eight years, starting in 2018;
- support approximately 110 workers each day throughout the railway installations works period, and then 300 workers when the railhead is fully operational, with a peak of 450 (see Phase 4 below);
- be accessed via either:
  - the M40, A41, The Broadway, Edgcott Road, Grendon Road Buckingham Road and Perry Hill and /or the M40, A41, A4421 and A421 and/or the M40, A43, A421, Gawcott Road, Hillesden Road and Perry Hill from the west; or
  - the M1, A421 and/or M1, A509, A4146, A421, Gawcott Road, Hillesden Road and Perry Hill from the east. Indivisible abnormal load transporters will need to access between the A421 and Gawcott Road via Radclive Road in lieu of Gawcott Road. Materials required for the railway installation works including rail, sleepers, ballast

and overhead line equipment (OLE) will be delivered by rail via the Bicester to Bletchley Line and Aylesbury Link railway line;

- be used for the movement of route-wide earthworks for the Proposed Scheme. Surplus excavated material from southern sections of the route will be brought to the railhead via the Bicester to Bletchley Line and Aylesbury Link railway line and will be used to create the sustainable placement area adjacent to the Aylesbury Link. Material will also be temporarily stored in stockpiles before being transported, by lorry, along the haul road to be used at other locations;
- be capable of receiving and dispatching trains to/from the existing railway network via purpose built reception sidings; and
- provide support to rail installation works and satellite construction compounds in adjacent areas, as well as satellite construction compounds within the Calvert, Steeple Claydon, Twyford and Chetwode area, as illustrated in

2.3.32 The works within the IMD/Railhead itself will occur in the following broad phases (Figure 6 sets out the areas of activity within the construction boundary for each phase of works):

- Phase 1 (2016 to 2018): Establishment of the railhead and preparation of the site, which will be undertaken from West Street overbridge main compound, will include:
  - utility diversions;
  - construction of the railhead and associated access routes;
  - overbridge construction for road and footpath access over the site;
  - construction of drainage and temporary balancing pond;
  - landscaping and vegetation planting for visual screening;
  - preparation of the site for mass haul phase (receipt, storage and loading/unloading of excavated material either onto or off the site);
  - construction of connections from existing Bicester to Bletchley Line; and
  - construction of the sidings for use during the mass haul phase.
- Phase 2 (2019 to 2020): Operation of railhead and roadhead for route-wide materials movements (mass haul), which will include:
  - movement of excavated material into the compound by rail and road; and
  - unloading of excavated materials and stockpiling at the designated sustainable placement area south of the Bicester to Bletchley Line, prior to use elsewhere along the route. Material will be transferred to the sustainable placement area via the new Addison Road overbridge.

- Phase 3 (2021): Commissioning of the railhead for rail systems installation works, which will include reconfiguration of the sidings' and construction of the working areas for use during the rail installation phase, within the same footprint.
- Phase 4 (2022 to 2025): Operation of railhead for rail systems installation works.
- Phase 5 (2026): Decommissioning of the railhead and establishment of the IMD, which will include:
  - demobilisation of the railhead sidings;
  - modification for operation of the IMD (including removal of temporary earthworks, restoration of original ground levels); and
  - permanent fencing and landscaping.
- Phase 6 (2026 onwards): IMD operation. More information about the operation of the IMD can be found in Section 2.4, and Volume 1, Section 4.3.

2.3.33 The works to construct the railhead will be conducted during standard working hours as far as possible, although the works to the existing Bicester to Bletchley Line to create the connections will be undertaken during weekend possessions and there will be midweek night working for preparation and follow up works. Rail deliveries into the railhead will be undertaken both during day and night time hours and through weekends, though unloading will be undertaken during standard working hours.

2.3.34 Key civil engineering and railway installation works managed directly from this construction compound will include:

- transfer of excavated material from route-wide earthworks to point of use;
- high speed railway installation, to the north and south, including the northern and southern access spurs into the IMD; and
- commissioning of the IMD as the permanent facility for maintenance works for the Proposed Scheme.

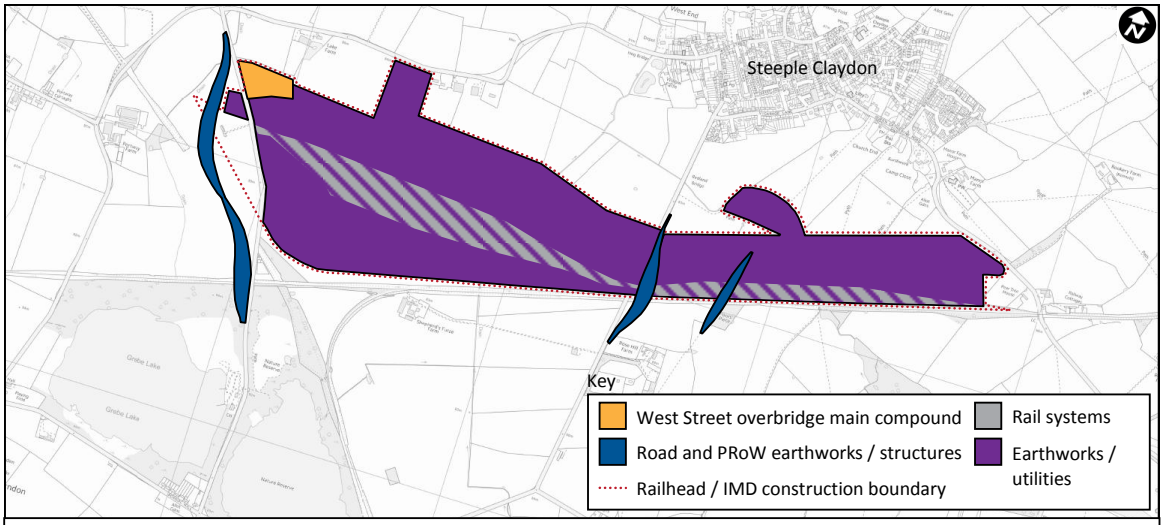
2.3.35 The high speed railway installation works will include track laying, overhead line equipment, communications equipment and traction power supply installation. The installation of track in open areas and green tunnels will be of standard ballast or slab track configuration. Volume 1, Section 5.17 describes a typical track layout and Section 6.22 describes the associated construction activities.

2.3.36 The track will be laid in both directions away from the Calvert railhead main compound, with access to the Proposed Scheme through the northern and southern rail access spurs. The limits of railway installations along the route supported from this construction site will be approximately 40km to the south as far as the Chilterns tunnel north portal (see CFA Report 9), and 60km to the north to Long Itchington Wood tunnel (see CFA Report 16). Before the railway installation works can

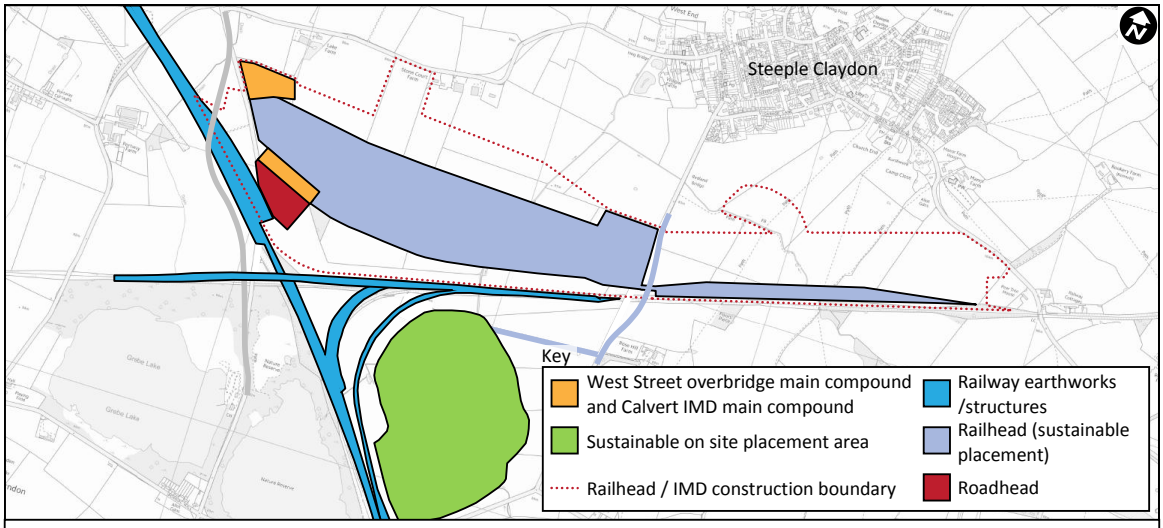
commence, adequate civil engineering work will need to be completed to allow a continuous track laying sequence.

2.3.37 Railway installation works within the Calvert, Steeple Claydon, Twyford and Chetwode area will take approximately one year and three months to complete, commencing in 2023 working towards the south, and one year and three months, commencing in 2022 working towards the north.

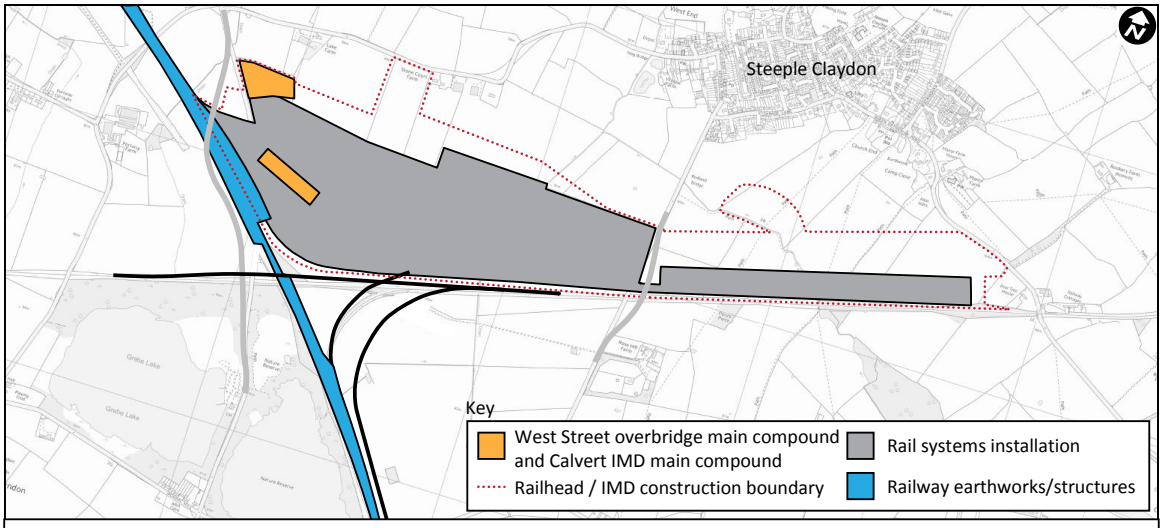
Figure 7: Construction phasing at the Infrastructure Maintenance Depot



Phase 1 (2016-2018): Establishment of the Railhead/IMD and preparation of the site.



Phase 2 (2019-2020): Operation of railhead and roadhead for sustainable placement.



Phase 3 (2021): Commissioning of railhead for rail systems installation works.

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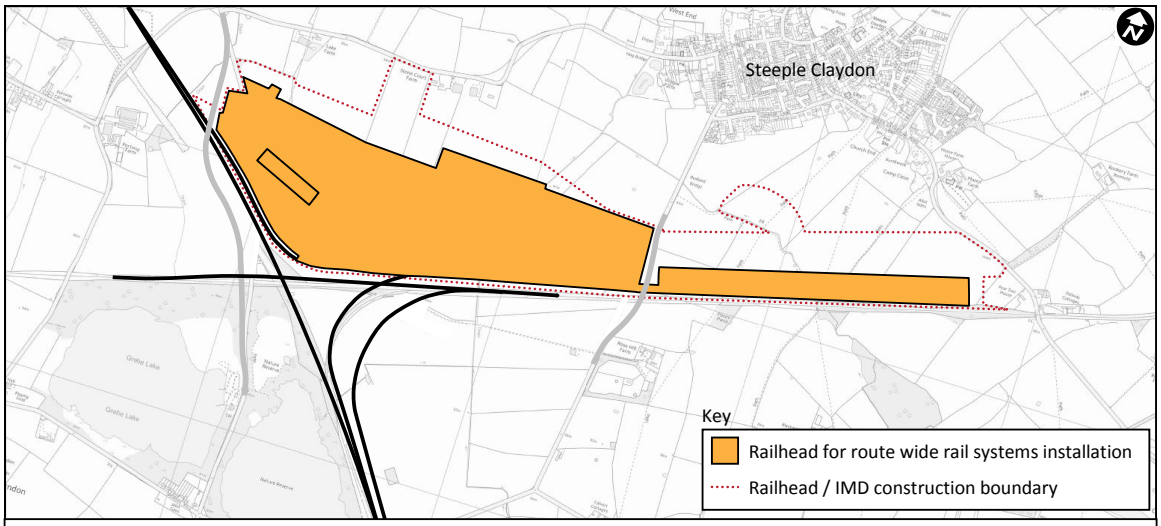
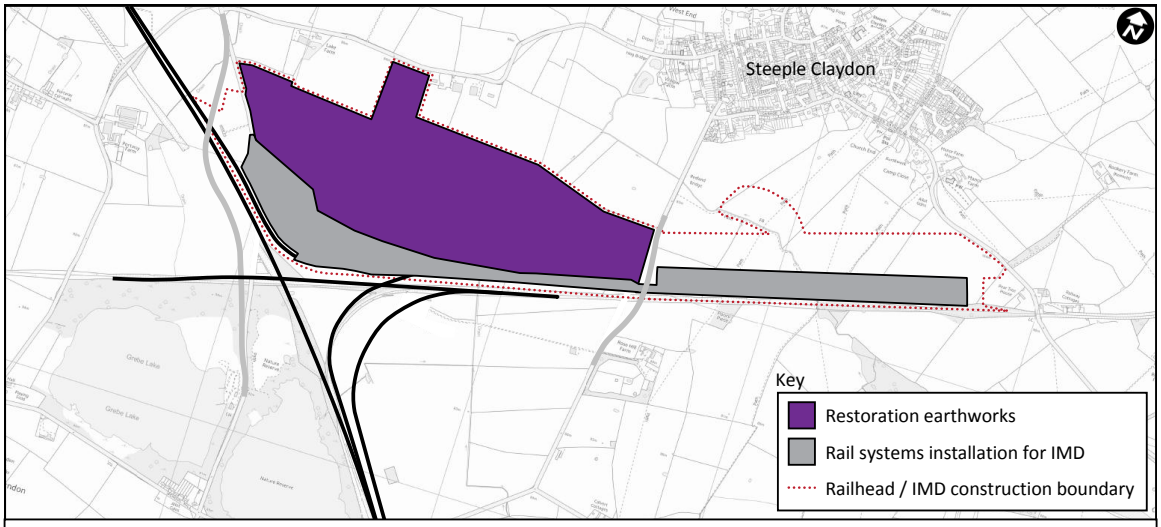
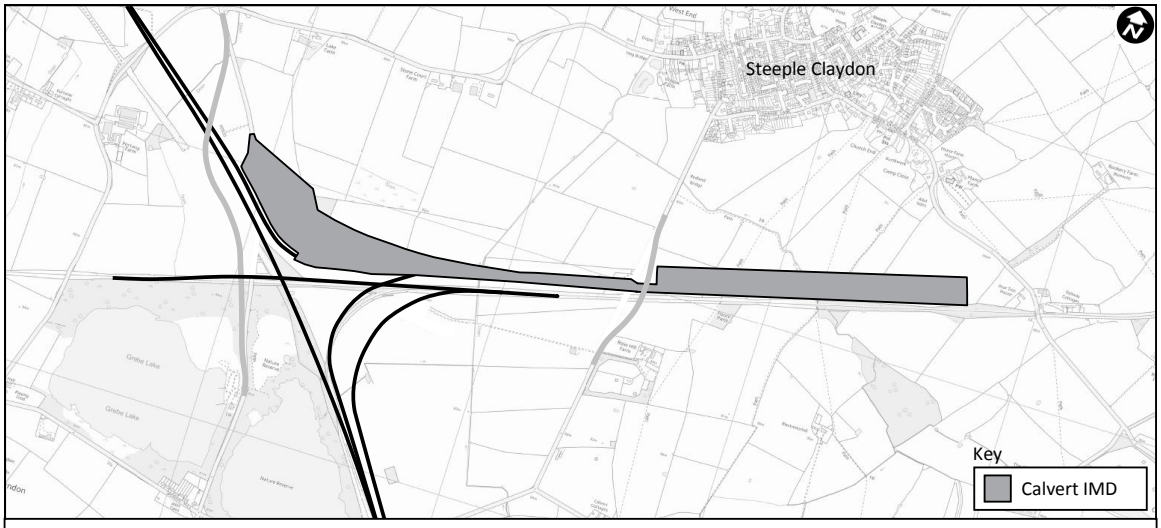


Phase 4 (2022-2025): Operation of railhead for rail systems installation works.



Phase 5 (2026): Decommissioning of the railhead and establishment of the IMD.



Phase 6 (2026 onwards): IMD operation.

IMD reception sidings satellite compound

2.3.38 This compound will be used for railway installation works only, to the north of Calvert, on the north side of the existing Bicester to Bletchley Line. The compound will:

- be operational for approximately two years, starting in 2018;
- support approximately 70 workers each day throughout much of the railway systems installation works, increasing to a maximum of 95 workers each day during the peak period of activity;
- be accessed via the existing Bicester to Bletchley Line by rail; and
- be accessed via either:
  - the M40, A41, The Broadway, Edgcott Road, Grendon Road Buckingham Road and Perry Hill and /or the M40, A41, A4421 and A421 and/or the M40, A43, A421, Gawcott Road, Hillesden Road and Perry Hill from the west; or
  - the M1, A421 and/or M1, A509, A4146, A421, Gawcott Road, Hillesden Road and Perry Hill from the east. Indivisible abnormal load transporters will need to access the route from the A421 via Gawcott Road or Radclive Road; and
- be managed from Calvert railhead main compound.

2.3.39 Key railway installation works in this section will be:

- installation of new connections into the IMD and railhead sidings from the existing Bicester to Bletchley Line (see Calvert railhead main compound);
- construction of the IMD reception sidings (see Calvert railhead main compound); and
- realignment of the Bicester to Bletchley Line to the north where it crosses the Proposed Scheme. These works will also be managed from the Bicester to Bletchley Rail line satellite compound.

Bicester to Bletchley rail line satellite compound

2.3.40 This compound will be used for railway installation works only, to the north of Calvert, on the north side of the existing Bicester to Bletchley Line. The compound will:

- be operational for approximately 10 months, starting in 2019;
- support approximately 40 workers each day throughout much of the railway systems installation works, increasing to a maximum of 50 workers each day during the peak period of activity;
- be accessed via the existing Bicester to Bletchley Line; and
- be managed from Calvert railhead main compound.

2.3.41 This compound together with the IMD reception sidings satellite compound will be used to manage the realignment of the Bicester to Bletchley Line to the north where it crosses the Proposed Scheme.

School Hill green overbridge satellite compound

2.3.42 This compound will be used for civil engineering and railway installation works, between approximately Sheephouse Wood and Calvert. The compound will:

- be operational for approximately seven years and three months, comprising civil engineering works for approximately five years and nine months, starting in 2016 (including a one year and nine month period for railway installation works); and railway installation works for a further one year and six months, starting in 2023 (see construction programme: Figure 8);
- support approximately 90 workers each day throughout much of the civil engineering works period; increasing to a maximum of 190 workers each day during the peak period of activity;
- support approximately 40 workers each day throughout the first railway installations works period, increasing to a maximum of 50 workers each day during the peak period of activity; and 30 workers per day throughout the second railway installations period, increasing to a maximum of 50 workers each day during the peak period of activity;
- be accessed via either:
  - the M40, A41, The Broadway, Edgcott Road, Grendon Road Buckingham Road and Perry Hill and /or the M40, A41, A4421 and A421 and/or the M40, A43, A421, Gawcott Road, Hillesden Road and Perry Hill from the west; or
  - the M1, A421 and/or M1, A509, A4146, A421, Gawcott Road, Hillesden Road and Perry Hill from the east. Indivisible abnormal load transporters will need to access between the A421 and Gawcott Road via Radclive Road in lieu of Gawcott Road. Access to the satellite compound will be directly from Perry Hill prior to the demolition of the existing railway bridge, after which access will be via a temporary road from Perry Hill through the IMD to Addison Road and then to School Hill; and
- be managed from the West Street overbridge main compound for the civil engineering works and from Calvert railhead main compound for the railway installation works.

2.3.43 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;
- cuttings, embankments and landscaping earthworks;
- construction of bridges, retaining walls and viaducts;

- highway and footpath construction and reinstatement;
- permanent fencing;
- rail systems installation; and
- landscaping and planting.

2.3.44 The compound will be used to manage construction of Calvert cutting, which will take approximately five years to complete and the Aylesbury Link railway line realignment which will take approximately six months to complete for the civil engineering works. Volume 1, Section 5.2 describes a typical cutting, and Volume 1, Section 6.8 describes the typical approach to their construction.

2.3.45 Demolition of three properties and two structures will be required:

Table 2: Demolitions associated with works managed from the Bicester to Bletchley rail line satellite compound

Description	Location
Residential property (The Station House (formerly Hazelbach) and one associated outbuilding)	School Hill, Calvert
Residential property (12a Brackley Lane)	Calvert
Residential property (12b Brackley Lane)	Calvert
A telecommunication mast, which will be relocated	Near School Hill and Calvert Landfill waste transfer sidings
Calvert Station overbridge crossing the Aylesbury Link railway line	School Hill, Calvert

2.3.46 Diversion of one road will be required, involving the temporary closure of School Hill, which will be re-routed via Addison Road, West Street and Perry Hill for a period of between one year and six months and two years, with permanent reinstatement across the new School Hill green overbridge along the original alignment.

2.3.47 Diversion of two PRoW will be required:

- a temporary alternative route for public Footpath SCL/13 to the east for a period of 12-18 months, adding a negligible distance. It will then be permanently diverted 30m to the west across Footpath SCL/13 green overbridge, adding approximately an additional 70m; and
- a temporary alternative route for public Bridleway SCL/18 to the west for a period of 12-18 months, adding an additional 250m. It will then be permanently diverted approximately 30m to the west across Footpath SCL/13 green overbridge, adding an additional 70m.

2.3.48 Temporary diversion of the private access to Calvert Landfill site will be required during the construction of the Calvert green overbridge.

2.3.49 No diversions of key utilities or watercourse will be required.

2.3.50 Key railway systems installation works will include:

- the installation of Portway Farm auto-transformer station. See Volume 1, Section 5.17 for a generic description of power supply features including auto-transformer stations, and Volume 1, Section 6.23 for a description of associated construction activities;
- realignment of the Aylesbury Link railway line to the east, from the south of Sheephouse Wood northwards (works also supported by Aylesbury Link line satellite compound);
- relocation of the short curved section of the track linking the Aylesbury Link railway line and the Bicester to Bletchley Line (works in part undertaken from Aylesbury Link line satellite compound); and
- relocation of Calvert landfill waste transfer sidings from their existing location on the west side of the Aylesbury Link railway line, to the east side (works in part undertaken from Aylesbury Link line satellite compound). This will involve widening of the existing cutting, construction of a new access road over the Calvert green overbridge, installation of the sidings and gantries[16], construction of connections to the realigned Aylesbury Link railway line and recovery of existing sidings.

Aylesbury Link line satellite compound

2.3.51 This compound will be used for railway installation works only, in the vicinity of Calvert. The compound will:

- be operational for approximately one year and nine months, starting in 2019;
- support approximately 40 workers each day throughout much of the railway systems installation works, increasing to a maximum of 50 workers each day during the peak period of activity;
- not provide worker accommodation;
- be accessed via the existing Aylesbury Link railway line; and
- be managed from Calvert railhead main compound for the railway installation works.

2.3.52 This compound together with the School Hill green overbridge satellite compound will manage the following works:

- systems realignment of the Aylesbury Link railway line to the east, from Sheephouse Wood northwards;
- relocation of the short curved section of the track linking the Aylesbury Link railway line and the Bicester to Bletchley Line; and
- relocation of the Calvert Landfill waste transfer sidings from their existing location on the west side of the Aylesbury Link railway line, to the east side (see School Hill green overbridge satellite compound).

[16] The gantries are bridge like frameworks used to support the overhead equipment for waste transfer between trains and HGVs within the Calvert Landfill site.

Chetwode cutting satellite compound

2.3.53 This compound will be used for civil engineering works only, from approximately south of Chetwode to Newton Purcell. The compound will:

- be operational for approximately two years and nine months, starting in 2017;
- support approximately 130 workers each day throughout much of the civil engineering works period; but will increase to a maximum of 290 workers each day during the peak period of activity;
- be accessed via either the:
  - M1, A421 and/or M1, A4146, A421 and School End from the east; or
  - the M40, A41, A4421, A421 and/or the M40, A43, A421 and School End from the west; and
- be managed from the West Street overbridge main compound.

2.3.54 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.

2.3.55 The compound will be used to manage construction of the Chetwode cutting and Barton Hartshorn embankment, which will take approximately two years and nine months to complete. Volume 1, Section 5.3 describes typical cuttings and embankments, and Volume 1, Section 6.8 describes the typical approach to their construction.

2.3.56 Demolition of four properties will be required:

Table 3: Demolitions associated with works managed from the Chetwode cutting satellite compound

Description	Location
Residential property (Old Stable Cottage and one associated outbuilding)	Adjacent to The Green (road)
Residential property (Rosehill Cottage)	The Green
Residential property (Sunflower Cottage)	The Green

Three commercial outbuildings associated with Manthorn Farm	Adjacent to The Green

2.3.57 Diversion of two roads will be required:

- The Green will remain open during construction with a permanent realignment approximately 100m to the north over the new overbridge; and
- a temporary closure of School End which will be re-routed via the A4421, for a period of between one year and one year and six months. It will then be permanent realigned along the original alignment across the School End overbridge.

2.3.58 Diversion of three PRoW will be required:

- Footpath CHW/18 will remain open during construction. It will then be permanently diverted, approximately 100m to the east across the realigned 'The Green', adding approximately an additional 200m;
- Footpath CHW/11 will remain open during construction. It will then be permanently diverted, approximately 150m to the west across School End overbridge, adding approximately an additional 150m; and
- a temporary alternative route for public Footpath BHA/3/1 to the east for a period of nine to twelve months, adding 200m. It will then be permanently diverted 200 to the north across Footpath BHA/2 overbridge, adding approximately an additional 200m;
- Footpath BHA/2 will remain open during construction. It will then be permanently diverted approximately 200m to the west across Footpath BHA/2 overbridge, adding approximately an additional 300m.

2.3.59 Diversion of three major utilities and the installation of two new major utilities will be required, the key ones being a permanent new Western Power line connecting to Chetwode auto-transformer station.

2.3.60 Diversion of two watercourses will be required:

- permanent realignment of a dry valley at Manthorn Farm, which will require a diversion of approximately 700m to the south; and
- permanent realignment of a watercourse at Barton Hartshorn, which will require a diversion of approximately 120m to the south.

Chetwode auto-transformer station satellite compound

2.3.61 This compound will be used for railway installation works only, to the south of Chetwode. The compound will:

- be operational for approximately one year and six months, starting in 2021;
- support approximately 30 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;

- not provide worker accommodation;
- be accessed via either:
  - the M1, A421 and/or M1, A4146, A421, School End and private access track leading to Manthorn Farm from the east; or
  - the M40, A41, A4421, A421 and/or the M40, A43, A421, School End and private access track leading to Manthorn Farm from the west; and
- be managed from the Calvert railhead main compound.

2.3.62 Key railway systems installation works will be the installation of Chetwode auto-transformer station. See Volume 1, Section 5.18 for a generic description of power supply features including auto-transformer stations, and Volume 1, Section 6.23 for a description of associated construction activities.

Construction waste and material resources

2.3.63 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 Calvert, Twyford, Steeple Claydon and Chetwode area have been prepared and are presented in Volume 5: Appendix WM-001-000.

2.3.64 The majority of excavated material 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.

2.3.65 Based on the mitigation earthworks design approach adopted for the Proposed Scheme, local excess or shortfall of excavated material within the Calvert, Twyford, Steeple Claydon and Chetwode area will be managed with the aim of contributing to the overall balancing of excavated material on a route-wide basis. This overall balance of excavated material is presented in Volume 3, Section 14.

2.3.66 An area of sustainable placement will be used within the Calvert, Steeple Claydon, Twyford and Chetwode area to permanently dispose of surplus excavated material generated from bored tunnels in the London Metropolitan area. This material will be moved off-site by rail as the location at which this surplus excavated material arises and the volumes generated make road transportation impracticable. It will therefore be most efficient to take this material to a rail-connected disposal site. The continuous (i.e. 24 hour, 7 day per week) bored tunnelling activity in the London Metropolitan area require that any disposal site must provide certainty that the quantity of surplus excavated material generated can be moved at the rate at which it is produced. A sustainable placement area within the Calvert, Steeple Claydon, Twyford and Chetwode area can provide this certainty, and capture the environmental benefits associated with the sustainable placement of surplus excavated material moved by rail.

2.3.67 The quantity of surplus excavated material originating from the Calvert, Twyford and Chetwode area that will require off-site disposal to landfill as excavation waste is shown in Table 4. This is the forecast quantity of contaminated excavated material that is chemically unsuitable for reuse within the Proposed Scheme and which will be taken directly from the Calvert, Twyford, Steeple Claydon and Chetwode 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.

2.3.68 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%.

2.3.69 The quantities of estimated construction, demolition and excavation wastes that will require off-site disposal to landfill are shown in Table 4.

Table 4: 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	6,372,406	14,772
Demolition	25,363	2,536
Construction	98,211	9,821
Worker accommodation	163	82
TOTAL	**6,496,143**	**27,211**

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

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

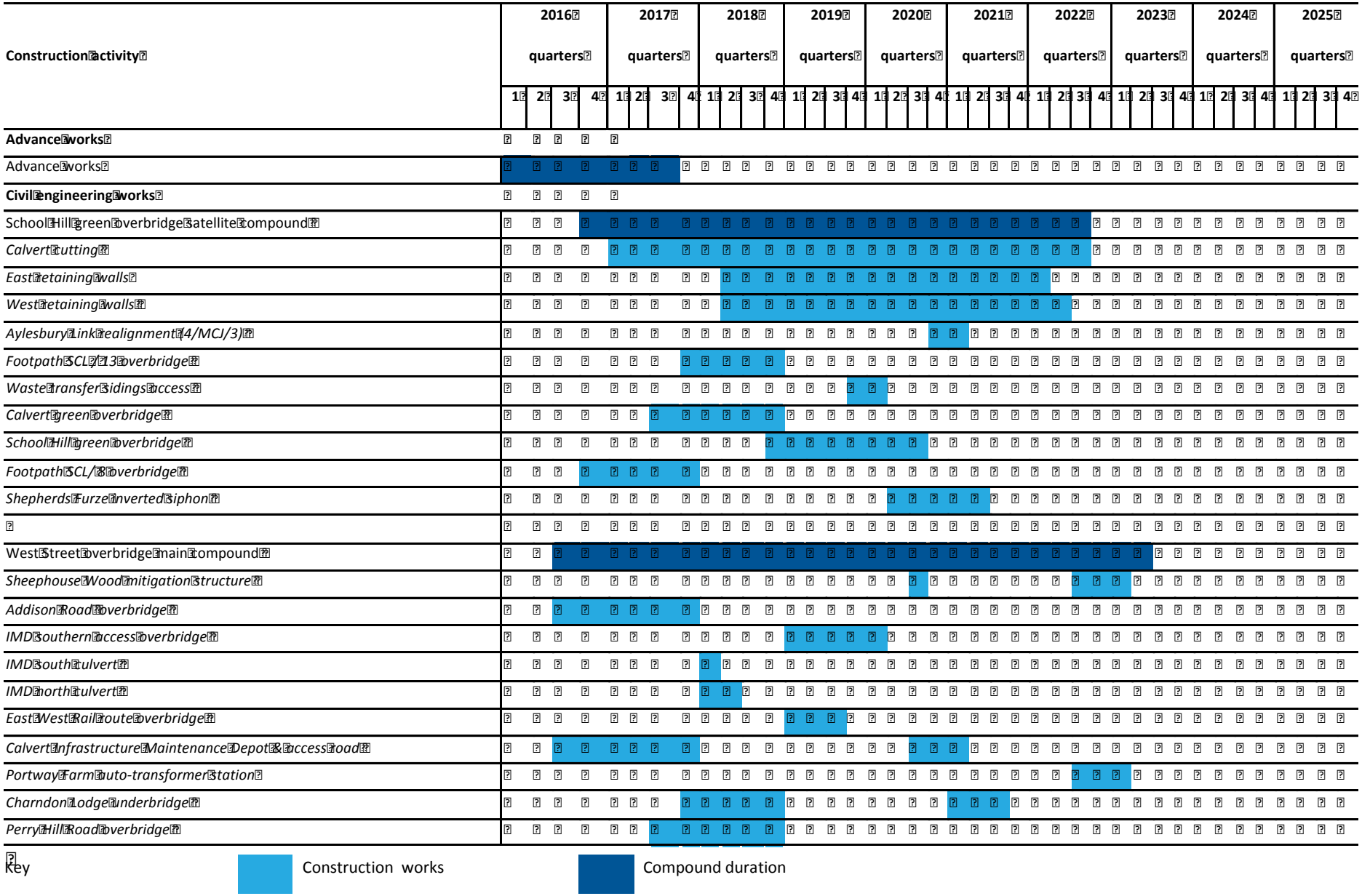
Commissioning of the railway

2.3.72 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.

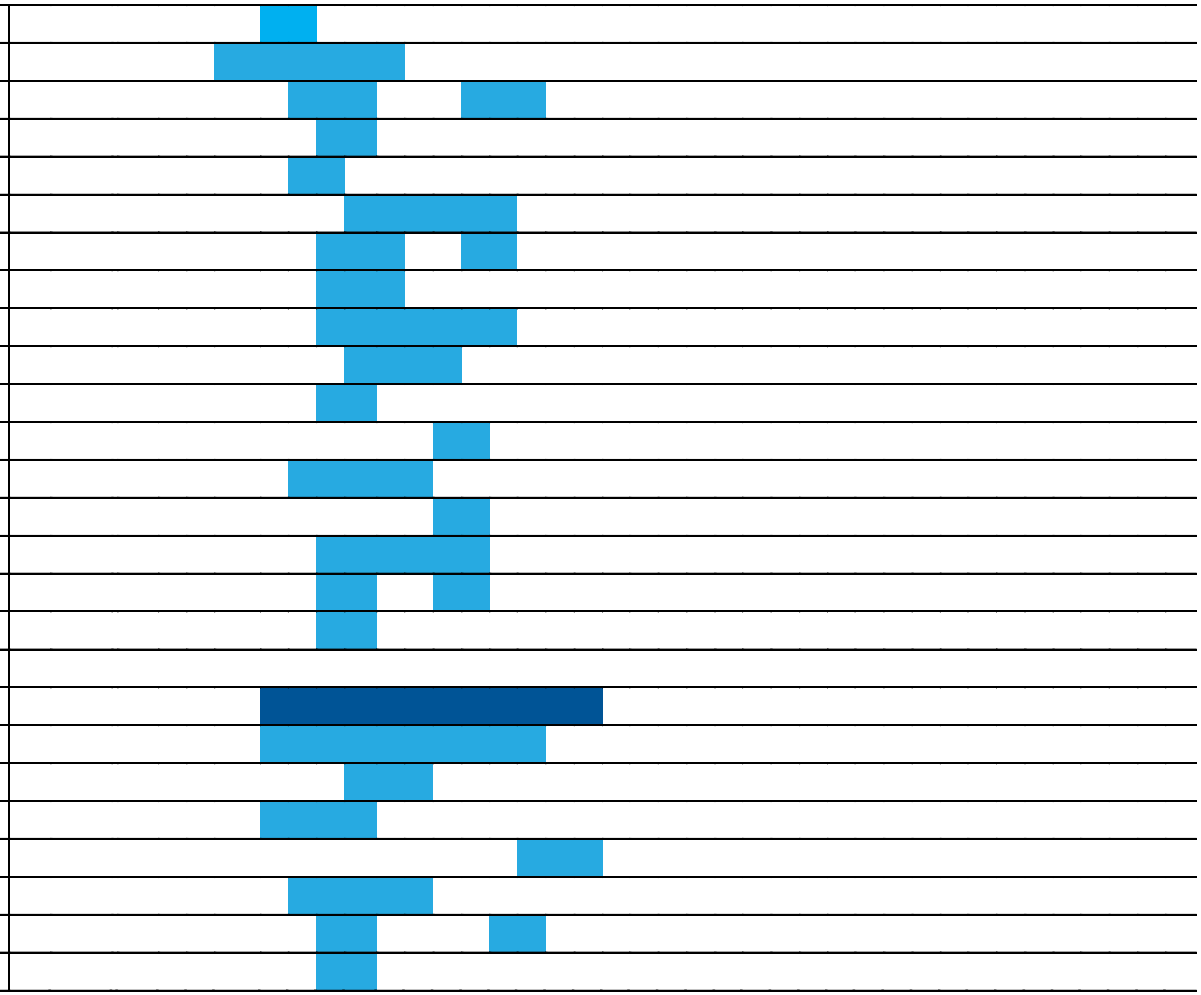
Construction programme

2.3.73 A construction programme that illustrates indicative periods for the construction activities previously described is provided in Figure 8.

Figure 8: Construction programme



Portway culvert	
West Street overbridge	
Twford embankment	
Twyford east culvert	
Twyford west culvert	
Twyford viaduct	
Cowley embankment	
Footpath PBI / 5 accommodation overbridge	
Twyford cutting	
Restricted Byway PBI / 5A accommodation overbridge	
Godington east culvert	
Godington east embankment	
Godington east viaduct	
Godington west embankment	
Godington west viaduct	
Chetwode embankment	
Godington west culvert	
Chetwode cutting satellite compound	
Chetwode cutting	
'The Green' realignment	
Footpath CHW / 18 accommodation overbridge	
Chetwode auto-transformer station	
School End overbridge	
Barton Hartshorn embankment	
Barton Hartshorn culvert	



Construction activity	2016 quarters				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	1	2	3	4
Rail infrastructure and systems works																																								
Calvert railhead main compound (until end 2026)																																								
Mass haul sidings preparation																																								
Mass haul sidings operation																																								
Conversion to railhead																																								
Railhead operations																																								
Demobilise sidings and modify for IMD operation																																								
High speed railway installation works northwards within CFA 13																																								
High speed railway installation works southwards within CFA 13																																								
IMD reception sidings satellite compound																																								
IMD reception sidings – mass haul phase																																								
IMD reception sidings – rail systems phase																																								
Bicester to Bletchley Line works																																								
Bicester to Bletchley Rail Line satellite compound																																								
Bicester to Bletchley Line works																																								
Aylesbury Link Line satellite compound																																								
Realignment of existing conventional railway Aylesbury link lines and relocation of FCC sidings																																								
School Hill green overbridge satellite compound																																								
Portway Farm auto-transformer station installation																																								
Realignment of existing conventional railway Aylesbury link lines and relocation of FCC sidings																																								
Chetwode auto-transformer station satellite compound																																								
Chetwode auto-transformer station installation																																								
Commissioning																																								
Commissioning (until end 2026)																																								

2.4 Operation of the Proposed Scheme

Operational specification

2.4.1 Volume 1, Section 4.4 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 Calvert, Steeple Claydon, Twyford and Chetwode 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, the scheme will operate at up to 360kph (225mph). The trains will be either single 200m long trains or two 200m long trains coupled depending on demand and time of day.

Maintenance

2.4.5 Volume 1, Section 4.3 describes the maintenance regime for HS2.

2.4.6 The intention is that inspections of the route will take place on a regular basis, at night when the railway is not operating. There will be routine preventative maintenance, including grinding and milling of the rails to keep them in good condition, and more periodic heavy maintenance as necessary.

2.4.7 Railway maintenance vehicles would be parked either at the Calvert infrastructure maintenance depot, or in the defined maintenance loops either to the south of the A4010 Risborough Road, near Stoke Mandeville, or at Wormleighton, south of Ladbroke. The maintenance loops could also be used in the case that a passenger train could not continue unassisted to its destination.

Calvert Infrastructure Maintenance Depot (IMD)

2.4.8 The IMD will operate 24 hours a day, seven days a week once the Proposed Scheme is operational. Infrastructure maintenance operations, including routine line checks and replacement of tracks and overhead line equipment, will be managed and resourced from the IMD. The planning, management and preparation for maintenance activities will be carried out at the IMD itself during the daytime. The majority of the maintenance works will be carried out at locations along the Proposed Scheme during the night-time. Volume 1, Section 4.3 provides further information about the maintenance activities carried out at or from the IMD.

2.4.9 Up to 300 staff will work out of the IMD in three, eight hour shifts during each 24 hour period. Therefore there will be approximately 80 to 100 people working at the IMD at any time.

2.4.10 Supplies will be delivered to the depot via road or rail, depending on what is most efficient. The majority of heavy materials will arrive by rail, with an access road only being used for light equipment and spare parts or if rail transport is not appropriate.

2.4.11 Lighting will be required for all external working areas of the IMD, including general circulation areas and walkways, with enhanced lighting to loading areas. The height of lighting installations will be kept as low as possible to facilitate maintenance and to reduce light pollution. Automatic lighting control systems complete with photocells and time clocks will be used to operate all external lighting. The external lighting at the IMD will satisfy the environmental guidance for a 'dark sky' lighting installation. The luminaires and their support systems will also be installed to reduce the visual impact of the lighting installation. LED or low energy lamps will be used for lighting in the external areas to reduce the energy consumption. The luminaires utilise a combination of 8m single and twin arm road lanterns, 6m single and twin arm road lanterns and 1m bollards.

2.4.12 The power supply for the IMD will be provided from the Western Power substation at the eastern end of the site, off Addison Road. A feed will be run from the substation to an onsite transformer, from which power for the IMD will be supplied. A new sewer will run from the IMD along the highway to Steeple Claydon where it will connect to an existing sewer.

Operational waste and material resources

2.4.13 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.

2.4.14 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.

2.4.15 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.

2.4.16 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.

2.4.17 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%.

2.4.18 On this basis, approximately 150 tonnes of operational waste will be reused, recycled and recovered during each year of operation of the Proposed Scheme in the Calvert, Twyford, Steeple Claydon and Chetwode area. Approximately 31 tonnes will require disposal to landfill (see Table 5).

Table 5: 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 trains	0	0
Rolling stock maintenance	0	0
Track maintenance	167	25
Ancillary infrastructure	14	6
TOTAL	**181**	**31**

2.4.19 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. Community forum meetings were held on:

- 11 April 2012 at Steeple Claydon Village Hall;
- 26 June 2012 at Calvert Green Community Centre;
- 4 September 2012 at Calvert Green Community Centre;

- 15 November 2012 at Best Western Hotel;
- 5 February 2013 at Calvert Green Community Centre; and
- 15 September 2013 at Buckingham Best Western Hotel.

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:

- potential impacts on the surrounding nature reserves and Sheephouse Wood, including any wildlife habitats within these;
- the interface between the EWR, the Greatmoor Energy from Waste facility, Calvert landfills, the Proposed Scheme and HS2 Phase Two, particularly with regards to land required for their construction and operation;
- potential noise effects of the Proposed Scheme when on viaduct;
- potential impacts on the local road network and the effects any changes may have on local communities, for example increased journey times due to construction traffic on local roads;
- potential impact and land required for the temporary railhead and permanent IMD;
- potential impacts of temporary construction sites on agricultural land and its return to an agricultural use;
- potential effects of noise on dairy farming and productivity;
- how noise will be assessed and how noise effects will be mitigated; and
- potential effects on users of the local rights of way that link villages in the area, especially footpaths leading to the school in Steeple Claydon.

2.5.5 In addition to the engagement through the community forums, the draft Environmental Statement and Design Refinement 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 Environmental Statement and the development of the 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 Calvert, Steeple Claydon, Twyford and Chetwode area, consultations on the draft Environmental Statement and on the Design Refinement were held on 4 June 2013 at Calvert Green Village Hall/Calvert Green Community 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 Environmental Statement consultation have been analysed and an overview of those received and how the Environmental Statement has taken account of responses is contained in the Draft Environmental Statement Consultation Summary Report (Volume 5: Appendix CT-00X-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 has been to ensure that the Proposed Scheme draws the right balance between engineering requirements, cost and potential environmental impacts.

2.6.3 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.

Calvert Infrastructure Maintenance Depot

2.6.4 The January 2012 announced route and the Proposed Scheme includes an IMD between Calvert and Steeple Claydon. A number of alternative locations for the IMD had previously been considered. Environmental consideration of the IMD options was published in the 'Appraisal of Sustainability – Post Consultation Route Refinements, January 2012', and is summarised below.

2.6.5 A preferred location for the IMD site formed part of the 2011 London-West Midlands consultation route at a site near Calvert and Steeple Claydon. The public consultation on the IMD focused largely on issues around road access, workforce availability, and night-time working. On road access, concern was expressed that the local road network around the IMD site at Calvert was not suited to the number of vehicles that would require access to the site. With little unemployment in the local area, it was suggested that the jobs created by the depot would be filled from elsewhere rather than by members of the local population. Concern was also expressed that with night-time working at the site, local residents, particularly from Steeple Claydon, would be impacted.

2.6.6 A comparative appraisal was undertaken of the proposed IMD site at Calvert with two alternative sites to the north-west of Aylesbury Vale Parkway station.

2.6.7 The proposed depot site at Calvert will be sited alongside the HS2 route and immediately north of the existing Bicester to Bletchley Line. The depot will be connected by rail to the HS2 route and to the rest of the railway network via the existing Bicester to Bletchley Line. The other two alternative sites would not have direct links to both the main HS2 railway and the rest of the railway network.

2.6.8 There was very little to distinguish between the three depot site options in terms of the area of land required, as none would have direct impacts on designated environmental features, but the Calvert site is the only option located within 100m of a residential property. The two alternative sites could have marginally higher impacts in terms of cultural heritage and landscape and visual.

2.6.9 Further alternatives have not been considered under the development of the location of the IMD and the January 2012 announced route was taken forward within the Proposed Scheme.

Finemere Wood to Sheephouse Wood

2.6.10 The route in this section is consistent with the January 2012 announced route and the Proposed Scheme will follow the alignment of the existing Aylesbury Link corridor as close to ground level as possible between Finemere Wood and Sheephouse Wood, within this area. Information has been provided to HS2 Ltd indicating the presence of Bechstein's bat, a rare and internationally important species that is protected under national and European legislation and surveys have provided more details of their extent and habitat. A number of options have been considered to mitigate potential impacts on these bats, involving lower alignments than the Aylesbury Link and providing structures over the route. As the section of route that would be most affected by these options is within CFA12 these options are described in more detail in Section 2.6 of the Waddesdon and Quainton area report (CFA12).

Rail access to the Infrastructure Maintenance Depot

2.6.11 To the north of Calvert and west of Twyford, the January 2012 announced route included one access line to the Calvert IMD from the southbound line of the route. Since January 2012 further operational requirements have been considered and a new rail connection into the IMD added.

2.6.12 The following two options were considered:

- Option A: The January 2012 announced route which included the provision of access from the Calvert IMD to the through route tracks through the provision of a northern link and associated additional sidings to facilitate turn-back of maintenance trains going southwards; and
- Option B: The Proposed Scheme, which would provide a direct southern access from the Proposed Scheme to the Calvert IMD, which would replace the additional turn back sidings on the north-facing link.

2.6.13 Both options would have construction impacts and land requirements associated with them: for Option A this would be on the east side of the proposed HS2 line at Twyford and for Option B on the east of the proposed line at Calvert. However, Option B would provide a more direct and quicker link to the route south of Calvert, compared to Option A. This would lead to a localised reduction in noise due to fewer night-time train movements in the immediate vicinity of Twyford.

2.6.14 In addition, although Option B would be more expensive, it would have whole life benefits as a result of more efficient maintenance and operational activities which more than outweigh the higher cost to construct. For these reasons Option B was adopted in the Proposed Scheme.

Bicester to Bletchley Line crossing of the Proposed Scheme

2.6.15 The Proposed Scheme in this location would cross the Bicester to Bletchley Line to the north of the Jubilee Calvert nature reserve adjacent to the IMD. The proposals to upgrade the Bicester to Bletchley Line as part of the East West Rail (EWR) proposals are expected to have been implemented at the time of construction of the Proposed Scheme. The January 2012 announced scheme would have required significant changes to the Bicester to Bletchley Line forming part of the EWR proposals; options were therefore considered to reduce conflicts between the two schemes and reduce disruption during construction.

2.6.16 The following three options were considered for this crossing, which would affect the section of the route between School Hill to the east of Twyford:

- Option A: The January 2012 announced route, with the Bicester to Bletchley Line passing over HS2, which would be at ground level;
- Option B: The Proposed Scheme, with HS2 partially lowered and the Bicester to Bletchley Line partially raised offline. This option would necessitate repositioning of the Bicester to Bletchley Line's Claydon Junction and the short curved section of track connecting to the Aylesbury Link railway line; and
- Option C: HS2 passing underneath the Bicester to Bletchley Line, which would stay at its current level.

2.6.17 The potential to put HS2 over the top of the Bicester to Bletchley Line was discounted on the basis that this would have increased both costs and environmental impacts.

2.6.18 In general, the differences between Options A, B and C would be marginal in terms of environmental impact. All three options would result in the demolition of several buildings at the Grade II listed Shepherd's Furze Farm (see Section 2.3).

2.6.19 Both Options A and B would require slightly more land during construction and operation because the Bicester to Bletchley Line would need to be realigned to the north of its current alignment. In addition, Option A would require a higher overbridge that, of the three options, would result in the largest visual effects.

2.6.20 Option C would have required more extensive excavation and below-ground construction over a greater distance, and so was not preferred.

2.6.21 Option B was considered to provide the best balance of environmental impacts and cost. For these reasons, Option B has been adopted in the Proposed Scheme.

2.6.22 HS2 Ltd is continuing to explore the development of the detailed design with East West Rail and NR.

Green tunnel at Chetwode

2.6.23 The Proposed Scheme passes adjacent to Chetwode and will be close to a number of properties including listed buildings. The route will be in cutting through the section and this is consistent with the route announced in January 2012.

2.6.24 Members of the local community have proposed an alternative option. They would prefer that the railway was in green tunnel as it passes Chetwode, in order to mitigate potential noise and visual effects.

2.6.25 If a green tunnel were constructed with the railway at its proposed depth, the top of the structure would be above ground level. Therefore, to construct the tunnel to be below the existing ground level, the depth of the cutting would need to be increased. This would increase the area of land required either side of the railway. Furthermore, the alignment in this location would be constrained by the existing rivers and their associated floodplains. Placing the route in a below ground green tunnel would require a significant further lowering of the route to allow rivers to be reinstated over the Proposed Scheme. This would have an effect on the alignment over a long length, land required and on properties adjacent to the route for some distance in either direction.

2.6.26 To increase the depth over an extended length of the alignment would increase the volume of material generated and based on the typical rates for construction would add to the cost of the Proposed Scheme.

2.6.27 The Proposed Scheme includes earthworks and noise fence barriers in this location in order to provide mitigation for noise and visual effects.

2.6.28 For these reasons the green tunnel option has not been incorporated into the Proposed Scheme.

Replacement of viaducts with embankments and culverts (various locations)

2.6.29 The route will travel along the Padbury Brook valley, crossing the brook and its tributaries a number of times via a combination of viaducts and embankments over culverts.

2.6.30 The January 2012 announced route included viaducts to cross all Flood Zone 3 areas. With the benefit of more detailed floodplain information, options for shortening each

viaduct by replacing part of each with embankments and/or culverts with associated additional floodplain storage were considered. Although this design change could increase impacts to the water environment, it would also help to reduce the potential visual and operational noise and vibration impacts.

2.6.31 This resulted in shorter viaduct structures and the adoption of embankments and culverts, or extended/oversized culverts, at the following three locations:

- floodplain crossings to the east of Twyford;
- floodplain crossing to the east of Godington; and
- floodplain crossing to the south-west of Barton Hartshorn.

FCC Environment relocated sidings access

2.6.32 The scheme presented in the draft ES showed the reinstatement of the existing railway sidings used by FCC Environment to the east of the Aylesbury Link railway line at Calvert.

2.6.33 Subsequently a potential alternative location for the reinstatement of the sidings was identified to the south of Sheephouse Wood. Three options were considered in this location:

- Option A: The Proposed Scheme with the location to the north of Decoypond Wood and to the south of School Hill. The configuration of this option would be such that vehicular access to the sidings would be located on the eastern side of the Aylesbury Link railway line, a vehicle loop at the northern end and a vehicle overbridge crossing to cross over the Aylesbury Link railway line and the HS2 route to the south;
- Option B: Access to the sidings would be located between Sheephouse Wood and Bridleway GUN/28 accommodation green overbridge. The configuration would be such that vehicular access to the sidings would be located on the eastern side of the Aylesbury Link railway line, a vehicle loop at the southern end and a new vehicle overbridge crossing to cross over the Aylesbury Link railway line and the HS2 route to the north; and
- Option C: Access to the sidings would be located between Sheephouse Wood and Bridleway GUN/28 accommodation green overbridge. The configuration would be such that vehicular access to the sidings would be located on the eastern side of the Aylesbury Link, a vehicle loop at the northern end and a vehicle overbridge to cross over the Aylesbury Link and the HS2 route to the south over the Bridleway GUN/28 accommodation green overbridge.

2.6.34 Option B and Option C have been discussed with FCC Environment (the landfill operator) and may have some benefit for the local community as some of the activities associated with the siding will be further away from residents within Calvert itself. However, there are particular constraints such as the Sheephouse Wood SSSI and Finemere Wood SSSI and the BBOWT Finemere Wood nature reserve in close proximity. There would also be other potential impacts with regard to ecology such as

the impact on bats and invertebrates (black hairstreak) species. The siting of the overbridge to the south would also have landscape and visual impacts by introducing a structure that would be out of context with the existing landscape. There would also be potential impacts to watercourse crossings such as the Muxwell Brook and the Megaditch.

2.6.35 Option A will be located closer to the settlement at Calvert but through sensitive design and mitigation potential impacts from relocating the siding to the eastern side of the Aylesbury Link would be no worse than for the other options. It would present benefits compared to the existing situation.in terms of proximity of the sidings from existing receptors and opportunities to introduce visual and ecological mitigation in this area. For these reasons Option A was adopted into the design of the Proposed Scheme.

Perry Hill Road alignment

2.6.36 The January 2012 announced scheme showed the permanent closure of Perry Hill (road) at Calvert where the existing road alignment intersected the layout of the Calvert IMD. The local community came forward with a proposal to keep Perry Hill open, by diverting the road to pass under the realigned Bicester to Bletchley Line and over the HS2 line. This would maintain this transport link and avoid the need for the alternative currently poor condition transport route via West Street and Main Street to be upgraded with its associated local agricultural impacts.

2.6.37 The following seven options were considered with the objective of keeping Perry Hill or West Street open, or a combination of the two:

- Option A: the January 2012 announced scheme, which would involve closing Perry Hill road on the northern side before intersecting the footprint of the IMD. The road would be closed on the southern side as it approached the HS2 route. The northern approach road would be used for vehicular access to the IMD and the railhead. West Street would remain open and traffic diverted round Main Street to Calvert. Footpath TWY/4/1 would also be diverted via a combined farm accommodation overbridge;
- Option B: this option would involve keeping Perry Hill open but realigning it so that Perry Hill would maintain a straighter layout, reduce land required and the impact to local agricultural practices. The option would cross the HS2 route on an overbridge and pass under the raised and realigned Bicester to Bletchley Line. The realignment would result in the overbridge crossing the route on a tight angle which could lead to engineering complexities and higher construction and maintenance costs and coincide with the proposed IMD layout which would then have knock-on effects on operational activities of the sidings and the car park;
- Option C: this option would involve reducing the angle of the Perry Hill road ridge to allow the road to pass over the route at a shallower angle. The road would then curve round to the south and west into the Portway Farm holding on the approach to pass under the Bicester to Bletchley Line. This option

would involve closing West Street at the crossing of the route and would provide access to West Street and Portway Road by a road connection from the realigned Perry Hill road running parallel between the route and the former GCML;

- Option D: this option would be similar to Option C but would reduce the land required as the realigned Perry Hill would run adjacent to the route. The options would involve keeping Perry Hill open and closing West Street and providing a similar access connection to West Street by a three-armed roundabout;
- Option E1: this option would involve a similar layout to Option D but the access to West Street would be moved further to the southwest with a junction located on Main Street and the West Street access running across Portway farm land;
- Option E2: this option would be very similar to both Option D and E1 but would involve the access road being located further to the southwest, running across the edge of Portway farm and parallel with the Bicester to Bletchley Line, connecting at Main Street; and
- Option F: The Proposed Scheme – this option was a later alternative put forward by the local community and involved a similar road layout for Perry Hill as Options E1 and E2 but removed the access to West Street across Portway Farm. This option would also involve keeping West Street open in a similar layout to Option A.

2.6.38 Options A, C, D, E1 and E2 would all involve some form of road closure to either Perry Hill or West Street and therefore would not meet the requests of the local community, as well as adversely affecting accessibility between the main settlements in the area. Option A would involve a large diversion of a local footpath and require additional land for the footpath diversion and farm accommodation access. Option C would require a large amount of land from the Portway Dairy Farm holding and would isolate large grazing blocks. Similarly the access road to West Street/Main Street within Option E1 would sever large grazing blocks to the south, requiring the provision of accommodation underbridges to maintain access.

2.6.39 Although Option B would have beneficial outcomes from an environmental and accessibility perspective, some refinements would be required to align the position of Perry Hill, reduce the skew of the overbridge and remove conflicts with the operational requirements of the IMD. A refined road alignment and some refinements to the layout of the IMD were subsequently adopted into the design, which allowed both West Street and Perry Hill to remain open to traffic, but the Option still does not perform well compared to other options on accessibility grounds.

2.6.40 Option F combines the benefits of Options A, B, E1 and E2 but will also mean that there will be no permanent closures of the local road network, a key desire of the community. It also retains the current main route through the area which is desirable for efficient traffic movements.

2.6.41 For these reasons Option F was incorporated into the design of the Proposed Scheme.

Station at Calvert

2.6.42 The January 2012 announced scheme assumed that workers will travel to the railhead by road. The local community suggested an alternative with a station or platform being provided at Calvert in order to provide opportunity for staff to come to the site on trains on the Bicester to Bletchley Line. This was proposed with the intention to reduce the volume of traffic using local roads around the IMD and the impacts associated with those vehicle movements. Locally, this was seen as having the added benefit of providing a station for residents' use after construction, if it were retained permanently.

2.6.43 Five options were considered:-

- Option A: the option assumes that all workers would travel to the railhead by road (no station);
- Option B: New Station on EWR with fare and accommodation incentive;
- Option C: New Station on EWR with no fare and accommodation incentive;
- Option D: Shuttle bus from temporary accommodation locations; and
- Option E: Shuttle bus with pick-up and drop-off at Winslow Station.

2.6.44 The appraisal of the above options indicated that there would be little benefit achieved from the provision of a station (Options B and C) at the Calvert IMD as it is anticipated that there would not be sufficient number of workers travelling to site from stations between the Bicester and Oxford or Milton Keynes areas. Although projected usage would increase under Option C, with fare incentives in place for construction workers (for example through subsidised fares) the potential usage is still envisaged to remain low and more effective use of subsidy would be through Option D or E. The provision of a station was also thought likely to increase journey times along the EWR routes with little demand for a stop and would have resulting detrimental consequences to the NR business case.

2.6.45 Options D and E would provide more flexibility in creating an effective travel plan for workers and could be more easily tailored to changing circumstances and travel time needs. It would also require less cost to establish and maintain. It is envisaged that these types of options would be incorporated into construction contracts with the contractor run services. A similar service could be introduced for the operational use of the IMD.

2.6.46 Improvement of rail services as part of the EWR project will occur on both the Bicester to Bletchley Line and the Aylesbury Link. Discussions with NR remain ongoing to ensure compatibility between the EWR project and HS2 schemes and further reviews of the potential for station developments in the area will remain under consideration.

2.6.47 At this stage, the options for a temporary station provision during the construction phase are not considered viable compared to other means of access by road. The case for provision of a station for use during the operational phase, which would be undertaken by NR, is also not currently seen as a viable and cost effective option and so these Options B and C have not been taken forward.

2.6.48 Options D and E as noted would have benefits from decreasing traffic movements and would be expected to be incorporated into the construction contracts. However, at this stage the actual use, routes and effectiveness of these type of travel plans is not known. As such, assessment of the travel impacts associated with the Calvert IMD are based on Option A, general car usage, as this will indicate the potential worst case for local impacts.

2.6.49 For the reasons above, Option A has been taken forward as the assumed method of transport for construction workers during the construction and operational phase.

Increased bunding at Twyford

2.6.50 The Proposed Scheme as presented in the draft ES would pass Twyford on an embankment and viaduct with cuttings at either end. Bunding on the western side was included within the Proposed Scheme to provide noise attenuation for receptors at Twyford. The local community proposed that the bund at Twyford be provided above the pantograph height (i.e. above the top of the train) to further mitigate noise and visual effects from the pantograph. As the Proposed Scheme is on embankment at this location, extending a bund to above the height of the pantograph would lead to a large structure, approximately 8m tall and depending on the gradient of the slope, approximately 25 metres wide. In addition, there would be restrictions on what could be proposed due to areas of floodplain close to the route that would need to be retained. Therefore, it is not considered feasible to increase the bund height above the height of the top of the train at this location for a continuous length.

2.6.51 The noise assessment has led to an increase in the height of the noise fence barriers in this location to 5m above the rail line and 4m above the rail line on viaduct sections to further mitigate the noise effects in this area and this has been adopted into the scheme.

2.6.52 Since the draft ES, as part of the work to develop the noise mitigation the length of the bunds has been increased from the Twyford Sewage Treatment Works past Twyford. Planting of both the bunds and the former GCML will provide a visual screen to mitigate the visual effects of raising the height of the barriers in this location, and this has also been adopted in the Proposed Scheme.

2.6.53 To create an embankment above pantograph level would require a very large earth bund with an extensive footprint. For this reason, whilst embankments have been included within the Proposed Scheme they are not as high as the community requested.

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 assessment sections (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 publically available information used in the assessment, and the results of surveys undertaken within this area, are contained in Volume 5: Appendix AG-001-013.

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 assumptions or limitations that are specific to the assessment in this 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 area. These include the underlying soil resources which 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). The area includes a series of rolling hills to the north-east which vary in altitude from around 80m to 105m above Ordnance Datum (AOD) and are characterised by moderate gradients. The main arterial drainage is provided by the Padbury Brook which crosses the Proposed Scheme a number of times, and the numerous drainage ditches which are found throughout the area. At the southern end of the study are Grebe Lake and Calvert Jubilee lake.

Geology and soil parent materials

3.3.3 The main geological features are described in detail in the land quality assessment (Section 8). The Peterborough member of the Oxford Clay Formation forms the principal underlying geology in this area. This formation is overlain by superficial deposits of mixed glacial material typically consisting of brownish grey mudstone. Near Twyford, superficial river terrace deposits of sand and gravel are also present.

3.3.4 The Kellaways Formation, which comprises sandstone, siltstone and mudstone, runs roughly south-west to north-east occupying valleys between Chetwode and Newton Purcell. Further north-west at Newton Purcell is Cornbrash limestone.

3.3.5 Superficial deposits of alluvium are mapped overlying the Kellaways Formation, in conjunction with the valleys and streams between Chetwode and Newton Purcell. Deposits of mid-Pleistocene till occupy the slopes and hilltops around Godington, Chetwode and Barton Hartshorn.

Description and distribution of soil types

3.3.6 The characteristics of the soils are described by the Soil Survey of England and Wales[17] and shown on the National Soil Map[18]. The soils are grouped into associations of a range of soil types. They are described in more detail in Volume 5: Appendix AG-001-013 and their distribution is shown on Map AG-02-013 (Volume 5, Agricultural, Forestry and Soils Map Book).

3.3.7 The soils throughout this area are described as highly variable with eight soil associations present. The predominant soil is that of the Denchworth association, comprising stoneless or slightly stony, wet, clay, clay loam or silty clay loam over clay soils which are typically poorly drained and fall within Wetness Class[19] (WC) IV.

3.3.8 The Evesham 2, Wickham 2 and Beccles 3 associations are present in the south and centre of the area. These soils also have fine loamy, sandy clay loam or clay topsoils and overlie clay. However, the Evesham 2 and Beccles 3 association soils are moderately well drained to imperfectly drained and are categorised as WC II or III, while Wickham 2 soils are slightly less well drained and are categorised as WC III or IV, imperfectly drained to poorly drained.

3.3.9 Associated with the streams and tributaries of Padbury Brook, which joins the River Great Ouse in the north-east, are soils of the Fladbury 1 association. These soils are deep clayey alluvial soils, and are poorly or very poorly drained, typically of WC IV to WC V. Soil textures are usually of clay or silty clay topsoil over clay subsoil.

3.3.10 The Ashley, Bishampton 2 and Ragdale soil associations are present in the north of the area. Ashley and Ragdale soils occur on the Cornbrash Limestone in the north of the area and comprise fine loamy, clay loam and clayey topsoil textures. Ashley soils are better draining than Ragdale, with the profiles typically within WC II to III, or III to IV, respectively. The Bishampton 2 soils have stoneless or slightly stony sandy loam or sandy clay loam topsoil over clay loam subsoil texture. They typically fall within WC II or III.

Soil and land use interactions

Agricultural land quality

3.3.11 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

[17] Soil Survey of England and Wales (1984), *Soils and their Use in South East England.*
[18] Cranfield University' (2001), *The National Soil Map of England and Wales 1:250,000 scale*. National Soil Resources Institute.
[19] The Wetness Class of a soil is classified according to the depth and duration of waterlogging in the soil profile and has six bands.

agricultural capability of land resulting from the interactions of soil, climate and the site.

3.3.12 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. There are two distinct soil characteristics within the area. These are the heavier textured clay loam and alluvial soils which are slowly permeable and moderately wet; and the better drained soils over limestone. There are no limitations to agricultural land quality arising from soil depth or chemical infertility.

3.3.13 Climate does not in itself place any limitation upon land quality in this section but the interactions of climate with soil characteristics are important in determining the wetness 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 three points within the area, and which are set out in Volume 5: Appendix AG-001-013. The data show average annual rainfall to be moderate at around 660mm and temperatures to be moderately cool. The number of Field Capacity Days[20] (FCD) is approximately 143, which is a shorter period than the average for lowland England (150 days) and is therefore considered to be favourable for providing opportunities for agricultural land working.

3.3.14 Gradient and microrelief, with complex changes of slope angle or direction over short distances, are not considered limiting in this local area. The floodplains of Padbury Brook extend across much of the area and flooding is a potential limitation to agricultural land quality.

3.3.15 Under the climatic conditions of this study area, poorly draining soils assessed as WC IV, such as the Denchworth, Wickham 2 and Fladbury associations which have a clay or clay loam topsoil texture are limited by restricted soil workability to no better than Subgrade 3b. For the slightly better draining Ashley, Bishampton 2 and Ragdale soils which are predominantly of WC III, a soil wetness limitation will also apply, the severity of which, whether to Subgrade 3a or Subgrade 3b, is dependent upon the composition of the topsoil.

3.3.16 Department for Environment, Food and Rural Affairs (Defra) mapping[21] shows that there is generally a low likelihood of encountering BMV land in this locality, which makes such land a resource of high sensitivity in this local area.

Other soil interactions

3.3.17 Soil fulfils a number of functions and services for society in addition to those of food and biomass production which are central to social, economic and environmental

[20] Field Capacity Days 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. 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.
[21] Defra (2005), *Likelihood of Best and Most Versatile Agricultural Land.*

sustainability. These are outlined in sources such as the Soil Strategy for England[22] and The Natural Choice: securing the value of nature[23], 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;
- protection of cultural heritage;
- providing raw materials; and
- providing a platform for human activities, such as construction and recreation.

3.3.18 Forestry resources represent a potentially multifunctional source of productive timber, landscape amenity, biodiversity and carbon storage capacity. The value and sensitivity of these resources are assessed in Section 7.

3.3.19 The wetland soils around the Calvert Jubilee Nature Reserve are considered to be an important resource in terms of their ecological value (see Section 7).

3.3.20 The presence of soil-borne cultural assets is reported in Section 6. Deposits of River Terrace Gravels associated with Padbury Brook have included a 'mammoth tooth and bone' at Steeple Claydon, and remains of mammoth, rhinoceros and elephant at Twyford. Bronze Age mill mounds and crop marks are found at Cowley Farm (CFA13/8), and Roman crop marks have also been found within the floodplains of Padbury Brook.

Land use

Land use description

3.3.21 Agricultural land use in this area is predominantly arable (including with rotational grass ley) with pockets of permanent pasture at the northern end of the study area and in the vicinity of Padbury Brook, to the north of Twyford. There is also a large dairy farm located south of Twyford which has associated short-term leys.

3.3.22 A number of environmental designations potentially influence land use within the study area. The whole area is a nitrate vulnerable zone (NVZ), which is an area in which nitrate pollution is a potential problem. Statutory land management measures apply which 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 which 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 which have land entered into an agri-environment scheme are identified in Table 6.

[22] Defra (2009), *Soil Strategy for England.*
[23] Defra (2011), *The Natural Choice: securing the value of nature.*

3.3.23 Woodland is relatively sparse through the area and represents some 5% of land cover compared to the national average of 10%. The main woods are to the south and include Decoypond Wood and around the lakes north of Calvert. There are also a number of copses in the vicinity of Chetwode Manor.

Number, type and size of holdings

3.3.24 There are 22 holdings in the study area as set out in Table 6. Most of the holdings are owner-occupied although there are some holdings on long-term tenancy agreements and other informal agreements. The size of the holdings ranges from small enterprises to large country estates and the boundaries of the holdings are shown on Maps AG-01-028 to AG-01-031 (Volume 5, Agriculture, Forestry and Soils Map Book) along with the location of the main farm buildings. Due to the poorly draining nature of many of the soils, significant areas of land have been subject to agricultural drainage.

3.3.25 Table 6 also sets out the sensitivity of individual holdings to change, which is determined by the extent to which they have the capacity to absorb or adapt to impacts, which in turn is determined primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, can better absorb impacts and are less sensitive. Units that rely on the use of buildings (such as intensive livestock and dairy farms, and horticultural units) are less able to accommodate change and have a higher sensitivity. 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 Series AG-01 (Volume 5, Agriculture, Forestry and Soils Map Book) and Volume 5: Appendix AG-001-013.

Table 6: Summary characteristics of holdings

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA13/1* Claydon Estate	Arable, beef cattle and sheep	1,400	Not known	None	Medium
CFA13/2 Portway, Greatmoor, and Shepherd's Furze	Dairy and arable	567	None	ELS	High
CFA13/3 Elm Tree/ Stone Court Farm	Arable	400	Christmas goods, Bed and Breakfast, buildings let	ELS	Medium
CFA13/4* Lake Farm	Arable, beef cattle and sheep	81	Not known	ELS and HLS	Medium
CFA13/5 Home Farm	Beef cattle	33	None	ELS	Medium

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA13/6 Cowley Lodge Farm	Arable and sheep	440	None	None	Medium
CFA13/7* Charndon Grounds Farm	Grazing	33	Not known	None	Medium
CFA13/8 Cowley Farm	Arable and sheep	170	Wheelie bin cleaning	ELS	Medium
CFA13/9 Casemore Farm	Arable and sheep	113	Residential lettings	None	Medium
CFA13/10 Grange Farm	Arable	374	Residential barn conversions let	ELS and HLS	Medium
CFA13/11 Moat Farm	Arable	226	Moto cross and clay pigeon shooting	ELS and HLS	Medium
CFA13/12 Chetwode Manor, including Manthorn Farm	Arable	437	None	ELS	Medium
CFA13/13 Barton Hill Farm	Arable with grazing let	55	Caravan site	ELS and HLS	Medium
CFA13/14 Barton Grounds Farm	Beef cattle	26	None	ELS	Medium
CFA13/15* Barton Farm	Grazing	16	Not known	ELS	Medium
CFA13/16* The Green, South Claydon	Grazing	4	Not known	ELS	Low
CFA13/17 Rose Hill Farm, Steeple Claydon	Grazing	6	None	None	Low
CFA13/18* Un-named paddock 1	Grazing	9	Not known	None	Medium
CFA13/19* Three Bridge Mill	Grazing	5	Not known	None	Low
CFA13/20*	Arable and	26	Not known	ELS and HLS	Medium

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
New Manor Farm	grazing				
CFA13/21* Un-named paddock 2	Pigs	2	Not known	None	Medium
CFA13/22* Un-named arable	Arable	22	Not known	None	Medium

* No Farm Impact Assessment interview conducted; data estimated.

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 on-going 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 adverse impacts on agriculture, forestry or soils during construction:

- agricultural overbridge at Twyford Mill, utilised by Cowley Farm (CFA13/8) and Restricted Byway PBI/5A;
- access to severed land under railway viaducts for Home Farm (CFA13/5), Portway Farm (CFA13/2) and Moat Farm (CFA13/11); and
- access to land associated with Moat Farm (CFA13/11) provided by Footbridge CHW/18 accommodation overbridge.

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 With the exception of land re-engineered to provide flood compensation capacity, 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 which would downgrade the quality of disturbed land. Some land with heavier textured soils may require 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-003-000/1):

- 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 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 the delivery of those permanent works.

3.4.6 All of the land required to implement the Proposed Scheme will, therefore, be affected during the construction phase. 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 agricultural interests to continue to access and effectively use residual parcels of land. There may also be the loss of, or disruption[24] to, buildings and operational infrastructure such as drainage. The Scheme design seeks, however, to minimise 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 it will be subject to a further period of five years of managed aftercare to ensure stabilisation of the soil structure.

3.4.8 In addition, a sustainable placement area for excavated material from the Proposed Scheme has been identified at Shepherd's Furze Farm extending to approximately 46ha. The landforms created will be returned to agriculture on completion of the works (including replacement of any existing hedge lines on their current alignment).

Temporary effects during construction

Impacts on agricultural land

3.4.9 During the construction phase, the total area of agricultural land used will be approximately 385.4ha as shown in Table 7. Of this total, some 211ha will be restored and available for agricultural use following construction.

[24] Structural disruption is disruption to the existing structure of farm holdings, principally from severance and the loss of key farm holdings.

Table 7: Agricultural land required for the construction of the Proposed Scheme

Agricultural land quality	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Grade 1	0	0	0
Grade 2	0	0	0
Subgrade 3a	44.3	11	22.1
BMV Subtotal	44.3	11	22.1
Subgrade 3b	341.1	89	188.8
Grade 4	0	0	0
Grade 5	0	0	0
Total agricultural land	385.4		210.9

3.4.10 The disturbance during construction to 44.3ha of land of BMV quality is assessed as an impact of low magnitude, comprising less than 20% of the agricultural land required. However, as BMV land in this local area is a receptor of high sensitivity, the effect on BMV land is assessed as a moderate adverse effect, which is significant.

3.4.11 Following construction the land required temporarily will be reinstated to its pre-existing agricultural condition, except where land is to be re-engineered for flood compensation and may be more prone to flooding. It is estimated that there will not be any significant surplus of topsoil or subsoil material arising from the Proposed Scheme in the area. The land required temporarily for the sustainable placement of excavated materials will have the topsoil stripped and stored prior to placement of the excavated materials, and restored to agricultural land use.

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 other 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[25]. These principles will be followed throughout the construction period. The clayey Denchworth and Ragdale soils are susceptible to compaction and smearing when moved in wet conditions or by inappropriate equipment and need particularly careful handling to avoid damage to soil structure.

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

3.4.14 Compliance with the draft CoCP will ensure the magnitude of impact on soil is low and the significance of the effect 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 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 8. 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 Maps AG-01-028 to AG-01-031 (Volume 5, Agriculture, Forestry and Soils Map Book) and Appendix AG-001-013, Volume 5.

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 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-001-013, Section 4. Where the sum of the land required by ALC grade differs from the total sum of the land required by holding, the difference is because some holdings are affected in more than one CFA and some holdings include non-agricultural land. The combined impact in holdings is reported once in the CFA where the main holding is located.

Table 8: Summary of effects on holdings during construction

Holding reference/name	Total area required	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA13/1 Claydon Estate	77.8ha (6%) Low	Small parcel severed near IMD with no access, downgraded due to size. Low	Negligible	Minor adverse	24.5ha
CFA13/2 Greatmoor, Portway and Shepherd's Furze	143.3ha (25%) High	Accommodation structure provided but small parcel may be inaccessible Medium	Negligible	Major adverse due to proportion of farm removed, severance and high sensitivity of holding	65.9ha
CFA13/3 Elm Tree/ Stone Court Farm	58.8ha (15%) Medium	Negligible	Negligible	Moderate adverse due to the proportion of the holding required	39ha
CFA13/4 Lake Farm	9.8ha (12%) Medium	Negligible	Negligible	Moderate adverse due to the proportion of the holding required	9.3ha
CFA13/5 Home Farm	11.8ha (35%) High	Inaccessible land during construction to east of viaduct High	Negligible	Major/moderate adverse due to proportion of farm removed and severance	7.4ha
CFA13/6 Cowley Lodge Farm	3.5ha (< 1%) Negligible	Negligible	Negligible	Negligible	1.8ha
CFA13/7 Charndon Grounds Farm	2.5ha (8%) Low	Negligible	Negligible	Minor adverse	2.3ha
CFA13/8 Cowley Farm	20.7ha (12%) Medium	Accommodation structure provided Low	Negligible	Moderate adverse due to proportion of holding removed	4.5ha
CFA13/9 Casemore Farm	7.4ha (7%) Low	Very small parcel severed to west. Downgraded due to small size. Low	Negligible	Minor adverse	2.4ha
CFA13/10 Grange Farm	1.1ha (< 1%) Negligible	Negligible	Negligible	Negligible	0.3ha

Holding reference/name	Total area required	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA13/11 Moat Farm	44.2ha (20%) High	Land severed to the east of the Proposed Scheme available under viaduct and a replaced crossing close to Manthorn Farm and the public highway Medium	Negligible	Major/ moderate adverse due to proportion of holding removed and severance	22.6ha
CFA13/12 Chetwode Manor, including Manthorn Farm	37.1ha (8%) Low	Accommodation structure provided Low	Negligible	Minor adverse	13.8ha
CFA13/13 Barton Hill Farm	15.3ha (28%) High	Negligible	Impact on diversified camping activity Medium	Major/ moderate adverse due to proportion of holding removed and disruption to camping	8.1ha
CFA13/14 Barton Grounds Farm	15ha (57%) High	Negligible	Negligible	Major/ moderate adverse due to proportion of holding removed	6.8ha
CFA13/15 Barton Farm	1.6ha (10%) Medium	Negligible	Negligible	Moderate adverse due to proportion of holding removed	0.7ha
CFA13/16 The Green, Steeple Claydon	0.4ha (10%) Medium	Negligible	Negligible	Minor adverse	0.3ha
CFA13/17 Rose Hill Farm, Steeple Claydon	0.3ha (6%) Low	Negligible	Negligible	Negligible	0.1ha
CFA13/18 Un-named paddock 1	2.9ha (32%) High	Negligible	Negligible	Major/ moderate adverse due to proportion of holding removed	1.3ha
CFA13/19 Three Bridge Mill	1.6ha (31%) High	Negligible	Negligible	Moderate adverse due to proportion of holding removed	1.6ha
CFA13/20 New Manor Farm	4.1ha (16%) Medium	Negligible	Negligible	Moderate adverse due to proportion of holding removed	2.7ha
CFA13/21 Un-named paddock 2	1.4ha (95%) High	Negligible	Negligible	Major/ moderate adverse due to proportion of holding removed	0.1ha

Holding reference/name	Total area required	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA13/22 Un-named arable	13.9ha (63%) High	Negligible	Negligible	Major/ moderate adverse due to proportion of holding removed	13.2ha

3.4.18 Overall, 14 holdings have been identified which will experience moderate, major/moderate or major adverse effects during construction, which are significant.

3.4.19 No agricultural enterprises which are sensitive to noise or vibration emitted during the construction phase, for example intensive poultry houses, have been identified near to the Proposed Scheme. The dairy buildings associated with Portway Farm (CFA13/2) lie some 250m distant from the main construction sites and will not be adversely affected by noise. The diversified camping activity at Barton Hill Farm may be adversely affected by construction noise and activity.

Cumulative effects

3.4.20 No committed development has been identified that will alter the agricultural, forestry or soil baseline condition in this area so there is no cumulative effects to assess.

Permanent effects from construction

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 to agricultural land, the total net area of agricultural land that will remain permanently removed from agriculture will be 174.5ha, as shown in Table 9.

3.4.23 A further 17.5ha of forestry land will also be permanently removed. The areas refer to agricultural land of a particular grade that is required permanently for the Proposed Scheme, and its proportion of the total area of agricultural land required permanently.

Table 9: Agricultural and forestry land required permanently

Agricultural land quality	**Total area required (ha)**	**Percentage of agricultural land**
Grade 1	0	0
Grade 2	0	0
Subgrade 3a	22.3	13
BMV subtotal	**22.3**	13
Subgrade 3b	152.2	87
Grade 4	0	0
Grade 5	0	0
Total agricultural land	**174.5**	
Forestry land	17.5	

3.4.24 The permanent change of 22.3ha of land of BMV quality to a non-agricultural land use is assessed as an impact of low magnitude, comprising less than 20% of the overall agricultural land requirement. However, as BMV land is a receptor of high sensitivity in this area the effect is moderate adverse, which is significant.

3.4.25 Some areas of agricultural land that are required for the construction of the Proposed Scheme will be restored for ecological and/or landscape mitigation and will be removed from mainstream agricultural production. These areas include land adjacent to Decoypond Wood, north of Twyford Mill and in the vicinity of Rose Hill Farm. This assessment assumes that this land will not return to agriculture. Some 15ha of agricultural land will be engineered to provide additional flood compensation capacity and will be subject to marginal downgrading in agricultural land quality. This assessment assumes that this land will not return to agriculture.

3.4.26 The only notable woodland to be affected by the Proposed Scheme will be Decoypond Wood located at the southern end of the area. Smaller unnamed copses in the vicinity of Chetwode will also be affected. Overall, the total amount of forestry land required to operate the Proposed Scheme will be 17.5ha, out of a total land area of approximately 484.7ha (including non-agricultural land) required to construct the Proposed Scheme. As such the woodland represents about (3%) of the land required and its loss is assessed as an impact of low magnitude. However, the extent of the forest cover in the study area is less than the average national woodland cover of 10% quantitatively the loss of woodland is significant. The qualitative assessment of this loss is addressed in Sections 7 and 9.

Impacts on holdings

3.4.27 The permanent residual effects from the construction of the Proposed Scheme on individual agricultural and related interests is summarised in Table 10. 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 degree of impact 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-001-013.

Table 10: Summary of permanent effects on holdings from construction

Holding reference/name	**Land required**	**Severance**	**Infrastructure**	**Scale of effect**
CFA13/1 Claydon Estate	53.3ha (4%) Negligible	Small parcel severed near IMD with no access, downgraded due to size. Low	Negligible	Minor adverse
CFA13/2 Greatmoor, Portway and Shepherd's Furze	77.4ha (14%) Medium	Access to land severed to the east available via West Street bridge. Medium	Residential property and farm buildings demolished High	Major adverse due to proportion of farm removed, severance, demolition and high sensitivity of holding
CFA13/3 Elm Tree/ Stone Court Farm	19.8ha (5%) Low	Negligible	Negligible	Minor adverse
CFA13/4 Lake Farm	0.5ha (1%) Negligible	Negligible	Negligible	Negligible
CFA13/5 Home Farm	4.4ha (13%) Medium	Access provided to severed land via new dedicated access from the highway. Medium	Negligible	Moderate adverse due to proportion of farm removed and severance
CFA13/6 Cowley Lodge Farm	1.7ha (< 1%) Negligible	Negligible	Negligible	Negligible
CFA13/7 Charndon Grounds Farm	0.2ha (1%) Negligible	Negligible	Negligible	Negligible
CFA13/8 Cowley Farm	16.2ha (9%) Low	Accommodation structure provided Low	Negligible	Minor adverse
CFA13/9 Casemore Farm	5.0ha (4%) Negligible	Access to severed land via viaduct. Negligible	Negligible	Negligible

Holding reference/name	Land required	Severance	Infrastructure	Scale of effect
CFA13/10 Grange Farm	0.8ha (< 1%) Negligible	Negligible	Negligible	Negligible
CFA13/11 Moat Farm	21.6ha (10%) Medium	Land severed to the east of the Proposed Scheme available under viaduct and a replaced crossing close to Manthorn Farm and the public highway Medium	Negligible	Moderate adverse due to proportion of holding removed and severance
CFA13/12 Chetwode Manor, including Manthorn Farm	22.2ha (5%) Low	Accommodation structure provided Low	Farm buildings demolished, downgraded as redundant Medium	Moderate adverse due to property demolition
CFA13/13 Barton Hill Farm	7.2ha (13%) Medium	Negligible	Negligible	Moderate adverse due to proportion of holding removed
CFA13/14 Barton Grounds Farm	6.6ha (25%) High	Negligible	Negligible	Major/moderate adverse due to proportion of holding removed
CFA13/15 Barton Farm	0.7ha (6%) Low	Negligible	Negligible	Minor adverse
CFA13/16 The Green, Steeple Claydon	0.1ha (2%) Negligible	Negligible	Negligible	Negligible
CFA13/17 Rose Hill Farm, Steeple Claydon	0.2ha (5%) Low	Negligible	Negligible	Negligible
CFA13/18 Un-named paddock 1	1.6ha (18%) Medium	Negligible	Negligible	Moderate adverse due to proportion of holding removed
CFA13/19 Three Bridge Mill	0ha (0%) Negligible	Negligible	Negligible	Negligible
CFA13/20 New Manor Farm	1.4ha (6%) Low	Negligible	Negligible	Minor adverse
CFA13/21 Un-named paddock 2	1.3ha (88%) High	Negligible	Negligible	Major/ moderate adverse due to proportion of holding removed and demolition

Holding reference/name	Land required	Severance	Infrastructure	Scale of effect
CFA13/22 Un-named arable	0.7ha (3%) Negligible	Negligible	Negligible	Negligible

3.4.28 Overall, it is likely that eight holdings will experience moderate, major/moderate or major permanent adverse effects from the construction of the Proposed Scheme, which are significant. Two holdings incur demolitions though only one holding has a residential property demolished (CFA13/2); the other unit loses farm buildings albeit CFA13/12 has planning permission for residential conversion; none of these holdings will cease to operate as a result of constructing the Proposed Scheme. Holding CFA13/21 will cease once construction commences due to the proportion of land required.

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

Cumulative effects

3.4.30 No committed development has been identified that will materially alter the agricultural, forestry or soil baseline condition in this area so there are no cumulative effects to assess.

Other mitigation measures

3.4.31 Soils from ancient woodland (where relevant) will be stored separately and will be utilised in this process, as discussed in Section 7. Mitigation will incorporate climate change adaptation and resilience measures, as far as practicable.

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 area of land which will have undergone a change of land use from agriculture to other land uses will be 174.5ha, of which 22.3ha is BMV. This is assessed as a moderate adverse residual effect which is significant.

3.4.33 A total of eight holdings have been identified that will experience moderate, major/moderate or major permanent effects, which is significant. Of these seven 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 only holding that will cease is the un-named pig farming unit at Twyford (CFA13/21). For one holding (CFA13/2) residential demolition will occur.

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 and soils.

Assessment of impacts and effects

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

- 24 hour operation of the IMD, seven days per week, including arrivals and departures of up to 300 staff in addition to deliveries made by road and rail;
- 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 Although the IMD will operate 24 hours a day, seven days a week when the line is operational, this will not have any significant adverse impact upon agricultural activity in the area. There are no sensitive agriculture or equestrian receptors that have been identified close to the Proposed Scheme and no significant effects have been identified by the assessment undertaken.

3.5.5 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.

Summary of likely significant residual effects

3.5.6 No significant residual effects on agriculture, forestry and soils have been identified for the 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 (PM_{10} and $PM_{2.5}$)[26] and dust.

4.1.2 With regard to air quality the main potential effects are anticipated to result from construction activities, traffic generated from construction activities and changes in traffic flows and new road alignments when the Proposed Scheme is operational.

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

- Appendix AQ-001-013; and
- Maps AQ-01-013 and AQ-02-013-01 to AQ-02-013-02.

4.1.4 Maps showing the location of the key environmental features can be found in Maps CT-10-028 to CT-10-031 (Volume 2, CFA13 Map Book).

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-001-013). 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 might occur from construction activities, from changes in the nature of traffic 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)[27]. 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 incorporates this concept of significance being proportional to the number of people affected. However, in cases where less than 10 properties are within 20m of the

[26] $PM_{2.5}$ and PM_{10} 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 micrometres in diameter.
[27] IAQM (2012), *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance*.

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 environmental conditions identified within the study area. The Calvert, Steeple Claydon, Twyford and Chetwode area lies mainly within Aylesbury Vale District, although a small section of the route lies within Cherwell District. It is predominantly rural, with concentrations of airborne pollutants well within air quality standards. There are few roads and road traffic flows are low. As a result, existing concentrations of airborne pollutants are low.

4.3.2 Estimates of background air quality have been obtained from the Department for Environment, Food and Rural Affairs (Defra)[28] background maps for 2012. These data are estimated for 1km grid squares for NOx, NO2, PM10 and PM2.5. All average background pollutant concentrations are well below relevant air quality standards. Values used for the background concentrations can be found in Volume 5: AQ-001-013.

4.3.3 Aylesbury Vale District Council carries out routine diffusion tube monitoring at a number of locations. However, almost all of these are at roadside locations or in towns in locations that are away from the Proposed Scheme within the Calvert, Steeple Claydon, Twyford and Chetwode area and will not be affected by traffic attributed to the construction or operation of the Proposed Scheme. On this basis, these monitoring data are not relevant to this assessment and are not considered representative of air quality at receptors.

4.3.4 Potential receptors are primarily those residential properties that will be close to construction activity and alongside roads where traffic flows will change as a consequence of construction activity or realignment of roads. Notable receptors that will be in close proximity to construction activity are residential properties at Brackley

[28] Department for Environment, Food and Rural Affairs (Defra) (2010), *Defra background maps 2010*; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed: October 2013.

Lane, School Hill, Rosehill Farm, Sunflower Farm, The Hermitage, Manthorn Farm, Lake Farm, Stone Court Farm, Pear Tree House and School End.

4.3.5 Receptors considered in the dust assessment are shown on Maps AQ-02-13-01 to AQ-02-13-02 (Volume 5: Air Quality Map Book). Notable receptors near roads where traffic flows will change are Perry Hill Cottages, Cheshire Cottages, 8 School Hill, 60 West Street, The Bungalow and Gawcott Fields.

Future baseline

4.3.6 Section 2.1 and Volume 5: Appendix CT-004-000/1 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.

4.3.7 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

4.3.8 The data used for the air quality assessment take account of predicted changes in traffic, which are derived from a combination of regional traffic growth factors and consideration of major locally consented schemes, as described in the Traffic and transport Section (Section 12). In this way, the assessment accounts for cumulative effects.

Construction (2017)

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

Operation (2026)

4.3.10 Future background pollutant concentrations have been sourced from Defra background maps 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 the 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 as 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 adapt and deliver the required environmental and community protection measures within each area through the implementation of specific measures required to control dust and other emissions from activities in the area.

4.4.2 The assessment has assumed that the general measures detailed in Section 7 of the draft CoCP (Volume 5: Appendix CT-003-000/1) 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 engagement with the Local Planning Authority to assess the effectiveness of the measures taken to prevent 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 and also 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 NO_2 and PM_{10}.

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 Calvert, Steeple Claydon, Twyford and Chetwode area, dust-generating activities will comprise the establishment of cuttings and embankments, earthworks associated with sustainable placement and the establishment of the IMD. 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, construction of structural embankments, landscaping, the construction and use of construction sites, construction of permanent replacement road infrastructure and bridges and the movement of vehicles onto local roads, with the possible transfer of dust and mud as well as the use of the haul route to remove excavated material.

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-001-013 where the scale of emission and their proximity to receptors is described fully.

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 during the construction period along the affected roads has identified that there are some roads that meet the criteria for a more detailed assessment. This assessment is described fully in Volume 5: Appendix AQ-001-013 Concentrations of NO_2 and PM10 were assessed at six roadside receptors representative of the most affected locations. The assessment concluded that impacts will be negligible at all receptors assessed, for NO_2, 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 This assessment has considered the potential cumulative construction air quality effects of the Proposed Scheme and other committed developments. In this area, there is no development that would be built at the same time as the Proposed Scheme and accordingly, construction emissions or activities that may result in air quality impacts from the Proposed Scheme is unlikely to result in any significant cumulative effects.

Other mitigation measures

4.4.11 No other mitigation measures during construction are considered necessary in this area.

Summary of likely significant residual effects

4.4.12 The methods outlined within the draft CoCP to control and manage potential air quality effects are considered effective in this location and no significant residual effects from dust emissions are considered likely. There will be no significant residual effects resulting from construction traffic emissions.

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 this study area.

Assessment of impacts and effects

4.5.2 Impacts from the operation of the Proposed Scheme will relate to changes in the volume, composition and distribution of road traffic, and in particular traffic movements associated with the IMD. There are no direct atmospheric emissions from the operation of trains that will cause an impact on air quality and these have therefore not been assessed. 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 includes the additional traffic from future committed developments.

4.5.4 Traffic data in the Calvert, Steeple Claydon, Twyford and Chetwode area have been screened to identify roads that required further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2026.

4.5.5 No roads are predicted to have sufficiently large changes in traffic flows to meet the criteria set out in the SMR for more detailed assessment. These include activities related to the operation of the IMD. The impact from the re-alignment of Addison Road has been assessed. No significant effects associated with the Proposed Scheme are predicted.

Cumulative effects

4.5.6 There are no cumulative effects anticipated to arise during operation of the Proposed Scheme.

Other mitigation measures

4.5.7 No other mitigation measures are considered necessary in this area.

Summary of likely significant residual effects

4.5.8 No significant residual effects will be 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 assessment for this study area comprise:

- demolition of seven residential properties;
- the temporary closure of School Hill which links the villages of Charndon and Calvert with Steeple Claydon;
- temporary impacts on amenity affecting some residential properties and the Great Moor Sailing Club in Calvert during construction;
- temporary and permanent impacts on residential amenity affecting some properties on School End in Chetwode; and
- impacts on amenity affecting some residential properties and The Church of the Assumption of the Blessed Virgin Mary (Church of England) in Twyford during operation.

5.1.3 Further details of the community assessments and write-ups of open space surveys and recreational public rights of way (PRoW) surveys undertaken within the study area are contained in the Volume 5: Appendix CM-001-013.

5.1.4 Significantly affected community resources are provided in CM-01-040b to CM-01-043b (Volume 5, Community Map Book).

5.1.5 The current assessment draws on existing information gathered from local and regional sources including Buckinghamshire County Council, Twyford Church of England First School and Sanctuary Care (for Lime Tree Court residential care home).

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.

5.2.2 Construction worker accommodation will be located at the West Street overbridge main compound, east of Twyford. Construction worker impacts on community resources are considered at a route-wide level in Appendix CM-002-000. The assessment takes into account the number of workers, the type and location of accommodation, working hours, facilities provided on construction compounds, experience from other large projects (such as HS1) and the measures contained in the draft CoCP. On this basis it is concluded that there will be no significant effects associated with construction worker accommodation.

5.3 Environmental baseline

Existing baseline

5.3.1 Baseline data on community resources was collected up to 1km from the centre line of the Proposed Scheme and, additionally, up to 250m from the boundary of 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, together with a wider corridor within which receptors or resources could be affected by a combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion. In addition, the study area has regard to the proposed routing of construction traffic and takes account of catchment areas for community facilities which could be affected where crossed by the Proposed Scheme. Overall, the study area is taken as the area of land which encompasses the likely significant effects of the Proposed Scheme.

5.3.3 This area includes Calvert and Charndon, Steeple Claydon, Twyford, Godington and Chetwode. The study area is rural, characterised by farmland interspersed between these villages. Outside these settlements, the population is mainly located in scattered farmhouses and rural cottages. Most of the only roads crossing the study area are B roads or rural lanes which link the villages.

Calvert and Charndon

5.3.4 The villages of Calvert and Charndon are located between Steeple Claydon and Marsh Gibbon. They are linked by School Hill. To the north-west of Calvert are two lakes, which are located either side of Perry Hill. Grebe Lake to the west is used by Great Moor Sailing Club for racing and recreational sailing. The lake to the east is part of the Calvert Jubilee Nature Reserve, a local wildlife site (LWS), managed by the Berks, Bucks & Oxon Wildlife Trust (BBOWT)[29]. There is also a disused sports ground near Sandstone Close, south-east of Calvert; and a small playground surrounded by an expanse of grass located within Calvert Green residential estate at Rustics Close.

5.3.5 Charndon has few community facilities in the village apart from a village hall and playing field.

Steeple Claydon

5.3.6 Steeple Claydon is a large village north of Calvert and Charndon. There are several community facilities within the village including shops; three public houses (The Prince of Wales; The Fountain Inn; and the Phoenix); Steeple Claydon Combined School; two churches (St Michael's Church and Steeple Claydon Methodist Church); a police station; public library; playing fields; and allotments.

[29] Berks, Bucks and Oxon Wildlife Trust; Calvert Jubilee nature reserve; http://www.bbowt.org.uk/reserves/calvert-jubilee; Accessed: October 2013.

Twyford

5.3.7 The small village of Twyford is located to the north-west of Charndon and Calvert and west of Steeple Claydon. Twyford has a number of community facilities including: a village hall; post office; shops; a public house (The Crown); The Church of the Assumption of the Blessed Virgin Mary and its associated church yard on Church Street; Twyford Church of England First School on Church Street; playing field and pavilion at the end of School Lane, which are home to Twyford Cricket Club and Twyford United Football Club; and Lime Tree Court residential care home on Church Street.

5.3.8 The Cross Bucks Way passes through Twyford and crosses through agricultural fields to the north of the village along PRoW (TWY/17).

Godington

5.3.9 The village of Godington comprising a cluster of houses and Godington Hall is located approximately 2.5km to the north-west of Twyford. The only community facility within the settlement is the Holy Trinity (Church of England) Church at the north-eastern end of the road.

Chetwode

5.3.10 Chetwode is located to the west of Preston Bissett. It is a small hamlet centred on Church of St Mary and St Nicholas (Church of England) and its associated churchyard with no other key community facilities. The hamlet has several outlying farmsteads and other isolated residential properties. Bernwood Jubilee Way passes Chetwode to the east along Footpaths CHW/18 and CHW/12/1.

Future baseline

Construction (2017)

5.3.11 Volume 5: Appendix CT-004-000 provides details of the developments which 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 developments described in the following paragraphs are likely to be completed prior to the commencement of construction in 2017.

5.3.12 A residential development located on Brickhill Way and Sandstone Close in Calvert Green (planning reference: 10/02571/APP, which is part of the allocation within the Saved Aylesbury Vale District Local Plan, January 2004 (Ref: RA.25)) will include 98 residential properties, two retail units and public open space. It is likely to be completed prior to the commencement of construction of the Proposed Scheme in 2017.

Operation (2026)

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

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 The villages of Calvert and Steeple Claydon are within close proximity to the Calvert railhead main compound, which will occupy the land required permanently for the IMD and the temporary railhead. The compound will be in place for approximately ten years (including two years for site establishment, which will be managed from the West Street main site compound) and will co-ordinate construction activities associated with construction of the IMD itself as well as being used for the movement of route-wide earthworks and railway installation works for the Proposed Scheme. Given the amount and length of time of construction activities in this area, particular attention has been given to the phasing of the construction works to reduce adverse effects on the communities of Calvert and Steeple Claydon from concurrent works.

5.4.2 The draft CoCP also includes a range of provisions that will help mitigate community effects associated with construction within this area, including the following (see Volume 5: Appendix CT-003-000/1):

- 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 which may affect community resources during construction (draft CoCP, Sections 5 and 16);
- specific measures in relation to air quality and noise will also serve to reduce impacts for the neighbouring communities including discretionary noise insulation for sensitive community resources and, in special circumstances, temporary rehousing (draft CoCP Sections 7 and 13); and
- where reasonably practicable, the avoidance of large goods vehicles operating adjacent to schools during drop off and pick up periods (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-001-013. 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.

Calvert and Charndon

Temporary effects

5.4.4 Construction of the cutting east of Calvert will sever School Hill, just east of the junction with Brackley Lane. There is a bridge on School Hill, which crosses the existing east-west running railway line; this will need to be reconstructed to cross the Proposed Scheme. During the construction of the new bridge, which will take a maximum of two years, School Hill will need to be temporarily closed. During this time traffic will be diverted via Perry Hill and West Street; the additional length of this journey will be approximately 2km[30]. Following completion of the new bridge on School Hill, the road and vehicular use will be reinstated.

5.4.5 School Hill, leading on to Addison Road is the principal road linking the small villages of Calvert and Charndon with Steeple Claydon. Steeple Claydon has a range of community infrastructure, including a combined school and nursery; two churches; three public houses; a post office; a GP surgery; a dentist; and a library. Neither Calvert nor Charndon have any community facilities with the exception of a community hall and village hall respectively. As such, residents of both of these villages are likely to need access to Steeple Claydon on a daily basis.

5.4.6 Whilst there is an alternative route to Steeple Claydon, this is nearly double the length of the existing journey and this re-routing will be in place for up to two years. Given this and that residents of Calvert and Charndon are likely to require use of facilities in Steeple Claydon daily, this is considered to be a moderate adverse isolation effect and therefore is significant.

5.4.7 Approximately ten residential properties on School Hill in Calvert are predicted to experience in-combination effects arising from the construction activities coordinated by the West Street overbridge main compound; Calvert railhead main compound; the School Hill green overbridge satellite compound; the Aylesbury Line Link satellite compound; and the Bicester to Bletchley (rail systems) compound. Durations for the compound operations can be found in Section 2.3 and Figure 8. These in-combination effects are:

- significant visual effects due to views of the construction of the School Hill green overbridge and additional light during the night from the School Hill green overbridge satellite compound; and
- significant noise increases due to HGV movements in the local area.

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

[30] Calvert to Steeple Claydon (from the junction of School Hill/Brackley Lane to the junction between West Street and Addison Road) is 2.6km via School Hill. During the closure of School Hill villagers would need to use Perry Hill and West Street. The distance is approximately 4.7km.

Community infrastructure

5.4.9 Great Moor Sailing Club is based at Grebe Lake on Perry Hill. It is a membership organisation with approximately300 members. The club hold races every weekend throughout the year (except February) and recreational sailing also takes place at the lake with sailing boats available for hire. The club also hosts social events including quiz nights, supper evenings, camp and sail weekends and evening talks. Great Moor is the only sailing club in the local area. The nearest alternative sailing clubs with a similar extent of facilities are in Oxford (approximately 24 miles away).

5.4.10 Great Moor Sailing Club is predicted to experience in combination effects arising from the construction activities coordinated by the West Street overbridge main compound; Calvert railhead main compound; the School Hill green overbridge satellite compound; the Aylesbury Link line satellite compound; and the Bicester to Bletchley rail line satellite compound. Durations for the compound operations can be found in Section 2.3 and Figure 8. These in-combination effects are:

- significant noise effects due to volume of HGV movements along Perry Hill in peak construction months; and
- significant increases in HGV traffic using Perry Hill.

5.4.11 Whilst it is expected that activities at the Great Moor Sailing Club will be able to continue during construction of the Proposed Scheme, given the overall duration of activities and that there is no alternative sailing centre in the local area, the combination of these effects is considered to have a moderate adverse effect on amenity for users of the club which is therefore significant.

Permanent effects

Residential properties

5.4.12 The Proposed Scheme will cross underneath the junction between School Hill and Brackley Lane in Calvert. The existing railway overbridge at School Hill will be rebuilt as part of the Proposed Scheme. Rebuilding this overbridge and also construction of the approach embankment will require the demolition of three residential properties: The Station House (formerly Hazelbach) on School Hill and numbers 12a and 12b on Brackley Lane. The permanent loss of these residential properties is not considered significant at a community level.

Steeple Claydon

Temporary effects

5.4.13 No significant temporary effects have been identified in the community assessment for Steeple Claydon.

Permanent effects

Residential properties

5.4.14 North-east of Calvert a short, curved section of the track will be built to divert the existing Aylesbury Link railway eastwards and connects it with the Bicester to Bletchley Line. Part of Shepherd's Furze Farm in Steeple Claydon will be within the footprint of this new track. The farm, which includes one residential property, will need to be demolished. The permanent loss of this property is not considered significant at a community level.

Twyford

Temporary effects

5.4.15 No significant temporary effects have been identified in the community assessment for Twyford.

Permanent effects

5.4.16 No significant permanent effects arising from construction have been identified in the community assessment for Twyford.

Godington

Temporary effects

5.4.17 No significant temporary effects have been identified in the community assessment for Godington.

Permanent effects

5.4.18 No significant permanent effects arising from construction have been identified in the community assessment for the community of Godington.

Chetwode

Temporary effects

5.4.19 Up to ten residential properties on School End in Chetwode are predicted to experience in-combination effects arising from the construction activities coordinated by Chetwode cutting satellite compound and Chetwode auto-transformer station compound (combined compounds). Durations for the compound operations can be found in Section 2.3 and Figure 8. These in-combination effects are:

- significant visual effects due to views of construction of the School End overbridge, the Chetwode cutting satellite compound, temporary storage stockpiles and addition light at night time from the satellite compound;
- significant noise increases due to HGV traffic along School End; and
- a significant increase in HGV movements along School End.

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

Permanent effects

Residential properties

5.4.21 South of Chetwode, three residential properties will need to be demolished. These are Old Stable Cottage, Rosehill Cottage and Sunflower Cottage, all of which are within the land required to construct and operate the Proposed Scheme. The permanent loss of these three properties is not considered significant at a community level.

5.4.22 Access rights over land are also required but will not result in loss of land from any properties in this area.

Cumulative effects

5.4.23 No temporary or permanent cumulative effects have been identified for any of the areas during construction.

Other mitigation measures

5.4.24 The assessment has concluded there are temporary significant adverse effects arising during construction of the Proposed Scheme in relation to amenity and isolation. However, no other mitigation measures have been identified at this stage.

Summary of likely significant residual effects

5.4.25 There will be temporary isolation effects for the communities of Calvert and Charndon during the temporary closure of School Hill, which is the principal link to community infrastructure in Steeple Claydon. There will also be temporary effects on amenity of some residential properties in Calvert and Chetwode and for the Great Moor Sailing Club.

5.5 Effects arising from operation

Assessment of impacts and effects

Calvert and Charndon

5.5.1 No significant operational effects have been identified in the community assessment for Calvert or Charndon.

Steeple Claydon

5.5.2 No significant operational effects have been identified in the community assessment for Steeple Claydon.

Twyford

Residential properties

5.5.3 Approximately five residential properties in Twyford, located on Church Street and Grange Close are predicted to experience in-combination effects arising from the operation of the Proposed Scheme: These in-combination effects are:

- significant visual effects due to the visibility of the Twyford viaduct and overhead line equipment; and

- significant increases in airborne noise due to new train services.

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

Community infrastructure

5.5.5 The Church of the Assumption of the Blessed Virgin Mary is at the end of Church Street in Twyford. It holds services every Sunday. The nearest alternative Anglican church is in Marsh Gibbon approximately 5.5km from Twyford.

5.5.6 The Church of the Assumption of the Blessed Virgin Mary, Twyford is predicted to experience in-combination effects arising from the operation of the Proposed Scheme: These in-combination effects are:

- significant visual effects (experienced by visitors to the graveyard of the church rather than users of the church building itself) due to the visibility of the Twyford viaduct and overhead line equipment; and
- significant noise effects (experienced by users of the church buildings as well as the grounds and graveyard).

5.5.7 The Church's activities will be able to continue during operation of the Scheme. However, given that this is the only church within the village and noise and visual effects will be permanent, the combination of these effects is considered to have a moderate adverse effect on amenity for its users. This is therefore significant.

Godington

5.5.8 No significant operational effects have been identified in the community assessment for Godington.

Chetwode

5.5.9 Up to 10 residential properties on School End in Chetwode are predicted to experience in-combination effects arising from the operation of the Proposed Scheme. These in-combination effects are:

- significant visual effects due to the visibility of the School End overbridge; and
- significant noise effects from passing trains.

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

Cumulative effects

5.5.11 No temporary or permanent cumulative effects have been identified for any of the areas during operation.

Other mitigation measures

5.5.12 The assessment has concluded that there are significant adverse effects arising during operation in relation to community resources. No other mitigation measures have been identified at this stage.

Summary of likely significant residual effects

5.5.13 Despite the application of planting, landscaping and noise fence barriers, without any further mitigation, the amenity of some residential properties in Chetwode and a small number of residential properties and the Church of Assumption of the Blessed Virgin Mary in Twyford will be experience views of and expected noise arising from the operation of the Proposed Scheme.

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 as a result of 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-001-013 – Baseline Report;
- Appendix CH-002-013 – Gazetteer of Heritage Assets;
- Appendix CH-003-013 – Impact Assessment Table; and
- Appendix CH-004-013 – Survey Reports.

6.1.4 Throughout this section, assets within the study areas are identified with a unique reference code, CALXXX further detail on these assets can be found in the gazetteer in Volume 5: Appendix CH-002-013.

6.1.5 Engagement has been undertaken with the Buckinghamshire County Council planning archaeologist and conservation officer 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) 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 intra-project 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[31] 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[32] were available for survey.

6.2.5 However, non-intrusive field survey was undertaken in a number of areas 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-001-013.

6.3.2 In addition to collating these 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;
- desk-top review of remote sensing data LiDAR, aerial photographs and hyperspectral data (see Volume 5: Appendix CH-004-012); and
- a programme of non-intrusive surveys including fieldwalking (see Volume 5: Appendix CH-004-013).

Designated assets

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

[31] Light detection and ranging (LiDAR) is a high resolution remote sensing technique to capture 3D data.
[32] 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: Decoypond Wood (CAL001), which extends into the land required, temporarily or permanently, for the construction of the Proposed Scheme;
- one conservation area of high value: Chetwode settlement (CAL098), which features particularly important built fabric; and
- one Grade II listed building of moderate value: Shepherd's Furze Farmhouse (CAL025).

6.3.4 The following designated assets are located within the ZTV (see Volume 5, Cultural Heritage Map Book):

- two Grade I listed buildings of high value: the Church of St Mary (referred to elsewhere in this report as The Church of the Assumption of the Blessed Virgin Mary) in Twyford (CAL057) and the Church of St Mary and St Nicholas in Chetwode (CAL117);
- two Grade II* listed buildings of high value: the Church of St Michael at Steeple Claydon (CAL037) and the Church of St John the Baptist at Preston Bissett (within grouping CAL088);
- nine areas of ancient woodland of high value. These form five discrete clusters of woodland at Oldfields Copse (CAL110), Round Wood (CAL111), Tingewick Wood (CAL112), and West Wood (CAL113);
- one conservation area of moderate value: Preston Bissett (CAL088); and
- a total of 57 Grade II listed buildings of moderate value. These are mostly concentrated in settlements of Twyford (including St Mary's House (CAL056)); Steeple Claydon, (including Manor Farm (CAL038)); and Chetwode, (including The Hermitage (CAL093)) and the Priory House (in grouping (CAL098)).

Non-designated assets

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

- Decoypond in Decoypond Wood (CAL002);
- remains of Three Bridge Mill, a medieval water mill with extant post-medieval buildings (CAL047);
- two hedgerows that qualify as historically important under the Hedgerow Regulations 1997 Criteria for Archaeology and History[33]; one which forms part of the county boundary between Oxfordshire and Buckinghamshire (CAL071), and one which forms part of the parish boundary between Twyford and Steeple Claydon (CAL030);

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

- remains of Chetwode Water Mill, a medieval water mill recorded on historic maps (CAL070);
- medieval earthworks at The Hermitage, Chetwode (CAL094); and
- medieval moated site to the north of The Hermitage, Chetwode (CAL095).

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

- the London extension of the Great Central Main Line (CAL004);
- The Station House (formerly Hazelbach) (CAL008);
- remains of the former Calvert Station (CAL009);
- railway bridge at Calvert Station (CAL010);
- the Buckingham Railway (CAL016);
- the disused earthworks of the London extension of the Great Central Main Line (CAL018);
- railway bridge north of Charndon (CAL020);
- railway bridge to the east of Glebe Lake (CAL021);
- the milepost on Perry Road (CAL024);
- railway bridge (CAL045) north of Portway Farm;
- railway bridge to the east of Twyford (CAL046);
- irregular earthworks, potentially medieval, to the north of Twyford (CAL052);
- ridge and furrow earthworks to the north-east of Twyford (CAL053);
- railway bridge over Padbury Brook (CAL060);
- ridge and furrow earthworks to the east of Twyford Mill (CAL062);
- railway bridge to the north of Twyford Mill (CAL068);
- railway bridge to the east of the Oxfordshire border (CAL069);
- Rosehill Cottage (CAL080);
- former fishponds at Sunflower Farmhouse (CAL082);
- outbuilding at Manthorn Farm (CAL084);
- railway bridge at Manthorn Farm (CAL086);
- railway bridge east of Barton Hill Farm (CAL108);
- Small group of ditches recorded during aerial photograph survey (CAL118); and

- Calvert Historic Landscape component (CAL125).

6.3.7 All non-designated heritage assets within 500m of the land required, temporarily or permanently, for construction of the Proposed Scheme are listed in the gazetteer in Volume 5: Appendix CH-002-012 and identified on Maps CH-01-040 to CH-01-043 (Volume 5, Cultural Heritage Map Book). These include a number of assets with upstanding remains, the setting of which have been considered, for example:

- Portway Farm (CAL043); and
- Rosehill Farm (CAL077).

Cultural heritage overview

6.3.8 The solid geology in the study area is dominated by undulating claylands comprising heavy blue-grey clays. Alluvial deposits are recorded at several locations along the channels of watercourses, including at several locations within the construction boundary, for example at the Infrastructure Maintenance Depot (IMD) and to the north-west of Twyford. Further details of the geology of the area are contained in Section 8.

6.3.9 Such deposits have the potential to contain deposits of palaeoenvironmental and archaeological interest. Deposits of River Terrace Gravels associated with Padbury Brook are recorded at several locations, including within the construction boundary at the proposed location of the IMD adjacent to Steeple Claydon. Gravel deposits have the potential to include redeposited remains of Palaeolithic date (circa 500,000 – 10,000 BC). A 'mammoth tooth and bone' was recorded in a gravel pit at Steeple Claydon in 1876, and remains of mammoth, rhinoceros and elephant have been found at Twyford (CAL041, CAL048). Based on the geology of the study area and these antiquarian records, there is potential for further Palaeolithic remains to lie within the land required for construction of the Proposed Scheme.

6.3.10 There is no known evidence of Mesolithic or Neolithic activity (circa 10,000 – 2,400 BC) within the study area. There may be some limited potential for currently unrecorded remains, particularly on rising ground overlooking the course of the Padbury Brook.

6.3.11 Evidence for Bronze Age (circa 2,400 – 700 BC) and Iron Age (c. 700 BC – AD 43) activity within the study area is limited to funerary features. A 'mill mound' is recorded at Cowley (CAL067); although this is recorded as a mill mound by the Buckinghamshire historic environment record (HER), a site visit carried out during this project suggests it is probably of Bronze Age date. Several further mill mounds and a crop mark indicative of a ring ditch lie within the study area and may be of similarly prehistoric origin. None of these mill mounds lie within the land required, temporarily or permanently, for construction of the Proposed Scheme.

6.3.12 Possible evidence of late prehistoric or Roman (AD 43 – 410) settlement has been recorded as a series of sub-rectangular cropmarks adjacent to the Padbury Brook

(CAL075). The location of these cropmarks fits with a pattern of settlement on higher ground adjacent to a water supply.

6.3.13 There is evidence in the surrounding landscape beyond the study area for Roman occupation of the claylands, including the small town at Fleet Marston and evidence of smallholdings in its hinterland. This occupation of the claylands is in addition to the river valleys, which had been exploited since the earlier prehistoric period. A Roman road forms the northern boundary of the study area and there is antiquarian reference to Roman pottery and metalwork near to Pond Farm (CAL015) within the study area.

6.3.14 The pattern of settlement which exists today in the study area was generally laid out during the early medieval (AD 410 – 1066) and medieval (AD 1066 – 1540) periods. Chetwode is a dispersed settlement and is recorded in a 10th century charter[34] as lying to the north of the Royal Forest of Bernwood. The village included an Augustinian Priory, founded in 1245 and associated with Notley Abbey. The village church, a Grade I listed building dedicated to St Mary and St Nicholas (CAL117), was formerly the chancel of the priory and includes a rare example of a medieval stained glass window dating from the 13th or 14th century.

6.3.15 Most Buckinghamshire villages decreased in size during the later medieval period and the earthwork remains of the shrunken and deserted medieval villages are recorded across the study area, at Twyford (CAL050, CAL051, CAL054), Cowley (CAL065), Steeple Claydon (CAL035, CAL036), Godington (CAL072), and Barton Hartshorn (CAL105). These settlements also include extant medieval churches and other historic buildings. In particular, Twyford includes both the Grade I listed Church of St Mary (CAL057) and the adjacent St Mary's House (CAL058), a Grade II listed building formed of two medieval timber-framed halls. Steeple Claydon similarly includes a medieval Church (CAL037) and Manor House (CAL038).

6.3.16 In addition to these settlements there is a well-preserved shrunken medieval village comprising house platforms and hollow ways at Cowley Farm (CAL065). There are documentary references to a chapel suggesting this was a substantial settlement prior to its desertion.

6.3.17 The earthwork remains of a water mill, potentially of medieval date, lie to the east of Godington (CAL070). This feature partially survives as earthworks, but has been affected by recent use as a go-kart track. A second water mill is recorded at Three Bridge (CAL047).

6.3.18 Earthwork remains of moats at Allen's Ground (CAL044), The Hermitage (CAL094 and CAL095 and CAL096), and Barton Hartshorn (CAL105), as well as fishponds at Chetwode (CAL097) and Chetwode Manor (CAL090) represent the remains of outlying manorial and ecclesiastical sites of early medieval and medieval date.

[34] Baines, A. H. B. (1988), '*The Chetwode-Hillesden Charter of 949' in Records of Buckinghamshire Volume 24*.

6.3.19 These settlements were supported by an agricultural base, typically open strip fields. These strip fields survive as areas of ridge and furrow earthworks and evidence of furrows (now removed) may survive below ground. None of the parishes within the study area have been identified as "priority townships" in the English Heritage assessment[35] of ridge and furrow in the South Midlands.

6.3.20 The majority of built heritage within the study area dates from the post-medieval and early modern periods (1540-1900), including the majority of the buildings in the villages of Steeple Claydon, Chetwode and Twyford. Twyford (CAL059) is a small village adjacent to the Padbury Brook, with the name 'Twyford' derived from the need for two crossings across the double stream. Twyford includes six Grade II listed buildings of post-medieval date (as well as the medieval St Mary's House and the Churchyard Cross), and non-designated buildings of similar date.

6.3.21 Steeple Claydon (CAL039) is a larger village, incorporating 17 Grade II listed buildings (as well as the medieval Church and Manor House), largely of post-medieval date. Chetwode is a considerably smaller, much more dispersed settlement. The core of the village is medieval, centred around the church (CAL117) but there are extant post-medieval buildings within the conservation area, including The Hermitage and Priory House (CAL093).

6.3.22 Shepherd's Furze Farm (CAL025) is a Grade II listed farmhouse dating to 1770. It was originally part of the Verney family estate and the east elevation of the property faces toward the family seat of Claydon House, outside the study area.

6.3.23 Post-medieval and modern industry is represented by clay extraction pits at Calvert that were worked during the 19th and 20th centuries. The Proposed Scheme largely follows the route of the former Great Central Main Line (CAL004), a railway line established at the end of the 19th century. Several railway bridges lie within the study area (CAL010, CAL021, CAL022, CAL023, CAL045, CAL060, CAL061, CAL068, CAL069, CAL086, and CAL108), which are predominantly small structures in engineering brick. There was also a siding at Calvert which survives as a low earthwork. Calvert Station (CAL009), now disused, lies within the land required, temporarily or permanently, for the construction of the Proposed Scheme.

6.3.24 The landscape within the study area is a mix of parliamentary and piecemeal enclosure. This was carried out on private estates from the 16th century onwards, with more organised parliamentary enclosure carried out in the 18th and 19th centuries. As well as the enclosed field systems, clustered villages possibly a result of assarting (woodland clearance) predominate, with outlying manors and farmsteads in the surrounding countryside.

[35] Hall, D. (2001), *Turning the plough: Midland open fields landscape character and proposals for management.* Northamptonshire County Council and English Heritage.

Future baseline

Construction (2017)

6.3.25 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)

6.3.26 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-003-000/1):

- 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:

- construction of the Proposed Scheme in cutting past Chetwode (CAL098) to reduce the impact on the conservation area;
- the provision of landscape bunds and planting to further reduce the impact within the setting of Chetwode (CAL098);
- retaining existing planting and the reduction in footprint of screening bunds in order to limit physical impacts on the earthworks at The Hermitage (CAL093); and
- the provision of planting around Twyford (CAL059), including along the course of the former railway line, which will also serve to reinforce the course of the former railway, preserving it in the landscape.

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 The Church of St Mary and St Nicholas in Chetwode, a Grade I listed building (CAL117), is an asset of high value. Construction activities associated with the Chetwode cutting will noticeably change the existing local sound environment and disturb the quiet character of its surroundings, a key element of its value. These activities will last for approximately two years and nine months. This impact will affect the ability to appreciate the historical rural context of the building. This will constitute a medium adverse impact and a major adverse effect.

6.4.5 Church of St Mary in Twyford, a Grade I listed building (CAL057), is an asset of high value. Construction activities associated with the Twyford viaduct and embankment will noticeably change the existing local sound environment experienced in the grounds of the building, a key element of its value, for a period of approximately two and a half years. This impact will affect the ability to appreciate the historical context of the building. This will constitute a medium adverse impact and major adverse effect.

6.4.6 Chetwode settlement (CAL098) is a conservation area of high value. Construction activities associated with the Chetwode cutting will noticeably change the existing local sound environment and alter the setting of the building. These activities will last for approximately two years and nine months. This impact will affect the ability to appreciate the historic rural context of the buildings and wider settlement. This will constitute a medium adverse impact and a major adverse effect.

6.4.7 Rose Hill Farm (CAL027) is a Grade II listed building, an asset of moderate value. Construction activity associated with the IMD and temporary railhead will noticeably change the landscape to the west of the farm; a key element of its value. Although located in proximity to existing railway infrastructure, the building still retains a rural setting which will be altered during construction, for approximately eight years. This will constitute a medium adverse impact and moderate adverse effect.

6.4.8 Blackmoorhill Farm (CAL028) is a Grade II listed building, an asset of moderate value. Construction activity associated with the IMD and temporary railhead will noticeably change the landscape to the west of the building a key element of its value. Although located in proximity to existing railway infrastructure, the building still retains a rural setting which will be altered during construction, for approximately eight years. This will constitute a medium adverse impact and moderate adverse effect.

6.4.9 The Church of St Michael at Steeple Claydon, is a Grade II* listed building (CAL037) of high value. The character of the setting of the building will be changed by the construction of the IMD and temporary railhead which will be visible in views to the south across the associated medieval earthworks, a key element of its value. This will noticeably change the setting and adversely affect the ability to appreciate the building within its historical context, for a period of approximately eight years. This will constitute a low adverse impact and moderate adverse effect.

6.4.10 St Mary's House, a Grade II listed building (CAL056), is an asset of moderate value will have its local sound environment noticeably changed by construction activities associated with the Twyford embankment and viaduct which will last for a period of approximately two and a half years. Additionally, views from the house to the north and the relationship between the building and the nearby medieval earthworks, which contribute to its value, will be interrupted. This will constitute a medium adverse impact and moderate adverse effect.

6.4.11 The village of Twyford contains a grouping of assets of moderate value (CAL059). Although the Proposed Scheme is located in proximity to extant former railway infrastructure, the village currently retains a rural setting which will be changed during construction, for a period of approximately two and a half years. This will noticeably alter the setting of the village and adversely affect the ability to appreciate it within its historical context, a key element of its value. This will constitute a medium adverse impact and a moderate adverse effect.

6.4.12 Sunflower Farmhouse is a Grade II listed building (CAL083), an asset of moderate value will experience changes to its local sound environment through construction of the Proposed Scheme in cutting, construction of the Footpath CHW/18 accommodation overbridge and placement of temporary excavated material storage directly adjacent to the farm. This will adversely affect the ability to appreciate the building within its historical rural context, a key element of its value, for a period of approximately three and half years. Additionally views from the farmhouse across the garden to the south, which includes a medieval fishpond that contributes to its value, will be interrupted. This will constitute a medium adverse impact and moderate adverse effect.

6.4.13 The Hermitage is a Grade II listed building (CAL093), an asset of moderate value. Construction activities associated with the Proposed Scheme, including the construction of the Chetwode cutting, will noticeably change the existing local sound environment and alter the grounds of the building, a key element of its value. Also, views of construction activity within the grounds of, and immediately adjacent to, The Hermitage will also disturb the setting of the asset. These activities will last for approximately two years and nine months. These impacts will affect the ability to appreciate the historic context of the building. This will constitute a medium adverse impact and moderate adverse effect.

Cumulative effects

6.4.14 There will not be any cumulative effects from temporary impacts on heritage assets within the study area.

Permanent effects

6.4.15 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 mpacts

6.4.16 The Station House (formerly Hazelbach) (CAL008), an asset of low value, will be demolished as part of the construction of the Proposed Scheme. This will constitute a high adverse impact and moderate adverse effect.

6.4.17 Any below ground remains associated with Calvert Station (CAL009), assets of low value, will be removed by the construction of the waste transfer sidings. This will constitute a high adverse impact and moderate adverse effect.

6.4.18 A railway bridge at Calvert Station (CAL010), an asset of low value, will be demolished. This will constitute a high adverse impact and moderate adverse effect.

6.4.19 Shepherd's Furze Farmhouse (CAL025), a Grade II listed building, an asset of moderate value, will be demolished as part of the construction of the IMD and temporary railhead. This will constitute a high adverse impact and major adverse effect.

6.4.20 Railway bridge over the Padbury Brook (CAL060), an asset of low value. This will be demolished to allow the construction of the Twyford viaduct. This will constitute a high adverse impact and moderate adverse effect.

6.4.21 Railway bridge to the north of Twyford Mill (CAL068), an asset of low value, will be demolished. This will result in a high adverse impact and moderate adverse effect.

6.4.22 The remains of Chetwode Mill (CAL070), an asset of moderate value, will be partially removed to construct an overbridge. This will constitute a medium adverse impact and moderate adverse effect.

6.4.23 An outbuilding at Manthorn Farm (CAL084) an asset of low value. This will be demolished. This will constitute a high adverse impact and moderate adverse effect.

6.4.24 Moat around The Hermitage (CAL094), an asset of moderate value. The southern and western area of the moat lies within the land required for the construction of the Proposed Scheme. This will constitute a medium adverse impact and moderate adverse effect.

6.4.25 An historic hedgerow situated along the parish boundary between Twyford and Steeple Claydon (CAL030), an asset of moderate value will be removed as part of the

construction of the IMD. This will constitute a high adverse impact and major adverse effect.

6.4.26 Rosehill Cottage (CAL080), an asset of low value, will be demolished. This will constitute a high adverse impact and moderate adverse effect.

6.4.27 A complex of hedgerows near to Rose Hill Farm (CAL120), an asset of low value, will be removed. This will constitute a high adverse impact and moderate adverse effect.

6.4.28 A complex of hedgerows to the west of Steeple Claydon (CAL121), assets of low value, will be removed. This will constitute a high adverse impact and moderate adverse effect.

6.4.29 A complex of hedgerows to the north of Godington (CAL122), an asset of low value, will be removed. This will constitute a high adverse impact and moderate adverse effect.

6.4.30 An area of ridge and furrow earthworks (CAL124) north of Portway Farm, an asset of low value, will be removed by the temporary railhead. This will constitute a high adverse impact and moderate adverse effect.

6.4.31 A complex of hedgerows to the south of Newton Purcell (CAL126), an asset of low value, will be removed. This will constitute a high adverse impact and moderate adverse effect.

Impacts on the setting of heritage assets

6.4.32 Rose Hill Farm (CAL027), a Grade II listed building, is an asset of moderate value. The character of the setting of the building will be noticeably different due to construction of the overbridge to the north and the IMD to the west. Although located in proximity to existing railway infrastructure, the building still retains a rural setting which will be altered by the construction of the IMD. The farm will be subject to a medium adverse impact and moderate adverse effect.

6.4.33 St Mary's House (CAL056), a Grade II listed building, is an asset of moderate value. The presence of the Proposed Scheme on embankment will noticeably change the character of the setting of the building will be noticeably different and the relationship between the building and the nearby medieval earthworks will be altered, removing this element of the value of the asset. There will be no change to its relationship with the nearby church. This will constitute a medium adverse impact and moderate adverse effect.

6.4.34 The Church of St Mary (CAL057), a Grade I listed building, is an asset of high value. The presence of the Proposed Scheme on embankment will noticeably change the character of the setting of the building and the relationship between the building and the nearby medieval earthworks, an element of its value, will be altered. There will be no change to its relationship with the nearby St Mary's House, Churchyard Cross, or

the village of Twyford. This will constitute a medium adverse impact and major adverse effect.

6.4.35 Sunflower Farmhouse (CAL083), a Grade II listed building, is an asset of moderate value. The character of the setting of the building will be noticeably different and the relationship between the building and the former fishponds to the south, an element of its value, will be lost due to construction of the Footpath CHW/18 accommodation overbridge. This will constitute a medium adverse impact and moderate adverse effect.

6.4.36 The Hermitage (CAL093), a Grade II listed building, is an asset of moderate value. The character of the setting of the building will be noticeably changed by the presence of the Proposed Scheme in cutting and the introduction of landscaping adjacent to the Hermitage. The relationship between the building and the surrounding moat, a second moat to the north and a small element of extant ridge and furrow earthworks to the east, all elements of its value, will be lost. This will constitute a medium adverse impact and moderate adverse effect.

Permanent cumulative effects

6.4.37 There are no cumulative effects considered to be of specific relevance to the cultural heritage topic.

Other mitigation measures

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

- suitable locations for advance planting, to reduce impacts on the setting of assets; and
- locations where the physical impact on below ground assets can be reduced through the design of earthworks.

Summary of likely residual significant effects

6.4.39 A range of archaeological assets will be permanently lost due to the construction of the Proposed Scheme; these assets include: any below ground remains associated with Calvert Station (CAL009), the remains of Chetwode Mill (CAL070) and the moat around The Hermitage (CAL094). A programme of archaeological works will be prepared to investigate, analyse, report and archive these assets.

6.4.40 The Proposed Scheme will result in the demolition of Shepherd's Furze Farmhouse (CAL025; a Grade II listed building), The Station House (formerly Hazelbach) (CAL008), Rosehill Cottage (CAL080), and several railway bridges. A programme of built heritage works will be prepared to investigate, analyse, report and archive these assets.

6.4.41 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: St Mary's House (CAL056), Sunflower Farmhouse (CAL083), The Hermitage (CAL093), Rose Hill Farm (CAL027) and the village of Twyford (CAL059). Sections of four historically important hedgerows will also be removed. Further consideration will be given to the historic vegetation and landscapes as part of the planting and landscape design plans that will be prepared for HS2.

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 scheme design to reduce potential impacts on identified assets; and
- landscape planting will increasingly reduce impacts on the setting of the designated 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 Chetwode settlement (CAL098), a conservation area of high value, will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a major adverse effect.

6.5.4 The Church of St Mary in Twyford, a Grade I listed building (CAL057), an asset of high value, will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a major adverse effect.

6.5.5 The Church of St Mary and St Nicholas in Chetwode, a Grade I listed building (CAL117), an asset of high value, will have its setting changed by the movement of

trains and the associated increase in noise. This will constitute a medium adverse impact and a major adverse effect.

6.5.6 Rose Hill Farm (CAL027), a Grade II listed building, an asset of moderate value, will have its setting changed by the movement of trains and the associated increase in noise. In combination with the presence of the constructed Scheme this will result in a medium adverse effect resulting in a moderate adverse effect.

6.5.7 St Mary's House, a Grade II listed building (CAL056), an asset of moderate value, will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and moderate adverse effect.

6.5.8 The village of Twyford, a complex of assets of moderate value (CAL059), will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a moderate adverse effect.

6.5.9 Sunflower Farmhouse, a Grade II listed building (CAL083), an asset of moderate value, will have its setting changed by the movement of trains and the associated increase in noise. In combination with the presence of the constructed Scheme this will result in a medium adverse effect resulting in a moderate adverse effect.

6.5.10 The Hermitage, a Grade II listed building (CAL093), an asset of moderate value, will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a moderate adverse effect.

Cumulative effects

6.5.11 Assessment of cumulative 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 Section 2 and shown in Map Series CT-13 (Volume 5, Cross Topic Appendix 1 Map Book). No significant cumulative effects have been identified in relation to cultural heritage.

Other mitigation measures

6.5.12 Refinements to the mitigation measures incorporated into the design of the Proposed Scheme will be considered during detailed design to reduce further the significant effects described above.

Summary of likely residual significant effects

The setting of several historic settlements, buildings and landscapes will be affected visually and by noise once the Proposed Scheme becomes operational. This includes: Chetwode (CAL098), the Church of St Mary in Twyford, (CAL057), the Church of St Mary and St Nicholas in Chetwode (CAL117), St Mary's House (CAL056), Sunflower Farmhouse (CAL083), The Hermitage (CAL093), Rose Hill Farm (CAL027), Blackmoorhill Farm (CAL028) and the village of Twyford (CAL059). In due course, visual effects will reduce as planting matures and the new railway assimilates 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 and fragmentation of habitat used by Bechstein's bat (and assemblage of eleven other bat species) between Sheephouse Wood Site of Special Scientific Interest (SSSI) and Calvert Jubilee Nature Reserve Local Wildlife Site (LWS) and consequential mitigation; habitat loss and disturbance leading to adverse effects of Decoypond Wood LWS, Calvert Jubilee Nature Reserve LWS, Calvert Brick Pits LWS, Calvert Railway Station LWS and Barton Hartshorn Railway Wood LWS and consequential mitigation, and loss and fragmentation of habitat used by black hairstreak butterfly habitat and consequential mitigation.

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

- results of ecological surveys (Appendices EC-001-002, EC-002-002, EC-003-002, and EC-004-002);
- a register of local/parish level effects which are not described individually in Volume 2: Appendix EC-005-002; and
- data obtained from bat trapping/radio tagging study of bats in the Bernwood Forest carried out in 2012 and 2013 (Volume 5: Appendix EC-006-002).

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 (BBOWT); Environment Agency; North Bucks Bat Group; Bernwood Forest Bechstein's Project; and the Upper Thames (Berkshire, Bucks and Oxon) Branch of Butterfly Conservation.

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 CT-001-000/2). Further detail, including the study area for individual surveys, is provided within the SMR Addendum. 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 (WFD) 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, including Sheephouse Wood SSSI, Decoypond Wood LWS and large tracts of land in Chetwode and in the north of the area around Preston Bissett and Barton Hartshorn. Further details are provided in Appendices EC-001-002 to EC-004-002 in Volume 5. However, in addition to the standard range of surveys described in the SMR, where direct access could not be obtained to woodland for bat surveys at Decoypond Wood (CFA13); Sheephouse Wood, Hewin's Wood, Grendon and Doddershall Woods, Greatsea Wood and Romer Wood (all in CFA12), radio tracking surveys of several species of bat were undertaken in close proximity to those woodlands.

7.2.4 These surveys were carried out to establish the range of species present and their use of the habitats that will be affected by the Proposed Scheme. Effort was focused on woodland species including Bechstein's, Natterer's, Daubenton's and brown long-eared bats, as these species frequently use hedgerows and other habitat corridors to move between roosts and foraging areas. A number of bats were trapped in mist nets and fitted with radio tags so their movement through the landscape could be recorded, and their roosting locations determined.

7.2.5 Bat radio tracking surveys in this area were carried out alongside those of the North Bucks Bat Group and the Bernwood Forest Bechstein's Group. HS2 has worked collaboratively with these organisations by sharing information on radio tagged bats, in order to limit the numbers of bats that were caught and to make best use of the data obtained from the surveys. Further information is provided in Volume 5: Appendix EC-006-002.

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

7.2.7 The precautionary approach to the assessment has been adopted is identifies 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 (Appendices EC-001-002 to EC-004-002, EC-006-002 and the Maps EC-01 to EC-12, Volume 5, Ecology Map Book. Statutory and non-statutory designated sites are shown on Volume 5, Map EC-01.

7.3.2 Land required for the construction of the Proposed Scheme and that adjacent to it consists of arable farmland and improved pasture intersected by native hedgerows. The Proposed Scheme will pass between ancient woodlands in the south of this area and the adjacent Waddesdon and Quainton area (CFA12) that are remnants of the former Bernwood Forest. Land required for the construction of the Proposed Scheme includes several areas of neutral grassland and scrub, as well as woodland at Decoypond Wood LWS near Calvert and Barton Hartshorn Railway Wood LWS in the north of the area. The route passes Calvert landfill site and is close to the two large lakes near Calvert village (Grebe Lake at Calvert Brick Pits LWS and the lake at Calvert Jubilee Nature Reserve LWS). The Padbury Brook is the most ecologically significant watercourse in this area. It is crossed by the Proposed Scheme at Twyford and north of Godington.

Designated sites

7.3.3 There is one statutory designated site within 500m of the land required for the construction of the Proposed Scheme, which is of national value. It is:

- Sheephouse Wood SSSI (58.9ha) – designated for ancient woodland, and for assemblages of plants, woodland birds (including three species of woodpecker and woodcock) and invertebrates (including black hairstreak butterfly). The majority of the site lies within Waddesdon and Quainton (CFA12) and it is adjacent to land required for the construction of the Proposed Scheme south-east of Calvert.

7.3.4 Three further SSSIs in the northern part of CFA12 are relevant to the assessment as they provide important habitat for the Bechstein's bat population present in the Bernwood Forest, which have been recorded within this CFA. All three SSSI's are designated for ancient woodland and assemblages of plants, woodland birds and invertebrates. They are:

- Finemere Wood SSSI (47.9ha) – situated to the north-east of the Proposed Scheme and close to areas required for ecological mitigation and for utilities works (overhead power lines);
- Grendon and Doddershall Woods SSSI (67ha) – located approximately 325m south of the land required for the construction of the Proposed Scheme; and
- Ham Home-cum-Hamgreen Woods SSSI (23ha) – located approximately 2km from land required for the construction of the Proposed Scheme but approximately 100m of the site's boundary is adjacent to the A41 Bicester Road, which will be used by construction traffic.

7.3.5 Further information on the above SSSI are presented in CFA12 report, Section 7.

7.3.6 There are five LWS and four Biological Notification Sites (BNS) relevant to the assessment in this area, each of which is of county/metropolitan value. They are:

- Decoypond Wood LWS (8.6ha) – designated for ancient semi-natural woodland comprising a mix of wet ash and hazel coppice with oak birch and field maple. The site supports a number of woodland plants including wood sedge, bluebell, primrose and wood millet. It is located south-east of Calvert village. The western edge of the site is within land required for the construction of the Proposed Scheme and areas for ecological mitigation adjoin the eastern and northern boundaries;
- Calvert Jubilee Nature Reserve LWS (39.3ha) – is a BBOWT nature reserve comprised of grassland, scrub, woodland and wetland habitats which support a number of plants that are uncommon in Buckinghamshire, including blue fleabane and devil's bit scabious. The site is important for its overwintering bird assemblage, which includes tufted duck, teal, pochard, and water rail. It is also designated for its invertebrate assemblage (including green hairstreak, dingy skipper and grizzled skipper). It is situated to the north of School Hill and the eastern and northern edges of the site are within the land required for the construction of the Proposed Scheme;
- Calvert Brick Pits LWS (55.6ha) – designated for species-rich scrub habitats and calcareous grassland which supports plant species uncommon in Buckinghamshire, including trailing tormentil and blue fleabane. The site also supports a diverse assemblage of butterflies. It is located west of Calvert Jubilee Nature Reserve LWS and the northern edge of the site is within the land required for the construction of the Proposed Scheme;
- Calvert Railway Station LWS (2.2ha) – designated for wet grassland and scattered scrub which supports plant species rare in Buckinghamshire including sneezewort, betony and carnation sedge. The site is also designated for its invertebrate assemblage including butterflies and dragonflies. It is located south of School Hill and is within land required for the construction of the Proposed Scheme;
- Barton Hartshorn Railway Wood LWS (1.9ha) – designated for remnant fen, wet woodland and wet grassland habitats. Notable plant species present include greater tussock sedge, blunt-flowered rush and fen bedstraw. The LWS is north-west of School End and the western edge of the site is within land required for the construction of the Proposed Scheme;
- Railway Cutting North of Twyford BNS (8.5ha) – is part of the former Great Central Main Line disused railway and is designated for diverse grassland amongst hawthorn scrub. The site is partially within land required for the construction of the Proposed Scheme;
- Chetwode Cutting BNS (3.3ha) – designated for its neutral grassland and ponds which support marginal vegetation including various rushes and unbranched bur-reed. This section of the Great Central Main Line is south of Chetwode village. Most of the site is within land required for the construction of the Proposed Scheme;

- Padbury Brook Three Bridge Mill BNS (1.6ha) – a section of the watercourse designated for good water quality and associated marginal habitat, although moderate water quality was recorded more recently. The site is south-west of Three Bridge Mill and a small section at the western end of the BNS lies within land required for the construction of the Proposed Scheme; and
- Redland Bridge BNS (0.1ha) – a section of watercourse forming a tributary of the Padbury Brook designated for good water quality. It is located south-west of Steeple Claydon and is within the land required for construction of the Proposed Scheme.

Habitats

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

Woodland

7.3.8 Sheephouse Wood is ancient semi-natural broadleaved woodland and most is an example of the habitat of principal importance lowland mixed deciduous woodland as identified in Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)[36], and a local Biodiversity Action Plan (BAP) habitat. Given the national scarcity of ancient woodland, and that ancient woodland is the primary reason for the designation of the SSSI it is of national value. It is situated immediately to the south of the study area and further information is provided in CFA12 report, Section 7.

7.3.9 Decoypond Wood is a smaller wood comprising a mix of wet ash and relic hazel coppice with oak, birch and field maple. It is ancient semi-natural woodland and contains variety of ancient woodland indicator plants. Like Sheephouse Wood, it is a fragment of the former Bernwood Forest. It is of county/metropolitan value.

7.3.10 The perimeter of Calvert Jubilee Nature Reserve LWS supports a woodland mosaic comprising the National Vegetation Classification (NVC) community for ash-maple woodland W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland and oak-bramble W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland. This vegetation lies partly within land required for the construction of the Proposed Scheme. It qualifies as a habitat of principal importance but is not a reason for designation of the LWS and is therefore of district borough value.

7.3.11 An area of wet osier dominated woodland at Barton Hartshorn Railway Wood LWS is partly within land required for the construction of the Proposed Scheme. It has a limited understorey with occasional pignut and remote sedge on the banks of dissecting streams. Wet woodland is a habitat of principal importance, and is one of the habitats for which the site is designated. It is therefore of county/metropolitan value.

[36] *Natural Environment and Rural Communities Act 2006 (Chapter 16).* London. Her Majesty's Stationery Office.

7.3.12 Lowland mixed deciduous woodland, a habitat of principal importance is also present around the margins of Calvert Brick Pits LWS, in a single stand south-east of Steeple Claydon and either side of the Proposed Scheme south-east of Calvert. All lie partly within land required for the construction of the Proposed Scheme. None are ancient woodland. Woodland in land required for the construction of the Proposed Scheme that is not classified as a habitat of principal importance includes that at Moat Farm in Godington, along the Great Central Main Line near Chetwode, Manthorn Farm in Chetwode and at Manor Farm in Barton Hartshorn. Woodlands of similar size are widespread locally and each of these stands is therefore of local/parish value.

7.3.13 Young broadleaved plantation is located within the Proposed Scheme north and east of Calvert Jubilee Nature Reserve LWS, and north of Barton Hill Farm in Newton Purcell. Typical canopy species include ash, pedunculate oak, birch, alder, and sycamore. This habitat type is common in the wider area and it is of local/parish value.

Grassland

7.3.14 Much of the neutral to calcareous grassland at Calvert Jubilee Nature Reserve LWS does not adhere closely to a specific NVC community. However, some areas are similar to the sheep's fescue-meadow oat grass community type CG2 *Festuca ovina-Avenula pratensis* grassland. The upright brome community CG3 *Bromus erectus* grassland is also present. Glaucous sedge is dominant and these communities also support a wide range of broadleaved species including birds-foot trefoil, wild strawberry, heath speedwell and blue fleabane. Other areas are dominated by false oat grass, Yorkshire fog and tufted hairgrass. They are unusually species-rich and contain species such as lady's bedstraw, bird's-foot trefoil, selfheal, agrimony, fairy flax and common spotted orchid. Species-rich grassland is uncommon and is a reason for the designation of the LWS, and as such the grassland areas are of county/metropolitan value.

7.3.15 Calvert Brick Pits LWS includes neutral to calcareous grassland along with species indicative of moist soils, and patches of scattered hawthorn and bramble scrub with small ash saplings. The grassland including calcareous indicators such as hairy violet, fairy flax and yellow-wort, with frequent seedlings of shrub species. Only the margins of this area of habitat are within the land required for the construction of the Proposed Scheme. The grassland is a key reason for the designation of the LWS and is therefore of county/metropolitan value.

7.3.16 Calvert Railway Station LWS comprises a mosaic of early-successional grasslands that shows affinities to the false oat grass (NVC community type) MG1 *Arrhenatherum elatius* grassland and the crested dog's tail – black knapweed grassland (NVC community type) MG5 *Cynosurus cristatus-Centaurea nigra* grassland. Species present in these grassland communities include glaucous sedge, quaking grass, grass vetchling, chalk knapweed, common fleabane and heath speedwell. At the time of field survey there was evidence of vegetation clearance and subsequent

recolonisation that may restore the grassland for which the site is designated. The whole site and its grassland communities are within land required for the construction of the Proposed Scheme. Although none of the grassland habitats currently qualify as being habitats of principal importance, they may gain that status in the future. On a precautionary basis, the grassland habitats are considered to be of county/metropolitan value.

7.3.17 Surveys at the Railway Cutting North of Twyford BNS found that the features for which the BNS was designated are now degraded or absent and the site mainly contains species poor semi-improved grassland. The grassland is dominated by false oat grass and more species-rich grassland is declining due to lack of management. Although the site is valued at county/metropolitan level by virtue of its BNS designation, its integrity is compromised and both grassland stands lack sufficient diversity to qualify as habitats of principal importance. They are valued at local/parish level.

7.3.18 A 1ha strip comprising a mosaic of hawthorn scrub and grassland of false oat, rye grass and crested dog's-tail lies along the disused Great Central Main Line railway near Church View Farm and south of the Railway Cutting North of Twyford BNS. It is within land required for the construction of the Proposed Scheme. Given that the habitat is only of moderate diversity and consists of vegetation types that are relatively widespread, it is of local/parish value.

Hedgerows

7.3.19 There are approximately 20km of hedgerow in the land required for the construction of the Proposed Scheme. Of those accessible for a detailed survey, at least 9km qualify as important hedgerows (under the Hedgerows Regulations 1997[37]. Hedgerows in this area are typically dominated by hawthorn, blackthorn, rose, field maple, ash and pedunculate oak. Typical ground flora includes herb robert, dog's mercury and wood false brome. As part of the precautionary assessment, it is assumed that further important hedgerows will be found within land that was not surveyed. In light of this the hedgerow network is considered as being of district/borough value.

Scrub

7.3.20 Calvert Jubilee Nature Reserve LWS supports extensive areas of blackthorn – bramble scrub. Within this scrub are small areas of grassland with a rich assemblage of broadleaved species, some of which are indicative of calcareous conditions (already described). Part of this vegetation is within land required for the construction of the Proposed Scheme. The site also supports approximately 1.5ha of mature hawthorn scrub with oak and mature ash, and this is partly within land required by the Proposed

[37] *The Hedgerows Regulations 1997 (1997 No. 1160).* London. Her Majesty's Stationery Office. The Hedgerows Regulations 1997 comprise 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.

Scheme. While not a reason for designation, scrub contains areas of species-rich grassland and has some value in supporting invertebrate communities present at the site and as such is of county/metropolitan value.

7.3.21 The scrub community in the adjacent Calvert Brick Pits LWS is primarily dominated by mature grey willow and hawthorn. In parts it has a ground flora indicative of wet conditions, including wild angelica and marsh thistle. This vegetation partly is within land required for the construction of the Proposed Scheme along the northern and eastern margins of the LWS. Scrub is not a habitat for which the site is designated but it forms a mosaic with species-rich grassland and has some value in supporting invertebrate communities present at the site and as such is of county/metropolitan value.

7.3.22 The Railway Cutting North of Twyford BNS supports hawthorn scrub with a species-poor ground flora. This habitat type is common in the wider area but here contributes in part to the site's designation. It is therefore of local/parish value.

7.3.23 The Great Central Main Line disused railway cutting, between Twyford and Newton Purcell including Chetwode Cutting BNS, is covered in dense scrub consisting of hawthorn, field rose and blackthorn, and occasional pedunculate oak and ash trees. It is included within land required for the construction of the Proposed Scheme to ensure its value as a visual screen is retained. This habitat type is common in the wider area and is not a reason for the designation of the Chetwode Cutting BNS. It is therefore of local/parish value.

7.3.24 Scrub is also present at Portway Farm, the Hermitage near Chetwode and along the Padbury Brook in Twyford. Typical species include blackthorn and hawthorn. As this habitat is common in the wider area, these stands are of local/parish value.

Water bodies

7.3.25 There are two large water bodies within 250m of land required for the construction of the Proposed Scheme. Grebe Lake (approximately 22.8ha) is within Calvert Brick Pits LWS. Comprehensive ecological data are lacking and the use of the lake by a sailing club creates significant disturbance to waterfowl in particular. Grebe Lake is 100m west of the large lake (approximately 19.7ha) within Calvert Jubilee Nature Reserve LWS. Both water bodies support otter, which is a species of principal importance. Lakes are a habitat of principal importance, and on the basis of their ecological importance is of up to county/metropolitan value.

7.3.26 Approximately 36 ponds are within or adjacent to land required for the construction of the Proposed Scheme, most of which are concentrated near Calvert and Chetwode. One pond within land required for the construction of the Proposed Scheme contains great crested newt and is therefore a habitat of principal importance. A further two ponds at Chetwode Cutting BNS contain a high diversity of marginal and aquatic

vegetation including unbranched bur-reed, and thus can also be classified as habitats of principal importance. All of the ponds are considered to be of local/parish value.

7.3.27 For the purpose of this assessment all ponds that were identified as requiring habitat survey but where access has been unavailable are on a precautionary basis considered to be of up to district/borough value.

Wetlands

7.3.28 The lakes at Calvert Jubilee Nature Reserve LWS and Calvert Brick Pits LWS have small areas of swamp vegetation in the shallow margins to the north largely comprising great willowherb, bulrush, reedmace and reed canary-grass. This is most extensive at the north-eastern end of the lake at Calvert Brick Pits. This habitat is one of the features for which Calvert Brick Pits LWS is designated and is therefore of county/metropolitan value.

7.3.29 There are small remnant patches of fen vegetation around the wet woodland at Barton Hartshorn Railway Wood LWS, including greater tussock sedge, sharp-flowered rush, blunt-flowered rush and fen bedstraw. As this habitat is one of the features for which the site is designated, these areas are considered to be of county/metropolitan value.

Watercourses

7.3.30 Padbury Brook will be crossed by the route north of Twyford and east of Godington. The watercourse has been modified and its channel is characteristic of over-deepened rivers, but where there is variation in bank profile a variety of macrophytes are present. The brook also supports otter, aquatic invertebrate and moderately species-rich fish populations. It is the largest watercourse in the area and is a habitat of principal importance. It is of district/borough value.

7.3.31 The route will also cross tributaries of Padbury Brook adjacent to Twyford and at Barton Hartshorn. These watercourses are adversely impacted by siltation and characterised by slow flow velocity and poor to fair water quality. They are of local/parish value.

Arable/cultivated land

7.3.32 Three small traditional orchards are located adjacent to the land required for the construction of the Proposed Scheme at Rose Hill Farm in Steeple Claydon, Manor Farm in Godington and at Rosehill Farm in Chetwode. These were typically dominated by apple and plum trees. Whilst these orchards are very small and isolated, traditional orchards are a habitat of principal importance and are uncommon in the wider area. Therefore, they are of district/borough value.

7.3.33 Two arable field margins, which are managed for conservation purposes, were recorded within land required for the construction of the Proposed Scheme. The first to the south of Preston Bissett comprises a semi-improved grass verge, approximately

10m wide and dominated by large-leaved Timothy grass, reed canary grass and hogweed with creeping thistle. The second is north of Calvert and is a coarse grass margin approximately 5m wide. Although a habitat of principal importance, arable field margins are common and readily created and are, therefore, of local/parish value.

Protected and/or notable species

7.3.34 A summary of the species relevant to the assessment is provided in Table 11.

Table 11: Protected and/or notable species

Species/ species group	Value	Receptor	Baseline and rationale for valuation
Bats	National	A population of Bechstein's bat associated with habitat in the south of this area from Sheephouse Wood to Calvert Jubilee Nature Reserve LWS, and other habitats within CFA12., See CFA12 report, Section 7.	As reported in Waddesdon and Quainton (CFA12), radio-tracking studies and desk-top data have recorded population of Bechstein's bat comprising at least three colonies each containing several maternity roosts either side of the Proposed Scheme. These bats moved between maternity colonies in Grendon and Doddershall woods and Finemere Wood, and between Grendon and Doddershall Woods and Sheephouse Wood (all within CFA12). They commute at various points along the Aylesbury Link railway line in CFA12 and also cross it at Grendon Junction, Benfield's Overbridge, Costello Underbridge and along the western boundary of Sheephouse Wood. Further information is provided in CFA12 report, Section 7. No commuting activity was observed between colonies in CFA12 and habitat in this area, however a roost of single male Bechstein's bat was recorded in Decoypond Wood and there is a 2011 record from Calvert Jubilee Nature Reserve LWS. It is considered that these bats are part of the same population described in the Volume 2 report for CFA12. There were no records of bats using the Aylesbury Link railway line to move between Decoypond Wood and other roosts and foraging areas, but on the basis of information collected from surveys in CFA12, it is possible that they do so occasionally. Bechstein's bat are a specialist of woodland habitats and, therefore, other small areas of habitat, such as the hedgerow linking Decoypond Wood and Sheephouse Wood to the east of the Proposed Scheme are also important to maintaining conservation status of the population. Bechstein's bats are a very rare species in the UK Bat Conservation Trust (2012)[38] and are also

[38] Bat Conservation Trust (BCT) (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
			classified as near threatened at the European level[39]. The roosts in this area are near the north-westerly edge of this species range in the UK. Consequently, maternity colonies and associated habitat that maintains these roosts are important to maintain the favourable conservation status of the UK population of Bechstein's bat.
	Regional	Assemblage of bats associated with woodland habitat using the Aylesbury Link railway line and nearby woodland habitat from the Edgcott Road (in CFA12) to Calvert Jubilee Nature Reserve LWS. (Volume 5: Appendix EC 003-002).	The vegetation along the Aylesbury Link railway and nearby woodland, as well as adjoining hedges, scrub and water bodies provide foraging, roosting and commuting habitat for an assemblage of woodland bat species. Three roosts of Daubenton's bat were recorded in Decoypond Wood, two of which were maternity colonies, and there are further maternity roosts in Finemere Wood in CFA12. Roosts of brown long-eared bat were recorded in Decoypond Wood and nearby on the Aylesbury Link railway line, with numerous further roosts in Sheephouse Wood and Finemere Wood in CFA12. Maternity colonies of Brandt's, Natterer's and whiskered bats were recorded in woodland in CFA12. In this area, trapping surveys recorded these three species near Decoypond Wood or at Calvert Jubilee Nature Reserve LWS. Data from radio-tracking surveys shows that Daubenton's bats use the Aylesbury Link railway line and School Hill as flightlines from Finemere Wood and Decoypond Wood to reach Calvert Jubilee Nature Reserve LWS and Calvert Brick Pits LWS for foraging. Brown long-eared bats were also recorded at Calvert Jubilee Nature Reserve LWS. In CFA12, Brandt's, brown long-eared, Natterer's and whiskered bats were all shown to use parts of the Aylesbury Link railway line for commuting between roosts, foraging areas and other flightlines. They are also likely to use the Aylesbury Link railway line as a flightline in this area. Daubenton's, Natterer's, brown long-eared, whiskered and Brandt's bats are frequently associated with woodland. The latter two species are considered to be rare and their presence as part of the recorded assemblage is notable. Maternity roosts of all these species are important to maintain the unusually diverse assemblage and strong populations of woodland bats. The Aylesbury Link railway line and other identified flightlines are likely to connect roost sites with

[39] *Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora*, The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			foraging habitat and are therefore important in maintaining the conservation status of this assemblage.
	County/ metropolitan	Populations of serotine and noctule and Leisler's bats associated with Calvert Jubilee Nature Reserve LWS and the existing railway corridor between Finemere fishing lake and Sheephouse Wood in CFA12.	Activity surveys recorded low to moderate activity from unidentified species of the *Myotis* genus and high levels of noctule bat activity in the scrub and woodland at the north-eastern edge of Calvert Jubilee Nature Reserve LWS. One Leisler's bat was radio tagged on the Aylesbury Link railway line adjacent to Calvert Jubilee Nature Reserve LWS and subsequently recorded foraging in that area. Static monitoring data indicated low levels of activity of serotine bat at Calvert Jubilee Nature Reserve LWS. Transect surveys also recorded this species foraging adjacent to the Aylesbury Link railway line between Greatmoor Farm and Sheephouse Wood in CFA12. There are very few records for Leisler's bat in Buckinghamshire and the presence of these three species as part of the wider assemblage of bats present in this area is of note.
	County/ metropolitan	Populations of common pipistrelle and soprano pipistrelle bats associated with the Aylesbury Link Railway line from Station Road, Quainton in CFA12 to Calvert Jubilee Nature Reserve LWS.	Common and soprano pipistrelle have been shown to use much of the Aylesbury Link railway line between Station Road, Quainton in CFA12 and Calvert Jubilee Nature Reserve LWS, and it is likely that the railway line forms a continuous flightline of this species. A maternity colony of common pipistrelle is present along the Aylesbury Link railway line to the north of Decoypond Wood, and a transitional roost of *Pipistrellus* sp. is present at Calvert Jubilee Nature Reserve LWS. High levels of activity were recorded for both species and the presence of a maternity colony is important in maintaining populations over wide areas.
	County/ metropolitan	Assemblage of bats associated with the Chetwode area.	Field surveys recorded several roosts in this area which include two brown long-eared maternity colonies (respectively, between 20-30 individuals and 38 individuals), and a common pipistrelle maternity roost (70 individuals) at properties in Chetwode. A day roost for both brown long-eared (1-5 individuals) and Brandt's (1 individual) bats was recorded near The Hermitage. An additional brown long-eared day roost was recorded near Sunflower Farm (est. 1-5 individuals). Four further roosts for common pipistrelle were recorded: day roosts south of Chetwode (1 individual) and near the Hermitage (1-5 individuals), a transitional roost near School End (3 individuals), and a tree roost near Sunflower Farm (1-5 individuals). A day roost for soprano pipistrelle (1 individual) was also present. Although common and soprano pipistrelle and brown long-eared bats are common and

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			widespread in Buckinghamshire, maternity roosts are important for maintaining the conservation status of their populations. Although only one day roost was recorded, Brandt's bats are considered to be rare and their presence as part of the recorded assemblage is notable.
	County/ metropolitan	Daubenton's populations associated with the Former Great Central Main Line disused Railway Line and the Chetwode area.	Two Daubenton's roosts supporting maternity colonies bats were recorded. Flightlines for this species were recorded along the Former Great Central Main Line disused railway line that links to Calvert Jubilee Nature Reserve LWS. Daubenton's bats are considered to be common, but are associated with water bodies and their distribution is restricted to suitable habitat. Maternity roosts are also important for maintaining the conservation status of their populations.
	Up to county/ metropolitan	Nathusius' pipistrelle population associated with Calvert Jubilee Nature Reserve LWS.	Activity recorded low levels of Nathusius' pipistrelle activity at the site indicative of occasional foraging. Nathusius' pipistrelle is a rare bat and unlikely to occur frequently in Buckinghamshire.
	Up to county/ metropolitan	Assemblage of bat assumed to be present near Barton Hartshorn.	The habitat in this area comprises woodland, a woodland and scrub mosaic along the Great Central Main Line, hedgerows and arable/pastoral fields. Access for surveys was restricted but the presence of common pipistrelle, brown long-eared, Daubenton's and Brandt's bat has been confirmed to the south of this area near Chetwode, and are considered likely to be foraging in this area. A hibernation roost for an individual brown long-eared bat was recorded in an underbridge near Barton Hartshorn. As part of the precautionary assessment, it is assumed that individuals from known maternity roosts would use this area for foraging and low numbers of Brandt's bat would also be present.
	District/ borough	Assumed assemblage of bats present in the central part of this area – between Twyford and Chetwode.	The habits present in this area largely comprise arable fields bounded by hedgerows. Woodland and scrub on the Great Central Main Line is also present. The habitat is less diverse and of a lower quality for bat populations in this area than the habitat to the north towards Chetwode and Barton Hartshorn and south near Twyford and Calvert. Habitat is largely unsuitable for Bechstein's bat and there are no nearby desk study records for this species. Common pipistrelle, soprano pipistrelle and brown long-eared bats have been recorded roosting to the south of these areas in Twyford. These species are common and

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			widespread in Buckinghamshire.
	Local/parish	Common pipistrelle, soprano pipistrelle and brown long-eared bat populations associated with land at Twyford.	Transitional roosts supporting common and soprano pipistrelle supporting individual bats were recorded in a residential property to the north of Twyford. A brown long-eared night roost was also recorded at the same site (estimated to be 1 individual). These species are common and widespread in Buckinghamshire.
Terrestrial Invertebrates	Regional	Colonies of black hairstreak in the vicinity of the Proposed Scheme between the River Ray in CFA12 to Railway Cutting North of Twyford BNS.	Desk study records indicate approximately 40 black hairstreak colonies are in the vicinity of the Proposed Scheme. The majority are associated with ancient woodland in CFA12 including Finemere Wood, Sheephouse Wood and Grendon and Doddershall Woods. In this area, colonies at Calvert Jubilee Nature Reserve LWS and in railside habitat to the south of Steeple Claydon are within the land required, as are records on the former Great Central Main Line railway adjacent to the Railway Cutting North of Twyford BNS and at Decoypond Wood. Black hairstreak are endangered in the UK[40] and have a restricted distribution that follows a belt of clay soils between Oxfordshire in the south-west and Cambridgeshire the north-east. The populations in this area are important in maintaining the distribution of black hairstreak in the southern part of this range[41].
	Regional	The terrestrial invertebrate assemblage at a complex of brownfield sites in the Calvert area: Calvert Landfill Site, Calvert Railway Station LWS, Calvert Jubilee Nature Reserve LWS and Calvert Brick Pits LWS.	Collectively 24 Nationally Scarce/Nationally Notable species were recorded in 2013, with individual sites supporting four to eight Nationally Scarce/Nationally Notable species. The desk study returned a number of notable records, from the Calvert area: small heath, dingy skipper, wall, white admiral, grizzled skipper, cinnabar moth and double square-spot moth. None are Red Data Book species. The five sites are considered collectively to be of greater than county value due to the presence of the assemblage of species associated with early successional habitats, the large extent and variety of early successional habitats present, as well as the high diversity of invertebrate species present.
	County/ metropolitan	The terrestrial invertebrate assemblage at the Great Central Main Line near Barton Hartshorn.	Surveys recorded an assemblage including one species of Red Data Book Insufficiently Known status (RDBK) and three Nationally Scarce/Nationally Notable species. It is considered to be county value despite the presence of a Red Data Book species due to its small size, the absence of a discrete assemblage

[40] Fox, R., Warren, M.S., and Brereton, T.M. (2010), *A new Red List of British Butterflies, Species Status 12; 1-32*. Joint Nature Conservation Committee, Peterborough.
[41] UK Butterflies; Black hairstreak; http://www.ukbutterflies.co.uk/species.php?species=pruni; Accessed: October 2013.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			of species associated with a single broad habitat type and possible uncertainty over the status of the Red Data Book species.
Birds	County/ metropolitan	Assemblage of breeding birds at Calvert Jubilee Nature Reserve LWS and Calvert Brick Pits LWS.	Field survey recorded 76 bird species within this area. Notable records were seven common tern nests, one gadwall and two Cetti's warbler territories. Long-eared owl was recorded but was not breeding. The common tern, gadwall, and Cetti's warbler populations are of county significance (more than 1% of the county population).
	County/ metropolitan	Breeding barn owl population between Twyford and Godington.	Six barn owl nests were recorded during field surveys and from desk study records. This population size is of county importance.
	County/ metropolitan	Breeding turtle dove population associated with Calvert Jubilee Nature Reserve LWS and Calvert Brick Pits LWS.	Turtle dove was not detected during field surveys but desk study records indicate that two territories of the species is present. One was recorded within land required for the construction of the Proposed Scheme. The exact location of the other pair is not known but on a precautionary basis, it is assumed to be within land required for the construction of the Proposed Scheme. These records exceed the threshold for county significance (more than 1% of the county population).
	County/ metropolitan	Breeding nightingale population at Calvert Jubilee Nature Reserve LWS.	Nightingale was not recorded during field surveys but there is a desk study record of a breeding pair. The exact location cannot be pinpointed so on a precautionary basis, it is assumed that the pair may be within land required for the construction of the Proposed Scheme. This record exceeds the threshold for county significance (more than 1% of the county population).
	County/ metropolitan	The assemblage of wintering birds at Calvert Jubilee Nature Reserve LWS.	Field surveys recorded 73 wintering bird species of which 44 were at Calvert Jubilee LWS. Notable species recorded were a large number of lesser black-backed gulls (peak count 1500), merlin, shoveler, great black-backed gull and Cetti's warbler. Desk study records also include short-eared owl, and whooper swan. The lesser black-backed gulls wintering population is of county/metropolitan importance (more than 1% of the county population).
	County/ metropolitan	Breeding barn owl population near Chetwode.	There are two barn owl territories in this area of connected habitat. These records exceed the threshold for county significance (more than 1% of the county population).
	District/ borough	Breeding red kite population south-east of Twyford.	Two red kite nests were recorded within this area. These records do not meet the threshold for county significance. However in view of the national scarcity of this recovering species, breeding pairs in this area are important to the

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			wider regional population.
	Local/parish	Red kite pair near Calvert.	A red kite nest was recorded within this area. These records do not meet the threshold for county significance. However in view of the national scarcity of this recovering species, breeding pairs in this area are important to the wider regional population.
	Local/parish	The assemblage of breeding birds south-east of Twyford.	Field survey recorded 64 bird species within this area. Desk study records also include common crossbill, tree sparrow and corn bunting, however, it is not confirmed that these birds are breeding.
	Local/parish	The assemblage of breeding birds near Chetwode.	Field survey recorded approximately 69 bird species within this area. Notable species recorded was one possible kingfisher territory. There were also desk study records for cuckoo, woodcock and lesser spotted woodpecker, but only on one occasion and therefore, breeding was not confirmed.
	Wintering bird assemblage associated with farmland near Chetwode and Godington	Field surveys recorded 73 bird species within this area. Notable species recorded were merlin, red kite and green sandpiper. Desk study records also include bean goose, black redstart and corn bunting. The numbers and assemblages of wintering birds were typical of open countryside with no particularly significant populations of rare bird species.	Wintering bird assemblage associated with farmland near Chetwode and Godington.
Otter	County/ metropolitan	The otter population on the Padbury Brook.	Activity in this area was concentrated along Padbury Brook and its tributaries where evidence of otter presence was recorded at eight locations during field surveys, most of which were along the main watercourse north east of Twyford and east of Godington. The Padbury Brook has extensive suitable habitat for this recovering species and the concentration of records in the vicinity of the watercourse suggests that it is a local stronghold.
	Local/parish	The otter population at Calvert Jubilee Nature Reserve LWS and Calvert Brick Pits LWS.	Evidence was recorded at Calvert Jubilee LWS and Calvert Brick Pits LWS. However, few signs of presence were detected. The IDB watercourses M23 and M24 may provide movement routes linking the main population in the Padbury Brook with this area. However, given the limited evidence recorded at either LWS, these watercourses are of limited importance in this respect.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
Amphibians	County/ metropolitan	The great crested newt metapopulation[42] associated with land north of Calvert Landfill.	Field surveys recorded a medium population size class, spread across three breeding ponds comprising two ponds with medium populations and one with a small population. The peak nightly count (for all three ponds combined) is 35 individuals, which together form a metapopulation. Populations of this size meet criteria for county significance[43]. Great crested newt are a species of principal importance.
	County/ metropolitan	The great crested newt metapopulation associated with land north of Portway Road in Twyford.	Field surveys recorded a medium population size class, spread across three breeding ponds comprising one pond with a medium population and two with small populations. The peak nightly count (for all three ponds combined) is 36 individuals, which together form a metapopulation. Populations of this size meet criteria for county significance.
	Up to county/ metropolitan	Great crested newt metapopulation associated with un-accessed land near Rose Hill Farm, south of Steeple Claydon.	Surveys recorded a medium sized population (13 adults) in a pond approximately 20m from land required for the construction of the Proposed Scheme. There are five additional un-accessed ponds, three within, one directly adjacent and one within 10m of land required for the construction of the Proposed Scheme, linked by terrestrial habitat that is suitable for great crested newt. On a precautionary basis, it is assumed that medium metapopulations of great crested newts are present in these five ponds.
	Up to county/ metropolitan	The potential great crested newt metapopulation associated with un-accessed land at Pond Farm, south of School Hill, Calvert.	An un-accessed ponds and drains which are within land required for the construction of the Proposed Scheme. On a precautionary basis, it is assumed that medium metapopulations of great crested newts are present in these two ponds.
	Up to county/ metropolitan	The potential great crested newt metapopulation associated with un-surveyed portions of the GCML north-east of Godington.	There are ditches and ponds suitable for great crested newts at the GCML at this location. As part of a precautionary assessment, it is assumed that great crested newt metapopulations potentially meet criteria for county significance.
	District/ borough	The great crested newt metapopulation associated with Calvert Jubilee Nature Reserve LWS.	Field surveys recorded a small population size class, spread across two breeding ponds each with a small population, which together form a metapopulation. The peak nightly count (for both ponds) did not exceed more than three individuals. One of these ponds is within land required for the construction of the Proposed Scheme. It is feasible that there is movement of newts between this metapopulation and the one

[42] A metapopulation is a group of spatially separated populations of the same species which interact at some level.
[43] Buckinghamshire & Milton Keynes Environmental Records Centre (2009) Criteria for the Selection of Local Wildlife Site in Berkshire, Buckinghamshire and Oxfordshire.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			at Calvert Brick Pits LWS.
	District/ borough	The great crested newt metapopulation north-west of Calvert Brick Pits LWS.	Field surveys recorded a small population size class, spread across two breeding ponds each with a small population, which together form a metapopulation. The peak nightly count (for both ponds) did not exceed more than five individuals It is feasible that there is movement of newts between this population and the one at Calvert Jubilee LWS.
	District/ borough	An immature great crested newt in a pond at Sunflower Farm, near Chetwode.	Field surveys recorded a single immature great crested newt at a pond approximately 20m from land required for the construction of the Proposed Scheme.
Reptiles	County/ metropolitan	The reptile population assemblage associated with the Calvert landfill site, Calvert Jubilee Nature Reserve LWS and nearby parts of the Aylesbury Link railway line.	Assemblages of reptiles in and adjacent to land required for construction of the Proposed Scheme are present in these areas. These areas contained three species: common lizard, slow-worm and grass snake, the latter species present in high population densities. A single adder was recorded at the last location. These populations are probably linked by railway and river corridors. They meet criteria for designation of LWS in Buckinghamshire due to the presence of three species as well as to the presence of adder.
	County/ metropolitan	Reptile assemblages near Barton Hartshorn and Barton Hill Farm.	Survey records for reptiles were less common in the north of the area but include large and medium populations of grass snake. There were also seven records of common lizard and one record of slow worm (all low populations). Assemblages at both sites are within land required for the construction of the Proposed Scheme.
	Up to county/ metropolitan	Reptile assemblages on un-surveyed portions Great Central Main Line west of Chetwode and east of Godington.	There are linear strips of un-surveyed habitat suitable for reptiles running along the disused rail line at these locations. As part of a precautionary assessment, it is assumed that reptile assemblages potentially meet criteria for county significance.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
Plants	County/ metropolitan	Assemblage of notable plant species present at Calvert Jubilee Nature Reserve LWS.	There are records of the nationally scarce[44] species wild cabbage and marsh pea at Calvert Jubilee Nature Reserve LWS. True fox sedge, a species of principal importance, has also been recorded here. County rare species[45] recorded from this site include eared willow, blue fleabane, mat-grass, heath-grass and devil's-bit scabious.
	District/ borough	Assemblage of notable plant species present on the Great Central Main Line.	Two near threatened[46] plant species, dwarf spurge and sainfoin, have been recorded. As both of these species are restricted in their distribution, these populations are of wider importance. The county rare species, small teasel, has also been recorded here.
	District/ borough	Assemblage of notable plant species present on Calvert Railway Station LWS.	A limited number of county rare species recorded from Calvert Railway Station LWS include sneezewort, betony and carnation sedge.
	District/ borough	Black poplar.	Black poplar was recorded within land required for the construction of the Proposed Scheme during field surveys near Padbury Brook in Twyford, Calvert Brick Pits LWS and in a hedgerow near Church View Farm in Twyford. This species is locally important it is widespread in parts of Buckinghamshire.
	District/ borough	Assemblage of notable plant species present in the Twyford area.	There are records in the Twyford area of marsh stitchwort, a species of principal importance, and fringed water-lily, a near threatened species.
Aquatic Invertebrates	District/ borough	Aquatic invertebrate assemblage at Padbury Brook.	The macroinvertebrate diversity recorded during field surveys included freshwater shrimp, mayfly and caddis larvae and several families that are highly sensitive to organic pollution. However, only one species of local conservation interest was also recorded (the caddisfly *Polycentropus kingie*).
	Local/parish	Aquatic invertebrate assemblage in tributaries of the Padbury Brook.	Surveys recorded assemblages of macroinvertebrates of low to moderate diversity including freshwater shrimp, damselfly and caddisfly larvae.
Fish	District/ borough	The fish population assemblage in the Padbury Brook at Godington.	Surveys recorded eight species of fish. Roach were dominant along with dace and juvenile pike. Surveys also recorded bullhead, three-spined and nine-spined stickleback, minnow and stone loach. This fish assemblage is of importance due moderate species richness, although population densities were low.

[44] Stewart, A., Pearman, D.A. & Preston, C.D. (1994), Scarce plants in Britain.
[45] Buckinghamshire & Milton Keynes Environmental Records Centre (2009), Criteria for the Selection of Local Wildlife Site in Berkshire, Buckinghamshire and Oxfordshire.
[46] Cheffings, C. and Farrell, L., (2006), The Vascular Plant Red Data List for Great Britain and A tool for assessing the current conservation status of vascular plants on SSSIs in England-(2006).

Species/ species group	Value	Receptor	Baseline and rationale for valuation
	Local/parish	The fish population assemblages in tributaries of Padbury Brook and minor watercourses.	Surveys recorded widespread species such as three-spined and nine-spined stickleback and stone loach. Desk study records also comprised common species. Many of these watercourses suffer from poor connectivity and low flows, resulting in poor habitat quality and a fish population of relatively lower diversity, abundance and value.
Badger	Local/parish	At least five badger social groups utilising land required for the construction of the Proposed Scheme.	Field surveys identified four main, four subsidiary and 13 outlying setts within land required for the construction of the Proposed Scheme and a further two setts within 200m. The distribution of the setts suggests that they are associated with five social groups. Badgers are common and widespread in UK lowland habitats and are not considered to be threatened.
White-clawed crayfish	Negligible	White-clawed crayfish populations potentially present in un-surveyed locations.	White-clawed crayfish are unlikely to be present as signal crayfish have been recorded in this area. The latter is an invasive competitor and carrier of the 'crayfish plague' that has caused widespread declines in the native white-clawed species. There are two records from the Padbury Brook approximately 4km from the Proposed Scheme and from 1980 and 1981.
Water vole	Negligible	Water vole populations potentially present at Padbury Brook, around Grebe Lake and Calvert Jubilee Nature Reserve LWS and at several ponds.	Water vole was not detected during surveys, and there are no desk study records of the species within the land required for the construction of the Proposed Scheme. This could be due to the presence of mink, which is a predator of water voles and has been recorded north of the area. Therefore, despite the presence of suitable habitat water vole are considered to be absent from this area.
Hazel dormouse	Negligible	Hazel dormouse population potentially present in Decoypond Wood and associated hedgerow network.	There was no access for surveys in Decoypond Wood, or at Sheephouse Wood or Finemere Wood in CFA12, however surveys were completed in suitable habitat nearby, including ancient woodland adjoining the Calvert landfill site and hedges adjoining Finemere Wood in CFA12, and at Calvert Jubilee Nature Reserve LWS in this area. Although suitable habitat is abundant there is a single recent record only, from 2009 from a small wood near Hilsdon approximately 2.7km from the land required.

Future baseline

Construction (2017)

7.3.35 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 of this report, with further details provided in Appendix CT-004-000 of Volume 5. These developments will affect the character and value of ecological resources as follows:

- the Greatmoor Energy from Waste facility and restoration of other parts of the FCC Environment waste facility is largely situated in CFA12 but is also likely to affect the distribution of great crested newt, black hairstreak and foraging bats (amongst other species) in the southern part of this area. Further information is provided in CFA12 report, Section 7; and
- the East West Rail project proposes to upgrade the Aylesbury Link railway line throughout this area to provide frequent and faster passenger trains and increased freight services by December 2017. The construction of the Aylesbury Link railway line can be accommodated within the existing railway corridor thus reducing loss of adjacent habitat. However, some small scale clearance of line-side vegetation within the railway corridor is likely prior to the construction of the Proposed Scheme, principally for installation of signalling and other rail infrastructure. This is unlikely to involve significant vegetation clearance and any reduction in habitat for reptiles, breeding birds, amphibians and badger, and for foraging, commuting and roosting bats is likely to be limited.

Operation (2026)

7.3.36 There are no known committed developments or changes to management in this area that will affect the operational baseline, beyond those described above in relation to the construction baseline.

7.3.37 Otter populations are increasing due to water quality improvements in river basins and other factors[47]. Their range is expected to increase throughout this area of the Proposed Scheme and, by the time of operation, it is possible that otter could be more numerous.

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:

- while not specifically designed for bats the overbridges at Footpath SCL/13, the waste transfer siding at Calvert; School Hill and at School End will provide

[47] Tracking Mammals Partnership (2009), *UK Mammals: Update 2009*. JNCC. Peterborough.

physical structures over the railway that will limit severance between existing habitats used as flightlines by bats (all in this area);

- while not specifically designed for bats the overbridges at Bridleway QUA/28A, Edgcott Road, Bridleway QUA/36, Bridleway GUN/28, and the underbridges at Footpath QUA/26, Adam's accommodation (near the River Ray), and Footpath CAG/2 (all within CFA12) will provide potential crossing points for commuting bats. Further details are provided in CFA12 report, Section 7;
- ensuring that the Proposed Scheme avoids habitat loss from Sheephouse Wood SSSI;
- minimising habitat loss within the Mega Ditch in CFA12, which provides a sheltered and unlit corridor for commuting and foraging bats;
- raising the vertical alignment of the Proposed Scheme onto viaducts, one north of Twyford and two east of Godington, which will reduce habitat loss and fragmentation of the watercourse at the Padbury Brook and its margins;
- all culverts will be suitably designed, to allow passage for mammals such as badger, otter and water vole, taking into account flood events, or an alternative dry tunnel will be installed; and
- construction of a retaining wall along the eastern boundary of Calvert Jubilee Nature Reserve LWS to restrict the width of the cutting and reduce incursion and enable subsequent habitat reinstatement.

7.4.2 The assessment also assumes implementation of the measures set out within the draft CoCP, which includes translocation of protected species where appropriate.

Assessment of impacts and effects

Designated sites

7.4.3 The Proposed Scheme will cross the western edge of Decoypond Wood LWS. Engineering earthworks associated with the construction of the eastern bank of Calvert cutting and result in the permanent loss of approximately 1.1ha (12.5%) of ancient woodland from the western side of Decoypond Wood LWS. The maintenance of extent ancient semi-natural woodland for which the site is designated and retention of features such as wood banks where ancient woodland indicator species are likely to be concentrated is key to its integrity. This loss will result in an adverse effect on site integrity that is significant at the county/metropolitan level.

7.4.4 The Proposed Scheme will cross the eastern edge of Calvert Jubilee Nature Reserve LWS in Calvert cutting. Maintaining the extent of the grassland habitats for which the site is designated is important in maintaining the integrity of the LWS. Construction access routes and the retaining walls of the Calvert cutting will result in the permanent loss of approximately 0.2ha of grassland from the eastern edge of the site. However, the majority of species-rich grassland is located in the northern and south eastern sections of the site and will be retained. Approximately 3.5ha of scrub will be lost from

the northern, eastern and part of the western margin of the site. Scrub is not a reason for designation, but provides habitat for invertebrates that are a reason for the designation of the LWS. In combination habitat losses of this scale and magnitude are considered to result in a permanent adverse effect on the integrity of the LWS that will be significant at the county/metropolitan level.

7.4.5 Wintering birds at Calvert Jubilee Nature Reserve LWS will be adversely affected by noise and visual disturbance caused by construction activities. They are one of the features for which the site is designated and their conservation status is partially dependent on the availability of suitable habitat and availability of suitable feeding resources within an area that is subject to limited disturbance. Construction works will take place within 35m of the lake and will have an approximate duration of five years. This disturbance will temporarily reduce the suitability of the eastern, northern and western edges of the LWS for bird foraging and roosting. Construction will therefore result in a temporary adverse effect on the integrity of the site that will be significant at the county/metropolitan level.

7.4.6 The Proposed Scheme will cross the northern and eastern edge of Calvert Brick Pits LWS. Construction of new embankments along the line of the Bicester to Bletchley Line and construction access routes to the IMD will result in the permanent loss of approximately 2ha of dense scrub and woodland (approximately 7% of terrestrial habitat). The majority of this habitat loss will be along the eastern perimeter of the site, adjacent to Calvert Jubilee Nature Reserve LWS. The reduction in the extent of the designated habitat will have an effect on site integrity significant at the county/ metropolitan level.

7.4.7 Construction of Barton Hartshorn embankment and landscape earthworks will result in the loss of approximately 0.2ha of wet woodland and grassland from the western and southern edges of Barton Hartshorn Railway Wood LWS (approximately 12% of the site). These habitat types are reasons for designation of the site and therefore loss of this magnitude will result in a permanent adverse effect on site integrity that is significant at the county/metropolitan level.

7.4.8 Calvert Railway Station LWS will be affected by the construction of the Calvert cutting that will result in the permanent loss of habitats at this site. While field surveys have shown this site to have been subject to recent clearance, due to the range of species recorded it is considered that the site may recover. As such, on a precautionary basis it is assumed that its removal will result in a permanent adverse effect on site integrity at up to the county/metropolitan level.

7.4.9 No effects of greater than local/parish significance are anticipated on the following designated sites which form part of the baseline: Sheephouse Wood SSSI; Redland Bridge BNS; Railway Cutting North of Twyford BNS; Chetwode Cutting BNS; and Padbury Brook Three Bridge Mill BNS.

Habitat

7.4.10 Approximately 1.1ha of ancient woodland along the western edge of Decoypond Wood will be removed by the construction of engineering earthworks associated with the eastern bank of the Calvert cutting. The conservation status of ancient woodland is dependent on maintaining, amongst other things, its extent and species composition, and connectivity to similar habitat. As ancient woodland cannot be recreated the loss would remain a permanent adverse effect that is significant at the county/metropolitan level.

7.4.11 Wet woodland is included in the Buckinghamshire Biodiversity Action Plan for woodland[48], however, its extent in the county is not known, but most will be associated with floodplains of larger rivers. The loss of approximately 0.2ha of this habitat at Barton Hartshorn Railway Wood LWS will result in a permanent adverse effect that is significant at the district/borough level.

7.4.12 Nineteen important hedgerows (4.5km) that are in land required for the construction of the Proposed Scheme and 16 other important hedgerows (4.4km) that will be partially intersected, will be affected. These effects are concentrated at the temporary railhead north-east of Calvert and north-east of School End where the Chetwode cutting will be constructed. Historically, hedgerow habitat has been removed throughout Buckinghamshire leading to a widespread decline. In view of this, the proportion and extent of important hedgerows are integral to the conservation status of this habitat, and so is the continuity of the network as a system of wildlife corridors. Loss and fragmentation of this magnitude will therefore result in a permanent adverse effect on hedgerow conservation status that is significant at the district/borough level.

Species

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

7.4.14 None of the known Bechstein's roosts will be removed during construction in this area or in the Waddesdon and Quainton area (see CFA12 report), but the loss of connecting and surrounding habitat could affect them. The connectivity of hedgerow and other boundary features, such as mature trees and watercourses that connect to woodland are important to the conservation of this species by providing habitat linkages between roosts and foraging areas. If there is no mitigation, the removal or disturbance of habitat features that are utilised by roosting Bechstein's bat or

[48] Buckinghamshire & Milton Keynes Biodiversity Partnership, Woodland Habitat Action Plan http://www.buckinghamshirepartnership.gov.uk/media/1022778/Woodlands.pdf Accessed: October 2013.

commuting between roosts and foraging sites has the potential to result in an adverse effect on the population Bechstein's bat.

7.4.15 The majority of roosting, foraging and commuting activity for the Bechstein's bat population is within the Waddesdon and Quainton area (CFA12) and is associated with large woodlands either side of the Proposed Scheme that contain maternity colonies. In the CFA12 area, construction of the Proposed Scheme between Edgcott Road and the northern end of Sheephouse Wood will involve clearance of vegetation on the Aylesbury Link railway line and the Bridleway GUN/25 which are associated with the key crossing points and flightlines utilised by Bechstein's bats to move between roosts and foraging areas (see Table 11). Habitat fragmentation may also disrupt the activity of Bechstein's bat associated with the recently reported roost to the south of Edgcott Road, which is assumed to form part of the wider population present in the Bernwood Forest. The associated reduction of access to foraging habitat could affect the viability of the Bechstein's breeding colonies in this area. For further details see CFA12 report, Section 7.

7.4.16 The construction of the Proposed Scheme in this area will result in further loss of existing vegetation along the Aylesbury Link railway line between Sheephouse Wood and the Calvert Jubilee Nature Reserve LWS. Bechstein's bats were not recorded commuting along this part of the railway line in radio tracking surveys carried out in 2012 and 2013. However, a single bat was recorded roosting in Decoypond Wood, and, based on data on movements of Bechstein's bats further south in the CFA12 study area, the use of the Aylesbury link railway line in this area by low numbers of bats as a flightline for commuting between roosting and foraging habitat cannot be ruled out.

7.4.17 The overbridges and underpasses described as avoidance and mitigation measures would provide a degree of habitat connectivity for Bechstein's bat. However, without additional mitigation[49], the habitat loss and resulting fragmentation of flightlines for Bechstein's bats described in Table 11 will reduce connectivity between roosts and foraging areas. It could result in bats being unable to reach foraging areas or having to expend additional energy to do so, and having to forage for longer periods and use sub-optimal habitat. As such, without additional mitigation, the fragmentation of foraging and commuting habitat associated with the construction of the Proposed Scheme will result in a permanent adverse effect on the conservation status of this Bechstein's bat population that is significant at the national level.

7.4.18 The assemblage of bats associated with the woodland habitats in the southern part of this area and in CFA12 will be affected by the loss of approximately 5km of vegetation along the Aylesbury Link railway line between the Edgcott Road in CFA12 and School Hill. It will also involve removal or modification of features known to provide bat

[49] Proposed additional mitigation provision is discussed in the subsequent section under the heading 'other mitigation'. The measures detailed are committed and are described here as 'additional' to distinguish them from the avoidance/mitigation measures that formed a fundamental aspect of the engineering design.

flightlines over the Proposed Scheme at the School Hill green overbridge, and at Grendon Junction and Benfield's Overbridge (which will be replaced by Bridleway GUN/28 accommodation green overbridge) in CFA12. These habitats are important in maintaining the numbers and diversity of bats associated with woodland habitats in this area, for which favourable conservation status depends on the connectivity between roosting and foraging areas.

7.4.19 This 5km section of the Aylesbury Link railway line is used in its entirety by Daubenton's bats for commuting to and from foraging localities both sides of the Proposed Scheme. Brandt's, whiskered bats, brown long-eared bats and Natterer's bats are known to use parts of this corridor to commute to foraging habitats either side of the Proposed Scheme in CFA12. All of these species have been recorded on Aylesbury Link railway near Decoypond Wood or at Calvert Jubilee Nature Reserve LWS, and as such are also likely to use the railway corridor as a flightline in this area.

7.4.20 The movement across the Proposed Scheme by these species, is at the Adam's underbridge, Grendon Junction, Ditchburn's Overbridge (which will be replaced by Bridleway QUA/36 accommodation green overbridge), Costello Underbridge (which will be replaced by Footpath CAG/2 underbridge) (all CFA12), from the western edge of Sheephouse Wood and at the School Hill green overbridge. The Adam's accommodation underbridge and Costello underbridge in CFA12, used by brown long-eared, Brandt's, and whiskered bats are retained in the Proposed Scheme. The overbridges and underpasses described as avoidance and mitigation measures will provide a degree of habitat connectivity. However, in the absence of additional mitigation these structures will not fully mitigate the adverse effects on the assemblage of woodland bat species present.

7.4.21 Construction of Calvert cutting will result in the loss of up to two Daubenton's maternity roosts in Decoypond Wood, and brown long-eared bat roosts on the Aylesbury Link railway line to the south of Decoypond Wood and adjacent to Sheephouse Wood. Vegetation clearance in this area will also fragment rail-side habitat which, in turn, could also indirectly affect additional maternity roosts of Brandt's, brown long-eared, Daubenton's whiskered bats which are close to the Proposed Scheme.

7.4.22 Without additional mitigation, the removal of vegetation along the Aylesbury Link railway line and loss of features providing crossing points over the Proposed Scheme would result in a permanent adverse effect on the conservation status of this assemblage of woodland bats that is significant at the regional level.

7.4.23 Noctule, serotine and Leisler's bats use habitats at Calvert Jubilee Nature Reserve LWS for foraging, as well as habitat within and adjacent to Finemere Wood, Sheephouse Wood and Grendon and Doddershall Woods in CFA12. These species utilise linear vegetation and its fragmentation will have some effect on commuting and foraging behaviour, but they are frequently recorded flying high in open habitats.

Consequently, they are less likely to be affected by habitat fragmentation arising from the Construction of the Proposed Scheme. As such, there will be no significant effect on the conservation status of the populations of noctule, serotine and Leisler's bats in this area.

7.4.24 The removal of vegetation on the Aylesbury Link railway line could disrupt movement for Nathusius' pipistrelle bats that have been recorded foraging at Calvert Jubilee Nature Reserve LWS. Although low levels of activity were recorded during static monitoring, the location of roosts and flightlines are unknown. Therefore, as a precaution, it is assumed that habitat removal along Aylesbury Link railway line will result in a permanent adverse effect on the conservation status of the Nathusius' pipistrelle population that will be significant at up to the county/metropolitan level.

7.4.25 The removal of vegetation along the Aylesbury Link railway line north of Sheephouse Wood to Calvert Jubilee Nature Reserve LWS will affect populations of common pipistrelle and soprano pipistrelle bats present in this area. The construction of Calvert cutting and the waste transfer sidings (also at Calvert) will involve the loss of a maternity roost for common pipistrelle bats. Although pipistrelle bats are not strongly reliant habitat linkages, the removal along the Aylesbury Link railway line will affect a flightline used by both species. Favourable conservation status of common pipistrelle bat and soprano pipistrelle bats depends on maintaining roosts and foraging habitat, and linkages between them. The combined effect of the loss of roosts and fragmentation of commuting routes will have an adverse effect on the conservation status of both species, which is significant at up to the county/metropolitan level.

7.4.26 The bat assemblage at Chetwode will be adversely affected by the construction of the Chetwode cutting. As part of the precautionary assessment, it is assumed that bats recorded roosting in the Chetwode area utilise Great Central Main Line railway and adjacent hedgerows for foraging and commuting. Construction of Chetwode cutting will result in the fragmentation of foraging habitat along the Great Central Main Line railway from roosts to the east of the Proposed Scheme.

7.4.27 Construction of the Chetwode cutting will result in the loss of a transitional roost for common pipistrelle. There are maternity and day roosts for brown long-eared bats and day roosts for Brandt's bat and common pipistrelle that are directly adjacent to the land to be required for the construction of Chetwode cutting. These roosts would not be directly lost, but they are in close proximity to construction works, and the associated fragmentation of foraging habitat is likely to make them unsuitable for continued use. The combined effect of habitat fragmentation and roost loss of this scale and magnitude will result in an adverse effect on the conservation status of the bat assemblage which is significant at the county/metropolitan level.

7.4.28 Construction of Chetwode cutting will also result in the loss of a maternity roost of Daubenton's bats, and fragment foraging and commuting habitat along the Great Central Main Line disused railway from roosting opportunities to the east of the

Proposed Scheme. The favourable conservation status of this species depends on maintaining roosts and foraging habitat, and linkages between them. The combined loss of this roost and adjacent foraging and commuting habitat will result in an adverse effect on the conservation status of the Daubenton's bat population which is significant at the county/metropolitan level.

7.4.29 Construction of Barton Hartshorn embankment and Barton to Mixbury cutting will involve habitat loss and fragmentation from the Great Central Main Line. As part of the precautionary assessment, it is assumed that bats recorded in the south of this area including common pipistrelle, soprano pipistrelle, brown long-eared and Brandt's bats, use this habitat for foraging and commuting. The construction of the Proposed Scheme is therefore likely to disrupt a flightline used by these species. However, the construction of the School End overbridge will provide a degree of habitat connectivity over the Proposed Scheme between the Great Central Main Line and habitat to the east which includes Barton Hartshorn Railway Wood LWS. Construction of Barton Hartshorn embankment will also result in the loss of a hibernation roost in which a single brown long-eared bat was recorded. Hibernation roosts are occupied during the winter period and must have a stable temperature regime and are therefore important to maintaining the conservation status of brown long-eared bats. The combined effect of the loss and fragmentation of foraging habitat along the Former Great Central Main Line disused railway line and at Barton Hartshorn Railway Wood along with the loss of a hibernation roost will have an adverse effect on the conservation status of the bat assemblage concerned which is significant at up to the county/metropolitan level.

7.4.30 Between Twyford and Chetwode the construction of Cowley embankment, Twyford cutting, Godington east and west embankments and Chetwode embankment and will affect the assemblage of bats assumed to be present as part of the precautionary assessment which is associated with the arable landscape in this area. The construction of these features will result in the severance of hedgerows which are likely to be used for both foraging and commuting by the bat assemblage present. The Great Central Main Line will also be fragmented from habitat on the eastern side of the land to be required for construction of the Proposed Scheme. This is likely to result in an adverse effect on the conservation status of the bats assemblage, which will be significant up to the district/borough level.

7.4.31 Black hairstreak butterflies will be affected by construction of the Proposed Scheme. Their conservation status depends upon the presence of suitable blackthorn scrub habitat and as the species has limited dispersal ability, habitat connectivity between colonies is also of importance. Construction of the Portway auto-transformer feeder station and Calvert cutting will affect two colonies along the eastern edge of Calvert Jubilee Nature Reserve LWS, of which a proportion are likely to remain as suitable habitat, extends beyond the land required for the construction of the Proposed Scheme. Two further colonies, one immediately south of Calvert Jubilee Nature

Reserve LWS and one south of Steeple Claydon will be removed, the latter during construction of the temporary railhead. There are a small number of records at an area north-east of Decoypond Wood, which is also within land required to construct the Proposed Scheme. In addition, one further colony will be removed in CFA12. Due to the presence of extensive colonies associated with ancient woodland in CFA12, the loss of those listed above is considered to represent an adverse effect on the conservation status of the local black hairstreak population at the district/borough level.

7.4.32 Factors affecting the population size and activity of otters include water quality, availability of suitable holt sites, suitable marginal vegetation and the absence of disturbance. Construction impacts on otters include installation of three viaducts, one north of Twyford and two east of Godington. Also, temporary diversion of the Padbury Brook and installation of culverts on the watercourse and its tributaries will be necessary. The construction of each viaduct will take around one year and construction of all three viaducts will be completed within 20 months. During this time, measures in the draft CoCP (Appendix CT-003-000/1) will reduce the effect of disturbance from construction activity to the extent that will there will not be a significant adverse effect on the conservation status of the otter population present on the Padbury Brook or its tributaries.

7.4.33 Scrub and grassland along the Aylesbury Link railway line, at the Calvert landfill site and Calvert Jubilee Nature Reserve LWS, together with nearby habitat in the northern part of CFA12, supports an assemblage of widespread reptile species of county/metropolitan significance. The conservation status of these species depends on maintaining the extent and connectivity of habitat, and limited levels of disturbance. Prior to the construction of the Proposed Scheme, the construction of the Greatmoor Energy from Waste facility will alter the distribution of reptiles in this area. However, the Proposed Scheme is still likely to adversely affect reptiles. Extensive loss and disturbance of reptile habitat will occur in this area; for the construction of the Calvert cutting, the waste transfer sidings, the chords to access the IMD and for Aylesbury Link rail line chord to the Bicester to Bletchley line, realignment of the Aylesbury Link rail line to the east of the Proposed Scheme, and diversion of the Addison Road overbridge. None of the populations known to be present will be completely removed, but, loss and fragmentation of habitat will extend for approximately 4.7km from River Ray to the northern end of Calvert Jubilee Nature Reserve LWS, and for approximately 3.7km from Main Street, Charndon to Queen Catherine Road. Due to the extent of habitat loss and habitat fragmentation, there will be a permanent adverse effect on the conservation status of reptiles that will be significant at the county/metropolitan level.

7.4.34 Reptile population assemblages near Barton Hartshorn and Barton Hill Farm will be affected by the construction of the Barton to Mixbury cutting and the Chetwode cutting. Disturbance, habitat loss and fragmentation will result in a permanent

adverse impact on the conservation status of the population assemblages that will be significant at the county/metropolitan level.

7.4.35 As part of the precautionary assessment, it is assumed that unsurveyed land on the Great Central Main Line west of Chetwode could support large populations and/or a diverse assemblage of widespread reptile species. The construction of the Proposed Scheme will remove habitat in this area and result in an adverse effect on conservation status of widespread reptiles at up to the county/metropolitan level.

7.4.36 Barn owl territories will be affected by the removal of farmland, wood edges, rough grassland and field margins which as foraging habitat sites are integral to the conservation status of this species. A nest site will be lost at Stone Court Farm due to the construction of a temporary stockpile, although habitat loss at this location will be localised due to the availability of similar retained or adjacent habitat. Construction of the Twyford embankment and the implementation of floodplain compensation works will result in the loss of five nest sites and associated foraging habitat to the north-east of Twyford. In combination, the loss of existing nest sites and foraging habitat in these locations will result in a permanent adverse effect on the conservation status of the barn owl population that will be significant at the county/metropolitan level.

7.4.37 Great crested newts will be affected by the removal of breeding ponds during construction. Maintaining the extent and quality of breeding ponds and suitable terrestrial habitat is important to the conservation status of this species. One of two ponds containing great crested newt at Calvert Jubilee Nature Reserve LWS will be removed by the construction of the Calvert cutting and Portway auto-transformer feeder station. This will also remove approximately 6ha of surrounding scrub and woodland forming terrestrial habitat associated with these ponds. This will constitute a permanent adverse effect on the conservation status of this metapopulation that is significant at the district/borough level.

7.4.38 As part of the precautionary assessment, it is assumed that a great crested newt metapopulation is present near Pond Farm south of School Hill which would be affected by the School Hill green overbridge satellite compound, access for the waste transfer sidings and a temporary materials stockpile. This will involve the removal of a pond, drains and associated terrestrial habitat. If a metapopulation is present in the area, these effects will result in a permanent adverse impact on the conservation status of great crested newt that is significant at up to the county/metropolitan level.

7.4.39 As part of the precautionary assessment, it is assumed that a great crested newt metapopulation is present near Rose Hill Farm, south of Steeple Claydon. Construction of the IMD and temporary railhead would result in the loss of an un-surveyed pond that is within land required for the construction of the Proposed Scheme. The loss of aquatic and associated terrestrial habitat would result in a permanent adverse impact on the conservation status of the metapopulation that would be significant at up to the county/metropolitan level.

7.4.40 Surveys of Calvert Railway Station LWS indicated that its botanical interest was still present despite clearance, and it is possible that three county rare species carnation sedge, betony and sneezewort may recolonise. The site is within the land required for the construction of the Proposed Scheme and permanent loss of these species from the site, should they be present when construction commences, would be an adverse effect on their conservation status at the district/borough level.

7.4.41 No significant adverse effects are expected for the following species receptors which form part of the baseline and are valued at district/borough level are as follow:

- great crested newt metapopulations associated with land north of Calvert Landfill, north of Portway Road in Twyford, north-west of Calvert Brick Pits LWS, at Sunflower Farm and near Chetwode and unsurveyed portions of the GCML north-east of Godington.
- fish and invertebrate assemblages in the Padbury Brook;
- notable plants other than those at Calvert Jubilee Nature Reserve LWS;
- red kite near Calvert and south-east of Twyford;
- farmland bird assemblages throughout this area; and
- wintering birds other than those at Calvert Jubilee Nature Reserve LWS.

7.4.42 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

7.4.43 This section describes additional elements designed to reduce or compensate for significant ecological effects. These include measures such as habitat creation, habitat enhancement, green bridges and wildlife underpasses.

7.4.44 Ancient woodland habitat is irreplaceable. The loss of ancient woodland within Decoypond Wood LWS will result in a significant adverse effect at a county/metropolitan level. However, this loss of woodland will be compensated through a range of measures. Ancient woodland soil with its associated seed bank will be salvaged and translocated to an approximately 5.7ha receptor site that will adjacent to northern and eastern edges of the site that will link it to Sheephouse Wood SSSI. This will help maintain the conservation status of remaining ancient semi-natural woodland as well as increasing the connectivity of fragmented ancient woodland parcels. Other measures such as planting native tree and shrub species of local provenance, and translocation of coppice stools and dead wood may also be appropriate.

7.4.45 While not fully replicating the woodland that will be lost, the large increase in woodland extent will maintain the integrity of woodland in the area. When mature,

the new woodland will result in a beneficial effect that is significant at the district/borough level, but will be of benefit to some species prior to maturity.

7.4.46 Compensation for the removal of approximately 3.5ha of scrub at Calvert Jubilee Nature Reserve LWS and approximately 2ha of scrub from Calvert Brick Pits LWS will be provided by the creation of an approximately 4ha of scrub and woodland habitat extending south from School Hill to Decoypond Wood. The School Hill green overbridge will provide habitat connectivity between scrub and woodland habitat retained in the LWS and the new habitat. Post-construction, additional compensation will be provided by the creation of scrub and grassland habitat along the southern edge of the Bicester to Bletchley line, where this is adjacent to the IMD – from Shepherd's Furze Farm to Queen Catherine Road. It will comprise a diverse mosaic of scrub and grassland similar to the present in parts of both LWS. This habitat will be in close proximity to planting on landscape earthworks to the north of the IMD. Following establishment in 7-10 years, the extent of scrub habitat creation in the vicinity Calvert Jubilee Nature Reserve LWS or Calvert Brick Pits LWS will ensure that adverse effects on these sites will be offset and there will be no significant residual adverse effects.

7.4.47 Mitigation for loss of species-rich grassland at Calvert Railway Station LWS will be provided by creation of similar grassland on part of the 12.5ha area for ecological mitigation adjacent to the Great Central Main Line, north of Twyford. Although the site cannot be replicated in its current location, the creation of a larger area of similar habitat means that the adverse effect on the conservation status of this grassland habitat type will be offset. Grassland compensation will be provided in accordance with the approach outlined in ecological principles of mitigation in Volume 5: Appendix CT-001-000/2.

7.4.48 Approximately 0.8ha of compensatory habitat will be created east of Barton Hartshorn Railway Wood LWS to compensate for the loss of approximately 0.2ha of osier willow wood from the LWS. Creation of a 3.2 ha area of wetland habitat creation to the south of Rosehill Farm, Chetwode and additional habitat creation within replacement floodplain storage adjoining the Padbury Book near Three Mills Bridge will offset the loss of fen habitat from the site. New habitat will be provided adjacent to the watercourse flowing into the LWS, providing habitat connectivity. Planting will be conducted in accordance with the ecological principles of mitigation detailed in Volume 5: Appendix CT-001-000/2. This will ensure that there will be no significant residual adverse effects.

7.4.49 Mitigation for the loss and fragmentation of important hedgerows will include planting of over 15km of replacement hedges in accordance with the ecological principles of mitigation in Volume 5: Appendix CT-001-000/2. This includes planting to the north of the IMD, which will reinstate the hedgerow network removed for the operation of the railhead. Linear planting between Sheephouse Wood and Calvert;

north of Perry Hill, along the northern edge of the IMD, along the Chetwode cutting and Barton Hartshorn embankment; and on the eastern side of the route near the Godington viaducts will also contribute to the extent and connectivity of habitat networks in this area. Planting will be conducted in accordance with the ecological principles of mitigation detailed in Volume 5: Appendix CT-001-000/2. Once established in 5-7 years there will be no significant adverse effect on the conservation status of important hedges in this area.

7.4.50 Mitigation for the loss of habitat connectivity north of the Edgcott Road overbridge in CFA12 to School Hill includes linear planting on the five overbridges in this area to create multi-purpose structures that will provide safe crossing points for wildlife, particularly for bats. These multi-purpose structures will include planted habitat corridors of between 25 and 30m in width as follows:

- Bridleway QUA/36 accommodation green overbridge (CFA12), 200m west of Finemere Wood will replace the existing level crossing at Grendon Junction. This will reinstate a movement corridor between Finemere Wood and Hewin's Wood and Grendon and Doddershall Woods. This corridor comprises the Akeman Street disused railway and Muxwell Brook which are used by Bechstein's, Natterer's, Daubenton's, Brandt's and brown long-eared bats;
- Bridleway GUN/28 accommodation green overbridge (CFA12), 100m east of Upper Greatmoor Farm will replace the existing Benfield's Overbridge at this location. It will replicate an existing link between Sheephouse Wood and Finemere Wood to Grendon and Doddershall Woods. Survey records show that Bechstein's bats cross the Proposed Scheme at this point;
- Footpath SCL/13 green overbridge (CFA13), is adjacent to planting on the northern boundary of Sheephouse Wood SSSI. The overbridge will provide links to habitats to the west of the Proposed Scheme and provide crossing locations for Daubenton's, brown long-eared, Brandt's, whiskered, common pipistrelle and soprano pipistrelle bats;
- Calvert green overbridge (CFA13) will include an access road for the waste transfer siding. It will include planting that will provide crossing points for the movement of Daubenton's, brown long-eared, and Bechstein's bats recorded roosting in Decoypond Wood as well as Natterer's, common pipistrelle and soprano pipistrelle bats; and
- School Hill green overbridge (CFA13) to be constructed to the east of the existing bridge to carry School Hill over the route of the Proposed Scheme and to provide a crossing point for the movement of Daubenton's, common pipistrelle and soprano pipistrelle bats that move from Sheephouse Wood, Decoypond Wood and Shrubs Wood. Planting will on side of the carriage way, with highway lighting directed away from it.

7.4.51 Planting on the green bridges will comprise a double row of tall scrub that will provide a sheltered habitat corridor suitable for commuting bats. A network of planted areas on either side of the Proposed Scheme will guide bats to crossing points and link

existing woodlands. This includes linear planting to link Sheephouse Wood, Decoypond Wood and Calvert Jubilee Nature Reserve LWS, as well as links between ancient woodlands to the north-east of the Proposed Scheme in CFA12, as shown on Maps CT-06-052-L1, CT-06-053, CT-06-053-02, CT-06-053-L1, CT-06-054 and CT-06-055 (Volume 2, CFA12 and CFA13 Map Book). For Bechstein's bats as well other species, the proposed mitigation described above will mitigate the fragmentation of hedges and treelines that currently link woodland either side of the Proposed Scheme north of the Edgcott Road to School Hill Road and thus enable the bats to reach habitat required for breeding and foraging. The total area of woodland planting is over 20ha and this will compensate for the loss of foraging habitat that will occur from the removal of woodland along the Aylesbury Link railway line.

7.4.52 Mitigation for Bechstein's bat and other species to the south of the Edgcott Road (in CFA12) will consist of the provision of further crossing points suitable for bats. Further details are provided in CFA12 (Waddesdon and Quainton area) report.

7.4.53 The proposed planting will not be sufficiently mature to provide habitat linkages immediately. As such fragmentation of habitats used by Bechstein's bats and other species will still arise in the years following construction. In order to reduce the time for establishment, replacement habitats will be created where practicable prior to construction of the Proposed Scheme. In accordance with the principles of ecological mitigation provided in Volume 5 Appendix CT-001-000/2 this will include measures to ensure that the temporary habitat severance that could fragment habitat for bats is addressed during construction. Measures used will include the retention of habitat corridors for as long as possible and the use of movable screens to provide connectivity between vegetation used by commuting bats.

7.4.54 Habitat fragmentation affecting Daubenton's bat that commute along the Aylesbury Link Railway to foraging habitat at Calvert Jubilee Nature Reserve LWS; as well as common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle which are considered likely to do so; will be mitigated though the provision of the green overbridges and linear planting already described.

7.4.55 The loss of up to two maternity roosts of Daubenton's bat at Decoypond Wood, and a nearby common pipistrelle maternity roost and brown long-eared bat roost due to the construction of Calvert cutting and the waste transfer sidings, will be mitigated by providing replacement roosting provision adjacent to Decoypond Wood in accordance with the approach identified in the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2).

7.4.56 Construction of the Proposed Scheme will fragment foraging habitat for bat assemblages and Daubenton's population at Chetwode and the assumed bat assemblage at Barton Hartshorn. Mitigation comprising linear planting parallel to the Chetwode cutting will provide a flightline to guide bats to the crossing point over the

route that is provided by the School Hill green overbridge. This will enable bats to move between roost sites and foraging habitat on the Great Central Main Line.

7.4.57 Construction of the Chetwode cutting will involve the direct loss of roosts for common pipistrelle and Daubenton's bats, and a hibernation roost of brown long-eared bat. It will also have indirect effects on roost viability on a maternity roost for brown long-eared bats, and day roosts for Brandt's bats and common pipistrelle. This will be addressed by provision of replacement bat roosting habitat in accordance with the principals of mitigation as set out in ecological principles of mitigation Volume 5: Appendix CT-001-000/2. Compensatory roosts will be located south of Godington viaduct over the Padbury Brook in an area of grassland habitat creation near retained vegetation along the former Great Central Main Line.

7.4.58 Fragmentation of habitat which has the potential to affect the bat assemblage assumed to be present between Twyford and Chetwode will be mitigated by the provision of linear planting to encourage bat species to cross the route. This will be provided at the Twyford Mill overbridge. The linear planting will be linked to existing hedgerows in the surrounding landscape.

7.4.59 Following the implementation of the measures proposed it is expected that any adverse effects on bats arising from the construction of the Proposed Scheme will be reduced to the local/parish level or below. There will therefore be no significant effect on the conservation status of the bat species concerned.

7.4.60 The loss of colonies of black hairstreak butterfly will be mitigated for by planting blackthorn on the green bridges detailed earlier and in the habitat creation areas described above in relation to mitigation of habitat fragmentation for bats. The new planting will include a large proportion of blackthorn that will greatly increase available habitat once blackthorn is sufficiently mature to provide habitat for egg-laying (estimated at 10-15 years). Following maturation of habitat there will be no adverse effects on the conservation status of black hairstreak in this area.

7.4.61 There will be an adverse effect on the conservation status of barn owl at the county/metropolitan level due to loss of three territories. 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 1.5km 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 would be likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

7.4.62 Compensatory habitat to address impacts on great crested newt metapopulations at Calvert Jubilee LWS and Calvert Brick Pits LWS, and those potentially affected to the south of School Hill and near Rose Hill Farm south of Steeple Claydon will be provided within approximately 4.4ha of linear planting linking Decoypond Wood and Sheephouse Wood. These areas have habitat connectivity with metapopulations in

the adjoining part of CFA12. Mitigation for any adverse effects on metapopulations potentially present near Godington in northern part of this area will be provided by an approximately 3.2ha area of wetland habitat creation to the south of Rosehill Farm, Chetwode. Compensation habitat will be provided in in accordance with the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2). The creation of these habitats will be sufficient to maintain the numbers and distribution of great crested newt currently present and as such, there will be no adverse effects on the conservation status of great crested newt populations in this area.

7.4.63 In the southern part of the area compensatory reptile habitat will be created in the margins of linear planting linking Sheephouse Wood and Decoypond Wood. Any adder utilising habitat in land required for the construction of the Proposed Scheme would be translocated to a receptor site immediately south of the IMD that has connectivity with retained vegetation. Together, these areas will reinstate habitat linkages and provide sufficient area for translocation of animals from land required for the construction of the Proposed Scheme. In the northern part of this area compensatory reptile habitat will be created adjacent to the former Great Central Main Line to provide a receptor site for populations near Barton Hartshorn and Chetwode. As such, there will be no long term adverse effects on the conservation status of the reptile population in this area and in the northern part of CFA12.

7.4.64 Mitigation measures to address the potential killing, injury and disturbance of badgers will be provided in accordance with the ecological principles of mitigation identified within Volume 5: Appendix CT-001-000/2. This will include the provision of badger-proof fencing and replacement setts where necessary. New planting within the ecological mitigation areas will benefit badgers present in those areas by improving foraging habitat and providing new opportunities for sett creation.

Summary of likely residual significant effects

7.4.65 The mitigation, compensation and enhancement measures described above reduce the effects to a level that is not significant except for the loss of 1.1ha of ancient woodland at Decoypond Wood.

7.4.66 Ancient woodland is irreplaceable. However, there would be a corresponding permanent beneficial effect due to the increased area of broadleaved woodland and woodland connectivity in the area in the area between the Sheephouse Wood and Decoypond Wood resulting from extensive new woodland planting.

7.4.67 The permanent loss of three barn owl territories represents a residual significant effect. However, with the implementation of the mitigation measures proposed the residual effect on barn owl would be reduced to a level that is not significant. 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:

- seven green overbridges located between Bridleway QUA/28A in CFA12 and School Hill which provide crossing points at a sufficient height above the Proposed Scheme to reduce potential killing of bats through contact with trains; and
- provision of three underbridges in CFA12 – Footpath QUA/26, Adam's accommodation underbridge and Footpath CAG/2 underbridge allowing bats to fly beneath 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 Due to the large areas over which bats forage it is likely that any loss of, or displacement from, suitable foraging habitat in the vicinity of the Proposed Scheme would in itself amount to only a small proportion of the wider available resource. However, the impact of any such disturbance or displacement could be greatly increased if bats are hampered in moving between breeding sites, hibernation sites and other roosts which they commonly utilise.

7.5.5 Bechstein's bat and several other bat species present in this area require habitat connectivity in order to move between foraging and roosting sites. They will be affected by habitat fragmentation during the operation of the Proposed Scheme in a similar way to that described during construction. Radio tracking surveys carried out in 2012 and 2013 demonstrated that Bechstein's bats and other species associated with woodland habitat use linear vegetation to reach the Aylesbury Link railway line

and that much of their movement across the Proposed Scheme was concentrated at the crossing points identified in Table 11. Therefore, the mitigation provided by crossing points and planting of new habitat corridors, and measures to address the temporary loss of connectivity as new habitat matures described for construction effects will also mitigate for the effects of habitat fragmentation during operation.

7.5.6 Where the route of the Proposed Scheme bisects, or is located in close proximity to existing features known to be utilised regularly by foraging or commuting bats, there is an increased risk that bats could be killed or injured as a result of collisions with passing trains or associated turbulence. The significance of any such effect will be dependent on both the flight 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.

7.5.7 The green overbridges, underpasses and associated planting provide crossing points to channel bats to the existing key crossing points at School Hill (CFA13), as well the Adam's accommodation underbridge, Grendon Junction, Benfield's overbridge (which will be replaced by Bridleway GUN/28 accommodation green overbridge) and the Costello Underbridge (which will be replaced by Footpath CAG/2 underbridge) (all in CFA12), that have been demonstrated by radio tracking surveys to link roosts and foraging areas. This will reduce the risk of killing and injury, but will not fully mitigate these effects in the operational phase of the Proposed Scheme. Bats may continue to commute along vegetation close to the Aylesbury Link railway line, resulting in risk of collision. In addition, bats were recorded crossing the route of the Proposed Scheme along the western boundary of Sheephouse Wood. This includes Bechstein's as well as Brandt's and Daubenton's bats.

7.5.8 Without additional mitigation, the ongoing loss of individuals of these species over several generations, particularly where roosts are present close to the Proposed Scheme could have an adverse effect on their conservation status significant at the national level for Bechstein's bat, the regional level for the assemblage of woodland bat species, and at up to the county level for Nathusius' pipistrelle.

7.5.9 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 in this area.

7.5.10 The majority of bird species that are known to be present in the area are not considered to be particularly vulnerable to collision with trains. However, barn owls 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. Evidence suggests that such mortality is likely to result in the loss of all breeding populations of barn owls within 1.5km of the Proposed Scheme.

Other mitigation measures

7.5.11 This section describes additional elements designed to reduce or compensate for significant ecological effects. These include measures (such as habitat manipulation and fencing) to discourage species from foraging close to the Proposed Scheme:

- Sheephouse Wood mitigation structure will be provided to avoid potential impacts on bats crossing the HS2 route corridor adjacent to Sheephouse Wood. This will extend from the south of Sheephouse Wood to its northern extent at Footpath SCL/13 green overbridge, a distance of approximately 800m. The structure will provide a physical barrier to bats and for purposes of this ES has been assessed as a box shaped enclosure. This will be approximately 10m above rail level. Lighting will be used, if required, to discourage bats from flying close to areas of wind turbulence around the structure. This will be designed for minimal light spillage;
- areas of new planting providing habitat linkages for bats between the Finemere Wood and the School Hill which are set back from the Proposed Scheme to encourage species to avoid it as much as possible;
- vegetation management will be carried out to provide an approximately 20m corridor on both sides of the Proposed Scheme between Footpath SCL/13 green overbridge and Calvert green overbridge to remove tall vegetation and hence reduce the risk of bats flying close to trains. For similar reasons, vegetation clearance will also be carried out in CFA12 and further details are provided in the CFA12 report; and
- in the northern part of this area, removal of habitat on the Great Central Main Line to the north of School End where the Proposed Scheme joins the alignment of the Great Central Main Line. This will remove habitat connectivity between the retained habitat on the Great Central Main Line and Proposed Scheme and therefore reduce the risk of bats colliding with trains.

7.5.12 Following the implementation of the measures proposed it is anticipated that any adverse effects on bats as consequence of the operation of the Proposed Scheme will be reduced to the local/parish level or below. There will be no significant effect on the conservation status of the species concerned.

7.5.13 Train strike is likely to result in the loss of barn owls which nest close to the route. As part of the precautionary assessment it is assumed all territories within close proximity to the route could be lost and therefore adverse effects are likely to remain significant at the county/metropolitan level. To offset these losses 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 would be likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

Summary of likely residual significant effects

7.5.14 The mitigation, compensation and enhancement measures described above are likely to reduce the residual ecological effects during operation to a level that is not significant, except for barn owl. 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 presents the baseline conditions that exist along the Proposed Scheme in relation to land quality and reports the likely impacts and any significant effects resulting from construction and operation of the Proposed Scheme. Consideration is given to land that potentially contains contamination and land that has special geological significance, 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 of this area include Padbury Brook and tributaries; the underlying Secondary A aquifers (Alluvium, River Terrace sand and gravels, Kellaways and Cornbrash Formations); Grebe Lake and the lake at Calvert Jubilee nature reserve; Local Wildlife Sites (LWS) including West Wood, Great Moor Sailing Club, Calvert Jubilee, Barton Hartshorn Railway Wood, and Decoypond Wood; Tingewick Meadows SSSI and Sheephouse Wood SSSI; and the existing Aylesbury Link railway line at the southern end of the route.

8.1.4 The main land quality issues in this area include:

- current and historical landfills in and around Calvert;
- existing and historical railway lines along the route;
- sewage works east of Twyford; and
- Barton Hartshorn Airfield (former RAF Finmere).

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-001-013: 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 Water resources and flood risk assessment. 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 Aylesbury Vale and Cherwell District Councils, the Ministry of Defence (MoD) and the Environment Agency regarding contaminated land and with Buckinghamshire and Oxfordshire County Councils with regards to mineral policy. To date, information has been received on mineral extraction and Mineral Safeguarding Areas (June 2013) and contaminated land.

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 (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2). 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 areas of 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 Familiarisation 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 the site visit 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-01-028b to LQ-01-031a (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-02-013 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

8.3.3 Geological mapping shows four areas of infilled ground within 250m of the route. The first area is at Calvert Landfill no.4 and 5 pits, located at the southern end of the area,

adjacent to the south of the route (Map LQ-01-028b, site 13-01, Volume 5, Land Quality Map Book). The second area is immediately to the north of Calvert village and to the south of the lake at Calvert Jubilee nature reserve on the southern side of the Proposed Scheme, on the site of Calvert Pit 1 Historical Landfill (Map LQ-01-028b, site 13-08). The third is north of Calvert village, at the lake at Calvert Jubilee, part of the Calvert Jubilee nature reserve (also an LWS), (Map LQ-01-029, site 13-09, Volume 5, Land Quality Map Book) and the fourth site is immediately west of the lake at Calvert Jubilee at Grebe Lake (Map LQ-01-029, site 13-10, Volume 5, Land Quality Map Book).

8.3.4 A shallow cover of track bed materials will be present on the route where it follows the Aylesbury Link railway line. A cover of made ground may also be present in built up areas of the route section as a result of previous cycles of development.

8.3.5 Superficial deposits are absent from the southern third of the route. In central areas, mainly to the north of the village of Twyford, the route will cross river alluvium that comprise clay, silts, sands and gravels, as well as River Terrace sand and gravel deposits associated with the Padbury Brook.

8.3.6 In the vicinity of Barton Hartshorn, drift deposits consist of Glacial Till, comprising a clay or sand matrix with sand and gravel, but also with Glaciofluvial sand and gravel deposits outcropping at the surface on the route north-west of School End.

8.3.7 The bedrock geology underlying the majority of the route through this area is the Ancholme Group, consisting of the Oxford Clay Formation made up of the Peterborough Member and Stewartby Member, which comprise mudstone with a thickness of greater than 25m, and the Kellaways Formation, which comprises mudstone, siltstone and sandstone with a thickness of approximately 5m. These groups are underlain by the Cornbrash Formation.

8.3.8 The Cornbrash Formation outcrops below the northern 500m of the route in this area. The outcrop is described as limestone and is the upper layer of the Great Oolite Group, which has a thickness of approximately 40m and comprises limestone, mudstone and sandstone.

Groundwater

8.3.9 The Kellaways Formation and Cornbrash Formations have both been designated in this area as Secondary A aquifers by the Environment Agency, whereas the Oxford Clay Formation has been designated in this area as unproductive strata. The glaciofluvial sand and gravel, river alluvium and River Terrace sand and gravels have been designated as Secondary A aquifers. The superficial Glacial Till has also been designated as unproductive.

8.3.10 This route section does not pass through any Source Protection Zones (SPZ).

8.3.11 There are no groundwater abstractions for Public Water Supply (PWS) or other licensed abstractions within 1km of this section of the route.

8.3.12 Cherwell District Council reports that there are four private unlicensed abstractions within 2km of the route.

8.3.13 Further detail on the groundwater beneath the Proposed Scheme can be found in Section 13, Water resources and flood risk assessment.

Surface waters

8.3.14 There are a number of surface watercourses and other water features in this area of which the most significant is Padbury Brook and its tributaries. The route will cross Padbury Brook to the east of Twyford and twice to the north-east of Godington.

8.3.15 Grebe Lake and Calvert Jubilee lake are surface water features present on the site of the historical clay, brick and tile extraction areas and the historical Aylesbury Borough Council Refuse and Buckingham Rural District Council Refuse Tips north of the village of Calvert.

8.3.16 There is one licensed surface water abstraction within the study area which is potentially linked to another licence approximately 1.3km from the route.

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

Current and historical land use

8.3.18 The southern end of the study area is dominated by the operational and historical Calvert landfills, detailed in Table 12.

Table 12: Landfill sites located within the study area

Area name	Area location	Description
Calvert Landfill no.4 and 5 pits (13-01)	Adjacent and to the west of the Proposed Scheme at the south-eastern end of the study area, south-east of Calvert village and immediately south-west of Decoypond Wood. (Map LQ-01-028b, D8; Volume 5, Land Quality Map Book)	Current co-disposal site.
Calvert Pit 1 Historical Landfill (13-08)	Located at the south-eastern end of the study area to the west of the Proposed Scheme, immediately north-west of Calvert village. (Map LQ-01-029, H8; Volume 5, Land Quality Map Book)	Historical landfill which was licensed to take inert, industrial, commercial and household waste.
Historical Aylesbury Borough Council Refuse Tip (13-10)	Located at the south-eastern end of the study area to the west of the Proposed Scheme, running north-west of Calvert village. (Map LQ-01-029, F8; Volume 5, Land Quality Map Book)	Historical landfill which was licensed to take commercial waste.
Historical Buckingham Rural District Council Refuse Tip (13-09)	Located at the south-eastern end of the study area to the west of the Proposed Scheme, north of Calvert village, at Calvert Jubilee lake. (Map LQ-01-029, G7; Volume 5, Land Quality Map Book)	Historical landfill which was licensed to take industrial and commercial waste.

8.3.19 Other current potentially contaminative land uses include:

- a sewage works east of Twyford; and

- the Aylesbury Link railway line adjacent to the route in the southern extent of the area.

8.3.20 Other historical land uses identified within the study area with the potential to have caused contamination include:

- a historical brickworks immediately to the north-west of Calvert Landfill no.4 and 5 pits;
- historical railway lines; and
- Barton Hartshorn Airfield (former RAF Finmere) in the northern extent of the area.

8.3.21 Contaminants commonly associated with these uses could include metals, semi-metals, asbestos, organic and inorganic compounds at all sites and additionally radiological substances and explosive ordnance at the former RAF Finmere site, and pathogens associated with the sewage works. Infilled pits could also give rise to landfill gases such as methane, carbon dioxide and volatile organic compounds (VOC).

Other regulatory data

8.3.22 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). Of note is a current environmental permit registered to Calvert Landfill no.4 and 5 pits (Map LQ-01-028b, site 13-01; Volume 5, Land Quality Map Book).

Mining/mineral resources

8.3.23 Policy CS1 of the Aylesbury Vale Local Plan 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; that consideration has been given to prior extraction of the protected mineral; or that the need for a proposed development outweighs the economic value of the mineral resource.

8.3.24 There are no recorded shallow mines or mineral reserves currently being worked within this study area.

8.3.25 There are no Mineral Consultation/Safeguarding Areas in the study area, nor have any Preferred Mineral Sites, current extractions and sites with planning permission been identified.

8.3.26 A former clay pit and area of sand and gravel quarrying is shown to the south-west of the route at the southern end of the study area in the area now occupied by Calvert Landfill, Grebe Lake, Calvert Jubilee nature reserve, and housing for the village of Calvert.

8.3.27 Where present, the River Terrace sands and gravels have been identified as sand and gravel resources by the BGS (British Geological Survey).

Geo-conservation resources

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

Receptors

8.3.29 The potential sensitive receptors that have been identified within this study area are summarised in Table 13.

Table 13: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land Contamination	People	Residents in existing properties	High
		Workers e.g. Calvert Landfill and existing railway	Medium
	Controlled waters	Secondary A aquifer of the Kellaways and Cornbrash Formations	Medium
		Secondary A aquifer of the Glaciofluvial Sand and Gravel, Alluvium or River Terrace Sand and gravel	Medium
		Padbury Brook	High
		Grebe Lake and Calvert Jubilee lake	Medium
	Natural Environment	LWS including West Wood, Great Moor Sailing Club, Calvert Jubilee, Barton Hartshorn Railway Wood, and Decoypond Wood	Medium
		Tingewick Meadows SSSI and Sheephouse Wood SSSI	High
	Built Environment	Buildings and property	Low to high[1]
		Underground structures and services	Low
Impacts on mining mineral sites (severance and sterilisation of mineral sites)	Mineral resources	Mineral resource of sand and gravel	Low

[1]The range in receptor sensitivity for buildings and property relates to the range in building and property construction and use throughout the study area.

Future baseline

8.3.30 There is currently planning permission for a major housing development over the former Calvert Brickworks site. It is assumed, should the development go ahead, that a site investigation and potential remediation of the site will be undertaken and therefore there will be a potential beneficial effect to baseline conditions. Planning has been approved for the Greatmoor Energy from Waste facility located in the Waddesdon and Quainton area (CFA12). Within this development there will be a mono-cell to accept hazardous air pollution control residues in Calvert Landfill no.6 pit located immediately to the south-east of the southern boundary of the Calvert, Steeple Claydon, Twyford and Chetwode area. This has been assessed in the Land quality report for the Waddesdon and Quainton area and is therefore not considered as a committed development site within this study area.

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 (see Volume 5: Appendix CT-003-000/1). 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, gasses 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 5 and 16).

8.4.2 The draft CoCP requires that prior to and during construction a programme of further investigations, which may include both desk based and site based work, will take place in order to confirm the full extent of 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)[50]; and

[50] Environment Agency, (2004), *CLR11 Model Procedures for the Management of Land Contamination.*

- British Standard BS10175 Investigation of Potentially Contaminated Sites (2011)[51].

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)[52]. 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, where practicable, 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 reuse) or to an appropriately permitted landfill.

Assessment of impacts and effects

8.4.5 This section of the route will start in a retained cutting along the existing Aylesbury Link railway line for approximately 4km as far as Twyford. The route will then pass through a series of alternating embankments and cuttings to the end of the study area, with an approximately 60m long viaduct (Twyford viaduct) over Padbury Brook, and two viaducts (Godington east viaduct and Godington west viaduct) north-east of Godington, also over Padbury Brook.

8.4.6 There will be two auto-transformer stations, one at Portway Farm and the other, Chetwode auto-transformer station, to the west of the Proposed Scheme, south-east of Manthorn Farm.

8.4.7 The IMD will be located to the north-east of the route, to the north of Calvert, alongside the existing Bicester to Bletchley Line at Claydon Junction. The Aylesbury Link railway line and Bicester to Bletchley Line are proposed to be upgraded as part of the East West Rail (EWR) project and a new intersection bridge will be constructed where the route and the Bicester to Bletchley line will cross.

Land contamination

8.4.8 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

[51] British Standard BS10175, *(2011), Investigation of Potentially Contaminated Sites*.
[52] Sustainable Remediation Forum UK, (2010), *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation*.

pose contaminative risks for the Proposed Scheme. In total, twelve areas were considered during this screening process; nine of these areas were taken forward to more detailed risk assessments (Stages C and D), in which the potential risks were assessed more fully. The majority of the areas undergoing the more detailed risk assessments were historical landfills and historical or current railway lines. All areas assessed are shown on Maps LQ-01-028b to LQ-01-031a (Volume 5, Land Quality Map Book) and those considered as potentially posing a risk to the Proposed Scheme are labelled with a reference number.

8.4.9 Conceptual site models (CSM) have been produced for the nine areas taken to Stage C and D assessments. The detailed CSM are provided in Volume 5 (Appendix LQ 001-013, 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 cut 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.

8.4.10 A summary of the baseline CSM is provided in Table 14. 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, the assessment is based on precautionary, worst case assumptions and may therefore report a higher risk than that which actually exists.

Table 14: Summary of baseline CSM for sites which may pose a contaminative risk for the Proposed Scheme

Area reference (1)	**Area name**	**Main potential impacts**	**Main baseline risk** (2), (3)
13-1	Calvert Landfill no.4 and 5 pits (Map LQ-01-028b, D8; Volume 5, Land Quality Map Book)	Exposure of on-site human receptors (commercial) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on-site human receptors (commercial) to contamination by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of on-site human receptors (commercial) to asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site human receptors (residential) to contamination by direct contact, ingestion and inhalation of contaminants in soil and	Moderate/low

Area reference (1)	Area name	Main potential impacts	Main baseline risk (2), (3)
		soil-derived dust.	
		Exposure of off-site human receptors (residential) to contamination by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of off-site human receptors (residential) to asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI and Decoypond Wood LWS) to lateral migration of contaminants in groundwater/leachate and surface run-off.	Low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI and Decoypond Wood LWS) to windblown dusts.	Low
		Exposure of on-site properties (commercial) to build-up of asphyxiative or explosive gases.	Moderate/low
		Exposure of on-site properties (commercial) to direct contact of property with contaminants in soil and groundwater.	Low
		Exposure of off-site properties (residential) to lateral migration and build-up of asphyxiative or explosive gases in off-site properties.	Moderate
		Exposure of off-site properties (residential) to direct contact with contaminants in soil and groundwater.	Very low
13-2	Aylesbury Link railway line adjacent to the Proposed Scheme (Map LQ-01-029, F5; Volume 5, Land Quality Map Book)	Exposure of off-site human receptors (residential and commercial) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on-site humans (commercial) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure to asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI Decoypond LWS, Calvert Jubilee LWS, Calvert Brick Pits, Great Moor Sailing Club LWS) to lateral migration of contaminants from soil to groundwater through culverts and surface run-off.	Low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI, Decoypond LWS, Calvert Jubilee LWS, Calvert Brick Pits, Great Moor Sailing Club LWS) to contaminants in windblown dusts.	Very low
		Exposure of off-site properties (commercial and residential) to lateral migration and build-up of asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site properties (commercial and residential) to direct contact of below ground building structures and services with contaminated groundwater/soil.	Very low
13-3	Former Calvert Brickworks (Map LQ-01-029, I8; Volume 5, Land Quality Map Book)	Exposure of on-site human receptors (residential) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on-site humans (residential) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure of on and off-site properties (residential and commercial) to	Very low

Area reference (1)	Area name	Main potential impacts	Main baseline risk (2), (3)
		direct contact with contaminants in soil and groundwater.	
13-6	Sewage Works (Map LQ-01-029, B7; Volume 5, Land Quality Map Book)	Exposure of on – and off-site human receptors (residential and commercial) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on – and off-site humans (residential and commercial) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure of on – and off-site humans (residential and commercial) to asphyxiative or explosive gases.	Moderate
		Exposure of Secondary A River Terrace Deposits to vertical and lateral migration of contaminated groundwater.	Low
		Exposure of on – and off-site properties (residential and commercial) to build up of asphyxiative or explosive gases.	Moderate
		Exposure of on-and off-site properties (residential and commercial) to direct contact with contaminants in soil and groundwater.	Very low
13-7	Dismantled Rugby to Quainton Great Central railway adjacent to the route (Map LQ-01-029, E6; Volume 5, Land Quality Map Book)	Exposure of off-site human receptors (residential and commercial) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Low
		Exposure of off-site human receptors (residential and commercial) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Low
		Exposure of off-site human receptors (residential and commercial) to asphyxiative or explosive gases.	Moderate/low
		Exposure of Secondary A Alluvium and Kellaways Formation to vertical and lateral migration of contaminants in groundwater.	Low
		Exposure of Secondary A Alluvium and Kellaways Formation to contaminants in surface run-off.	Low
		Exposure of ecological receptors (Calvert Jubilee LWS, Barton Hartshorn Railway Wood LWS) to lateral migration of contaminants in groundwater and surface run-off.	Low
		Exposure of ecological receptors (Calvert Jubilee LWS, Barton Hartshorn Railway Wood LWS) to contact with windblown dusts.	Very low
		Exposure of off-site properties (residential) to lateral migration and build up of asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site properties (residential) to direct contact of contaminants in soil and groundwater.	Very low
13-8	Calvert Pit 1 Historical Landfill (Map LQ-01-029, H8; Volume 5, Land Quality Map Book)	Exposure of on-site human receptors (residential) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on-site human receptors (residential) to contamination by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of on-site human receptors (residential) to asphyxiative or	Moderate/low

Area reference (1)	Area name	Main potential impacts	Main baseline risk (2), (3)
		explosive gases.	
		Exposure of off-site human receptors (residential) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Low
		Exposure of off-site humans (residential) to contamination by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of off-site human receptors (residential) to asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site ecological receptors (Calvert Jubilee LWS and Calvert Brick Pits, Great Moor Sailing Club LWS) to lateral migration of contaminants in groundwater and surface run-off.	Low
		Exposure of off-site ecological receptors (Calvert Jubilee LWS and Calvert Brick Pits, Great Moor Sailing Club LWS) to contaminants in windblown dusts.	Very low
		Exposure of on-site properties (residential) to lateral migration and build-up of asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site properties (residential) to lateral migration and build-up of asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site properties (residential) to direct contact with contaminants in soils and groundwater.	Very low
13-9	Historical Buckingham Rural District Council Refuse Tip (Map LQ-01-029, G7; Volume 5, Land Quality Map Book)	Exposure of off-site human receptors (residential) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Low
		Exposure of off-site humans (residential) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of off-site humans (residential) to asphyxiative or explosive gases.	Moderate/low
		Exposure of on-site ecological receptors (Calvert Jubilee LWS) to contaminants in surface water within lake.	Moderate/low
		Exposure of on-site ecological receptors (Calvert Jubilee LWS) to contaminants in windblown dusts.	Very low
		Exposure of off-site properties (residential) to lateral migration and build-up of asphyxiative or explosive gases.	Moderate/low
		Exposure of off-site properties (residential) to direct contact with contaminants in soil or groundwater.	Very low
13-10	Historical Aylesbury Borough Council Refuse Tip (Map LQ-01-029, F8; Volume 5, Land Quality Map Book)	Exposure of on-site human receptors (commercial) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on-site human receptors (commercial) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of on-site human receptors (commercial) to asphyxiative or explosive gases.	Moderate/low

Area reference (1)	Area name	Main potential impacts	Main baseline risk (2), (3)
		Exposure of off-site human receptors (residential) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Low
		Exposure of off-site human receptors (residential) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of off-site human receptors (residential) to asphyxiative or explosive gases.	Moderate/low
		Exposure of on-site ecological receptors (Calvert Brick Pits, Great Moor Sailing Club LWS) to contaminants in surface water within lake.	Moderate/low
		Exposure of on-site ecological receptors (Calvert Brick Pits, Great Moor Sailing Club LWS) to contaminants in windblown dusts.	Very low
		Exposure of on and off-site properties (residential and commercial) to lateral migration and build up of asphyxiative or explosive gasses.	Moderate/low
		Exposure of on and off-site properties (residential and commercial) to lateral migration of contaminants in soil and groundwater.	Very low
13-11	Airfield (formerly RAF Finmere) (Map LQ-01-031, B2; Volume 5, Land Quality Map Book)	Exposure of on-site human receptors (residential and commercial) to contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust.	Moderate/low
		Exposure of on-site human receptors (residential and commercial) by inhalation of ground-gas and volatile vapours from contaminated soil/water.	Moderate/low
		Exposure of on-site human receptors (residential and commercial) to asphyxiative or explosive gases.	None
		Exposure of Secondary A Undifferentiated glaciofluvial deposits and Kellaways Formation to leaching of contaminants in soil and vertical and lateral migration of contaminants in groundwater.	Low
		Exposure of on-site ecological receptors (West Wood LWS and Tingewick Meadows SSSI) to lateral migration of contaminants in groundwater and surface run-off.	Low
		Exposure of on-site ecological receptors (West Wood LWS and Tingewick Meadows SSSI) to contact with contaminants in windblown dusts.	Low
		Exposure of on and off-site properties (residential and commercial) to lateral migration and build-up of asphyxiative or explosive gasses.	None
		Exposure of on and off-site properties to direct contact with contaminants in soil and groundwater.	Low

(1) Each area is assigned a unique identification number (See Volume 5: Appendix LQ-001-013).
(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

8.4.11 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.

8.4.12 Table 15 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-001-013.

8.4.13 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 low/ moderate. 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 15: Summary of temporary (construction) effects

Area reference	Area name	Main baseline risk	Main construction Risk (1)	Temporary effect (and significance)
13-1	Calvert Landfill no.4 and 5 pits	Very low to moderate/low	Very low to moderate/low	Negligible (not significant)
13-2	Aylesbury Link railway line adjacent to the Proposed Scheme	Very low to moderate/low	Very low to moderate/low	Negligible (not significant)
13-3	Former Calvert Brickworks	Very low to moderate/low	Very low to moderate/low	Negligible (not significant)
13-6	Sewage Works	Very low to moderate	Very low to moderate	Negligible (not significant)
13-7	Disused Rugby to Quainton Great Central railway adjacent to the route	Very low to moderate/low	Very low to moderate/low	Negligible (not significant)
13-8	Calvert Pit 1 Historical Landfill	Very low to moderate/low	Very low to moderate/low	Negligible (not significant)
13-9	Historical Buckingham Rural District Council Refuse Tip	Very low to moderate/low	None to moderate/ low	Negligible (not significant)
13-10	Historical Aylesbury Borough Council Refuse Tip	Very low to moderate/low	Very low to moderate/low	Negligible (not significant)
13-11	Airfield (formerly RAF Finmere)	None to moderate/low	none 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.

8.4.14 Table 15 indicates that based upon the assessment, the construction phase is expected to have a negligible effect on the receptors overall and is not considered to be significant in relation to potential land contamination.

8.4.15 The railway cutting immediately adjacent to the operational Calvert Landfill will require excavation into what is expected to be natural ground adjacent to the landfill after passing through any track bed material. The landfill is formed in a former clay pit, the base of which lies below the existing railway ground level and the landfilling has been raised above the existing rail level. The landfill lining (below ground) is offset from the edge of the railway cutting excavation by varying distances, but expected to be about 15-20m or more from the excavation side. The cutting will have retained wall sides with ground anchors. The length of the anchors will be designed to avoid penetrating the landfill lining or entering the waste.

8.4.16 Grouting of the anchors into the natural clay is expected to mitigate any potential effects from creation of ground gas or leachate pathways into the cutting. Implementation of the measures set out in the draft CoCP will further mitigate any such potential effects. In addition to the excavation and treatment of contaminated soils, mitigation measures may include the installation of ground (landfill) gas and leachate control systems on a temporary or permanent basis.

8.4.17 It is unlikely that the remaining historical landfills will cause an effect due to their distance from the Proposed Scheme. However, in the event that unexpected contamination is encountered during the construction of the route in this area, this will be remediated as described in the draft CoCP resulting in an overall beneficial effect.

8.4.18 Construction compounds located in this study area will include the storage of potentially hazardous substances, such as fuels and lubricating oils and may also be used for temporary storage of potentially contaminated soils. Mitigation measures set out within the draft CoCP include management of risks from the storage of such materials.

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

Permanent effects

8.4.20 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.

8.4.21 Table 16 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 001-013.

Table 16: Summary of permanent (post-construction) effects

Area ref	Area name	Main baseline risk	Main post – construction Risk (1)	Post -construction effect and significance
13-1	Calvert Landfill no.4 and 5 pits	Very low to moderate/low	Very low to moderate/low	Negligible – not significant
13-2	Aylesbury Link railway line adjacent to the Proposed Scheme	Very low to moderate/low	Very low to moderate/low	Negligible – not significant
13-3	Former Calvert Brickworks	Very low to moderate/low	Very low to moderate/low	Negligible – not significant
13-6	Sewage Works	Very low to moderate	Very low to moderate	Negligible – not significant
13-7	Disused Rugby to Quainton Great Central railway adjacent to the route	Very low to moderate/low	Very low to moderate/low	Negligible – not significant
13-8	Calvert Pit 1 Historical Landfill	Very low to moderate/low	Very low to moderate/low	Negligible – not significant
13-9	Historical Buckingham Rural District Council Refuse Tip	Very low to moderate/low	None to moderate/low	Negligible – not significant
13-10	Historical Aylesbury Borough Council Refuse Tip	Very low to moderate/low	Very low to moderate/low	Negligible – not significant
13-11	Airfield (formerly RAF Finmere)	None to moderate/low	None 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.

8.4.22 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.

8.4.23 Table 16 shows that the Proposed Scheme results in either a reduction or no change in the level of risk already existing at each site for both on site and off site receptors.

Mining/mineral resources

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 No geo-conservation areas such as SSSI or LGS are present in the study area.

Other mitigation measures

8.4.27 Whilst Table 16 indicated that there is not likely to be a significant effect from Calvert Landfill, further mitigation measures to prevent gas or leachate migration from the Calvert Landfill may be required depending on local ground conditions, which will be confirmed prior to construction. These measures could include vents and/or barriers. If these further measures are required and adopted, the effect of any gas migration or leachate from the landfill will not be significant.

8.4.28 The CoCP details the approach to managing potential land contamination matters. No additional mitigation measures are considered necessary to mitigate risk from land contamination at construction phase beyond those set out in the draft CoCP and instigated as part of the required remediation strategies. However, in addition to the excavation and treatment of contaminated soils, it may also be necessary to install gas and leachate control systems within affected old landfill sites on a temporary or permanent basis, in order to ensure that 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

8.4.29 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, including the IMD, will be in accordance with environmental legislation and good practice whereby appropriate spillage and pollution response procedures will be established to ensure that there will be no significant risk to receptors including maintenance workers and controlled waters.

Assessment of impacts and effects

8.5.3 There will be two auto-transformer stations proposed in this study area, at Portway Farm and near Chetwode. Auto-transformer stations can, in principle, be a source of contamination 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.

Other mitigation measures

8.5.5 No other mitigation measures will be required beyond what has already been outlined relating to land quality in the Calvert, Steeple Claydon, Twyford and Chetwode area.

8.5.6 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

8.5.7 No significant residual effects are anticipated associated with the operation of the Proposed Scheme.

9 Landscape and visual assessment

9.1 Introduction

9.1.1 This section reports 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 (LCAs) 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:

- potential temporary effects to LCA and visual receptors during construction arising from the use of the temporary railhead to the south-west of Steeple Claydon, the construction of a sustainable placement area as part of the route-wide mass haul, the presence of construction plant, removal of existing vegetation, and severance of agricultural land; and
- potential permanent landscape and visual effects during operation arising from the presence of new engineered landforms within the existing landscape, a new infrastructure maintenance depot (IMD) which will be operational 24 hours a day, seven days a week; new viaducts; noise fence barriers; highway infrastructure (overbridges); overhead line equipment and regular passing of high speed trains. Permanent effects will reduce over time as the planting established as part of the Proposed Scheme matures.

9.1.4 A separate but related assessment of effects on the setting of heritage assets is included in Section 6 (Cultural Heritage). Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in Volume 5: Appendix LV-001-013, 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.

9.1.5 The extent of the landscape and visual study area, the distribution of visual receptor viewpoints and the location of verifiable photomontages has been discussed in consultation with Buckinghamshire County Council, Oxfordshire County Council, Aylesbury Vale District Council, and Cherwell District Council. Summer field surveys, including photographic studies of LCAs and visual assessment of viewpoints, were undertaken from July 2012 to October 2012 and from May 2013 to June 2013. Winter surveys were undertaken from January 2013 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 (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/1). 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), which are shown on Maps LV-07-047b to LV-07-051 and LV-08-047 to LV-08-051 (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-0001-000/2), and is an indication of the theoretical visibility of the Proposed Scheme. In some locations lack of data on vegetation cover may 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 landscape character areas and visual receptors.

9.2.3 LCAs and visual receptors within approximately 1km of the Proposed Scheme have been assessed. Long distance views of up to around 1.5km have been considered at selected locations such as Hillesden, Preston Bissett and Godington.

Limitations

9.2.4 During the baseline survey, there were some areas which were inaccessible (such as private land associated with commercial premises and residential buildings). In these instances, professional judgement has been used to approximate the likely views from these locations.

9.3 Environmental baseline

Existing baseline

Landscape baseline

9.3.1 The character of the area is predominantly rural. Settlement is generally dispersed, with a number of notable villages including: Calvert, Steeple Claydon, Twyford, Preston Bissett and Chetwode. Land use comprises mixed agriculture, with pasture dominating, particularly close to watercourses. Field patterns are generally regular and bounded by mature hedgerows. Overall woodland cover is low, except to the south of the area which contains the well-wooded Calvert Jubilee Nature Reserve LWS and Decoypond Wood. To the south around Calvert, the rural character is interrupted by the presence of the Calvert Landfill site.

9.3.2 The settlement of Chetwode contains a conservation area and a number of notable historic buildings including the Church and Priory of St. Mary and St. Nicholas and The Hermitage. There are also conservation areas in Twyford and Preston Bissett. Industrial heritage is present in the well-vegetated dismantled Great Central Main

Line. A network of minor roads and tracks traverse the study area and the A4421 is one of only a few major roads in the area, passing along the northern edge of the study area. There are also two existing freight railway lines (the Aylesbury Link railway line and the Bicester to Bletchley Line). The Cross Bucks Way and the Bernwood Jubilee Way are two promoted PRoW that cross this area.

9.3.3 The LCAs have been determined with reference to National Character Areas[53], the Landscape Plan for Buckinghamshire Part 1: Landscape Character Assessment[54], The Aylesbury Vale Landscape Character Assessment[55], and The Cherwell District Landscape Assessment[56].

9.3.4 Descriptions of all LCAs are provided in Volume 5: Appendix LV-001-013 Part 2. For the purposes of this assessment, the study area has been sub-divided into seven discrete LCAs, three of which are most likely to be affected, namely Claydon Bowl, Twyford Vale, and Preston Bissett Plateau Edge. A summary of these LCAs is provided below. The LCAs are shown on Maps LV-02-047 to LV-02-051 in Volume 2, CFA13 Map Book).

Claydon Bowl LCA

9.3.5 This LCA comprises a ridge of higher ground around the edges which slopes to lower ground in the centre to form a bowl. Located in the centre is the National Trust owned Claydon House Estate and Parkland, which is designated as a Grade II listed Registered Park and Garden. The area supports mixed farming but the north-west of this LCA, which coincides with the study area, is predominantly open arable farmland. The LCA generally has a strong hedgerow pattern that unifies the area. As a result, the condition of the landscape is considered to be good. Tranquillity is considered to be high due to a low level of settlement, relative low number of publicly accessible highways, and an infrequent freight train service. Up to four trains a day travel along the Bicester to Bletchley Line south of Steeple Claydon and the Aylesbury Link railway line to the south-west of the LCA. This LCA features Claydon House Estate and Parkland and therefore has a national level value. Therefore, this area has a high degree of sensitivity.

Twyford Vale LCA

9.3.6 This LCA comprises a shallow agricultural valley of relatively level landform which supports mixed farming. A well-maintained hedgerow pattern unifies the area and there are few visual detractors. As a result, the condition of the landscape is considered to be good. Tranquillity is high as there are a number of secluded areas with little road access. The area is valued at the district level due to the presence of an

[53] Countryside Agency (now Natural England), (1999), *Countryside Character Volume 7: South East and London*, Countryside Agency, Cheltenham.
[54] Buckinghamshire County Council, (2001), *Landscape Plan for Buckinghamshire Part 1: Landscape Character Assessment*, Buckinghamshire County Council, Aylesbury.
[55] Jacobs, (2008), *Aylesbury Vale: Areas of Sensitive Landscape, prepared for Buckinghamshire County Council and Aylesbury Vale District Council*, Aylesbury Vale District Council, Aylesbury.
[56] Cobham Resource Consultants (1995), *Cherwell District Landscape Assessment, Section 3: Oxfordshire Estate Farmlands*, Cherwell District Council, Banbury.

extensive PRoW network, including two promoted rights of way: the Cross Bucks Way and the Bernwood Jubilee Way. Therefore, this area has a high degree of sensitivity.

Preston Bissett Plateau Edge LCA

9.3.7 This is a rural LCA comprising an undulating clay plateau incised by a number of small streams. The conservation area at Chetwode, containing historic structures such as The Church of St Mary and St Nicholas, The Priory and The Hermitage, is a valued part of landscape character. A well-maintained, strong hedgerow pattern and numerous areas of woodland mean the landscape is generally considered to be in a good condition. Tranquillity is considered to be high due to extensive areas of woodland creating a sense of seclusion and relatively low levels of traffic. The area is valued at the district level due to the extensive network of PRoW, including the promoted Bernwood Jubilee Way, and the presence of a conservation area at Chetwode. Therefore, this area has a high degree of sensitivity.

Visual baseline

9.3.8 Descriptions of the identified representative viewpoints are provided in Volume 5: Appendix LV-001-013 Part 2. A summary description of the distribution and types of receptors most likely to be affected is provided below. The viewpoints are shown on Maps LV-03-047 to LV-03-051 and LV-04-047 to LV-04-051 in Volume 2, CFA13 Map Book. The viewpoints are numbered to identify their locations. 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, 7: active sports.

9.3.9 No protected views have been identified within the study area.

9.3.10 Residential receptors have a high sensitivity to change and are located in the main villages of Calvert, Steeple Claydon, Twyford and Chetwode, as well as at smaller dispersed settlements throughout the area such as Godington. Views within the study area are typically rural across agricultural fields with occasional agricultural buildings and settlement. The combination of gently undulating topography and intervening hedgerow vegetation bordering fields generally limits the extent of views. The slightly elevated topography around Steeple Claydon, however, affords more open views across large arable fields to the south, and the slightly raised topography around Preston Bissett affords longer-distance views across the lower lying vale landscape to the south and west.

9.3.11 Recreational receptors, also with a high sensitivity to change, are located on PRoW throughout the study area, including promoted footpaths such as the Bernwood Jubilee Way and the Cross Bucks Way. The viewpoints are typically located in rural agricultural locations, with pasture or arable fields in the foreground and vegetated field boundaries providing some degree of enclosure. The undulating topography and intervening hedgerow vegetation generally limits the extent of views, except from the elevated topography around Steeple Claydon and Preston Bissett which offers views over the surrounding lower ground.

9.3.12 Viewpoints for people travelling along scenic roads have a medium sensitivity to change and are located on School Hill, Main Street, West Street and from public highways around Chetwode. These views are largely rural, overlooking arable land and pasture, with roadside vegetation generally limiting the extent of views.

Future baseline

9.3.13 A summary of the committed developments which are assumed to be built and occupied prior to either the construction and/or of operation of the Proposed Scheme is provided below, along with the consequential effect on the character of LCAs and nature of views. Developments which will introduce new visual receptors which may be significantly affected are also described. These developments are shown on Maps CT-13-028-CT-13-031 (Volume 5, Cross Topic Appendix 1 Map Book).

Construction (2017)

9.3.14 The East West Rail project proposes to upgrade the existing freight railway lines (Bicester to Bletchley Line and the Aylesbury Link) to passenger services by 2017. The proposals include two passenger trains per hour in each direction on the Bicester to Bletchley Line, and one passenger train per hour in each direction on the Aylesbury Link railway line. The project also proposes to accommodate upgraded freight services. This will run directly through Claydon Bowl LCA and a small area of Twyford Vale LCA causing a localised reduction in tranquillity. This will reduce overall tranquillity in Claydon Bowl LCA and will cause a reduction in sensitivity to medium. However, it will not be sufficient to reduce overall tranquillity in Twyford Vale LCA as the project will be located on the southern edge of the LCA and so the sensitivity will be unchanged for the assessment of effects during construction.

9.3.15 The residential development in Calvert Green (on Brickhill Way and Sandstone Close) will introduce new buildings and new tree planting within the Calvert Clay Pits LCA. Due to the extent of existing housing development in the LCA, (described in Volume 5: Appendix LV-001-013 Part 2) the Calvert Green development will not be wholly uncharacteristic and the sensitivity will be unchanged for the assessment of effects during construction. However, views from the existing residences on the edge of Calvert Green will be further obstructed by the development. These views are suitably represented by viewpoint 151.2.001 shown on Map LV-03-047 (Volume 2, CFA13 Map Book).

9.3.16 The Greatmoor Energy from Waste facility, will comprise a large building (180m long, 70m wide and 52m high) including a chimney stack (up to 95m high). The Energy from Waste structure (within CFA12) is assumed to be completed by 2017 with landfill operations in Pit 6 (within CFA12) continuing through to 2026. Within CFA13 there will be phased landfill restoration to landfill pits 4 and 5 within Calvert Clay Pits LCA. Restoration planting would be in a juvenile state at the time of construction and therefore the overall sensitivity of the Calvert Clay Pits LCA would be unchanged for the assessment of effects during construction.

Operation (2026)

9.3.17 The East West Rail project will cause a localised reduction in tranquillity in Claydon Bowl LCA and Twyford Vale LCA. This will reduce overall tranquillity in Claydon Bowl LCA and will cause a reduction in sensitivity to medium. However, it will not be sufficient to reduce overall tranquillity in Twyford Vale LCA as the project will be located on the southern edge of the LCA, and so the sensitivity will be unchanged for the assessment of effects during operation.

9.3.18 By 2026, the tree planting established as part of the development in Calvert Green (described within the Construction section above) will have matured; although it will not alter the character of the Calvert Clay Pits LCA. The sensitivity of this area will remain as low during year 1 of operation. Although new residential receptors will be introduced by the Brickhill Way development, these will be suitably represented by viewpoint 151.2.001.

9.3.19 Phased landfill restoration as part of the Greatmoor Energy from Waste facility will be such that by 2026, Calvert Clay Pits LCA is likely to be subject to a level of restoration. This will replace existing landfill operations in Pit 4 and 5 (within CFA13) with a landscape of pasture and woodland planting and will also introduce new PRoW to the south-east of Calvert. The planting of hedgerows and woodland copses will increase woodland cover substantially and will serve to improve landscape condition. However, due to the on-going landfill activities within the adjacent Pit 6 and the presence of the Energy from Waste facility to the south (both within CFA12), the sensitivity of this LCA will remain low for the assessment of effects during year 1 of operation.

9.3.20 Although new recreational receptors will be introduced to the south-east of Calvert by the Greatmoor Energy from Waste facility, these will be suitably represented by viewpoint 147.3.001 (reported in Volume 5: Appendix LV-001-012).

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 are temporary and vary over the construction period depending on the intensity and scale of the works at the time.

9.4.2 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 study area will generally be considered to be long-term given the construction programme (see Section 2.3). Overall, civil engineering works in this study area will be undertaken between the start of 2017 and the middle of 2023.

9.4.3 The West Street overbridge main compound will be in place for approximately six years and nine months. Satellite compounds will be in place for between approximately three and six years. The civil engineering works at most individual sites along the route in this study area will occur for a period of between approximately six months and two and a half years, with the exception of the Calvert cutting (approximately five and a half years) and East and West retaining walls (approximately four 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.

9.4.4 The construction works that have been taken into account in determining the effects on landscape and visual receptors include:

- Sheephouse Wood mitigation structure;
- Calvert cutting including retaining walls;
- the FCC Environment waste transfer sidings east of Calvert;
- Calvert green overbridge and the waste transfer sidings east of Calvert;
- School Hill green overbridge;
- Aylesbury Link railway line realignment;
- the temporary railhead, including construction and use for the mass haul and rail systems phases;
- the IMD, and associated Addison Road overbridge and Footpath SCL/8 overbridge;
- the sustainable placement area, including use for the mass haul phase, south of Shepherd's Furze Farm;
- presence of the Perry Hill Road 1 roadhead and Perry Hill Road 2 roadhead and associated vehicular traffic;
- the East West Rail overbridge;
- Perry Hill overbridge, West Street overbridge and Charndon Lodge underbridge;
- Twyford embankment;
- Twyford viaduct;
- Footpath PBI/5 accommodation overbridge;
- Restricted Byway PBI/5A accommodation overbridge;
- Godington east viaduct and Godington west viaduct;
- Chetwode cutting;
- Footpath CHW/18 accommodation overbridge;

- School End overbridge; and
- Footpath BHA/2 overbridge and associated earthworks.

Avoidance and mitigation measures

9.4.5 Measures that have been incorporated into the draft CoCP (Volume 5: Appendix CT-003-000) to avoid or reduce landscape and visual effects during construction include the following (see Volume 5: Appendix CT-003-000/1):

- maximising the retention and protection of existing trees and vegetation where possible (draft CoCP, Section 12);
- use of well-maintained hoardings and fencing (draft CoCP, Section 5);
- designing lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses (draft CoCP, Section 5);
- 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);
- managing flood risk and other extreme weather events which may affect landscape and visual receptors during construction (draft CoCP, Section 16); 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).

9.4.6 These measures have been taken account of in the assessment of the construction effects.

Assessment of temporary impacts and effects

9.4.7 The most apparent changes to landscape character and viewpoints during construction will relate to the temporary presence of construction plant, the removal of existing landscape elements (such as trees, hedges and agricultural land), and the activity associated with introduction of the Proposed Scheme including cuttings up to 11m deep and embankments up to 5m high.

9.4.8 Changes will be most notable with the emerging construction of the IMD, Calvert cutting; embankments at Twyford and Cowley; Chetwode cutting and the construction and operation of the temporary railhead south-west of Steeple Claydon.

9.4.9 The height of the construction plant and the close proximity of construction activities to viewpoints, especially in areas with clear visibility and little intervening screening in the landscape will greatly affect visual impacts during construction. The topography in certain locations and the retention of intervening hedgerows and trees will partially screen low level construction activity.

Landscape assessment

9.4.10 The following section describes the likely significant effects on LCAs during construction. All LCAs within the study area considered to experience a not significant effect (minor adverse or negligible) are described in Volume 5: Appendix LV-001-013 Part 4.

Claydon Bowl LCA

9.4.11 The Proposed Scheme will run along the south-western boundary of this LCA for approximately 2.3km, and the IMD will be located south of Steeple Claydon (also located within Twyford Vale LCA). Construction activities associated with the IMD, temporary railhead, waste transfer sidings, Calvert cutting, including diaphragm walls, Bicester to Bletchley line and the Aylesbury Link realignment will introduce large volumes of construction plant and activity and will impact the rural setting of the area. Tall plant machinery used to construct overbridges such as Footpath SCL/8 overbridge and Bridleway GUN/28 accommodation green overbridge in CFA12, will be visible in characteristic views from higher ground, such as Knowl Hill and Steeple Claydon.

9.4.12 Construction of Grendon Underwood embankment (in CFA12), and Calvert cutting will result in the loss of a linear belt of approximately 1.5ha of ancient woodland separated from the south-western edge of Sheephouse Wood by the existing Aylesbury Link railway line. However this will not result in the loss of SSSI woodland. Furthermore, vegetation loss will occur along the two existing railways east of Calvert and south of Steeple Claydon. In addition, loss and severance of hedgerow vegetation will occur within the footprint of the IMD and temporary railhead to the south of Steeple Claydon and the waste transfer sidings near Decoypond Wood. This will impact the existing strong hedgerow pattern within the LCA.

9.4.13 The construction of the Calvert cutting (up to 6m depth), including retaining walls; mitigation earthworks along the northern edge of the IMD and temporary material stockpiles will all have a noticeable impact in an area where the landscape is generally flat and open.

9.4.14 The introduction of extensive construction activity into the area, including vehicles and lighting, will reduce tranquillity. In particular the route-wide mass haul will increase traffic due to construction vehicles into the west of the LCA with the use of School Hill and Addison Road.

9.4.15 The concentration of construction activity associated with the IMD and temporary railhead will be uncharacteristic within the rural setting. Also the loss of characteristic landscape elements such as hedgerows and agricultural land will substantially alter the rural character and setting of the area. In addition, the emerging engineered profiles will be uncharacteristic in this relatively flat landscape. Therefore the magnitude of change will be high.

9.4.16 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect.

Twyford Vale LCA

9.4.17 The route will run through the centre of this LCA between Calvert Jubilee Nature Reserve and Rosehill Farm, and the IMD will be located between Calvert Jubilee Nature Reserve and Addison Road (also located within Claydon Bowl LCA). Construction activities associated with the IMD, temporary railhead, Bicester to Bletchley line and the Aylesbury Link realignment will introduce large volumes of construction plant and activity and will impact the rural setting of the area.

9.4.18 Construction of the IMD and temporary railhead will also include the loss of and severance of hedgerow vegetation, including the removal of the strong hedgerow patterns north and east of Twyford.

9.4.19 The construction of Calvert cutting (up to 6m deep and 1.2km in length) including retaining walls, embankments (up to 4.5m high and 2.4km in length) mitigation earthworks and temporary material stockpiles will introduce new features into this existing flat landscape. In addition, the construction of a sustainable placement area (up to 5m high) to the south of Shepherd's Furze Farm will be particularly apparent within the flat landscape.

9.4.20 Construction activities will introduce vehicles and disturbance which will be uncharacteristic in this rural LCA. This will be noticeable to the east of the LCA with the use of Perry Hill Road, School Hill and Addison Road which will be used for the route-wide mass haul movement. Overall, construction activities will cause a noticeable reduction in tranquillity.

9.4.21 The loss of characteristic landscape elements such as hedgerows and agricultural land and the introduction of large scale construction activities will substantially alter the rural character and setting of the area. In addition, the emerging engineered profiles will be uncharacteristic in this relatively flat landscape. Therefore the magnitude of change will be high.

9.4.22 The high magnitude of change, assessed alongside the high sensitivity of the LCA, will result in a major adverse effect.

Preston Bissett Plateau Edge LCA

9.4.23 The Proposed Scheme will pass through the LCA between Rosehill Farm and Newton Purcell. The construction of Chetwode cutting (up to 10.5m in depth, approximately 1.9km in length), a large earthwork mound associated with Footpath BHA/2 overbridge, and temporary material stockpiles will alter the naturally undulating topography within this study area.

9.4.24 Construction activities will also result in the removal of the woodland at Manthorn Farm (approximately 1.3ha) and approximately 900m of vegetation from the

dismantled railway line between Barton Hill Farm and Newton Purcell. These are notable features within the local landscape context and contribute to the moderate woodland cover in the LCA. In addition there will be a loss and severance of hedgerow vegetation in fields adjacent to the Proposed Scheme, which will impact the strong hedgerow pattern in the LCA.

9.4.25 The concentration of construction activity around Chetwode cutting satellite compound and the use of Perry Hill Road for the route-wide mass haul movement will cause a noticeable reduction in tranquillity to the east and west of the LCA respectively. The visual presence of construction plant associated with the IMD and temporary railhead at Calvert to the south-east (within Twyford Vale LCA) will reduce the perception of tranquillity around Hillesden in the east of the LCA. In addition the construction of Chetwode cutting will occur around 100m to the west of the conservation area at Chetwode and will cause a noticeable impact on its setting.

9.4.26 The introduction of engineered profiles will be uncharacteristic within this naturally undulating topography. Although historically there has been a rail corridor through the area, it has been dismantled for some time and is now well integrated into the landscape. The loss of characteristic landscape elements such as the strong hedgerow pattern, and the introduction of large-scale construction activity will reduce tranquillity, impact the setting of the conservation area at Chetwode and substantially alter the rural character of the area. Therefore the magnitude of change will be high.

9.4.27 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect.

Visual assessment

9.4.28 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 view, will be in leaf. Where residential 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 a not significant effect (minor adverse or negligible) are described in Volume 5: Appendix LV-001-013 Part 4.

9.4.29 The number identifies the viewpoint locations which are shown on Maps LV-07-047 to LV-07-051 (Volume 5, Landscape and Visual Assessment Map Book). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in the area – 2: Residential, 3: Recreational, and 4: Transport.

9.4.30 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 152.3.001: View west from PRoW (Footpath SCL/12) near Great Pond Farm

9.4.31 Construction activities associated with the Calvert green overbridge, Calvert cutting, the Aylesbury Link realignment and the waste transfer siding will be visible in left of the middle ground, approximately 600m away. This will include tall cranes and piling rigs associated with the construction of the Calvert cutting retaining walls. Views of the construction of School Hill green overbridge will be evident in the centre of the middle ground around 650m away, although views will be heavily filtered through the intervening larch woodland belt. Construction activities associated with the sustainable placement area will also be visible approximately 500m away in the right of the middle ground, to the right of Calvert Jubilee Nature Reserve. Beyond this in the right background views of tall plant and gantry cranes associated with the temporary railhead will be available, approximately 1.5km away. Overall this construction activity will cause changes to the existing rural characteristic of the view, but views will be partially filtered by intervening vegetation. Taking the above into account, the magnitude of change will be medium.

9.4.32 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 151.2.001: View north-east from the junction between School Hill and Brackley Lane, Calvert

9.4.33 The Proposed Scheme will cross the middle ground view around 110m away. The demolition of the residential properties (12a and 12b Brackley Lane and The Station House (formerly Hazelbach) and will be clearly visible in the right and left of the middle ground. Construction activities associated with School Hill green overbridge and Calvert cutting retaining wall will be clearly visible in the centre of the middle ground, approximately 100m away. This will include vegetation removal to the left of the existing road and views of tall cranes and piling rigs. Construction activities associated with the sustainable placement area will also be visible in the left background. The large-scale construction activity will be highly visible and will occur at proximity. Taking the above into account, the magnitude of change will be high.

9.4.34 The high magnitude of change assessed alongside the high sensitivity of the receptor will result in a major adverse effect.

9.4.35 At night, light from the School Hill green overbridge satellite compound will be clearly visible to the right of the background. However, this will be seen against a baseline featuring roadside lighting and light spill from residential properties to the right of view. Therefore the magnitude of change to this receptor at night is considered to be medium, resulting in moderate adverse effects.

Viewpoint 152.4.001: View south-west from School Hill, east of Calvert

9.4.36 The Proposed Scheme will cross in the middle ground of this view approximately 600m away across an agricultural landscape. The removal of vegetation will be clearly

visible to the right of the existing road and within the fields within the right of the middle ground. Construction activities associated with the sustainable placement area, including vehicles used for the route-wide mass haul, will be clearly visible in the right foreground and middle ground. Beyond this construction activities associated with Calvert cutting and the Aylesbury Link realignment will be visible in the background in front of Calvert Jubilee Nature Reserve. In addition tall construction plant used to construct School Hill green overbridge and Calvert cutting and the School Hill green overbridge satellite compound will be visible in the centre of the background. Overall this activity will represent a substantial change in the existing view of a rural road. Taking the above into account, the magnitude of change will be high.

9.4.37 The high magnitude of change, assessed alongside the medium sensitivity of the receptor, will result in major adverse effects.

Viewpoint 154.3.002: View south-west from PRoW (Footpath SCL/8) south of Steeple Claydon Allotment Gardens

9.4.38 Activities associated with the construction of the IMD and operation of the temporary railhead at Calvert will be clearly visible in front of the existing railway line in the middle ground of the view. This will include temporary material stockpiles and solid hoarding as well as the IMD reception sidings satellite compound, visible in the left middle ground approximately 350m away. In addition tall plant used to construct the Footpath SCL/8 overbridge (approximately 790m away) and Addison Road overbridge (approximately 1.1km away) will be clearly visible across the lower lying arable land beyond the arable fields. Overall this large-scale construction activity will result in the addition of new highly visible features, including tall construction plant, which will be uncharacteristic with the existing view across an intensely managed arable landscape. Taking the above into account, the magnitude of change will be high.

9.4.39 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

Viewpoint 154.2.003: View south-west from Church End, Steeple Claydon

9.4.40 Tall construction plant associated with the construction of Footpath SCL/8 overbridge (approximately 700m away) and the Addison Road overbridge (approximately 1km away) will be clearly visible in the middle ground of the view, appearing as elevated features within this relatively open farmland setting. Activities associated with the construction of the IMD and the operation of the temporary railhead will also be clearly visible along the line of the existing railway line, approximately 500m away at its closest point. This will include temporary material stockpiles and solid hoarding. Overall the construction of the Proposed Scheme will be highly visible and uncharacteristic within this relatively open and rural view. Therefore, the magnitude of change will be high.

9.4.41 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.42 The view of the Proposed Scheme from this location during construction is illustrated on the photomontage shown in Figure LV-01-193 (Volume 2, CFA13 Map Book).

9.4.43 Light associated with the construction of the IMD and temporary railhead will be clearly visible within the centre and right of the view. This will be seen against a baseline featuring only faint background light associated with Calvert village and Calvert Landfill site, and will be uncharacteristic within the existing view at night. Therefore, the magnitude of change is considered to be high, resulting in major adverse effects.

Viewpoint 154.2.002: View south-west from Addison Road, Steeple Claydon

9.4.44 Construction activities associated with the IMD and temporary railhead will be clearly visible within the middle ground view approximately 500m away. In addition the subsequent operation of the temporary railhead will be visible, including the ingress and egress of freight trains. Views of the Addison Road overbridge construction will also be available to the left of the existing electrical sub-station, approximately 550m away. In addition, the West Street overbridge main compound and Calvert railhead main compound will be visible in the background of this view about 1.6km away, filtered through intervening hedgerow vegetation. Overall, this concentration of construction activity will create visual intrusion in this rural view, although partially filtered by intervening vegetation within hedgerows. Therefore the magnitude of change will be medium.

9.4.45 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.46 At night, the use of lighting from West Street overbridge main compound and the Calvert railhead main compound will be visible within the background resulting in a clear change in the view, partially filtered by intervening vegetation. The magnitude of change will be medium, resulting in major adverse effects.

Viewpoint 156.2.002: View south from Elm Tree Farm, Steeple Claydon

9.4.47 Construction activities associated with the temporary railhead, the IMD and the removal of hedgerow vegetation will be clearly visible in the middle ground of the view, approximately 300m away. This will include approximately 3m high temporary material stockpiles in the centre of the view. In addition, the subsequent operation of the temporary railhead will be visible, including the ingress and egress of freight trains. The construction of the Addison Road overbridge will also be visible as an elevated feature in the left background, approximately 900m away. Views, however, will be filtered by intervening hedgerow vegetation. This will include tall construction plant associated with the Calvert railhead main compound around 900m away. Overall, the introduction of this large-scale construction activity, including tall plant,

will represent a major alteration to this open, flat, rural view. Therefore the magnitude of change will be high.

9.4.48 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.49 At night, the use of lighting from the Calvert railhead main compound and West Street overbridge main compound will cause a clearly visible change in the night-time view. Therefore, the magnitude of change will be high, resulting in major adverse effects.

Viewpoint 155.2.002: View north-east from Portway Farm, Twyford

9.4.50 Tall plant used to construct Perry Hill overbridge will also be visible, but filtered by the intervening woodland. Construction activities associated with Charndon Lodge underbridge and the East West Rail overbridge will be clearly visible in the right of the view next to Calvert Jubilee Nature Reserve, approximately 700m away. To the right, middle ground filtered views of the Bicester to Bletchley rail line satellite compound will also be available approximately 400m away. In addition, construction activities associated with the Calvert IMD will also be visible in the background, beyond the existing Perry Hill Road. Overall, this activity will result in the addition of new features that are highly visible and uncharacteristic within the existing views of farmland. Therefore the magnitude of change will be high.

9.4.51 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.52 At night, the use of lighting from the Calvert railhead main compound and West Street overbridge main compound will be visible in the right of view, over 700m away. This will be seen against a baseline featuring only faint light spill from the nearby residential property on the left, and distant light associated with Calvert on the right. This will be highly visible and uncharacteristic within the existing, relatively dark rural night-time view. Therefore the magnitude is considered to be high, resulting in a major adverse effect.

Viewpoint 156.4.001: View south-west from the road west of Lake Farm

9.4.53 The construction of Perry Hill and West Street overbridges will be clearly visible from this viewpoint. Construction of Perry Hill overbridge will be visible in the left foreground approximately 275m away, and activities associated with West Street overbridge will be visible approximately 300m away to the left of Portway Farm. In addition construction activities associated with Calvert cutting will also be clearly visible in the middle ground with some intermittent screening provided by roadside vegetation across the foreground. The existing mature coniferous shelter belt planting lining the road will largely restrict views to the right. Increased construction traffic associated with the route-wide mass haul movement will also be visible along Perry Hill. Overall this large-scale construction activity will be highly visible and

uncharacteristic within the existing rural view. Therefore, 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 major adverse effects.

Viewpoint 155.4.001: View north from West Street, east of Twyford

9.4.55 The Proposed Scheme will cross this near-distance view of a mixed-agricultural landscape approximately 130m away. Vegetation removal on either side of the road will be clearly apparent and will open up views to construction activities beyond including that associated with West Street overbridge, Calvert cutting and Twyford embankment. Views of tall construction plant used to construct Perry Hill overbridge will be visible to the right of the view behind Portway Farm. In addition, approximately 3m high temporary material stockpiles will be visible in the left of the view along the route of the dismantled railway. This large-scale construction activity will occur in proximity to the visual receptor and will cause a substantial change in the existing view of a rural road. Taking the above into account, the magnitude of change will be high.

9.4.56 The high magnitude of change, assessed alongside the medium sensitivity of the receptor, will result in major adverse effects.

Viewpoint 155.2.001: View north from Portway Road

9.4.57 Temporary material stockpiles and the construction of the Calvert cutting will be visible in the middle ground view, approximately 350m away and behind the dismantled railway, with views filtered through the intervening vegetation. In addition tall construction plant used in the construction of West Street overbridge will be visible in the right middle ground. This construction activity will represent a visible change that will be uncharacteristic within the existing rural view, but intervening vegetation will partially filter views. Therefore, the magnitude of change will be medium.

9.4.58 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

9.4.59 The night-time effect of construction lighting will be not significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 156.3.001: View south-west from the Cross Bucks Way PRoW (Footpath PB1/15) near Three Bridge Mill, Twyford

9.4.60 Construction activities associated with the Twyford embankment, including topsoil stripping and earthworks, will be clearly visible across the centre middle ground of the view approximately 400m away. To the left views of the construction of Calvert cutting will be heavily restricted by intervening hedgerow vegetation along Padbury Brook. Overall this construction activity will alter the existing rural character of the

view, but will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

9.4.61 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

Viewpoint 157.2.001: View north-east from Church Gate, Twyford

9.4.62 The construction of Twyford embankment will be clearly visible in the foreground beyond the dismantled railway, approximately 250m away. Tall construction plant used to construct Twyford viaduct will also be clearly visible alongside vegetation around The Assumption of the Blessed Virgin Mary (Church of England) Church in Twyford. Construction activities on this scale will be uncharacteristic within the existing view of a predominantly pastoral landscape and will represent substantial changes close to the viewer. Therefore, the magnitude of change will be high.

9.4.63 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.64 Additional lighting associated with construction of the Proposed Scheme will result in not significant effects. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 158.2.001: View south-west from Cowley Lodge

9.4.65 The Proposed Scheme will cross this middle-distance view approximately 600m away. Construction activities associated with Twyford embankment will be visible in the centre of the view in front of Twyford, with views filtered through intervening hedgerow vegetation. Views of the construction of the Twyford viaduct will also be available to the right of Twyford, filtered by intervening vegetation along the Padbury Brook. In addition, a temporary material stockpile will be visible in the centre background in front of Twyford. This large-scale construction activity will substantially change the existing rural view, but will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

9.4.66 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

9.4.67 Additional lighting associated with construction of the Proposed Scheme will result in not significant effects. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 158.3.001: View south-west from PRoW (Footpath TWY/16, PBI/8/11 and PBI/8/10) south-west of Cowley Lodge

9.4.68 Construction of Twyford embankment will be clearly visible across the open arable fields and pasturelands in the foreground, approximately 200m away. In addition, the tall construction plant used to construct Twyford viaduct will be visible in the right background with views filtered through the intervening vegetation lining the Padbury Brook. Overall this construction activity will represent a substantial change in the

existing rural view across farmland towards Twyford, and will be in proximity to the visual receptor. Taking the above into account, the magnitude of change will be high.

9.4.69 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

Viewpoint 157.3.001: View north-east from PRoW (Restricted Byway TWY/7) between Twyford and Twyford Mill

9.4.70 The construction of Footpath PBI/5 accommodation overbridge and Cowley embankment will be clearly visible in the middle round, 600m away behind the dismantled railway vegetation. Views of tall construction plant associated with the construction of Twyford viaduct will be available to the right of view 650m away, filtered through intervening hedgerow vegetation. Filtered views of construction activities associated with Restricted Byway PBI/5A accommodation overbridge will also be available around 750m from the viewer to the left of the view. This activity will be seen within the context of an agricultural landscape and will represent a substantial change in the existing view, but will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

9.4.71 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

Viewpoint 159.3.003: View north-east from PRoW (Restricted Byway PBI/5) north of Twyford Mill

9.4.72 Construction of Restricted Byway PBI/5A accommodation overbridge and associated removal of vegetation lining either side of the existing bridleway will be prominent in the centre foreground of the view, approximately 50m away. Construction of Twyford cutting will also be clearly visible on either side of the existing bridleway bridge, and will include earthworks and temporary material stockpiles. Tall construction plant used to construct Footpath PBI/5 accommodation overbridge will also be visible in the background, to the left of the dismantled railway route. Overall this construction activity will introduce prominent construction plant and existing views of the rural bridleway will be substantially changed. Taking the above into account, the magnitude of change will be high.

9.4.73 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

Viewpoint 160.2.001: View south-west from Cowley Farm

9.4.74 The construction of Footpath PBI/5 accommodation overbridge will be visible within the centre background, approximately 550m away, but views will be partly filtered by vegetation in the middle ground. Tall construction plant used for the construction of Restricted Byway PBI/5A accommodation overbridge will be visible to the right part of the view, in front of Twyford Mill, with views partly blocked by intervening topography. However viewers from second storey windows are likely to attain clearer

views of this construction activity. Overall, the construction activity will represent a substantial change to the existing view but will be partially screened by intervening vegetation and topography. Taking the above into account, the magnitude of change will be medium.

9.4.75 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

9.4.76 Additional lighting associated with construction of the Proposed Scheme will result in not significant effects. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 160.3.001: View south from PRoW (Footpath PBI/5) west of Cowley Farm

9.4.77 The closest visible construction activities will be those associated with Twyford embankment and Cowley embankment in the middle ground of the view, approximately 570m away. Views will be intermittently filtered however, through intervening vegetation in the middle ground. Tall construction plant associated with the construction of Footpath PBI/5 accommodation overbridge will also be visible approximately 1km away, in front of Twyford village. Views to the right are restricted by intervening topography. Overall this large-scale construction activity will represent a change in the view, but will be partially filtered by intervening vegetation and landform. Taking the above into account, the magnitude of change will be low.

9.4.78 The low magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

Viewpoint 159.3.001: View south from the Bernwood Jubilee Way PRoW (Footpath TWY/11) and PRoW (Bridleway TWY/10) west of Twyford Mill

9.4.79 The construction of Twyford cutting and Godington east viaduct and Godington west viaduct will be visible in the centre of the view, approximately 850m away, although views will be partially restricted by intervening middle ground topography and hedgerow vegetation. The construction of Restricted Byway PBI/5A accommodation overbridge will be visible around 950m away, but partially obscured by intervening mature vegetation associated with field hedgerows. Overall, this construction activity will cause a change in the existing rural view, but the change will occur at a distance and views will be largely filtered by intervening vegetation. Taking the above into account, the magnitude of change will be low.

9.4.80 The low magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

Viewpoint 162.2.001: View south-west from Main Street, Preston Bissett

9.4.81 The construction of Godington east viaduct and Godington west viaduct will be clearly visible in middle ground of the view, approximately 700m away, and in front of the existing dismantled railway embankment. However views will be partially filtered by intervening middle ground hedgerow vegetation. This activity will lead to a partial

alteration in the character of the view therefore, the magnitude of change will be medium.

9.4.82 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

9.4.83 Additional lighting associated with construction of the Proposed Scheme will result in not significant effects. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 161.3.001: View north from PRoW (Footpath 225/5) east of Moat Farm

9.4.84 The construction of Godington east viaduct and Godington west viaduct will be visible in the background of the view, approximately 420m away, beyond the existing dismantled railway embankment. These construction activities will be seen within a rural landscape and will represent a substantial change in the view but will be partially restricted by intervening landform and vegetation of the dismantled railway. Taking the above into account, the magnitude of change will be medium.

9.4.85 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in moderate adverse effects.

Viewpoint 164.4.001: View south from PRoW south-east of Chetwode

9.4.86 Construction activities associated with Chetwode cutting, including temporary topsoil stockpiles, will be visible in the centre middle ground in front of the dismantled railway approximately 450m away. The loss of hedgerow vegetation will also be clearly visible in the left of the view with the construction of a flood compensation area. Tall construction plant used to construct Godington east viaduct and Godington west viaduct will also be visible approximately 650m away behind the mixed species woodland. Overall, this construction activity will cause substantial changes in the existing rural view, although it will be partially filtered by the intervening vegetation. Therefore the magnitude of change will be medium.

9.4.87 The medium magnitude of change, assessed alongside the medium sensitivity of the receptor, will result in a moderate adverse effect.

Viewpoint 164.2.001: View south-west from 'The Green', Chetwode

9.4.88 The construction of 'The Green' realignment and loss of roadside vegetation will be clearly visible in the foreground of the view, approximately 50m away and to the left of the existing road. Vegetation loss and construction plant associated with the creation of the Chetwode cutting and Chetwode auto-transformer station will also be visible where the existing T-junction is located. The demolition of Sunflower Cottage will also be apparent in the background of the view. The introduction of large-scale construction activity and the removal of large amounts of roadside vegetation will cause a major alteration to this view and will occur at proximity to the visual receptor. Therefore, the magnitude of change will be high.

9.4.89 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.90 Additional lighting associated with construction of the Proposed Scheme will result in not significant effects. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 163.3.001: View north-east from PRoW (Footpath CHW/18) south of Manthorn Farm

9.4.91 Construction of Chetwode cutting will be clearly visible in the foreground of the view, approximately 125m away. This will include the demolition of Sunflower Cottage in the right middle ground. The removal of the woodland at Manthorn Farm in the centre of the view will open up views beyond towards Chetwode. Construction of Footpath CHW/18 accommodation overbridge will be prominent in the right of the middle ground and construction of 'The Green' realignment will also be visible in the right of the background. This activity will cause substantial changes to the existing view, therefore the magnitude of change will be high.

9.4.92 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

Viewpoint 166.2.003: View west from School End, Chetwode

9.4.93 The Proposed Scheme will cross this near-distance view across undulating arable land in the middle ground, approximately 350m away. Temporary material stockpiles approximately 3m high, loss of hedgerow vegetation and the construction of Chetwode cutting will be clearly visible across the middle ground in front of the dismantled railway. Construction plant used in the construction of School End overbridge and the Chetwode cutting satellite compound will be visible to the left of the residential properties along School End. This large-scale construction activity will occur in close proximity and will be uncharacteristic within the existing rural view. Taking the above into account, the magnitude of change will be high.

9.4.94 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.95 At night, light arising from the Chetwode cutting satellite compound will be perceptible in the right middle ground. This will be seen against a baseline featuring only faint night-time lighting associated with residential properties along School End. Therefore, the magnitude of change will be medium, resulting in moderate adverse effects.

Viewpoint 165.4.001: View north east from School End, west of Chetwode

9.4.96 The Proposed Scheme will cross this near-distance view approximately 100m away. The construction of School End overbridge will be prominent beyond the existing bridge. The Chetwode cutting satellite compound will be clearly visible to the right of the existing bridge. Construction activities associated with the Chetwode cutting, in particular earthworks and temporary material stockpiles, will be visible across the

middle ground of the view. In addition, vegetation losses will be apparent along the road on either side of the existing bridge and along the dismantled railway on the left of the view. Construction activities on this scale will cause substantial changes at close proximity to the existing view. Therefore, the magnitude of change will be high.

9.4.97 The high magnitude of change, assessed alongside the medium sensitivity of the receptor, will result in major adverse effects.

Viewpoint 166.2.001: View south-west School End, Chetwode

9.4.98 The Proposed Scheme will cross this near-distance view approximately 160m away. Roadside vegetation losses will be clearly visible within the centre of the view on either side of the road. This will reduce vegetation cover, thereby opening up views towards other construction activities. The construction of the School End overbridge and the Chetwode cutting satellite compound will be clearly visible in the middle ground to the left of the road in front of where the existing bridge is located. In addition, construction activity associated with Chetwode cutting will be visible across the centre of the view approximately 160m away. This will include clearly visible temporary material stockpiles. The introduction of this large-scale construction activity will cause substantial changes at close proximity to the existing view of a country lane. Taking the above into account, the magnitude of change will be high.

9.4.99 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.100 At night, lighting associated with the Chetwode cutting satellite compound in the centre middle ground will be perceptible within the largely unlit context featuring only faint night-time lighting. Therefore, the magnitude of change will be medium, resulting in moderate adverse effects.

Viewpoint 165.2.001: View north-east from Barton Hill Farm

9.4.101 The Proposed Scheme will cross this near-distance view approximately 180m away. Vegetation losses along the dismantled railway and from the mature woodland in the left background will be clearly visible and will open up views to construction activities beyond. The construction of the new School End overbridge and the adjacent Chetwode cutting satellite compound will be visible to the right of the view. This construction activity will be highly visible and uncharacteristic within the existing view. The removal of large amounts of vegetation will substantially alter the view. Taking the above into account, the magnitude of change will be high.

9.4.102 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in major adverse effects.

9.4.103 Additional lighting associated with Chetwode cutting satellite compound will be perceptible in the right middle ground. This will be seen against a baseline comprising a dark rural landscape. Therefore, the magnitude of change will be medium, resulting in moderate adverse effects.

Cumulative effects

9.4.104 Section 2.1 and Volume 5: Appendix CT-004-013 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 in Maps CT-13-028 to CT-13-031 (Volume 5, Cross Topic Appendix 1 Map Book).

Other mitigation measures

9.4.105 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 residual significant effects

9.4.106 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.

9.5 Permanent effects arising during operation

9.5.1 The specific elements of the Proposed Scheme that have been taken into account in determining the effects on landscape and visual receptors include the following, ordered from south to north:

- Calvert cutting;
- the FCC Environment waste transfer sidings east of Calvert;
- School Hill green overbridge;
- Sustainable placement area to the south of Shepherd's Furze Farm;
- Aylesbury Link realignment;
- the IMD;

- Addison Road overbridge;
- Footpath SCL/8 overbridge;
- East West Rail overbridge;
- Perry Hill overbridge;
- West Street overbridge;
- Twyford embankment;
- Twyford viaduct;
- Footpath PBI/5 accommodation overbridge;
- Restricted Byway PBI/5A accommodation overbridge;
- Godington east viaduct and Godington west viaduct;
- Chetwode cutting;
- Footpath CHW/18 accommodation overbridge;
- School End overbridge; and
- Footpath BHA/2 overbridge and associated earthworks.

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 and this process will continue as the design develops further. Measures that have been incorporated into the design of the Proposed Scheme include:

- the removal of footpath overbridges south of Steeple Claydon and east of Twyford and the removal of an accommodation overbridge north-east of Godington. This will reduce the impacts on the surrounding landscape and visual receptors;
- the route within Chetwode cutting (up to 10.5m in depth, and approximately 1.9km in length) will reduce visual impacts from Chetwode;
- embankment and cuttings, such as Twyford embankment and the highway realignment at Perry Hill Road, have been shaped so as to integrate the Proposed Scheme into the character of the surrounding landscape. Planting types will reflect tree and shrub species native to the local area and the form of planting will reflect the local landscape character;
- where it is considered that a noise fence barrier will create a visual impact on neighbouring residential properties, such as to the east of Twyford, planting will be provided for screening;

- balancing ponds, for example to the east of Portway Farm and to the north of Manthorn Farm, will be integrated into the landscape to alleviate flooding and, where possible, will also provide opportunities for biodiversity; and
- planting, including native broad-leaved woodland, shrub and hedgerows will be implemented to screen views from neighbouring residential properties and adjacent PRoW and to aid integration of the Proposed Scheme into the landscape. Species selection will take into account potential climate change impacts associated with the quality and availability of water and increase in pests and diseases in the future. This will be implemented at various locations along the Proposed Scheme such as adjacent to the Calvert IMD and adjacent Twyford embankment to the east of Twyford.

9.5.3 These measures have been taken account of in 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 during operation will arise from the presence of new engineered landforms and large infrastructure within the rural environment. This will include the IMD to the north of Calvert, the sustainable placement area to the south of Shepherd's Furze Farm as well as cuttings and embankments, elevated road bridges, overhead line equipment, noise fence barriers, and regular high speed trains.

9.5.5 At a number of locations, views of the Proposed Scheme will be obscured by the rising landform, retention of intervening hedgerows and trees and the Proposed Scheme within a cutting. Furthermore, effects will reduce over time as planting established as part of the Proposed Scheme, matures.

Landscape assessment

9.5.6 This section describes the significant effects on LCAs during year 1, year 15 and year 60 of operation. Not significant effects on LCAs are presented in Volume 5: Appendix LV-001-013 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 to 7.5m high). The assessment of effects in year 60 assumes all planting has reached its fully mature height.

Claydon Bowl LCA

9.5.8 The Proposed Scheme will run along the south-western boundary of this LCA and the IMD will be located south of Steeple Claydon (also located within Twyford Vale LCA). Landscape effects of the Proposed Scheme will include:

- presence of large-scale infrastructure associated with the IMD south of Steeple Claydon, the waste transfer sidings east of Calvert and the Sheephouse Wood mitigation structure (up to 10m in height, up to 800m in length) to the south-west of Sheephouse Wood. This will introduce large infrastructure within a predominantly rural context. This will impact characteristic views between

Steeple Claydon towards the lower ground to the south and will impact the setting of the village;

- engineered landforms, including Calvert cutting (up to 6m depth, and up to 1.8km in length), and elevated overbridges, such as Addison Road overbridge, within the natural gently undulating landform which will be uncharacteristic in the context of the adjacent landscape. However, earthwork profiling will help to integrate these structures into the gently undulating topography;
- presence of lighting around the IMD, which will impact the night-time character; and
- presence of high speed trains moving through the landscape.

9.5.9 There will be a reduction in tranquillity as a result of the visual presence of trains in a predominantly rural context. Operations and night-time lighting within the IMD will be particularly apparent from south of Steeple Claydon, and the new waste transfer sidings will be apparent from Knowl Hill.

9.5.10 Therefore, due to the major alteration to existing features of the character area, the magnitude of change is considered to be high in year 1 of operation.

9.5.11 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect in year 1 of operation.

9.5.12 Assuming the completion and operation of the EWR project set out in the future baseline, the sensitivity of the LCA would be medium and in combination with the high magnitude of change would result in a moderate adverse effect.

9.5.13 By year 15 of operation, mitigation planting and land-cover will have established sufficiently to achieve greater landscape integration of the Proposed Scheme into the agricultural landscape, including through:

- reducing the influence of the large infrastructural elements on the character of the landscape south of Steeple Claydon and east of Calvert whilst integrating with existing vegetation patterns;
- reducing the influence of engineered landforms and elevated highway infrastructure on the natural topography and character of the landscape, particularly Addison Road overbridge, Footpath SCL/8 overbridge and School Hill green overbridge; and
- partially screening and reducing the influence of the overhead line equipment and trains within the IMD to the south of Steeple Claydon.

9.5.14 Mitigation earthworks and planting along the northern edge of the IMD will serve to help integrate this feature into the natural topography of the LCA. However, the IMD and associated features will remain apparent and largely uncharacteristic within the setting of a rural landscape. Therefore the magnitude of change will be medium in year 15 of operation.

9.5.15 The medium magnitude of change, assessed alongside the high sensitivity of the LCA, will result in a moderate adverse effect.

9.5.16 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-001-013.

Twyford Vale LCA

9.5.17 The route will run through the centre of this LCA between Calvert Jubilee Nature Reserve and Rosehill Farm; and the IMD will be located between Calvert Jubilee Nature Reserve and Addison Road (also located within Claydon Bowl LCA). Landscape effects of the Proposed Scheme will include:

- presence of the Proposed Scheme including the IMD and the Aylesbury Link realignment north of Calvert. This will introduce large infrastructure and engineered landforms which will be uncharacteristic in the context of the adjacent rural landscape;
- engineered landforms, including Calvert cutting (up to 6m in depth, and approximately 1.2km in length) which will feature both retaining walls and open cuttings, Twyford embankments (up to 4.5m high) and a graded sustainable placement area to the south of Shepherd's Furze Farm (up to 5m high) will be noticeable within the relatively flat landform. However, mitigation earthworks along Twyford embankment, to the north of the IMD and the grading of the sustainable placement area will help to integrate these features into the natural topography;
- presence of Twyford viaduct, (up to 5m in height, and approximately 60m in length), including an approximately 4m high noise fence barrier and overhead line equipment on embankment will impact characteristic views across the flat landscape to the north of Twyford and will impact the setting of the village;
- presence of a noise fence barrier (up to a 5m in height, and approximately 1.1km in length) to the east of Twyford;
- presence of elevated overbridges, such as Perry Hill overbridge, and overhead line equipment which will be prominent within the relatively flat landscape and will impact characteristic views across the flat landscape. However earthwork profiling will help to integrate these structures into the natural topography;
- presence of lighting around the IMD which will have a localised impact on the night-time character and tranquillity; and
- presence of high speed trains moving through the landscape.

9.5.18 There will be a reduction in tranquillity of the LCA resulting from the presence of the large scale IMD facility and passing trains in the predominantly rural context. Operations within the IMD, including associated road traffic, will also be visually intrusive to the east of Twyford and would be uncharacteristic within the rural landscape setting.

9.5.19 Therefore, due to the major alteration to existing landscape character, the magnitude of change is considered to be high in year 1 of operation.

9.5.20 The high magnitude of change, assessed alongside the high sensitivity of the LCA, will result in a major adverse effect in year 1 of operation.

9.5.21 By year 15 of operation, mitigation planting and land-cover will have established sufficiently to achieve greater landscape integration of the Proposed Scheme into the agricultural landscape, including through:

- reducing the prominence of the extensive, large-scale infrastructure elements within the IMD;
- reducing the influence of engineered landforms and highway infrastructure, particularly Perry Hill overbridge, Footpath PBI/5 accommodation overbridge and Restricted Byway PBI/5A accommodation overbridge;
- partially screening and integrating Twyford viaduct and noise fence barrier into the landscape reducing their impact on the setting Twyford village;
- partially screening the overhead line equipment and passing trains on embankment reducing the impact on characteristic views across the flat landscape; and
- reinforcing the existing line of vegetation within the dismantled railway.

9.5.22 However, due to the continued influence of the IMD, which will be uncharacteristic within the rural setting, the influence of the sustainable placement area on the natural topography and elevated overbridge structures and overhead line equipment remaining apparent across the landscape, the magnitude of change will be medium in year 15 of operation.

9.5.23 The medium magnitude of change, assessed alongside the high sensitivity of the LCA, will result in a moderate adverse effect.

9.5.24 By year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming not significant. These are reported in Volume 5: Appendix LV-001-013.

Preston Bissett Plateau Edge LCA

9.5.25 The Proposed Scheme will pass through the LCA between Rosehill Farm and Newton Purcell. Landscape effects of the Proposed Scheme will include:

- engineered landforms, including Chetwode cutting (up to 10.5m deep and approximately 2km long), Barton Hartshorn embankment (up to 4m high and approximately 350m long) and elevated overbridges, such as the Footpath BHA/2 overbridge. This will be uncharacteristic in the context of the adjacent natural undulating landscape. However, mitigation earthworks will help to integrate these structures into the natural topography;

- presence of overhead line equipment and infrastructure associated with the Chetwode auto-transformer station. This will introduce large scale infrastructure which will impact the setting of the rural landscape. In addition the Proposed Scheme will pass approximately 100m to the west of the conservation area at Chetwode which will cause a noticeable effect on its setting; and
- presence of high speed trains moving through the landscape.

9.5.26 There will be a slight reduction in tranquillity within the LCA. However the influence of the Proposed Scheme, including the presence of passing trains, will be reduced since the route passes predominantly within Chetwode cutting across this LCA.

9.5.27 Therefore, due to the partial loss of existing characteristics of the LCA, the magnitude of change is considered to be medium in year 1 of operation.

9.5.28 The medium magnitude of change, assessed alongside the high sensitivity of the LCA, will result in a moderate adverse effect in year 1 of operation.

9.5.29 From year 15 and beyond to year 60 of operation, the maturity of mitigation planting and the establishment of land-cover will result in greater landscape integration and reduce effects to be not significant. These are reported in Volume 5: Appendix LV-001-013.

Visual assessment

9.5.30 This section describes the significant effects on visual receptors during year 1, year 15 and year 60 of operation. Not significant effects on visual receptors are presented in Volume 5: Appendix LV-001-013 Part 4.

9.5.31 The view of the Proposed Scheme from viewpoint 157.2.001 (illustrated in the photomontage shown in Figure LV-01-239 (Volume 2, CFA13 Map Book)) would not be significantly affected due to intervening proposed mitigation planting restricting views.

9.5.32 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.

9.5.33 Where significant effects have been identified, an assessment of effects at night-time arising from additional lighting has also been undertaken.

9.5.34 The first number identifies the viewpoint locations which are shown on Maps LV-04-047 to LV-04-051 (Volume 5, Landscape and Visual Assessment 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, and 4: Transport.

9.5.35 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 151.2.001: View north-east from the junction between School Hill and Brackley Lane, Calvert

9.5.36 School Hill green overbridge will be clearly visible in the centre middle ground approximately 110m from the viewpoint. The view will be more open due to the removal of 12a and 12b Brackley Lane, The Station House (formerly known as Hazelbach) and the vegetation in the left middle ground during construction. As the route is within the Calvert cutting, up to 6m deep, at this location only the top of the overhead line equipment will be visible either side of the new overbridge. The noise fence barrier to the west of Calvert cutting will be visible in the middle ground on either side of the overbridge. The sustainable placement area will also be visible in the left background. The addition of this infrastructure will be visible and in proximity to the receptor, but will be largely characteristic of the existing view which contains a railway and an overbridge. Therefore, the magnitude of change will be medium.

9.5.37 The view of the Proposed Scheme from this location during year 1 operation is illustrated on the photomontage shown in Figure LV-01-082 (Volume 2, CFA13 Map Book).

9.5.38 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.

9.5.39 In summer of year 1, proposed mitigation planting adjacent to School Hill green overbridge will be young and will offer little additional visual screening. School Hill green overbridge, the noise fence barrier and overhead line equipment will remain clearly visible. Therefore the magnitude of change is considered to remain medium meaning the overall effect will be unchanged.

9.5.40 The night-time effect of lighting during year 1 of operation will be not significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.41 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 152.4.001: View south-west from School Hill, east of Calvert

9.5.42 The sustainable placement area (up to 5m high) will be clearly visible in the right foreground and middle ground of the view. This will appear as a large graded earthwork restored to farmland, however proposed hedgerow vegetation will appear juvenile at year 1. In addition, School Hill green overbridge will be visible approximately 600m away in the centre background, to the left of the existing road. Overall this will represent a change to the existing view, but will be largely

characteristic of the existing view across farmland. Therefore, the magnitude of change will be medium.

9.5.43 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.

9.5.44 Due to a lack of intervening vegetation on the right of the view, there will be no additional screening during summer. Therefore, the magnitude of change will remain medium, giving rise to a moderate adverse effect.

9.5.45 By year 15 and beyond to year 60 of operation, hedgerow planting within the right middle ground will have matured, and will serve to replace that lost during construction and will help visually integrate the Proposed Scheme into the view. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 154.3.002: View south-west from PRoW (Footpath SCL/8) south of Steeple Claydon Allotment Gardens

9.5.46 The overhead line equipment and gantry cranes within the IMD will be clearly visible adjacent to the route of the existing railway 375m away from this viewpoint. Also Footpath SCL/ 8 overbridge (approximately 790m away) and Addison Road overbridge (approximately 1.1km away) will be visible as raised elements within this relatively flat and open agricultural landscape. However mitigation earthworks along the IMD that will appear as restored farmland will partially screen these features and begin to integrate them into the view. Distant views of the IMD and sustainable placement area will also be available in the right background approximately 1.7km away. Overall the magnitude of change will be medium.

9.5.47 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.

9.5.48 In summer, existing vegetation within the middle ground and background will partially obscure views towards the Proposed Scheme. However, due to the elevated location of the viewpoint, the taller elements such as gantry cranes, the overhead line equipment and overbridges will remain visible across most of the view. Therefore, the magnitude of change will remain medium, giving rise to a moderate adverse effect.

9.5.49 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 154.2.003: View south-west from Church End, Steeple Claydon

9.5.50 The overhead line equipment and gantry cranes within the Calvert IMD will be clearly visible in the left of the middle ground, approximately 650m from the viewpoint. However, these visible features will be seen above mitigation planting and earthworks

restored to farmland which will provide partial screening and integration into the view. Footbridge SCL/ 8 overbridge (approximately 840m away) and Addison Road overbridge (approximately 1.1km away) will also be visible as elevated features in this relatively flat, open rural landscape. In addition distant views of the IMD, the sustainable placement area and Perry Hill Road overbridge will be available in the centre background, around 1.6km away. Overall the magnitude of change will be medium.

9.5.51 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.

9.5.52 The view of the Proposed Scheme from this location during year 1 operation is illustrated on the photomontage shown in Figure LV-01-083 (Volume 2, CFA13 Map Book).

9.5.53 Due to the relatively elevated location of the viewpoint, intervening hedgerow vegetation will offer no additional screening during summer and so the taller elements of the IMD and associated overbridges will remain visible above the line of mitigation earthworks. Therefore, the magnitude of change will remain medium, giving rise to a moderate adverse effect.

9.5.54 Due to the elevated location of the viewpoint, night -time lighting associated with the Infrastructure Maintenance Depot will be visible in the right background. This will be seen against a baseline featuring light associated with Calvert village in the background and faint light spill from street lighting in Steeple Claydon. This large scale lighting will represent an alteration to character of the existing night-time view. Therefore, the magnitude of change is considered to be medium, resulting in a moderate adverse effect in the winter of year 1 of operation.

9.5.55 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 154.3.001: View south-west from PRoW (Footpath SCL/6) south of Elm Tree Farm

9.5.56 Mitigation earthworks and planting will screen views of the lower elements of the Calvert IMD. The main source of visual impact will be the taller elements within the IMD, including gantry cranes, lighting columns and overhead line equipment, which will be visible above the proposed planting and earthworks around 500m away. In addition, there will be views in the background of Perry Hill overbridge filtered through the clump of mature vegetation, the East West Rail overbridge to the right of the Calvert Jubilee Nature Reserve, and the School Hill green overbridge to the left of Calvert Jubilee Nature Reserve. Overall, this will represent a substantial change in the existing view. Therefore, the magnitude of change will be high.

9.5.57 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.

9.5.58 There will be no change to the assessment during summer due to the open nature of the view and hedgerow vegetation loss during construction.

9.5.59 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, further screening the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 154.2.002: View south-west from Addison Road, Steeple Claydon

9.5.60 The IMD will be the most visible element in this view. Taller elements of the IMD, such as the overhead line equipment, gantry cranes and lighting columns, will be visible over 700m away, filtered by intervening hedgerow vegetation. The Addison Road overbridge will be visible as a raised element within the left periphery of the view approximately 550m away, to the left of the existing electrical sub-station. However, mitigation planting and earthworks, visible as restored farmland, along the northern edge of the IMD will screen views to lower elements in the IMD and will help to visually integrate Addison Road overbridge into the view. Therefore, the magnitude of change will be medium.

9.5.61 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.

9.5.62 In summer of year 1 of operation, the screening effects of existing hedgerow vegetation in the foreground and middle ground will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

9.5.63 Night-time lighting at Calvert Infrastructure Maintenance Depot, including direct views of a number of lighting columns (up to 8m in height), will be visible in the centre of the middle ground and will be uncharacteristic within the existing view. Therefore, the magnitude of change to this receptor at night will be medium, resulting in a moderate adverse effect in the winter of year 1 of operation.

9.5.64 By year 15 and beyond to year 60 of operation, planting established as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 156.2.002: View south from Elm Tree Farm, Steeple Claydon

9.5.65 The Proposed Scheme will cause a substantial change to this rural view, but will be partially filtered by intervening vegetation and mitigation earthworks. Taller elements of the IMD such as the overhead line equipment, lighting columns and gantry cranes will be clearly visible across the middle ground of the view, approximately 700m away. These will be visible above mitigation planting and earthworks seen as restored

farmland, which will screen views to the lower elements within the IMD. Addison Road overbridge will also be visible where the existing road bridge is located, 900m from the viewpoint, although partially filtered by intervening hedgerow vegetation at ground level. Overall, the magnitude of change will be medium.

9.5.66 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.

9.5.67 In summer, hedgerow vegetation within the middle ground will further screen the Addison Road overbridge. However, due to the loss of vegetation during construction, views towards the IMD will remain unchanged during summer. Therefore, the magnitude of change will remain medium, giving rise to a moderate adverse effect.

9.5.68 At night, the additional light associated with the operation of the Infrastructure Maintenance Depot will be clearly visible at relative proximity in the middle ground of the view. This will include direct views of a number of lighting columns (up to 8m in height). Therefore, the magnitude of change to this receptor at night is considered to be high, resulting in a major adverse effect in the winter of year 1 of operation.

9.5.69 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 155.2.002: View north-east from Portway Farm, Twyford

9.5.70 The East West Rail overbridge will be clearly visible as an elevated structure approximately 800m from the viewpoint in the right middle ground next to Calvert Jubilee Nature Reserve. Views of Perry Hill overbridge, 350m away in the middle ground, will be filtered through the intervening vegetation of the woodland and dismantled railway. The IMD will also be visible 800m away in the centre middle ground, beyond the existing Perry Hill Road. This large-scale infrastructure will be highly visible and uncharacteristic with the existing view, but will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

9.5.71 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.

9.5.72 During summer, woodland vegetation will provide greater screening towards Perry Hill overbridge and the IMD. However, the right of the view is more open and so the East West Rail overbridge will remain clearly visible. Therefore, overall the magnitude of change will be medium, giving rise to a moderate adverse effect.

9.5.73 Night-time lighting at the Infrastructure Maintenance Depot will represent a clearly visible change. This will include direct views of a number of approximately 8m high lighting columns. Therefore, the magnitude of change is considered to be high, resulting in a major adverse effect in the winter of year 1 of operation.

9.5.74 By year 15 and beyond to year 60 of operation, the enhancement of existing planting and planting established adjacent to the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 156.4.001: View south-west from road west of Lake Farm

9.5.75 The main source of visual impact will be West Street overbridge, approximately 280m away to the left of Portway Farm and Perry Hill overbridge 450m away, to the left of the clump of mature vegetation. As the Proposed Scheme will cross the view within the Calvert cutting (up to 3m deep in this location) only the top of the overhead line equipment will be visible across the arable field approximately 275m away. Views to the right will be largely screened by the existing mature coniferous shelter belt. Overall, the Proposed Scheme will cause a substantial change in the existing view and the magnitude of change will be high.

9.5.76 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.

9.5.77 During summer, a lack of existing intervening vegetation and the low height of the proposed mitigation planting will mean the Proposed Scheme will remain clearly visible. Therefore, the magnitude of change will remain high, giving rise to a moderate adverse effect.

9.5.78 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 155.4.001: View north from West Street, east of Twyford

9.5.79 Views of West Street overbridge will be clearly visible in the centre foreground of the view approximately 130m away. In addition overhead line equipment will be clearly visible in the left middle ground beyond the dismantled railway approximately 130m away. Views of the track level however; will be screened by mitigation earthworks which will appear as restored farmland with a profile sympathetic to the surrounding topography. There will also be views of Perry Hill overbridge approximately 400m away in the arable field to the right of the view. As a result of the openness of the view and the close proximity to the Proposed Scheme, the magnitude of change will be high.

9.5.80 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.

9.5.81 Due to vegetation loss during construction and the low height of proposed mitigation planting adjacent to the Proposed Scheme there will be largely no change to the

assessment during summer. Therefore, the magnitude of change will be high, giving rise to a moderate adverse effect.

9.5.82 By year 15 of operation, enhancement of vegetation within the right foreground will provide some additional screening of the Perry Hill overbridge. In addition proposed planting along the west of Calvert cutting will provided additional screening towards the overhead line equipment in the left middle ground. However the West Street overbridge will remain clearly visible approximately 150m away. Therefore the magnitude of change will remain medium and will result in moderate adverse effects.

9.5.83 By year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 157.2.001: View north-east from Church Gate, Twyford

9.5.84 The Proposed Scheme will be highly visible, in close proximity to the viewpoint, and uncharacteristic within the existing view across farmland. The Twyford viaduct and a noise fence barrier (up to 4m high), will be clearly visible 350m away in the left middle ground, beyond the residential property. The overhead line equipment will also be visible across this view, approximately 200m away. Mitigation earthworks will provide partial screening of the lower elements of the Proposed Scheme and will begin to take on the appearance of restored farmland. In places, views of the Proposed Scheme will be filtered by intervening vegetation along the dismantled railway in the foreground. Enhancement planting within the dismantled railway will be young and will offer little additional screening. Overall, the magnitude of change will 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 The view of the Proposed Scheme from this location during year 1 operation is illustrated on the photomontage shown in Figure LV-01-085 (Volume 2, CFA13 Map Book).

9.5.87 During summer, existing vegetation within the dismantled railway across the middle ground will provide some additional screening towards the Proposed Scheme. However the Twyford viaduct, noise fence barrier and the overhead line equipment will remain largely visible. The mitigation planting within the dismantled railway will be immature and will provide little additional screening at year one of operation. Therefore, the magnitude of change will remain medium, giving rise to a moderate adverse effect.

9.5.88 The night-time effect of lighting during year 1 of operation will be not significant. This is reported in Volume 5: Appendix LV-001-013 Part 4.

9.5.89 By year 15 and beyond to year 60 of operation, planting established as part of the Proposed Scheme will have matured, providing additional screening. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 158.3.001: View south-west from PRoW (Footpath TWY/16, PBI/8/11 and PBI/8/10) south-west of Cowley Lodge

9.5.90 The Proposed Scheme will cause a substantial change in the foreground of this view approximately 150m away. The overhead line equipment and the approximately 3m high Twyford embankment will be clearly visible approximately 150m away crossing the fields in the foreground. In addition, Twyford viaduct and the associated noise fence barrier (up to 4m high) will be visible approximately 300m away in the background, with views filtered through the intervening vegetation lining the Padbury Brook. Overall, the magnitude of change will be high.

9.5.91 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.

9.5.92 During summer, vegetation within the foreground will provide some additional intermittent screening towards the Proposed Scheme. However, the overhead line equipment and Twyford embankment will remain clearly visible across the foreground of the view. Therefore, the magnitude of change will remain high, giving rise to a major adverse effect.

9.5.93 By year 15 proposed planting adjacent to Twyford embankment and Twyford viaduct will largely screen views of these structures. The top of overhead line equipment will, however, remain visible at proximity. Therefore the magnitude of change will be medium, giving rise to a moderate adverse effect.

9.5.94 By year 60 of operation, proposed planting adjacent to Twyford embankment and Twyford viaduct will largely screen views of these structures. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 159.3.003: View north-east from PRoW (Restricted Byway PBI/5) north of Twyford Mill

9.5.95 The Proposed Scheme will cause a clearly visible change at close proximity in the existing view. The Restricted Byway PBI/5A accommodation overbridge will be prominent in the view along the existing bridleway. At this location, the route is within the Twyford cutting (up 5m deep at this location), therefore only the overhead line equipment will be visible to the left and right of the bridleway, approximately 50m away. This will be seen above mitigation earthworks in the left foreground which will screen views to the lower elements of the Proposed Scheme. The Footpath PBI/5 accommodation overbridge will also be visible around 400m away in the right middle ground, filtered through the vegetation lining the dismantled railway. Overall, the magnitude of change will be high.

9.5.96 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.

9.5.97 During summer, the vegetation within the dismantled railway will provide additional screening towards Footpath PBI/5 accommodation overbridge in the right of the view. However, Restricted Byway PBI/5A accommodation overbridge and the overhead line equipment will remain clearly visible in the centre foreground. Therefore, the magnitude of change will remain high, giving rise to a major adverse effect.

9.5.98 By year 15, the vegetation within the dismantled railway and proposed planting between Footpath PBI/5 accommodation overbridge and Restricted Byway PBI/5A accommodation overbridge will have established sufficiently to offer some additional screening towards the Proposed Scheme. This will include partial screening of Footpath PBI/5 accommodation overbridge and the overhead line equipment in the right of the view. However the overhead line equipment in the left of view and Restricted Byway PBI/5A accommodation overbridge will remain visible to the left and centre respectively. Therefore the magnitude of change will be medium, giving rise to a moderate adverse effect.

9.5.99 By year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 160.2.001: View south-west from Cowley Farm

9.5.100 The Proposed Scheme will represent a substantial change to the existing view, crossing approximately 550m away at its nearest point. Views of the Footpath PBI/5 accommodation overbridge in the middle ground will be partially filtered by intervening middle ground vegetation. Restricted Byway PBI/5A accommodation overbridge will be visible in front of Twyford Mill, with views partly blocked by intervening topography. The overhead line equipment will also be intermittently visible in front of the dismantled railway, through gaps in intervening hedgerows. However, there are likely to be clearer views from second storey windows. Overall, the magnitude of change will be medium.

9.5.101 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.

9.5.102 In summer of year 1 of operation, the screening effects of existing vegetation in the middle ground of the view will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

9.5.103 The night-time effect of lighting during year 1 of operation will be not significant. This is reported in Volume 5: Appendix LV-001-013 Part 4.

9.5.104 By year 15 and beyond to year 60 of operation, planting established along the eastern side of the Proposed Scheme will have matured, providing additional screening to the

elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 162.2.001: View south-west from Main Street, Preston Bissett

9.5.105 The Proposed Scheme will cross this slightly elevated view approximately 700m away in the middle ground. This will introduce large-scale infrastructure into the existing view across a predominantly agricultural landscape, but views of lower elements will be filtered in places by intervening hedgerow vegetation in the middle ground. The approximately 5.5m high Godington east viaduct and Godington west viaduct (up to 5.5m in height) and associated noise fence barriers (up to 1.4m in height) will be clearly visible across the centre of the middle ground, in front of the existing dismantled railway embankment. Upon the viaduct structures the overhead line equipment will also be clearly visible. These structures will restrict existing views to Godington village and the well-wooded agricultural landscape in the centre of the background. Taking the above into account, the magnitude of change will be medium.

9.5.106 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.

9.5.107 In summer of year 1 of operation, the existing hedgerow vegetation in the middle ground will offer greater intermittent screening towards lower elements of the Proposed Scheme. However, the viaduct structures and overhead line equipment will remain visible. Therefore, the magnitude of change will remain medium, giving rise to moderate adverse effects.

9.5.108 The night-time effect of lighting during year 1 of operation will be not significant. This is reported in Volume 5: Appendix LV-001-013 Part 4.

9.5.109 By year 15 and beyond to year 60 of operation, planting established along the east of the Proposed Scheme will have matured, providing additional screening towards Godington east viaduct and Godington west viaduct. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 164.2.001: View south-west from 'The Green', Chetwode

9.5.110 There will be clear views of 'The Green' realignment, approximately 50m from the viewpoint in the foreground to the left of the existing road. There will be more open views along the country lane as a result of the loss of roadside vegetation during construction which will alter the character of this view. The route will be screened within the Chetwode cutting (up to 10.5m deep) 170m away at this location. Overall, the magnitude of change will be medium.

9.5.111 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.

9.5.112 The view of the Proposed Scheme from this location during year 1 operation is illustrated on the photomontage shown in Figure LV-01-087 (Volume 2, CFA13 Map Book).

9.5.113 During summer views will be largely unchanged from winter due to the removal of roadside vegetation during construction. Therefore, the magnitude will be medium, giving rise to a moderate adverse effect.

9.5.114 The night-time effect of lighting during year 1 of operation will be not significant. This is reported in Volume 5: Appendix LV-001-013 Part 4.

9.5.115 By year 15 and beyond to year 60 of operation, planting established as part of the Proposed Scheme will have matured, providing additional screening and integration to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 163.3.001: View north-east from PRoW (Footpath CHW/18) south of Manthorn Farm

9.5.116 Chetwode cutting (up to 10.5m in depth, and up to 100m in width) will be clearly visible across the arable field 100m from the viewpoint. Footpath CHW/18 accommodation overbridge will also be clearly visible as it crosses the Chetwode cutting at grade. These large features will be highly visible and uncharacteristic within the existing view of an agricultural landscape. Therefore, the magnitude of change will be high.

9.5.117 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.

9.5.118 Due to the relatively open nature of the view and vegetation losses during construction, there will be no change to the assessment during summer.

9.5.119 By year 15 and beyond to year 60 of operation, the lack of intervening proposed planting means effects will be unchanged from year 1.

Viewpoint 165.4.001: View north east from School End, west of Chetwode

9.5.120 The Proposed Scheme will cross this view of a country lane approximately 100m away. The School End overbridge will be clearly visible in the centre foreground along the existing road. The removal of vegetation during construction will be apparent to the left and right of the existing road, and will result in a more open, less wooded view. Mitigation earthworks in the left of the view, visible as restored farmland, will screen views of Chetwode cutting. Views of Chetwode cutting to the right will be filtered through existing vegetation lining the dismantled railway. Overall, the magnitude of change will be medium.

9.5.121 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.

9.5.122 During summer, the vegetation within the dismantled railway to the right of the view will offer greater screening towards Chetwode cutting. However, due to the lack of vegetation on the left of the road, the view will remain unchanged from winter. The magnitude of change will be medium, giving rise to a moderate adverse effect.

9.5.123 By year 15 and beyond to year 60 of operation, the enhanced planting within the dismantled railway to the right of the view will have established and will further screen the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Viewpoint 166.2.001: View south-west from School End, Chetwode

9.5.124 The result of the removal of roadside vegetation during construction on either side of the road will be the most apparent change. The new School End overbridge will be visible 160m away, in the centre middle ground along the existing road. Mitigation earthworks along the north-eastern edge of the Proposed Scheme will screen views of Chetwode cutting on either side of the road. These will be shaped to integrate with the natural topography and will be visible as restored farmland. Overall, the magnitude of change will be medium.

9.5.125 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.

9.5.126 Due to the loss of vegetation from the middle ground during construction, there will be no change to the assessment during summer.

9.5.127 The night-time effect of lighting during year 1 of operation will be not significant. This is reported in Volume 5: Appendix LV-001-013 Part 4.

9.5.128 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being not significant. These are reported in Volume 5: Appendix LV-001-013.

Cumulative effects

9.5.129 Section 2.1 and Appendix CT-004-013 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 operation of the Proposed Scheme. There are no known committed developments which are assumed to be completed by year 1 of operation of the Proposed Scheme which will result in consequential cumulative effects on LCAs or viewpoints. Committed developments which have been considered in the assessment are shown on Maps CT-13-028b to CT-13-031a (Volume 5, Cross Topic Appendix 1 Map Book).

Other mitigation measures

9.5.130 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 residual significant effects

9.5.131 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:

- effects on Claydon Bowl LCA arising from the presence of the IMD and its impact on the rural setting and on characteristic views from elevated locations around Steeple Claydon;
- effects on Twyford Vale LCA arising from the presence of the IMD to the north of Calvert and, the continued influence of the sustainable placement area on the natural flat topography and the continued impact of elevated overbridges and overhead line equipment on characteristic views across the relatively flat landscape;
- effects on people travelling along West Street, Twyford, (155.4.001) due to visibility of overhead line equipment at proximity;
- effects on views from recreational receptors south-west of Cowley Lodge (158.3.001) arising from the visibility of Twyford embankment and overhead line equipment at proximity;
- effects on views from recreational receptors north of Twyford Mill (159.3.003) arising from visibility of the overhead line equipment and Restricted Byway PBI/5A accommodation overbridge; and
- effects on views from recreational receptors south of Manthorn Farm (163.3.001) arising from visibility of Chetwode cutting and Footpath CHW/18 accommodation overbridge at proximity.

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:

- premises demolished, with their occupants and employees needing to relocate to allow for construction of the Proposed Scheme; and
- potential employment opportunities arising from construction in the local area (including in adjacent CFA).

Operation

10.1.5 The proposed operation of the route 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, 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 of this report provides a general overview of the Calvert, Steeple Claydon, Twyford and Chetwode area which includes data of specific relevance to socio-economics notably demographic and employment data. The following provides a brief overview of the area in terms of employment, economic structure, and labour market[57].

10.3.2 The vast majority of the area, including the main settlements, lies within the Aylesbury Vale District of Buckinghamshire with a small portion lying within Cherwell District in Oxfordshire.

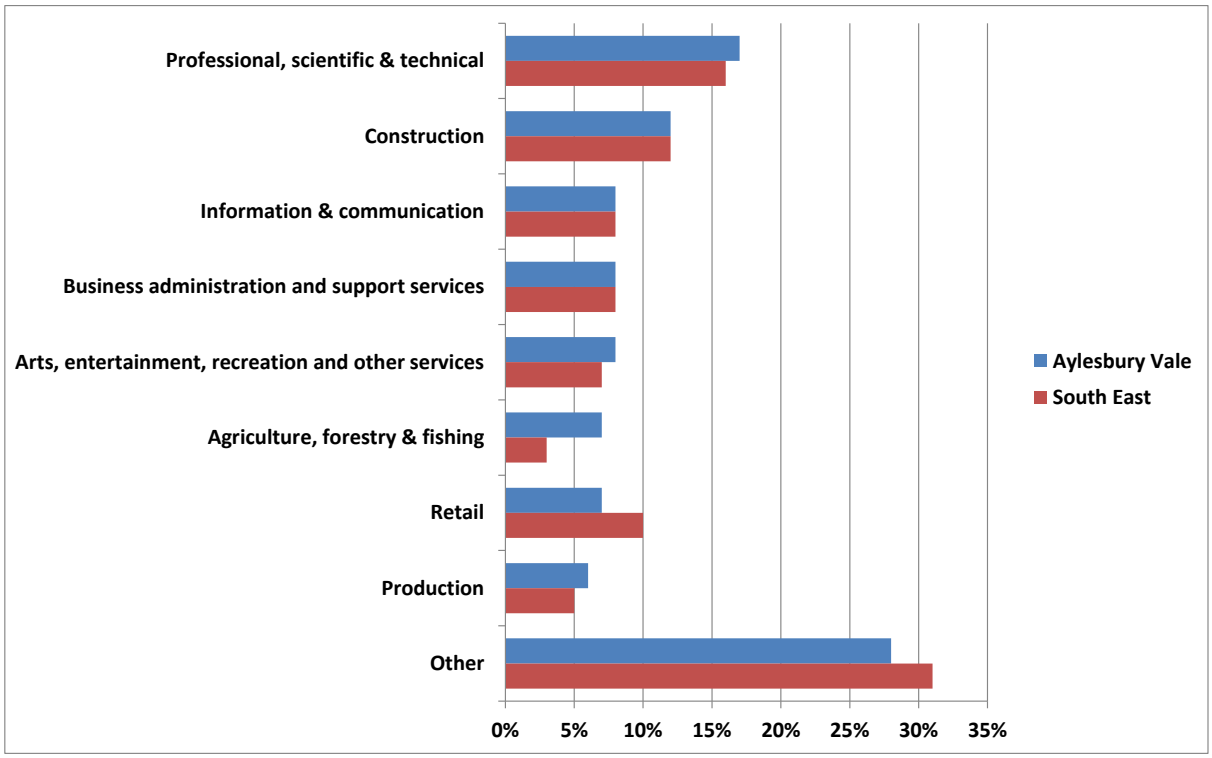
10.3.3 Where possible, baseline data has been gathered on demographic character areas (DCA)[58] to provide a profile of local communities. Map SE-02-014 (Volume 5, Socio-economics Map Book) shows the location of the DCA. The Calvert, Steeple Claydon, Twyford and Chetwode area contains Steeple Claydon, Chetwode, Barton Hartshorn, Calvert and Charndon, Preston Bissett, Godington and Twyford and Poundon DCA.

Business and labour market

10.3.4 Within the Aylesbury Vale District, the professional, scientific and technical services sector accounts for the largest proportion of employment (17%), with the construction (12%), information and communication (8%), and business administration and support services (8%) sectors also being major sources of employment within the district (see Figure 9)[59]. For comparison within the South East region, the professional, scientific and technical services sector also accounts for the largest number of businesses (16%), with the construction (12%), retail (10%) and information and communication (8%) sectors also accounting for relatively large numbers of businesses within the region[60].

[57] Further information on the socio-economics baseline, with regard to business and labour market profile, within the area are contained in Volume 5: Appendix SE-001-013.
[58] DCAs 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).
[59] The figure presents the proportion of businesses within each business sector in the district but not the proportion of employment by sector.
[60] Office for National Statistics (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 9: Business sector composition in Aylesbury Vale District and the South East[61] [62]



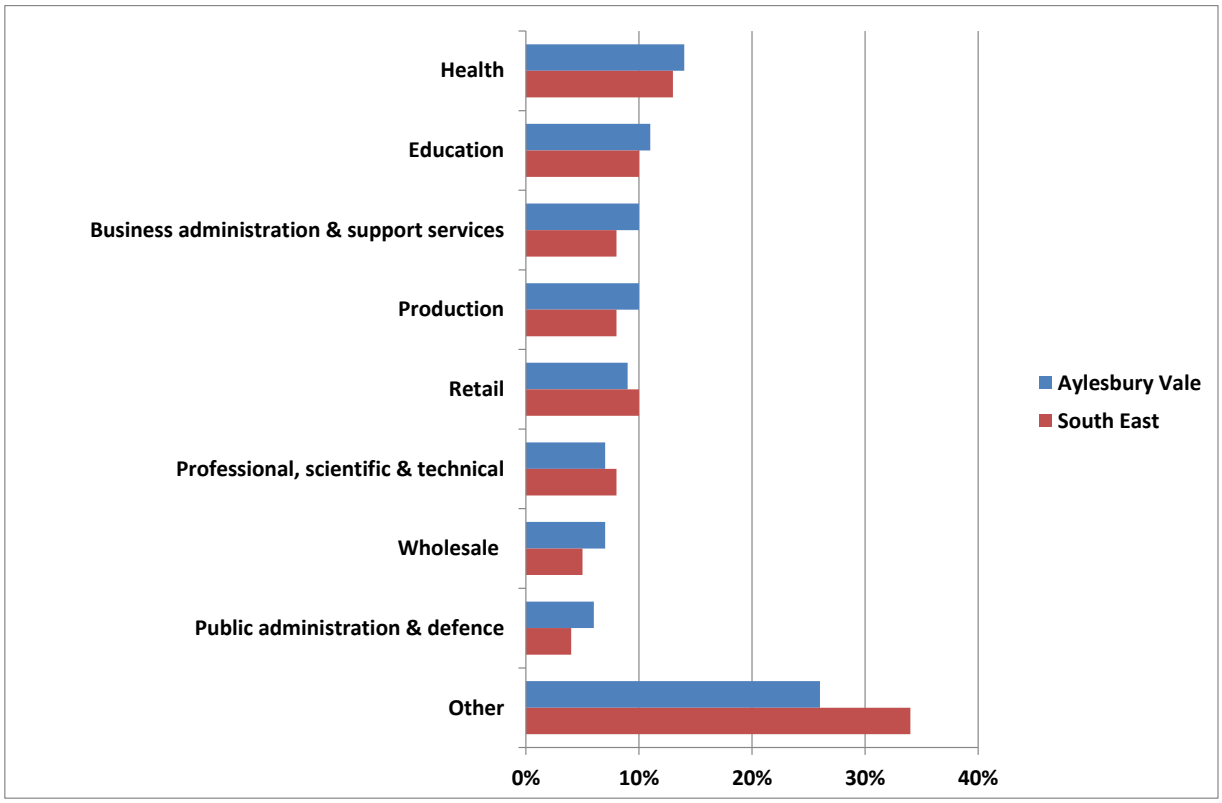
10.3.5 Approximately 66,000 people worked in the Aylesbury Vale District while 300 people worked within the Steeple Claydon DCA, and 100 within both the Calvert and Charndon DCA and the Twyford and Poundon DCA. Fewer than 100 jobs were recorded within each of the Chetwode, Barton Hartshorn, Preston Bissett and Godington DCA[63].

10.3.6 According to the ONS Business Register and Employment Survey 2011[63], the sector with the highest proportion of employment in Aylesbury Vale is health (14%), which is a slightly higher proportion than in both the South East and England (12%). Education makes up 10% of employment in the district, in line with that for both the South East (10%) and England (9%). Business administration and support services accounts for 9% of employment in the district, compared to 8% for both the South East and England as a whole (see Figure 10).

10.3.7 At DCA level, the leading sectors in terms of employment are: business administration and support services in Steeple Claydon (13%) and Godington (29%); production in Chetwode (17%) and Barton Hartshorn (17%); information and communication in Calvert and Charndon (16%) and Preston Bissett (16%); and construction in Twyford and Poundon (14%).

[61] 'Other' includes accommodation and food services, motor trades, transport and storage (including postal), finance and insurance, property, public administration and defence, wholesale, health and education sectors.
[62] ONS (2012), *UK Business: Activity, Size and Location 2011*, ONS, London.
[63] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London.

Figure 10: Employment by industrial sector in Aylesbury Vale and the South East[64]



10.3.8 According to the 2011 Census[65], the employment rate[66] within the Aylesbury Vale District in 2011 was 72% (which represents 91,000 people), higher than 68% recorded for the South East and 65% for England as a whole. The large difference between the number of jobs based in the district and those in employment indicates a high level of commuting out of the area. The employment rate recorded for the DCA were 76% in Steeple Claydon, 78% in Chetwode, 78% in Barton Hartshorn, 80% in Calvert and Charndon, 73% in Preston Bissett, 77% in Godington DCA and 69% in Twyford and Poundon.

10.3.9 In 2011, the unemployment rate for the Aylesbury Vale District stood at 5%, which was lower than the England average of 7%. The unemployment rate in both the DCA of Steeple Claydon and Calvert and Charndon was 4%, 1% in both Chetwode and Barton Hartshorn DCA, 3% in both Preston Bissett and Twyford and Poundon DCA and 2% in Godington[67].

10.3.10 According to the 2011 Census, 32% of the Aylesbury Vale 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, while 17% of Aylesbury Vale District residents had no qualifications, which is lower than that recorded both for the

[64] 'Other' includes agriculture, forestry and fishing, construction, motor trades, transport and storage (including postal), accommodation and food services, information and communication, finance and insurance, property and arts, entertainment, recreation and other services sectors.
[65] ONS (2012), *Census 2011*, ONS, London.
[66] 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.
[67] Unemployment figures have been rounded to the nearest whole number. DCA unemployment rates are presented for each DCA in this chapter while in Section 2 they are shown in aggregate.

South East (19%) and England (23%). In 2011, 29% of Steeple Claydon DCA residents aged 16 and over were qualified to NVQ4 level, compared to 33% in Chetwode DCA, 33% in Barton Hartshorn DCA, 37% in Calvert and Charndon DCA, 36% in Preston Bissett DCA, 41% in Godington DCA and 32% in Twyford and Poundon DCA.

10.3.11 In 2011, the proportion of residents with no qualifications was 17% in Steeple Claydon DCA, 12% in Chetwode DCA, 12% in Barton Hartshorn DCA, 10% in Calvert and Charndon DCA, 22% in Preston Bissett DCA, 10% in Godington DCA and 22% in Twyford and Poundon DCA.

10.3.12 The seven DCA are residential areas, set within a predominantly rural and agricultural area, recording high rates of employment, low unemployment and high qualification attainment compared to regional and national averages.

Future baseline

Construction (2017)

10.3.13 Volume 5: Appendix CT-004-000/1 provides details of the developments which are assumed to have been implemented by 2017. There are no consents or allocations in this area which are expected to accommodate significant additional employment by 2017.

Operation (2026)

10.3.14 Volume 5: Appendix CT-004-00/2 provides details of the developments which are assumed to have been implemented by 2026. There are no consents or allocations in this area which are expected to accommodate significant additional employment between 2017-2026.

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 phase.

10.4.2 The draft CoCP 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 socio-economic 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[68] have been identified within the area, which 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, which are expected to experience significant isolation effects as a result of the Proposed Scheme.

Construction employment

10.4.5 There are plans to locate construction compounds for the Proposed Scheme at the following locations in the area:

- School Hill green overbridge satellite compound;
- Aylesbury Link line satellite compound;
- Calvert Railhead main compound;
- Bicester to Bletchley rail line satellite compound;
- West Street overbridge main compound;
- Chetwode auto-transformer station satellite compound; and
- Chetwode cutting satellite compound.

10.4.6 The use of these sites could result in the creation of up to 4,700 person years of construction employment opportunities[69] or approximately 470 full-time equivalent jobs, 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).

[68] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level and reported in Volume 3.
[69] 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.

10.4.7 Direct construction employment created by the Proposed Scheme could also lead to opportunities for local businesses to supply the Proposed Scheme 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

10.4.8 No committed developments have been identified that are considered to interact with the Proposed Scheme.

10.4.9 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

10.4.10 Businesses directly affected, i.e. those that lie within the land which will be used for the construction of the Proposed Scheme, are reported in groups where possible to form defined resources, based on their location and operational characteristics. A group could contain either one or a number of businesses.

10.4.11 From an employment perspective, no significant direct effects on non-agricultural employment have been identified. The Proposed Scheme is not anticipated to result in the displacement or possible loss of jobs within this area.

Cumulative effects

10.4.12 No committed developments have been identified that are considered to interact with the Proposed Scheme.

10.4.13 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 (Volume 3).

Other mitigation measures

10.4.14 There are no significant adverse effects arising during construction in relation to businesses affected by the Proposed Scheme.

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 proposed 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 Proposed Scheme 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 The Proposed Scheme will create direct operational employment opportunities at locations along the route including stations, train crew facilities and infrastructure/maintenance depots. The Calvert IMD will be located within the area, with initial estimates suggesting a gross direct employment of approximately 290 jobs.

10.5.5 Direct operational employment created by the Proposed Scheme could lead to indirect employment opportunities for local businesses in terms of potentially supplying the Proposed Scheme or benefiting from expenditure of directly employed workers on goods and services.

10.5.6 Some of these employment opportunities will be accessible to residents in the locality and potentially neighbouring areas.

10.5.7 The impact of operational employment creation has been assessed as part of the route-wide assessment (Volume 3).

Cumulative effects

10.5.8 No committed developments have been identified that are considered to interact with the Proposed Scheme.

Other mitigation measures

10.5.9 The assessment has concluded that operational effects within this section of the route will be either negligible or beneficial and therefore mitigation is not needed.

Summary of likely residual significant effects

10.5.10 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 Calvert, Steeple Claydon, Twyford and Chetwode 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[70]; 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'[71].

11.1.2 The assessment of likely significant effects from noise and vibration on agricultural, community, heritage and 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).

[70] '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.

[71] 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).

11.1.7 More detailed information and mapping regarding the sound, noise and vibration assessment for Calvert, Steeple Claydon, Twyford and Chetwode is available in the relevant appendices in Volume 5:

- sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000);
- sound, noise and vibration baseline (Appendix SV-002-013);
- sound, noise and vibration construction assessment (Appendix SV-003-013);
- sound, noise and vibration operation assessment (Appendix SV-004-013); 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 baseline sound environment for this area is generally typical of a rural area, with some variation due to local sound sources.

11.2.2 The area contains a number of small villages such as Twyford and Calvert in addition to isolated residential dwellings and farms.

11.2.3 In Twyford the sound environment generally comprises natural sounds. Occasional light aircraft fly overhead and there are intermittent sounds from local road traffic and community activities. Daytime sound levels in Twyford are typically around 45 to 50dB[72]. Night-time sound levels are typically between 5 and 10dB[73] lower.

11.2.4 The Calvert landfill site is situated to the south of the village and makes use of the Bicester to Bletchley rail line to carry container trains to and from the site each day. The sounds of activity at the land fill and on the rail line are intermittently audible at properties around the perimeter of Calvert closest to these sources, where daytime sound levels are typically around 45dB.

11.2.5 In the Calvert area, local road traffic is an intermittently dominant sound source and, at the north-easterly edge of the settlement in the vicinity of School Hill Road, sound from the existing railways may also be heard occasionally. Natural sounds also contribute to the soundscape. Daytime sound levels in locations in the north of Calvert, close to School Hill Road, are typically between 56 to 63dB. In locations further from School Hill Road, sound levels are lower. Night-time sound levels in Calvert vary considerably depend upon the proximity to local sound sources and range typically from 35 to 55dB. The operational land fill site is a noticeable source at times on the south side of Calvert Green.

[72] Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,16hr.}$
[73] Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr.}$

11.2.6 In the area around Chetwode, there are several isolated working farms and residential properties. At these properties occasional local road traffic is audible, with natural sounds otherwise prevailing. The local sound environment also includes occasional aircraft over flights. Daytime sound levels are approximately 40 to 50dB at the more isolated settlements. In some areas, very few man-made noises are audible and natural sources are dominant. Sound from agricultural activity also contributes in some locations.

11.2.7 Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for this area in Volume 5: Appendix SV-002-013.

11.2.8 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[74]. 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

11.2.9 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 as well as expected growth in rail traffic associated with the East West Rail project. 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[75], tyre sound dominates and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

Construction (2017)

11.2.10 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.

Operation (2026)

11.2.11 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

[74] Further information is available in the Volume 5: Appendix SV-001-000, the SMR and its Addendum.
[75] Tyre noise typically becomes the dominant sound source for steady road traffic at speeds above approximately 30mph.

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 The following activities will need to be undertaken during the evening and night-time for reasons of safety, engineering practicability or to reduce the impact on existing transport:

- installation of new track and railway systems associated with the Aylesbury Link realignment works;
- movement of trains into and out of the Calvert rail sidings during the day, evening and night; and
- installation of new track and railway systems associated with the Bicester to Bletchley Line realignment works.

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-002-013.

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[76];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's 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 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[77] has been assumed along edge of the construction site boundary adjacent to the residential communities at Calvert and Chetwode. Taller screening has also been assumed along the construction site boundary adjacent to Godington to reduce sound levels at non-residential receptors.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.3.7 The mitigation measures described previously will reduce noise inside all dwellings such that it does not reach a level where it would significantly affect[78] residents.

Residential receptors: direct effects –communities

11.3.8 With regard to noise outside dwellings, the assessment of temporary effects takes account of construction noise relative to existing sound levels.

11.3.9 In locations with lower existing sound levels[79], construction noise effects[78] are likely to be caused by changes to noise levels outside dwellings. These may be considered by

[76] Warning signals that consist of bursts of noise.
[77] As described in the draft CoCP, provided as necessary by solid temporary hoarding, temporary earth stockpiles, screening close to the activities or other means to provide equivalent noise reduction.
[78] Information is provided in the emerging National Planning Practice Guidance – Noise; http://planningguidance.planningportal.gov.uk; Accessed October 2013.
[79] Further information is provided in Volume 5: Appendix SV-001-000.

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.

11.3.10 In this area, the mitigation measures reduce the effects of outdoor construction noise on the acoustic character around the local residential communities such that the adverse effects identified are considered to be not significant.

Residential receptors: indirect effects

11.3.11 Construction traffic is likely to cause adverse noise effects on residential receptors along the following local roads:

- Perry Hill (south of School Hill) where it passes to the west of Calvert (CSV13 C01) – approximately 10 dwellings located close to the road are forecast to experience an increase in outdoor noise levels of around 5dB during the peak months (further information on traffic flows is provided in Section 12: Traffic and Transport);
- School Hill (west of Perry Hill) to the west of Calvert (CSV13 N02) – approximately 15 dwellings located immediately adjacent to the lane are forecast to experience an increase in outdoor noise levels of around 3dB during the peak months (further information on traffic flows is provided in Section 12: Traffic and Transport); and
- School End where it passes to the north of Chetwode (CSV13 N03) – approximately 10 dwellings located immediately adjacent to the lane are forecast to experience an increase in outdoor noise levels of around 5dB during the peak months (further information on traffic flows is provided in Section 12: Traffic and Transport).

11.3.12 These adverse effects[78] would be a change in the acoustic character of the area such that there is a perceived change in the quality of life and are considered significant when assessed on a community basis taking account of the local context.

Non-residential receptors: direct effects

11.3.13 A significant construction noise effect has been identified on a worst case basis on the Church of the Assumption of the Blessed Virgin Mary, Church Street, Twyford (CSV13-N01). Significant noise effects have been identified during the daytime with noise levels rising at times to around 55dB over a period of approximately 1 month in 2018 during the construction of the Twyford west viaduct and then for a further 2 months in 2019 due to vehicle movements on haul roads within the construction boundary.

Non-residential receptors: indirect effects

11.3.14 On a worst case basis, construction traffic is likely to cause significant indirect noise effects at non-residential receptors along Perry Hill (north of School Hill) where it passes Grebe Lake affecting the use of the buildings at Great Moor Sailing Club (CSV13-N02). This is associated with a forecast increase in way side noise levels of

around 9dB in the peak months (further information on the traffic flows is provided in Section 12: Traffic and Transport).

Cumulative effects from the Proposed Scheme and other committed development

11.3.15 This assessment has considered the potential cumulative construction noise effects of the proposed scheme and other committed developments[80]. In this area, there are no developments that would be built at the same time as the Proposed Scheme and accordingly, construction noise or vibration from the Proposed Scheme is unlikely to result in any significant cumulative noise effects.

Summary of likely residual significant effects

11.3.16 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 affect[78] residents.

11.3.17 The measures also reduce the adverse effects[78] of outdoor construction noise on the acoustic character around the local residential communities such that the effects are not considered to be significant.

11.3.18 On a worst case basis, noise from specific construction activities has been identified as resulting in significant residual temporary effects over two short periods in 2018 and 2019 on the Church of the Assumption of the Blessed Virgin Mary, Church Street, Twyford.

11.3.19 Construction traffic on Perry Hill, School Hill and School End is likely to cause significant noise effects on adjacent residential and non-residential receptors where it passes through Calvert and Chetwode.

11.3.20 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.

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.

[80] Refer to Volume 5 : Appendix CT-004-000.

11.4.2 The expected passenger service frequency for both Phase One, and Phase One with Phase Two services are described in Volume 1[81]. 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 17. 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 17.

Table 17: 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	07:00-21:00 hours	18 (14)	330 kph for timetabled trains (assumed 90% of services), and 360 kph for 10% of services

Local assumptions – Calvert IMD

11.4.3 The Calvert IMD will be operational 24 hours a day, 7 days a week. The majority of the activities that produce the highest sound levels will occur during the daytime, when the inspection and maintenance trains will be maintained and prepared.

11.4.4 In general it is expected that maintenance materials will be received during the day. However, it is possible that deliveries of maintenance materials could occur by road or rail at any time of the day or night.

11.4.5 As soon as possible after the close of passenger service, inspection trains will depart from Calvert IMD travelling the length of the Proposed Scheme whilst inspecting the railway infrastructure and equipment. As soon as possible after the issue of inspection trains, trains required for any planned maintenance will depart from the IMD to travel to the required maintenance location.

11.4.6 Trains required for urgent, unplanned maintenance identified by that night's inspection will depart from either the IMD or the closest maintenance siding as required. Inspection and maintenance trains will return to the IMD before the start of passenger services.

Avoidance and mitigation measures

11.4.7 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

[81] The change in noise and vibration effects between the different passenger services is assessed in Volume 1.

measures have protected many communities from likely significant noise or vibration effects.

Airborne noise

11.4.8 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 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.

11.4.9 To avoid or reduce significant airborne noise effects, the Proposed Scheme incorporates noise barriers in the form of landscape earthworks, noise fence barriers and/or 'low-level' barriers on viaducts. Noise barrier locations are shown on Volume 2: Map Book – Sound, noise and vibration Map Series SV-05 (Volume 2, CFA13 Map Book).

11.4.10 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.

11.4.11 The Proposed Scheme incorporates 'low-level' noise barriers into the design of viaducts. Where needed to avoid or reduce significant airborne noise effects, these barriers 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.

11.4.12 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, CFA13 Map Book).

11.4.13 The Proposed Scheme also includes taller barriers, to a height of 5m above rail, to reduce the adverse noise effects in and around Calvert and Twyford.

11.4.14 Significant noise effects from the operational static sources such as line-side equipment will be avoided through their design and the specification of noise

emission requirements (for further information please see Volume 5: Appendix SV-001-000).

11.4.15 Noise insulation measures will be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996[82] (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 insulation under the Regulations will be identified and noise insulation offered at the time that the Proposed Scheme becomes operational.

11.4.16 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.

11.4.17 Following Government's emerging National Planning Practice Guidance[83], 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[84], 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[85]. 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[86], or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion[85], noise insulation will be offered for these additional buildings.

Ground-borne noise and vibration

11.4.18 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

Surface sections of route; airborne noise and ground-borne vibration

11.4.19 Taking account of the avoidance and mitigation measures incorporated into the Proposed Scheme, the assessment has identified approximately four residential dwellings, close to the Proposed Scheme, where noise would exceed the daytime trigger threshold set in the Regulations. It is therefore estimated that these buildings

[82] *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996*, London. Her Majesty's Stationery Office.
[83] National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk
[84] World Health Organization (2010), Night-time Noise Guidelines for Europe.
[85] 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 $_{LpAFmax}$ (where the number of train pass-bys exceeding this value is less than or equal to 20); or 80 dB $_{LpAFmax}$ (where the number of train pass-bys exceeding this value is greater than 20).
[86] Equivalent continuous level, $L_{pAeq,\ 23:00\text{-}07:00}$ measured without reflection from the front of buildings.

are likely to qualify for noise insulation under the Regulations. These residential properties are indicated on Map Series SV-05 (Volume 2, CFA13 Map Book):

- Rosehill Barns and Rosehill Farm, Chetwode;
- The Hermitage, Chetwode; and
- proposed residential property in committed development ref. CFA13/4 (refer to Section 2) to be located closest to the route.

11.4.20 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

11.4.21 The mitigation measures in this area will avoid airborne noise adverse effects on the majority of receptors, and at the following communities:

- Charndon;
- Steeple Claydon;
- Twyford (except as identified in Table 18);
- Calvert Green;
- Preston Bissett;
- Godington; and
- Bishops Hartshorne.

11.4.22 Taking account of the envisaged mitigation, Map Series SV-05 (Volume 2, CFA13 Map Book) shows the long term 40dB[87] 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[88]. In general, below these levels adverse effects are not expected.

11.4.23 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, CFA13 Map Book).

11.4.24 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

[87] Defined as the equivalent continuous sound level from 23:00 to 07:00 or $L_{pAeq,night}$)
[88] 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.

significant when assessed on a community basis[89] taking account of the local context[90].

11.4.25 In this study area, the direct adverse effects[78] on the areas of the residential communities identified in Table 18 are considered to be significant.

Table 18: 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
OSV13-C01	Airborne noise increase from new train services	Daytime and night-time	Calvert. Approximately 50 dwellings in the vicinity of Cotswolds Way, Brackley Lane, Sandy Road and Brickhill Way, and their associated shared community open spaces. Forecast increases in sound from the railway are likely to cause a moderate adverse effect on the acoustic character of the area around the closest approximately 35 properties. The effect on the acoustic character around the properties in this area that are located further from the railway would be a minor effect.
OSV13-C02	Airborne noise increase from new train services	Daytime and night-time	Twyford. Approximately 10 dwellings in the vicinity of Grange Close and Church Street closest to the route and their associated shared community open areas (local playing fields with clubhouse). Forecast increases in sound from the railway are likely to cause a moderate adverse effect on the acoustic character of the area around the closest approximately five properties. The effect on the acoustic character around the properties in this area that are located further from the railway would be a minor effect.
OSV13-C03	Airborne noise increase from new train services	Daytime and night-time	Chetwode. Approximately 25 dwellings in the vicinity of the road that runs through Chetwode and their associated shared community open areas. Forecast increases in sound from the railway are likely to cause a major adverse effect on the acoustic character of the area around the closest approximately five properties. The effect on the acoustic character around the properties in this area that are located further from the railway would generally be moderate.

Residential receptors: indirect effects

11.4.26 The assessment of operational noise and vibration indicates that significant indirect effects on residential receptors are unlikely to occur in this area.

Non-residential receptors: direct effects

11.4.27 The assessment of operational noise and vibration indicates that significant effects are likely on the non-residential receptor identified in Table 19.

11.4.28 The assessment of effects on non-residential receptors has been undertaken on a reasonable worst case basis taking account of public available information about each receptor. Further information can be found in Volume 5: Appendix SV-004-013.

[89] Further information is contained in Volume 1.
[90] Further information is provided in Volume 5: Appendix SV-001-000 and SV-004-013.

Table 19: 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
OSV13-N01	Minor adverse effect on activities[91] inside the church due to the operation of train services.	Daytime	Church of the Assumption of the Blessed Virgin Mary, Twyford

Non-residential receptors: indirect effects

11.4.29 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

11.4.30 The mitigation measures reduce noise inside all dwellings such that it does not reach a level where it would significantly affect[78] residents.

11.4.31 The avoidance and mitigation measures in this area will avoid noise and vibration adverse effects[78] on the majority of receptors and communities including shared open areas.

11.4.32 Taking account of the avoidance and mitigation measures and the local context, the residual permanent noise effects[78] on the acoustic character of the following areas of residential community closest to the route are considered significant:

- Calvert, in the vicinity of Cotswolds Way, Brackley Lane, Sandy Road and Brickhill Way;
- Twyford, in the vicinity of Grange Close and Church Street; and
- Chetwode.

11.4.33 On a reasonable worst case basis a significant noise effect has been identified on Church of the Assumption of the Blessed Virgin Mary, Twyford.

11.4.34 HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid these significant effects. In doing so HS2 Ltd will continue to engage with stakeholders to fully understand the receptor, its use and the benefit of the measures. The outcome of these activities will be reflected in the Environmental Minimum Requirements.

[91] Potential risk of activity disturbance, especially for activities that require good conditions for verbal communication if windows are open.

12 Traffic and transport

12.1 Introduction

12.1.1 This traffic and transport 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 Calvert, Steeple Claydon, Twyford and Chetwode area.

12.1.2 With regards to traffic and transport, the main issues in this area will be traffic generated during construction and by the Infrastructure Maintenance Depot (IMD) at Calvert during operation. Additional issues relate to closures or stopping up of both roads and PRoW, either temporarily or in some cases permanently, with associated diversions.

12.1.3 The effects on traffic and transport are assessed quantitatively, based on baseline traffic conditions and future projection scenarios.

12.1.4 A detailed report on traffic and transport and surveys undertaken within the area is contained in Volume 5: Appendix TA-001-000: Transport Assessment.

12.1.5 Figure 2 shows the location of the key transport infrastructure in this area.

12.1.6 Engagement has been undertaken with the key transport authorities including Buckinghamshire County Council and Oxfordshire County Council.

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, and in 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.

12.2.2 The study area includes the A4421 Neunkirchen Way/Wretchwick Way/Charbridge Lane, A421 Tingewick Road, A41 Aylesbury Road and local roads that are affected by the Proposed Scheme.

12.2.3 The baseline forecast traffic flows for the future years of assessment have been derived using the Department for Transport's traffic forecasting tool, Trip End Model Presentation Program (TEMPRO). The assessment covers the morning (08:00-09:00) and evening (17:00-18:00) 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

redistribution and reassignment of traffic, modal shift and peak spreading. As a consequence, adverse transport effects may be over-estimated.

12.3 Environmental baseline

Existing baseline

12.3.1 Existing conditions in the Calvert, Steeple Claydon, Twyford and Chetwode area have been determined through site visits, specially commissioned transport surveys, 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 June and September 2012 and February 2013. The surveys comprised 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 Buckinghamshire County Council and Oxfordshire County Council.

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 indicated that all of the roads, footpaths, bridleways and cycleways that will cross the route are used by no more than 30 people per day. The Proposed Scheme will affect 18 PRoW within this area and will cross all of them. In addition to these 18 PRoW, the Proposed Scheme crosses eight roads with potential for use by non-motorised users.

12.3.4 The main strategic roads affected by the Proposed Scheme are the A4421 Neunkirchen Way/Wretchwick Way/Charbridge Lane, A421 Tingewick Road and the A41 Aylesbury Road. The local highway links that will be affected by the Proposed Scheme include School Hill, Perry Hill, Addison Road, Main Street, West Street, School End/Barton Hartshorn Road, Barton Road, Buckingham Road, Gawcott Road, and Manor Farm Road.

12.3.5 Relevant accident data for the road subject to assessment has been obtained from Buckinghamshire County Council and Oxfordshire County Council for the three year period of 2009 to 2011. This has been assessed and any accident clusters have been examined. No accident clusters have been identified in the study area.

12.3.6 The following five bus services operate along roads that were subject to traffic and transport assessment:

- Route 16 – connecting Aylesbury to Steeple Claydon and serving Waddesdon, Quainton, Grendon Underwood, Edgcott and Calvert;
- Route 18 – connecting Buckingham to Aylesbury and serving Waddesdon, Grendon Underwood, Edgcott, Calvert, Steeple Claydon, as well as Twyford, Marsh Gibbon, Launton and Bicester;

- Route 30 – connecting Oakley to Bicester and serving Brill, Ludgershall and Arncott;
- Route 135 – connecting Buckingham to Steeple Claydon, Middle Claydon, East Claydon and Botolph Claydon and serving Gawcott, Hillesdon, Twyford, Poundon, Marsh Gibbon, Charndon, Calvert, and Padbury; and
- Route T94 – connecting Oxford to Bicester and serving Gosford, Islip, Charlton on Otmoor, Morton, Ambrosden, Piddington and Blackthorn.

12.3.7 Two of these services operate along the A41 Aylesbury Road with a combined weekday peak frequency of up to two buses an hour. Two of these services also operate along Edgcott Road, Grendon Road, Buckingham Road and Perry Hill with a combined weekday peak frequency of up to two buses an hour. Three of these services operate along School Hill with a combined weekday peak frequency of two buses an hour with Route 135 being a Saturday only service. Two of these services operate along Main Street with a weekday peak frequency of one bus an hour, again with Route 135 being a Saturday only service.

12.3.8 The Aylesbury Link railway line, which extends beyond Aylesbury Parkway, provides freight-only services carrying waste from London to the waste facility at Calvert. Freight services also use the Bicester to Bletchley Line.

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 by extrapolation to 2041. The factors have been derived for the individual road types and relevant wards. The baseline traffic volumes also take specific account of the planned changes to the Greatmoor Energy from Waste facility.

12.3.11 The proposed future East West Rail Link will provide a strategic railway connection between East Anglia and Central, Southern and Western England. It is expected to be fully operational by 2019.

12.3.12 East West Rail Link passenger services between Milton Keynes and Aylesbury are expected to commence operating on the upgraded Aylesbury Link railway line parallel with the Proposed Scheme from December 2017 with a service frequency of one train per hour in each direction. Future operations at the Calvert landfill site and potentially the Greatmoor Energy from Waste facility may also result in an increase in freight trains using this section of line of up to six trains per day. Some of these may arrive and depart via the Bicester to Bletchley Line.

12.3.13 EWR passenger services from Reading to Milton Keynes via Oxford, Reading to Bedford via Oxford and between Milton Keynes and Aylesbury are expected to

commence operating on the Bicester to Bletchley Line from December 2017, with a combined service frequency of up to three trains per hour in each direction. Freight services will also use this line.

12.3.14 No other changes to the traffic and transport baseline are anticipated in the Calvert, Steeple Claydon, Twyford and Chetwode area.

Construction

12.3.15 Construction activities have been assessed against 2021 baseline traffic flows, irrespective of when they occur during the construction period. Future baseline traffic volumes during peak hours in this area are forecast to grow by between around 11% and 16% by 2021, compared to 2012, depending on road type.

Operation (2026)

12.3.16 Future baseline traffic volumes during peak hours, in this area are forecast to grow by between around 18% and 26% by 2026 compared to 2012, depending on road type.

Operation (2041)

12.3.17 Future baseline traffic volumes in the peak hours, in this area are forecast to grow by between around 34% and 54% 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 adverse effects on transport users:

- a temporary railhead will be provided at Calvert to allow construction materials, including excavated materials, and equipment to be transported by rail where reasonably practicable and thereby reduce HGV road movements;
- transporting construction materials and equipment within and along the route of the Proposed Scheme, 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;
- providing temporary alternative routes where reasonably practicable to maintain connectivity for PRoW closed during construction;
- HGV routeing, as far as reasonably practicable, along the strategic road network and using designated routes for access, as shown on Map TR-03-057 (Volume 5, Traffic and Transport Map Book); and
- reducing daily travel by site workers by providing on site accommodation and welfare facilities.

12.4.2 The draft CoCP (see Volume 5: Appendix CT-003-000/1) includes measures which seek to reduce the adverse impacts and effects of deliveries of construction materials and equipment, including 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 through an overarching framework travel plan[92] that will require travel plans to be used along with a range of potential measures to mitigate the adverse impacts of traffic and transport movements associated with the 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, particularly 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 (Section 14) includes clear controls on vehicle types, hours of site operation, and routes for heavy goods vehicles, to reduce the impacts of road based construction traffic. In order to achieve this, generic and site specific management measures will be implemented during 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:

- the core site operating hours will be 08:00-18:00 on weekdays and 08:00-13:00 on Saturdays and site staff and workers will, therefore, generally arrive before the morning peak hour and depart after the evening peak hour (although the assessment has assumed that some 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). During railway installation works the temporary railhead at Calvert will operate 24 hours a day. It is anticipated that shift changeover times will not coincide with the highway peak hours; 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.

[92] 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.

12.4.7 The traffic and transport impacts within this area during construction are:

- 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 will include the delivery of plant and materials, movement of excavated materials and site worker trips.

12.4.9 Details of construction compounds are provided in Section 2. The duration of when there will be busy transport activity at each site is shown in Table 20. 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. The lower end of the range shows the average number of trips in the busy period and the upper end shows the average during the peak month.

Table 20: Typical vehicle trip generation for construction sites 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	West Street overbridge	Perry Hill, Buckingham Road, Grendon Road, Edgcott Road, The Broadway and A41 and/or Buckingham Road, Gawcott Road and A421 and/or Perry Hill, Hillesdon Road, Gawcott Road, A421 Tingewick Road	2016	Six years and nine months	38 months	650-1,240	470-1,240
Main	Calvert railhead		2018	Eight years			
Satellite	IMD reception sidings		2018	Two years			
Satellite	Bicester to Bletchley rail line (rail systems)	Rail access only via existing Bicester to Bletchley Line	2019	10 months	N/A	N/A	N/A
Satellite	School Hill green	Perry Hill, Buckingham	2016	Seven years and			

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	
	overbridge	Road, Grendon Road, Edgcott Road, The Broadway and A41 and/or Perry Hill, Hillesdon Road, Gawcott Road, A421 Tingewick Road		three months	37 months	230-320	30-40
Satellite	Aylesbury Link line		2019	One year and nine months			
Satellite	Chetwode cutting	School End, A421 Tingewick Road	2017	Two years and nine months	14 months	120-190	10-40
Satellite	Chetwode auto-transformer station	Private access to Manthorn Farm, School End, A421 Tingewick Road	2021	One year and six months			

12.4.10 Information on the indicative construction programme and methodology is provided in Section 2, 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 20. Consequently the peak movements will not generally occur at the same time, although in some instances there may be some overlap.

12.4.11 Where construction routes serve 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 flow will lead to significant increases in delays to vehicle users and congestion[93] at the following junctions:

- A421 with the A4421 and Sandpit Hill (moderate adverse effect);

[93] 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 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.

- A421 with Barton Road (minor adverse effect);
- Perry Hill with School Hill (moderate adverse effect); and
- Gawcott Road with the A421 (minor adverse effect).

12.4.14 Road closures and associated diversions will result in the following effects for all road users due to increased travel distance:

- temporary closure of School End for up to approximately one year and six months requiring a traffic diversion of approximately 6.9km via Manor Farm Lane and the A4421, resulting in a major adverse effect;
- temporary closure of West Street, west of Perry Hill, for up to approximately one year and six months requiring a traffic diversion of approximately 4.3km via School Hill and Perry Hill, resulting in a major adverse effect; and
- temporary closure of School Hill for up to approximately two years requiring a traffic diversion of approximately 6.9km via Addison Road and Perry Hill, resulting in a major adverse effect.

12.4.15 The closures of West Street and School Hill will not occur concurrently, so the diversions will not be in place at the same time.

12.4.16 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[94] for non-motorised users in the following locations:

- School End/Barton Hartshorn Road, north of the Proposed Scheme (moderate adverse effect) – an increase in HGV flow as well as all traffic flow;
- Manor Farm Road (moderate adverse effect) due to an increase in HGV flow as well as all traffic flow;
- Barton Road between Manor Farm Road and A421 (minor adverse effect) due to an increase in HGV flow as well as all traffic flow;
- Perry Hill, between West Street and Gawcott (major adverse effect) due to an increase in HGV flow;
- School Hill, between Perry Hill and Main Street (major adverse effect) due to an increase in all traffic flow;
- Perry Hill, between Buckingham Road and West Street (major adverse effect) due to an increase in HGV flow as well as all traffic flow;
- School Hill, between Perry Hill and Brackley Lane (major adverse effect) due to an increase in HGV flow as well as all traffic flow;

[94] In the context of this traffic and transport section, severance is used to relate to a change in ease of access for non-motorised users due to, for example, a change in travel distance or travel time or a change in traffic levels on a route that makes it harder for non-motorised users to cross. A reference to severance does not imply a route is closed to access.

- School Hill, between Brackley Lane and Addison Road (moderate adverse effect) due to an increase in HGV flow as well as all traffic flow;
- Buckingham Road/Gawcott Road (major adverse effect) due to an increase in HGV flow;
- Addison Road, south of Bicester to Bletchley Line railway (major adverse effect) due to increase in HGV flow as well as all traffic flow; and
- Addison Road, north of Bicester to Bletchley Line railway (minor adverse effect) due to increase in HGV flow as well as all traffic flow.

12.4.17 These traffic flow increases will not result in increases in congestion and significant delays except those identified above.

12.4.18 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. Minor utilities works are expected to result in only localised traffic and pedestrian diversions, which will be of short-term duration. No additional significant effects from these works are expected due to utilities works.

12.4.19 No significant effects on parking or loading have been identified during construction in the area.

12.4.20 The effect on accident and safety risks will not be significant as there are no locations where there are both accident clusters and substantial increases in traffic during construction.

12.4.21 It is expected that the construction of the Proposed Scheme will require a number of bus route diversions and these will result in significant delays to public transport users as follows:

- the closure of School Hill requiring the diversion of Route 16, 18 and 135 by approximately two and a half kilometres via Perry Hill and West Street resulting in a moderate adverse effect; and
- the closure of West Street requiring a diversion of Route 16 by approximately two kilometres via Perry Hill and School Hill, and Route 135 by approximately three and a half kilometres via Main Street, School Hill and Perry Hill resulting in a moderate adverse effect.

12.4.22 The temporary closures of West Street and School Hill will not occur concurrently so these bus diversions will not be in operation at the same time.

12.4.23 The construction of the Proposed Scheme will require a number of rail possessions in this area over a period of up to four years. The possessions will generally be short-term and most will take place during mid-week nights or weekends, although some will be necessary over mid-week days. As the possessions are short term in nature, the effect on delay to passenger and freight services will not be significant.

12.4.24 The Calvert Railhead will receive freight trains transporting construction materials and equipment, including excavated material from other sections of the Proposed Scheme. These trains will use available train paths between other services and will not therefore affect other passenger and freight services on the rail network.

12.4.25 There will be minor adverse effects on non-motorised users due to increased travel distance from ten PRoW and two road diversions for a period of up to two years at PBI/5A/3, SCL/18/2, SCL/8, TWY/4/1, TWY/18/2, TWY/19/3, CHW/225/5/10, CHW/225/4/10, CHW/24/2, BHA/3/1, School End and West Street. The majority of the diversions are between 100 and 300m in length, apart from the diversions at PBI/5A/3, SCL/8 and West Street where the length of diversions will be 800m. There will be moderate adverse effects at three PRoW and one road due to temporary diversions at School Hill, with the length of diversion being approximately 3km, at SCL/6/1, with a length of diversion being approximately 1.5km, and at both SCL/7 and SCL/9, with the length of diversion being approximately 1.8km. There are also permanent PRoW diversions which are discussed in Section 12.5.There will be no effects from disruption at stations or interchanges from construction of the Proposed Scheme in this area.

Cumulative effects

12.4.26 The assessment includes the cumulative effects of planned development during construction by taking this into account within the background traffic growth.

12.4.27 The assessment also takes into account construction traffic and transport impacts of works being undertaken in neighbouring CFA areas. From the adjacent areas to the north, Newton Purcell to Brackley (CFA14), cumulative construction daily traffic flows of approximately 190 cars/LGVs per day (two-way) and 10 HGV per day (two-way) have been included in the assessment for this area.

12.4.28 From neighbouring areas to the south, including Waddesdon and Quainton (CFA12) and the Stoke Mandeville and Aylesbury (CFA11) areas, the cumulative construction daily traffic flows of approximately 140 cars/LGVs per day (two-way) and 30 HGV per day (two-way) have been included in the assessment for this area.

Permanent effects

12.4.29 Any permanent effects of construction have been considered in the operations phase assessments for traffic and transport in Section 12.5 of this report. This is because the impacts and effects of ongoing increases in travel demand and the wider impacts and effects of the operations phase need to be considered together.

Other mitigation measures

12.4.30 The implementation of the draft CoCP (See Volume 5: Appendix CT-003-000/1) 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.

12.4.31 Rail replacement services will also be provided where necessary, when rail possessions are in place on the Aylesbury Link railway line and Bicester to Bletchley Line. Where 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.

12.4.32 No further traffic and transport mitigation measures during construction of the Proposed Scheme are considered necessary based on the outcomes of this assessment.

Summary of likely significant residual effects

12.4.33 Increased traffic during the most intensive periods of construction, particularly HGV traffic, will affect non-motorised users crossing and using; School End/Barton Hartshorn Road; Manor Farm Road; Barton Road; Perry Hill; School Hill; Buckingham Road/Gawcott Road and Addison Road.

12.4.34 Increased traffic during the most intensive periods of construction will also potentially cause additional intermittent traffic congestion and delay at a number of junctions in the area, including; A421 with the A4421 and Sandpit Hill; Barton Road with the A421; Perry Hill with School Hill; and Gawcott Road with the A421.

12.4.35 Non-concurrent temporary closures of West Street and School Hill and temporary closure of School End during construction will cause some additional delays for users of these roads due to the additional travel distance required by the associated diversions. The closures of West Street and School Hill will also require the diversion of three bus services, resulting in delays for some public transport users.

12.4.36 Temporary closures and associated diversion of twelve PRoW and three roads (PBl/5A/3, SCL/18/2, SCL/8, TWY/4/1, TWY/18/2, TWY/19/3, CHW/225/5/10, CHW/225/4/10, CHW/24/2, BHA/3/1, SCL/6/1, SCL/7 & 9, School End, West Street and School End) during construction will affect non-motorised users due to the increased travel distances required by associated diversions..

12.4.37 The significant effects that result from construction of the Proposed Scheme are shown on Map TR-03-057 (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 all roads crossing the Proposed Scheme in, or very close to their current location; and

- retaining all PRoW crossing the Proposed Scheme, with localised diversions kept to a minimum length where practicable.

12.5.2 The workplace travel plan for the IMD at Calvert will be used to help mitigate any impacts of traffic and transport movements associated with its operation, including reducing single occupancy car journeys and encouraging use of sustainable modes of transport. The travel plan's impact on reducing traffic has not been taken into account in this assessment, which will mean that adverse effects may be over-stated. A servicing and delivery strategy for the IMD at Calvert will also be implemented, which will include movement of materials by rail to reduce movement by road.

Assessment of impacts and effects

12.5.3 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 of this report).

12.5.4 The operational traffic and transport impacts within this area are:

- increase in inter-peak traffic flows from workers commuting to and from the IMD; and
- PRoW realignments.

12.5.5 Occasional traffic may access other areas of the Proposed Scheme for maintenance purposes. However, these infrequent vehicle movements are expected to be very low and will not have a significant effect.

12.5.6 The IMD will predominantly receive deliveries of materials and equipment by rail, which will take place approximately twice a week. This will be insufficient to have any impact on passenger rail or freight services. The number of deliveries received by HGV is expected to be no more than one per day and will not be significant.

12.5.7 Workers commuting to and from the IMD at Calvert are expected to result in substantial increases in off-peak (2100-2200) traffic flows, associated with shift working at the IMD, which will cause a significant increase in traffic related severance, for non-motorised users, in the following locations:

- Main Street, north of School Hill (minor adverse effect);
- West Street, west of Perry Hill (minor adverse effect);
- West Street, east of Perry Hill (moderate adverse effect); and
- Perry Hill, between Buckingham Road and West Street (moderate adverse effect).

12.5.8 No significant effects on parking or loading have been identified in the area resulting from the operation of the Proposed Scheme.

12.5.9 The effect on accidents and safety risks is not significant as there are no existing accident clusters where there are substantial increases in traffic during operation.

12.5.10 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.

12.5.11 There will be minor adverse effects on the relatively few non-motorised users as a result of severance from increased travel distance due to permanent PRoW and road realignments at CHW/11/1, CHW/18/1, PBI/9/3, PBI/6/2, TWY/16/1, TWY/17/1, TWY/18/2, SCL/6/1, SCL/7/2, BHA/3/1, BHA/2/2, SCL/7/1, SCL/9/1, PBI/6/3 and Addison Road. Eight of the PRoW realignments are between approximately 100m and 300m in length, with TWY/16/1 and TWY/16/2 being approximately 500m in length. The PRoW realignment at TWY/17/1 is approximately 800m in length and SCL/6/1 (footpath) is approximately 1.2km in length. The realignments at SCL/7/1, SCL/7/2 and SCL/9/1 are each approximately 1km in length..

12.5.12 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 increased background traffic growth.

Cumulative effects

12.5.13 The assessment includes cumulative effects of planned development during operation, by taking into account background traffic growth.

12.5.14 There will be no additional traffic in this area resulting from the operation of the Proposed Scheme in neighbouring areas.

Other mitigation measures

12.5.15 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

12.5.16 An increase in off peak traffic (21:00-22:00), due to workers commuting to and from the IMD will affect non-motorised users crossing, and using Main Street, West Street and Perry Hill.

12.5.17 Permanent realignments of 14 PRoW and one road (CHW/11/1, CHW/18/1, PBI/9/3, PBI/6/2, TWY/16/1, TWY/17/1, TWY/18/2, SCL/6/1, SCL/7/2, BHA/3/1, BHA/2/2, SCL/7/1, SCL/9/1, PBI/6/3 and Addison Road) will affect non-motorised users due to the increased travel distances..

12.5.18 The significant effects that result from the Proposed Scheme in 2026 and 2041 are shown on Map TR-04-068 (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 on 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 Padbury Brook, which is an ordinary watercourse in the study area becoming main river downstream at Padbury, its tributaries and associated floodplains;
- Calvert Jubilee Nature Reserve LWS and Grebe Lake;
- the Glaciofluvial Deposits, Kellaways Formation and the Cornbrash Formation Secondary A aquifers; and
- springs in the vicinity of Barton Hartshorn.

13.1.3 Key environmental issues relating to water resources and flood risk include:

- potential short-term impacts on surface water flows and quality as a result of construction works near the Padbury Brook and its tributaries;
- the risk of leachate being encountered during excavations close to Calvert Landfill (see Section 8: Land quality);
- potential risk of river flooding at the crossings of the Padbury Brook and its tributaries;
- potential risk of surface water flooding as a result of the construction of the Calvert infrastructure maintenance depot (IMD) and railhead; and
- potential impacts on the risk of surface water flooding for a number of minor watercourses

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[95] (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-002-013: Water Resources Assessment report;
- Appendix WR-003-013: Flood Risk Assessment; and
- Appendix WR-004-004: Hydraulic Modelling Report for the Padbury Brook at Twyford and Godington.

13.1.6 Map Series WR-01 to WR-03 and WR-05 to WR-06 showing some of the details, environmental baseline and design features referred to in this report and those in Volume 5 are all contained in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

13.1.7 Discussions have been held with the Environment Agency, Bedford Group of Internal Drainage Boards (IDB), Buckinghamshire County Council, Aylesbury Vale District Council and Cherwell District Council.

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 (see Volume 5: Appendix CT-001-000/1 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 A site visit was undertaken in December 2012 to the crossings of the Padbury Brook and tributaries to inform the assessment.

13.2.4 WFD classification data has been made available by the Environment Agency. For surface water bodies that do not have a WFD status class shown in the relevant River Basin Management Plan[96] (RBMP), the status class has been taken as the status class

[95] *Directive 2000/60/EC (Water Framework Directive) 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.
[96] Environment Agency (2009), *River Basin Management Plan, Anglian River Basin District*.

for the first downstream water body for which a status class is 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 Groundwater level data from the Environment Agency and other monitored locations such as private abstractions are limited in the study area. It is assumed that groundwater levels vary in a similar fashion to topography throughout the study area, with groundwater level contours roughly parallel to topographic contours. In the absence of more detailed information, it has been generally assumed that groundwater levels are within 1m of the ground surface.

13.2.6 Detailed hydraulic modelling has been undertaken for the Padbury Brook and its tributaries at Twyford and Godington. The outputs from this model are shown on Maps WR-05-028 to WR-05-031 and WR-06-028 to WR-06-031 (Volume 5, Water Resources and Flood Risk Assessment Map Book). The limitations associated with flood risk within this study area are described in detail in the Volume 5: Appendix WR-003-013.

13.3 Environmental baseline

Existing baseline – Surface water resources

Surface water features

13.3.1 All water bodies within the study area fall within the Upper and Bedford Ouse catchment, which includes the Padbury Brook and its tributaries. This sub-catchment falls within the Anglian River Basin District (RBD).

13.3.2 The route will cross the Padbury Brook in three locations. The Padbury Brook is regulated by the IDB under the name of 'the Twin Rivers'. A tributary of Padbury Brook draining a catchment to the south and east of Steeple Claydon is referred to by the Environment Agency as 'the Twin' WFD water body. Two branches of this 'River Twin' are referred to by the IDB as 'M23' and 'M24' and flow through the land proposed for Calvert IMD and railhead.

13.3.3 The current surface water baseline is shown on Maps WR-01-018 and WR-01-019 (Volume 5, Water Resources and Flood Risk Assessment Map Book) and all surface water features within the study area are assessed within Volume 5: Appendix WR-002-013. Table 21 only includes features potentially affected by the Proposed Scheme.

Table 21: Surface water features potentially affected by the Proposed Scheme

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book, map reference)	Watercourse classification[97]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[98]
Unnamed drain	A drain on the western and southern perimeters of Calvert landfill site west of the route. Does not connect to the IDB drains.	Not applicable	Not applicable	Not applicable	Low
Six ponds and watercourse	A network of unnamed ponds and drains to the south and north of Calvert from 250m west of the route up to 1km. Not connected to the IDB drains. (CFA13-P03)	Not applicable	Not applicable	Not applicable	Low
Drain identified by the IDB as M24	To the south of Steeple Claydon, upstream of the Twin. M24 will be crossed by the Calvert IMD and railhead at SWC-CFA13-16.	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Drain identified by the IDB as M23	Located south-west of Steeple Claydon, 1,000m south-west of SWC-CFA13-16. M23 will be crossed by the Calvert IMD and railhead at SWC-CFA13-15.	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Tributary to drain identified by the IDB as M23.	A tributary to the M23 drain originating north of Calvert. (SWC-CFA13-12)	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate

[97] 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.

[98] For examples of receptor value see Table 43 in the addendum to the SMR (Volume 5, Appendix CT-001-000/2).

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book, map reference)	Watercourse classification[97]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[98]
Tributary to drain identified by the IDB as M23.	A tributary to the M23 drain originating in Calvert Jubilee Nature Reserve LWS lake. (SWC-CFA13-01, SWC-CFA13-13 and SWC-CFA13-14)	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Lake (Calvert Jubilee Nature Reserve LWS)	Calvert Jubilee Nature Reserve LWS, located to the north of Calvert between Grebe Lake and the Proposed Scheme. Outflow via drain to M23.	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Grebe Lake	Located to the north of Calvert and to the west of the route.	Not applicable	Not applicable	Not applicable	Moderate
Drain S75	Located near Portway Farm. (SWC-CFA13-02, SWC-CFA13-17, SWC-CFA13-18 and SWC-CFA13-20)	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Four ponds	Four isolated ponds adjacent to and within 100m north of the route near Twyford Sewage Treatment Works. (CFA13-P09) (SWC-CFA13-19 and SWC-CFA13-21)	Not applicable	Not applicable	Not applicable	Low
Drain S76	The drain is located near Twyford and will be crossed by the route at SWC-CFA13-03.	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Padbury Brook	Padbury Brook north of Twyford (SWC-CFA13-04) and north-east of Godington (SWC-CFA13-08 and SWC-CFA13-09)	Ordinary watercourse	Padbury Brook (The Twins) (GB105033038210) Good	Good potential	High
Unnamed drain	An unnamed drain running parallel to Padbury Brook close	Ordinary watercourse	No status class shown in RBMP – assumed status	No status class shown in RBMP – assumed status	Moderate

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book, map reference)	Watercourse classification[97]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[98]
	to SWC-CFA13-04. (SWC-CFA13-05)		Good	Good potential	
Unnamed drain	An unnamed drain (tributary of Padbury Brook) flowing south and will be crossed by the route near Twyford. (SWC-CFA13-06)	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Unnamed drain	An unnamed drain (tributary of Padbury Brook) flowing south-west. It will be crossed by the route to the east of Godington. (SWC-CFA13-07)	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Unnamed drain	An unnamed drain at Moat Farm.	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Unnamed drain	An unnamed drain flowing east and crossed by the route, north-east of Godington. (SWC-CFA13-10)	Ordinary watercourse	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Two ponds	Two isolated field ponds approximately 65m and 195m east of the route on Rosehill Farm. (CFA13-P15)	Not applicable	Not applicable	Not applicable	Low
Two ponds	Two isolated field ponds approximately 100m east of the route near The Hermitage and Chetwode.	Not applicable	Not applicable	Not applicable	Low
Pond and watercourse (CFA13-P18)	A pond and drain approximately 270m east of the route within Chetwode. (CFA13-P16)	Not applicable	No status shown in RBMP – assumed status Good	No status shown in RBMP – assumed status Good potential	Moderate
Unnamed drain	The drain flows west from Barton	Ordinary	No status shown in RBMP – assumed	No status shown in RBMP – assumed	Moderate

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book, map reference)	Watercourse classification[97]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[98]
	Hartshorn and will be crossed by the route at SWC-CFA13-11 and by access road at SWC-CFA13-22.	watercourse	status Good	status Good potential	
Three ponds	Three field ponds within 50 – 250m west of the route, to the north of Barton Hill Farm. (CFA13-P22)	Not applicable	Not applicable	Not applicable	Moderate
Unnamed drain	The drain runs south along the CFA13/CFA14 boundary near Home Farm.	Not applicable	Not applicable	Not applicable	Moderate

13.3.4 In addition to the features listed in Table 21 there are also a large number of ponds, drains and three moats within the study area, but which are not considered likely to be affected by the Proposed Scheme. The details of these features are given in Volume 5: Appendix WR-002-013.

Water Framework Directive status

13.3.5 The Environment Agency have assessed the current status and predicted overall quality of the WFD water body 'Padbury Brook (The Twins)' (GB105033038210) to be Moderate with a 2015 objective of Good Potential.

13.3.6 The WFD water body 'The Twin' (GB105033030560) is currently at Good Potential and is predicted to remain the same as current conditions.

Abstractions and permitted discharges

13.3.7 There is one licensed surface water abstraction within the study area[99] which is potentially linked to another licence approximately 1.3km from the route. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

13.3.8 The Environment Agency reports that there are 24 current consented surface water discharges within the study area (details in Volume 5: Appendix WR-002-013, and see Maps WR-01-018 and WR-01-019 in Volume 5, Water Resources and Flood Risk Assessment Map Book).

[99] Surface water abstractions for public supply are not included.

Existing baseline – groundwater resources

Geology and hydrogeology

13.3.9 The geological formations within this area are described further, with a schematic geological cross-section in Volume 5: Appendix WR-002-013.

13.3.10 The location of private abstractions, geological formations and indicative groundwater levels are shown on Map WR-02-013 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.11 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 22. Unless otherwise stated, the geological groups listed are all crossed by the route.

Table 22: 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						
Alluvium	Valley floors of the Padbury Brook and its tributaries.	Clay, silt, sand and gravel	Secondary A aquifer	Not assessed by Environment Agency	Not assessed by Environment Agency	Moderate
River Terrace Deposits	Valleys of the Padbury Brook and its tributaries.	Sand and gravel	Secondary A aquifer	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Till	High ground to the north, west and south of Chetwode	Poorly sorted sediment with sand to gravel sized particles in a clay matrix	Unproductive strata	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low
Glaciofluvial Deposits	Outcrops on the margins of the Till on the hillsides to the north, west and south of Chetwode.	Sand and gravel	Secondary A aquifer	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Bedrock						
Ancholme Group (Oxford Clay Formation, Peterborough Member)	Across the central and eastern part of the study area between Grebe Lake and Chetwode	Mudstone	Unproductive Strata	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low
Ancholme Group (Oxford Clay Formation, Stewartby	On high ground around Poundon and Charndon and in the area of	Mudstone	Unproductive Strata	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low

Member)	Grebe Lake					
Ancholme Group (Kellaways Formation)	A 300m to 1km wide band running along the north-western end of the CFA.	Sandstone, siltstone and mudstone	Secondary A aquifer	Upper Bedford Ouse Oolite Good	Good	Moderate
Great Oolite Group (Cornbrash Limestone Formation)	Located on the north-western boundary of the CFA.	Limestone	Secondary A aquifer	Upper Bedford Ouse Oolite Good	Good	Moderate

Superficial deposits

13.3.12 Drift deposits are absent from the southern third of the route in this area. In central areas they consist of River Alluvium comprising clay, silts, sands and gravels and River Terrace Sands and Gravels generally following the route of Padbury Brook and its tributaries. Drift deposits of River Alluvium and River Terrace Sand and Gravels are both designated Secondary A aquifers. Otherwise the superficial deposits crossed are largely Tills which are designated as non-aquifers.

13.3.13 Groundwater flow within these deposits is likely to be in continuity with the local watercourses. In the vicinity of Barton Hartshorn, drift deposits consist of Glacial Till, comprising a clay or sand matrix with sand and gravel but also with glaciofluvial sand and gravel deposits outcropping at the surface along the route north-west of School End. Groundwater flow within these deposits is likely to be limited but is expected to be towards the base of the valleys.

Bedrock aquifers

13.3.14 The bedrock geology underlying the majority of the route in this section is the Ancholme Group consisting of the Oxford Clay Formation, comprising mudstone, and the Kellaways Formation, comprising mudstone, siltstone and sandstone. Approximately 500m of the northern-most part of the route is underlain by the Cornbrash Formation of the Great Oolite Group, described as limestone.

13.3.15 The Oxford Clay Formation is an aquitard (unproductive strata) and does not have any WFD classification. No groundwater is expected to be encountered.

13.3.16 The Kellaways Formation, comprising mudstone, is a Secondary A aquifer. The limited publicly available borehole records indicate that groundwater levels can be within 1m of the ground surface at Barton Hartshorn. Groundwater flow is expected to be towards the local watercourses.

13.3.17 The Great Oolite Group (Cornbrash Limestone Formation) is a Secondary A aquifer and likely to be in hydraulic connectivity with the overlying Kellaways Formation. A small outcrop is crossed by the route in the north-west of this study area.

13.3.18 The geological formations within the Calvert, Steeple Claydon, Twyford and Chetwode area are described in detail in Section 8, Land Quality and further details are provided in Volume 5: Appendix WR-002-013.

Water Framework Directive status

13.3.19 No WFD classification has been given by the Environment Agency to the superficial deposits.

13.3.20 The overall WFD status of groundwater in the study area is summarised in Table 22 and is largely classified as having Good Status.

Abstractions and permitted discharges

13.3.21 There are no licensed abstractions from groundwater within the study area and no Source Protection Zones (SPZ) will be crossed by the Proposed Scheme.

13.3.22 No unlicensed groundwater abstractions have been identified within the study area. There is the potential for unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

13.3.23 The Environment Agency reports that there are two consented discharges to ground in the study area (further details are provided in Volume 5: Appendix WR-002-013).

Surface water/groundwater interaction

13.3.24 Springs and issues are marked on Ordnance Survey maps at the base of the drift deposits in the area of Chetwode and Barton Hartshorn, as shown on Map WR-01-019, C3, C4 and E6 (Volume 5, Water Resources and Flood Risk Assessment Map Book). The latter springs may be supported by the underlying Kellaways Formation, further information regarding these springs is provided in Appendix WR-002-013).

13.3.25 It is likely that shallow groundwater will be present in close proximity to these springs and issues.

13.3.26 The Kellaways and Cornbrash Formations are likely to contribute baseflow to the Padbury Brook and its upstream tributary near the surface water crossings.

Water dependent habitats

13.3.27 The route will not cross any areas with statutory ecological designations in relation to surface water or groundwater.

13.3.28 However, there are a number of potentially water dependant habitats within 1km of the route in the study area and not crossed by the route. These include:

- Calvert Jubilee Nature Reserve LWS (see Map EC-01-029, G7, Volume 5, Ecology Map Book);
- Calvert Brick Pits LWS (see Map EC-01-029, F7);
- Barton Hartshorn Railway Wood LWS (see Map EC-01-031, D6);

- Calvert Railway Station LWS (see Map EC-01-029, I6);
- Decoypond Wood LWS (see Map EC-01-028, C6); and
- Field A Cowley Farm LWS (see Map EC-01-030, F4).

13.3.29 In addition to the above, the disused railway cutting at the BNS at Chetwode (see Map EC-01-031, H7) contains areas of neutral grassland and ponds and a second field south of Cowley Farm, known as field B Cowley Farm BNS (see Map EC-01-030, F5), contains an area of damp neutral grassland.

13.3.30 Further information on the above ecological receptors is given in Section 7 of this report.

Existing baseline – flood risk

River flooding

13.3.31 The agreed data set for river flooding is the Environment Agency Flood Zone Mapping as shown on Map WR-01-018 and Map WR-01-019 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.32 The Calvert IMD will cross two tributaries of the Padbury Brook managed by the IDB to the south of Steeple Claydon (see Map WR-01-018, SWC-CFA13-15 and SWC-CFA13-16). The easterly of these tributaries (SWC-CFA13-16, referred to by the IDB as M24), which originates in the grounds of Claydon House, is shown on the Environment Agency Flood Zone Maps. At this location, the IMD footprint will occupy approximately 8,600m^2 of Flood Zone 3. The upstream catchment at the crossing is approximately 4.9km^2. Land use in the area is predominantly arable land and pasture (moderate value).

13.3.33 There is no existing Environment Agency Flood Zone mapping associated with the westerly of these two tributaries (Map WR-01-018 SWC-CFA13-15 – referred to by the IDB as M23) as the catchment upstream of the crossing is 1.1km^2.

13.3.34 There is an existing flow restriction within the catchment of the Padbury Brook throughout this area, caused by the embankments and underbridges of the disused Great Central Main Line railway. Due to the complexity of the interactions between the Proposed Scheme and the watercourse, as well as the lack of existing hydraulic structures present in the Environment Agency model, a site specific hydraulic model was created to better understand the potential impacts to the risk of flooding in the Padbury Brook catchment. Further details on the modelling undertaken as part of the assessment are presented in the CFA13 Flood Risk Assessment (Volume 5: Appendix WR-003-013).

13.3.35 The route will cross the twin channels of the Padbury Brook (Map WR-01-018 SWC-CFA13-04 and SWC-CFA13-05) and its tributaries (SWC-CFA13-03, SWC-CFA13-06 and SWC-CFA13-21) close to Twyford. The Padbury Brook has a catchment size of approximately 73.8km^2 at this crossing. According to the site specific modelling of the

Padbury Brook, the route will cross 60m of Flood Zone 3 on viaduct, with embankments occupying approximately 7,000m^2. According to the Buckinghamshire preliminary flood risk assessment[100] (PFRA), flooding was experienced from the Padbury Brook at Twyford, Twyford Mill and Three Bridges Mill in 2003.

13.3.36 The tributary to the east of Twyford (referred to as 'S76' by the IDB) has a catchment size of approximately 3.6km^2 at the intersection with the route. According to the site specific modelling of the Padbury Brook, the route will occupy approximately 18,100m^2 of Flood Zone 3 at the Twyford tributary.

13.3.37 The route will cross the Padbury Brook twice more (see Map WR-01-019, SWC-CFA13-08 and SWC-CFA13-09) to the north of Godington. The Padbury Brook has a catchment size of approximately 67.8km^2 at the downstream intersection with the route (SWC-CFA13-09). According to the site specific modelling of the Padbury Brook, the route will cross approximately 150m of Flood Zone 3 on two 75m viaducts at Godington, with embankments occupying approximately 17,000m^2 of Flood Zone 3.

13.3.38 Land use in the floodplain in the vicinity of the crossings at Twyford and Godington is arable farm land and pasture (moderate value receptor). There are two residential properties, Church View Farm at Twyford and Moat Farm at Godington (high value receptors).

13.3.39 A further 3,000m^2 of Flood Zone 3 will be occupied to the north-east of Newton Purcell where the route will cross another tributary of the Padbury Brook (Map WR-01-019, SWC-CFA13-11). This watercourse is shown on Environment Agency records to have flooded in 1947, as indicated on Map WR-01-019 in the Volume 5, Water Resources and Flood Risk Assessment Map Book. Local receptors in the vicinity of this crossing include arable land (moderate value receptors) and woodland (low value receptor).

Surface water flooding

13.3.40 As stated in the Buckinghamshire and Oxfordshire Lead Local Flood Authority (LLFA) PFRA[101] reports, the locally agreed dataset for surface water flooding is the Environment Agency Flood Map for Surface Water (FMfSW), which is shown on Map WR-01-018 and Map WR-01-019 in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

13.3.41 The Proposed Scheme will cross a number of valleys within the study area that are shown on the FMfSW to be at risk of surface water flooding. These valleys include a watercourse (Map WR-01-018, SWC-CFA13-15) south-east of the Calvert IMD, where there are culverts below the existing railway embankment, and a tributary of the Padbury Brook upstream of the extent of river flooding east of Twyford (Map

[100] Jacobs and Buckinghamshire County Council (2011), *Buckinghamshire County Council Preliminary Flood Risk Assessment*.
[101] JBA Consulting (2011), *Oxfordshire Preliminary Flood Risk Assessment*.

WR-01-018, SWC-CFA13-02) that have either not been included in the Environment Agency Flood Zone Mapping, or have a catchment size less than 3km^2.

Sewer flooding

13.3.42 The agreed datasets for sewer flooding are Thames Water records in the Buckinghamshire and Oxfordshire PFRA reports.

13.3.43 The route will not pass through any significantly urbanised areas within this study area. The Buckinghamshire PFRA concludes that sewer flooding across the region is sporadic and infrequent. None of the areas identified in the Oxfordshire PFRA as experiencing sewer flooding problems are crossed by the route. Consequently, there is currently a low risk of flooding from sewers.

Artificial water bodies

13.3.44 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 from reservoirs is the Environment Agency Reservoir inundation map (RIM).

13.3.45 The route will cross an area shown on the Environment Agency RIM to have a risk of flooding associated with a failure of Tusmore Park Lake. The modelled flow paths from this water body follow the course of the Padbury Brook and its floodplain. A further area will be crossed at the Calvert IMD associated with a failure of the ornamental ponds within the grounds of Claydon House. Although there is the potential to have an impact on the extent and depth of residual risk of flooding from Tusmore Park Lake and Claydon House by way of the construction of embankments and other raised infrastructure within the mapped flood extent, the likelihood of such flooding occurring is extremely low and is therefore not considered further in detail within this assessment.

Groundwater flooding

13.3.46 The agreed data set for groundwater flooding is the Buckinghamshire and Oxfordshire PFRAs and the Aylesbury Vale District Council and Cherwell District Council strategic flood risk assessments[102] (SFRA).

13.3.47 There have been no recorded historical incidents of groundwater flooding within the study area. The Buckinghamshire PFRA identifies that a significant proportion of the land (>75%) at the Padbury Brook is susceptible to groundwater emergence. The Oxfordshire PFRA identifies that a significant proportion of the land at Godington (>75%) is susceptible to groundwater emergence. The SFRA reports do not identify any specific groundwater flood risks within the study area.

[102] Aylesbury Vale District Council (2012), *Aylesbury Vale Strategic Flood Risk Assessment* (Revised from: Royal Haskoning (2007)) and Scott Wilson (2009), *Cherwell and West Oxfordshire Strategic Flood Risk Assessment*.

Future baseline

13.3.48 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.

13.3.49 The East West Rail project consortium is working to upgrade infrastructure on the Bicester to Bletchley Line and Aylesbury Link railway line in this area. Calvert Landfill (pits no. 4 and 5) restoration proposals are understood to be implemented by December 2017.

13.3.50 All developments are required to comply with the National Planning Policy Framework (NPPF)[103], development plans and other legislation and guidance. As such committed developments should have a neutral effect on the water resources and flood risk baseline.

13.3.51 WFD future status objectives are set out in Table 21 and Table 22. This potential change in baseline is not considered to result in the reported effects from the Proposed Scheme changing in significance.

Climate change

13.3.52 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 to result in significant changes to the reported effects from the Proposed Scheme.

13.3.53 Current projections 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.

13.3.54 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.

[103] Department for Communities and Local Government (2012), *National Planning Policy Framework Technical Guidance*.

The sensitivity testing undertaken allows for variations in climate change factors included in other national guidance.

13.3.55 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, WR-002-013 and WR-003-013.

13.4.3 With regard to surface water features, the viaducts of the Proposed Scheme that will cross the Padbury Brook (SWC-CFA13-04, SWC-CFA13-08 and SWC-CFA13-09) will be designed to ensure that foundation works and permanent structures will reduce effects on water quality or flow.

13.4.4 The detailed design of all watercourse realignments and crossings will be completed in consultation with the Environment Agency to meet their objectives with respect to hydraulic capacity, flood risk, ecology and hydromorphology. Where culverts are required these will be kept as short as possible. Where reasonably practicable, the permanent channel realignments will be constructed in advance of other activities associated with the construction of the Proposed Scheme. The design mitigation including consideration of design features aligned with the objectives of the WFD (for example use of soft engineering solutions, aquatic marginal planting and the inclusion of natural forms) will ensure that the channels and structures are sufficiently sized to avoid a permanent impact on flow. The following surface water crossings will be dealt with in this way (see Maps WR-01-018 and WR-01-019 in Volume 5, Water Resources and Flood Risk Assessment Map Book), as discussed further in Volume 5: Appendix WR-002-013:

- the outflow from the Grebe Lake, a tributary of the River Twin (Map WR-01-018, SWC-CFA13-01);
- the tributaries of the Padbury Brook at Portway Farm (Map WR-01-018, SWC-CFA13-02) and Twyford (SWC-CFA13-03);
- the unnamed drain near Twyford (Map WR-01-018, SWC-CFA13-05 and SWC-CFA13-06);
- the unnamed drain to the east of Godington (Map WR-01-019, SWC-CFA13-07);
- the unnamed drain to the north-east of Godington (Map WR-01-019, SWC-CFA13-10); and

- the unnamed drain north of Barton Hill Farm (Map WR-01-019, SWC-CFA13-11).

13.4.5 Drainage has been designed to reduce the rate and volume of run-off from the railway and to avoid an increase in flood risk. The balancing ponds will provide mitigation to ensure that rainfall run-off from the Proposed Scheme including the IMD 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-06-054 to CT-06-060 (Volume 2, CFA13 Map Book), will be designed where practicable to discharge at existing run-off rates and will accommodate for events up and including the 1 in 100 annual probability (1%) including an allowance for climate change.

13.4.6 Realignments of eight minor roads including Calvert green overbridge, School Hill, Charndon Lodge underbridge (passing under the Bicester to Bletchley rail line), Addison Road, Perry Hill overbridge, West Street, The Green at Chetwode, and School End, are required as part of the Proposed Scheme in this area. Appropriate mitigation will be provided to address the risks to 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[104] and CIRIA[105] guidance to control the runoff rates and water quality in accordance with the necessary approvals.

13.4.7 With regard to groundwater resources, the Proposed Scheme does not penetrate below the clays of the Ancholme Group between Sheephouse Wood and Chetwode and hence does not affect groundwater within deeper aquifers.

13.4.8 The proposed cutting past Chetwode will have a depth of approximately 10m. It will pass through the Kellaways Formation which is overlain by a Till at the surface and potentially a thin layer of Glacial Sand and Gravels beneath the Till. There is one small spring located about 200m south of the route near this cutting and it is considered that this spring could support a nearby surface water abstraction licence (SWB4b). Land drainage associated with the Proposed Scheme will be discharged locally to ground or to the watercourse fed by this spring (see details in Volume 5: Appendix WR-002-013).

13.4.9 The Barton to Mixbury cutting in the north of the area will cut through the Great Oolite aquifer to a depth of about 2m with potential to encounter groundwater, which is of moderate value. Drainage from the cutting will be returned to ground or to local watercourses.

13.4.10 To reduce the potential for impacts to flood risk the Padbury Brook will be crossed on viaducts at Twyford and Godington reducing the amount of built footprint within the floodplain.

[104] Department for Transport; *Design Manual for Roads and Bridges*; Volume 4, Section 2; http://www.dft.gov.uk/ha/standards/dmrb/vol4/section2.htm; Accessed: October 2013.
[105] Murname, E., Heap, A. and Swain, A. (2006), *C648 Control of Water Pollution from Linear Construction Sites*, CIRIA, London, UK.

13.4.11 Replacement floodplain storage will be provided at the crossings of the Padbury Brook and tributaries to mitigate for any potential increase in the risk of flooding at locations where there will be a restriction to flow and a loss of floodplain. The replacement floodplain storage areas provided are shown on Maps CT-06-054 to CT-06-060 (Volume 2, CFA13 Map Book). Replacement floodplain storage areas will be provided prior to the construction of built structures within the floodplain in consultation with the Environment Agency.

13.4.12 To minimise potential adverse effects on flood risk all culverts (such as at the tributary of the Padbury Brook at Twyford and at the Calvert IMD) will be designed to convey the 1 in 100 year (1% annual probability) flow including an allowance for climate change, and the realigned watercourses will be designed with at least equal capacity to the existing system to ensure no loss of conveyance. This will ensure that flow is not cut off and continues to be conveyed to the downstream catchment, whilst ensuring downstream flood risk is not increased.

13.4.13 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-003-000/1). These will provide effective management and control of the impacts during the construction period.

13.4.14 The following examples illustrate how measures in the draft CoCP will reduce potentially adverse effects arising during construction on water resources and flood risk.

13.4.15 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 and to confirm the effectiveness of agreed temporary and permanent mitigation measures.

13.4.16 With regard to surface water, Section 16 of the draft CoCP stipulates that works in or near the watercourses at the crossings and realignments of the Padbury Brook and tributary watercourses will be designed in consultation with the Environment Agency, so that sediment mobilisation is managed, the potential for contamination from fuel spills is minimised and the works are timed to minimise the impact on water quality and water dependent habitats and species.

13.4.17 There will be a large area of sustainable placement between the Aylesbury Link railway line realignment and School Hill. The areas identified for sustainable placement are underlain by the Oxford Clay Formation which is unproductive strata. The areas identified for temporary material stockpiles are underlain by the Oxford Clay Formation, which is unproductive strata or Superficial deposits. Suitable water quality criteria will be defined prior to material being placed to ensure that the existing water quality of surface water courses or groundwater in the superficial deposits is not adversely affected by the quality of the placement material. The draft

CoCP (Sections 11, 15 and 16) defines appropriate measures that will be followed to ensure any impacts to surface water quality are minimised.

13.4.18 With regard to flood risk, Section 16 of the draft CoCP requires contractors to obtain the necessary approvals to enable discharge of dewatering and surface water runoff to watercourses or to the public sewer network from construction sites, such as at the Calvert IMD, avoiding an increase in the risk of surface water or sewer flooding.

13.4.19 Construction sites located within flood risk areas, such as at the Calvert IMD and the Twyford and Godington viaducts, will have site specific flood risk management plans prepared prior to construction, as stated in Section 16 of the draft CoCP.

13.4.20 In accordance with Section 16 of the draft CoCP, temporary material stockpiles and site offices will be located outside of Flood Zone 3 to avoid having an impact on the risk of flooding from the Padbury Brook.

Assessment of impacts and effects

13.4.21 This section describes the significant effects following the implementation of avoidance and mitigation measures.

13.4.22 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.

13.4.23 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).

13.4.24 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

13.4.25 The assessment shows that there will be no significant temporary adverse effects on surface water resources during the construction.

13.4.26 The Land quality section of this report (Section 8.4) sets out the assessment of potential impacts from construction in contaminated areas. This includes accounting for the draft CoCP requirements (Section 11) that will provide effective management and control during construction, starting with pre-construction ground investigation and subsequent risk assessment. The initial screening study for this assessment has identified a potential risk that leachate could be detected during construction of the cutting adjacent to the Calvert Landfill pits no. 4 and 5 (active) and Calvert Landfill pit no. 1 (closed). However, the risk assessment concludes that the temporary effect will be neutral in both cases (see Section 8.4 and Volume 5: Appendix LQ-001-013, Section

3, for the detailed risk assessment). This will be confirmed following the pre-construction ground investigation and the subsequent risk assessment and will identify if other mitigation is required for water resources.

Groundwater

13.4.27 The assessment shows that there will be no significant temporary adverse effects on groundwater or water dependent habitats during the construction period.

Flood risk

13.4.28 The assessment has identified no increase in flood risk during the construction process and therefore no significant temporary effects.

Cumulative effects

13.4.29 The design and planning of the Proposed Scheme is integrated with the proposed upgrades to the Bicester to Bletchley and Aylesbury Link railway lines associated with the East West Rail project and takes account of the Calvert Landfill (pits no. 4 and 5) restoration proposals. As a result, there will be no significant cumulative temporary effects on surface water, groundwater or flood risk in this area.

Permanent effects

Surface water

13.4.30 The assessment shows that there will be no significant permanent adverse effects on surface water resources.

Groundwater

13.4.31 The assessment shows that there will be no significant permanent adverse effects on groundwater resources or water dependent habitats.

Flood risk

13.4.32 The assessment shows that there will be no significant permanent adverse effects on flood risk from all sources.

13.4.33 Hydraulic modelling has shown that the Twyford viaduct and approach embankments will throttle flow in the Padbury Brook and cause an increase in floodwater levels upstream of the Proposed Scheme. This increase will be largely contained within the area between the Proposed Scheme and former Great Central Main Line embankment. Upstream of the existing Great Central Main Line embankment there is predicted to be a small increase in flood water levels for the 1 in 100 annual probability (1%) flood event, with a minimal increase in flood extent. Replacement floodplain storage will be provided on the west bank upstream of the former Great Central Main Line embankment to ensure that the Proposed Scheme does not have a significant effect on the agricultural land between the Great Central Main Line and the Proposed Scheme, and upstream of the Great Central Main Line. There will be no increase in flood risk to Church View Farm, a high value receptor, as a result of the marginal increase in flood water level or extent. The severity of flooding downstream of the

Proposed Scheme will be reduced leading to beneficial effects in this area. There will be a significant beneficial effect on land downstream of the Twyford viaduct (east of the Proposed Scheme) on both banks of the Padbury Brook due to this restriction of flows. More information can be found in the CFA13 Flood Risk Assessment (Volume 5, Appendix WR-003-013).

Cumulative effects

13.4.34 There are no committed developments that have been identified which will result in significant cumulative effects.

Other mitigation measures

13.4.35 Should the pre-construction ground investigation and risk assessment confirm a potential risk of leachate release a site-specific monitoring programme will be put in place in consultation with the Environment Agency and the IDB. Any monitoring could include monitoring of the quality of water captured by the drainage system for the Proposed Scheme once in place as well as local surface watercourses and water bodies to determine if there is any deterioration in water quality. If the site-specific monitoring indicates a significant risk to water resources, this will inform the detailed design which will need to provide a means of separating potentially contaminated drainage from other track drainage, such as the use of cut-off valves and the collection and appropriate disposal of drainage water to ensure that the polluted water will not enter receiving watercourses.

13.4.36 No other mitigation measures are envisaged for surface water, groundwater or flood risk.

Summary of likely significant residual effects

13.4.37 Downstream of the Twyford viaduct (east of the Proposed Scheme) on both banks of the Padbury Brook (Map WR-01-018 SWC-CFA13-02 and SWC-CFA13-05) there will be a reduced risk from river flooding in the 1 in 100 year (1% annual probability) event including an allowance for climate change. This will be a permanent beneficial effect.

13.4.38 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 watercourses 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-06-054 to CT-06-060 (Volume 2, CFA13 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 watercourses 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 flooding 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, groundwater resources or flood risk.

14 References

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