

The High Speed Rail (London – West Midlands) (Greatmoor Railway Sidings Etc.) Order

Environmental Statement – technical appendices

Volume 4.1:

Additional information Part A

- Greatmoor Energy from Waste (EfW) masterplan
- Operational timing restrictions for bats
- Scoping opinion
- Scoping opinion responses

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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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1 Introduction

- 1.1.1 This general appendix contains third party documents that have been referred to as part of Volume 2: the Main Environmental Statement.

2 Greatmoor EfW facility masterplan

- 2.1.1 The Greatmoor Environmental Landscape Restoration Planting masterplan (GR3/1, June 2011) is included on the following page.
- 2.1.2 This drawing shows the expected landscape restoration for the Greatmoor EfW facility and Calvert landfills.



Jubilee Pits Local Nature Reserve.
In consultation with BBOWT, explore the options for creating new scrapes for wading birds.

Proposed Woodland.
To comprise mixed broadleaved woodland with designated access routes. Blackthorn and privet to be included in thickets or around the margins of the woodland for butterflies

Proposed Muxwell Brook and Ponds.
Re-instate the Muxwell Brook, creating a naturalized water channel with scrub and rough grassland banks, providing ideal bat commuting and foraging habitat. New balancing pond will also provide valuable foraging for bat species. Additional small wildlife pond for great crested newts breeding.

Enhanced Bat and Newt Habitats.
To include rough grassland, planting and terrestrial habitat for Great Crested Newts. Bat corridor to be integrated along edge of proposed woodland to link to adjacent existing woodland.

Proposed open woodland and species rich grassland.

Callow Mounds.
Restored in 2010/11 with Great Crested Newt mitigation ponds and terrestrial habitat, tree and scrub planting and enhancement of existing aquatic habitats.

Existing farmland.
Strengthen woodland links along field boundaries.

Ecological Enhancement.
Pond creation and grassland for habitat improvement.

Existing hedgerows.
To be retained in and around the EFW/IVC plant. Existing hedges to be supplemented with blackthorn around field margins.

Tenanted farmland.
Return to low intensity pasture by seeding and appropriate management.

Reinstated historic field pattern to enhance setting of Lower Greatmoor Farm.

Mega-Ditch
Provision of a new wooded corridor linking to railway vegetation for local Bechstein Bat habitat connectivity.

Retain some bare ground as open mosaic habitat for butterfly species. Potential to create a habitat for glow worms.

Landfill Gas Power Station

Lower Greatmoor Farm Orchard & Garden

Additional mitigation area with blackthorn scrub thickets for Black Hairstreak Butterfly

Proposed small car park. 12 spaces.

Existing hedgerows
To be enhanced with blackthorn and other native species including privet

Existing Improved grassland.
Sward to be managed as species rich grassland with low intensity grazing to improve species diversity.

South Facing Slopes on Pit 6.
Additional blackthorn planting in thickets, creating a scrub grassland mosaic. Creation of areas of open ground on shallow mounds within the mosaic, allowing selected areas to naturally colonise from surrounding species-rich grasslands.

Proposed Circular Bridleway.
Woodland planting thinned and managed for improved access.

Existing Improved Grassland
Mitigation to include new ponds suitable for breeding amphibians, hedge and tree planting and grassland management to enhance terrestrial habitats for badgers, newts, reptiles and bats and create new habitat linkages for mobile fauna.

- LEGEND**
- Application boundary
 - Land under the control of WRG
 - Existing vegetation
 - Proposed woodland
 - Proposed shrub planting
 - Proposed hedgerows & hedgerow trees
 - Proposed species rich grassland
 - Existing arable land, returned to low intensity pasture
 - Proposed orchard & garden for Lower Greatmoor Farm
 - Proposed habitat creation
 - Proposed scrapes, shallows & wetlands
 - Open water areas
 - Proposed Access Routes
 - Reinstated Public Rights of Way
 - Existing Public Rights of Way Bridleways and Footpaths

The restoration design for Pit 4 & 5 is permitted

Revision	By	CHK'd By	Date	Comments
A	ET	SLP	AUG 2011	Information on ecological impact, habitats & Lower Greatmoor Farm Orchard.

waste recycling group

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Site	GREATMOOR		
Project	GREATMOOR BUCKINGHAMSHIRE		
Drawing Title	RESTORATION MASTERPLAN		
Project File Reference	411,0197,00783	Drawn By	ET
Scale	1:5000 @ A0	CHK'd By	SLP
Date	JUNE 2011	Revision	A
Drawing Number	GR 3/1		

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3 Details on lighting hours

- 3.1.1 Further details on lighting hours are contained within the report on "Operational Timing Restrictions to Minimise Effects on Bats", June 2016.
- 3.1.2 This report is included in the following 26 pages.

Alternative Waste Rail Sidings, Calvert, Buckinghamshire

OPERATIONAL TIMING RESTRICTIONS TO MINIMISE EFFECTS ON BATS

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1.0 INTRODUCTION

Current operating times of FCC's Waste Sidings operation at Calvert are 0430 to 2300 Monday to Friday (18.5 hours total) and from 0700 to 1600 on Saturdays.

The construction and operation of HS2 will directly affect Calvert Landfill's current rail sidings and therefore an alternative site for the sidings is proposed on land to the south. The alternative sidings are on the other side of the rail tracks, necessitating a crossing for HGVs and other vehicles unloading the waste and spoil from trains and transporting it to Calvert Landfill and Greatmoor Energy from Waste (EfW) Facility. It is currently proposed that this crossing point would be a multi-use green overbridge, which supports an access road to the rail sidings suitable for HGVs, a bridleway (GUN/28) and green infrastructure, including a double-hedgerow, which is designed to act as a crossing point for wildlife, including bats.

The proposed rail sidings have undergone various design iterations to minimise the risk of impacts to bats and other wildlife. This report focusses upon the operation of the sidings to avoid or reduce potential impacts further.

1.1 Study Aims

The operation of the proposed new rail sidings infrastructure and HGV traffic passing between the sidings and the waste facilities at Calvert carry a risk of disturbing bats as a result of operational noise, lighting, etc. whilst bats are active. The movement of vehicles in this area may reduce the efficacy of the proposed Green Overbridge at bridleway GUN/28 as a bat crossing point of the HS2 tracks, thereby increasing the risk of bats colliding with high speed trains. It has therefore been suggested that restrictions to the Monday – Friday operational hours of the waste sidings facility would reduce the potential for impacts to the local bat population; principally by reducing the movement of vehicles and operation of other noise-generating machinery whilst bats are active.

This report sets out the rationale for the voluntary restriction of the Monday – Friday operating hours, based upon the ecology and behaviour of bats species recorded locally. Section 2 sets out a brief review of bat emergence and behaviour and Section 3 presents two options for the voluntary restriction of operating hours. A brief discussion is presented in Section 4 which concludes with FCC's preferred option.

1.2 Operational Limits

Due to the nature of the waste sidings facility and the predicted impacts upon bats, it is only proposed to restrict the unloading of waste containers and spoil and the associated truck movements to Calvert Landfill and Greatmoor EfW. Trains arrive and depart the sidings outside these hours, as train movements are determined by the allocation of train paths by Network Rail. The movement of waste trains in and out of the sidings is not considered to represent a significant risk of disturbance to bat activity.

FCC has reviewed the suggested alterations to its current sidings operating hours and has indicated that it must retain the minimum core operating hours of 0700-1830 Monday – Friday at all times. There are no proposals to modify working hours on Saturdays. FCC's other operations at Calvert and Greatmoor are controlled by separate planning consents and operating restrictions. There are no proposals to alter any other consented operations within the site at the current time.

1.3 Consultation and Review

This paper presents FCC's preferred option for operating times for the facility. Drafts of the proposed operational timing restrictions were tabled at a meeting between HS2 and FCC in February 2016 and reviewed in April 2016. This final version takes account of comments made during meetings.

2.0 BAT BEHAVIOR AND EMERGENCE TIMES

All UK native bats are broadly nocturnal, i.e. they are more active at night than during the day. Typically, bats emerge from roosts after sunset and return to roosts before sunrise, although there is variation in emergence time between individuals, males and females and different species. Table 1 below provides further information on the published median emergence times of the species of bat that are considered to be most sensitive to the operations of the proposed alternative rail sidings for Calvert Waste Facility.

Table -1 – Bat Emergence Times

Species	Median emergence time after sunset (minutes)	Reference source
Bechstein's	33	Jones & Rydell, 1994 ¹ .
Brandt's	30	P. Shepherd (pers comm,)
Brown long-eared	54	Jones & Rydell, 1994 ¹ .
Common pipistrelle	20	University of Bristol, 2005 ²
Soprano pipistrelle	20	University of Bristol, 2005 ²
Daubenton's	84	Jones & Rydell, 1994 ¹ . Jurczynszyn & Bajaczyk (2001) ³ found that females were likely to emerge earlier than males.
Noctule	5	Jones & Rydell, 1994 ¹ .
Whiskered	32	Jones & Rydell, 1994 ¹ .

1 - Jones, G. & Rydell, J. (1994). Foraging strategy and predation risk as factors influencing emergence time in echolocating bats. *Philosophical Transactions of the Royal Society: Series B*. 346, 445-455

2 - University of Bristol (2005). *The Bats of Britain*. School of Biological Sciences, University of Bristol. Available at: <http://www.bio.bris.ac.uk/research/bats/britishbats/> [Last modified 16th April 2005]

3 - Jurczynszyn, M. & Bajaczyk, R. (2001). Departure dynamics of *Myotis daubentonii* (Kuhl, 1817) (Mammalia, Chiroptera) from their hibernaculum. *Mammalia*, 65, 121-129.

Bat emergence times are, by definition, recorded at bat roosts. However, neither HS2 nor FCC has recorded any bat roosts in the location of the proposed sidings. Therefore, the potential for disturbance of bats is limited to disruption of their ability to commute or forage in the vicinity of the sidings and its access routes; for example, a reduction of use of bat flight lines. In general, bats have the potential to be disturbed by the proposed alternative sidings location roost within the mature woodlands north and east of the proposed sidings. Approximate "as the crow flies" distances from the main woodland blocks to the proposed Green Overbridge and Sidings Access Road bridge, incorporating Bridleway GUN/28, is presented below:

- Sheephouse Wood is >700m away;
- Romer Wood is >500m away;
- Finemere Wood is >500m away.

The nearest known bat roost to the proposed GUN/28 bridge is a summer, non-maternity roost of common pipistrelle bats at Lower Greatmoor Farm, approximately 250m to the south-west. It is widely reported that bats often forage in the vicinity of their roosts immediately after emergence and before re-entry. Some bats, especially lactating females, also spend considerable time foraging close to maternity roosts, for example, commuting distances between maternity roosts and foraging areas in Bechstein's bats had a mean of 0.7 km¹.

¹ Fitzsimmons, Hill and Greenaway, 2002 - Patterns of habitat use by female Bechstein's bats (*Myotis bechsteinii*) from a maternity colony in a British woodland.

3.0 SEASONAL OPERATIONAL RESTRICTIONS OF PROPOSED SIDINGS FACILITY

The ecology of local bat populations, summarised in Section 2, has informed the proposed restrictions to operational hours. All bat species that are recorded locally emerge after sunset, with a range of between 5 and 84 minutes after sunset for median emergence time. There is less published information about roost return times, but it is usual for bats to return to roosts at or before dawn. The principle of the proposed restriction is to avoid operations during the highest risk times for bat activity, i.e. limiting operations before sunrise and after sunset during the months when bats are most active, i.e. March – October inclusive. Typically, UK native bats species are torpid, i.e. hibernate in the winter months (November – February) and only occasionally arouse for feeding during milder weather. Due to the considerably lower levels of bat activity in the winter, no restrictions to working hours during this period are considered necessary.

Two options for the restriction of operating hours have been developed:

- Option A - Seasonal operational restrictions with monthly changes in operational hours
- Option B - Seasonal operational restrictions with fortnightly changes in operational hours

Both options are presented as Tables with the proposed times compared with sunrise and sunset times. A more detailed analysis is presented in Figures 1 and 2, which illustrates the proposed operating times against the daily changes in sunrise and sunset times. Appendix A provides the tabulated data used to generate these Figures.

3.1 Option A - Monthly Changes in Operational Hours

Month	Sunrise and Sunset times ²	Revised Operating Time – Option A	Notes, including overlap with sunrise and sunset times
January	08.04 16.21	0430 - 2300	Bats not active – no restrictions necessary
February	07.18 17.17	0430 - 2300	Bats not active – no restrictions necessary
March (until 27th March*)	06.15 18.09	0700 - 1830	Restricted by 7 hours. Operation continues for between 46 mins and 2 mins after sunset until 26th and commences 2 mins before sunrise on 1st March.
April	06.04 20.02	0645 – 1930	Restricted by 5.75hrs. No overlap.
May	05.08 20.52	0530 – 2030	Restricted by 3.5hrs. No overlap.
June	04.43 21.26	0500 – 2115	Restricted by 2.25hrs. No overlap.
July	05.03 21.16	0530 – 2045	Restricted by 3.25hrs. No overlap.
August	05.49 20.26	0615 – 1945	Restricted by 5hrs. No overlap.
September	06.40	0700 – 1830	Restricted by 7hrs. Operation

² Sunrise and sunset for 15th of each month in Buckingham for 2016 (<http://www.sunrise-and-sunset.com/en/sun/united-kingdom/buckingham>). Buckingham is broadly on the same longitude as Calvert. Note that sunrise and sunset figures are slightly different to those presented in Appendix A.

Month	Sunrise and Sunset times ²	Revised Operating Time – Option A	Notes, including overlap with sunrise and sunset times
	19.17		commences between 1 min and 4 mins before sunrise for 3 days.
October (Until 30 th October*)	07.30 18.08	0700 - 1830*	Restricted by 7hrs. Operation commences between 1 min and 55 mins before sunrise. Operation continues for between 2 mins and 54 mins after sunset.
November	07.25 16.11	0430 - 2300	Bats not active – no restrictions necessary
December	08.06 15.52	0430 - 2300	Bats not active – no restrictions necessary

* Accounts for change between GMT and BST. Note this date will vary from year to year.

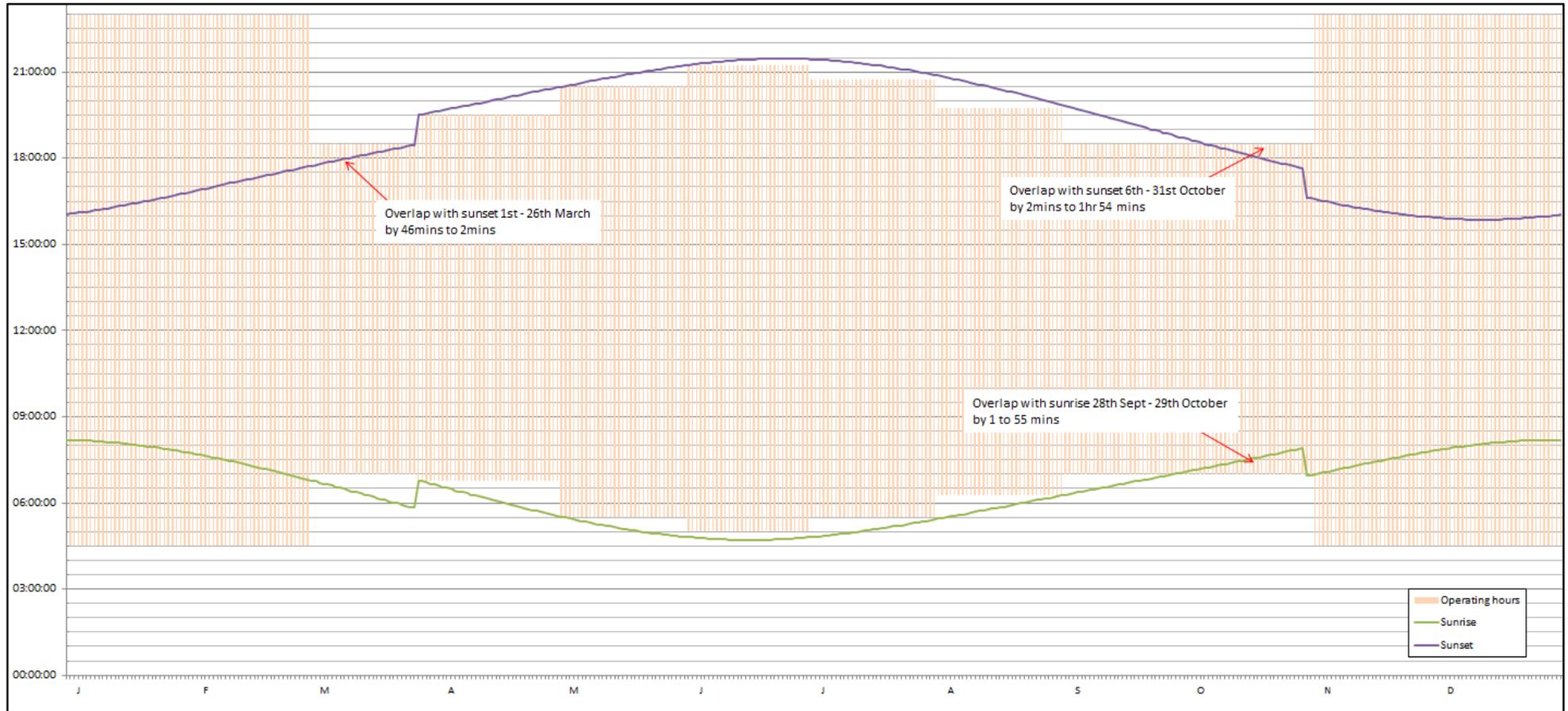


Figure 1 – Sunset and Sunrise Against Option A Modified Monthly Operating Hours

3.2 Option B – Seasonal Operational Restrictions with Fortnightly Changes in Operational Hours

Option B maximises the fit between operational periods and sunset/sunrise by altering the operational periods at approximately fortnightly intervals. It results in an increase of operating times by an average of 12 minutes per day.

Period	Sunrise and Sunset times ¹	Revised Operating Time – Option B	Notes
January	08.04 16.21	0430 - 2300	Bats not active – no restrictions necessary
February	07.18 17.17	0430 - 2300	Bats not active – no restrictions necessary
March (29 th February – 13 th March)	06.49 – 06.20 17:43 - 18.06	0645 - 1830	Restricted by 6.75 hours. Operation commences between 2 mins and 4 mins before sunrise (29 th Feb to 1 st March). Operation continues for between 47 mins and 24 mins after sunset.
March (14 th – 26 th March*)	06.17 – 05.50 18.07 - 18.28	0615 – 1830	Restricted by 6.25 hours. Operation continues for between 23 mins and 2mins after sunset.
April (27 th March – 10 th April)	06.47 – 06.15 19.30 - 19.54	0645 – 1930	Restricted by 5.75hrs. No overlap.
April (11 th - 24 th April)	06.13 – 05.45 19.55 – 20.18	0615 - 1945	Restricted by 5 hours. No overlap.
April/May (25 th April – 8 th May)	05.43 – 05.19 20.19 – 20.41	0545 - 2015	Restricted by 4 hours. No overlap.
May (9 th – 22 nd May)	05.17 – 04.58 20.43 – 21.02	0515 – 2030	Restricted by 3.25hrs. No overlap.
May/June (23 rd May to 5 th June)	04.57 – 04.46 21.03 – 21.19	0500 - 2100	Restricted by 2.5hrs. No overlap.
June (6 th – 19 th June)	04.45 – 04.43 21.19 – 21.27	0445 – 2115	Restricted by 2hrs. No overlap.
June/July (20 th June – 3 rd July)	04.43 – 04.50 21.27 – 21.26	0500 – 2115	Restricted by 2.25hrs. No overlap.
July (4 th – 17 th July)	04.51 – 05.05 21.25 – 21.14	0515 – 2115	Restricted by 2.5hrs. No overlap.
July (18 th – 31 th July)	05.07 – 05.25 21.13 – 20.54	0530 – 2045	Restricted by 3.25hrs. No overlap.
August (1 st – 14 th Aug)	05.27 – 05.48 20.53 – 20.28	0600 – 2015	Restricted by 4.25hrs. No overlap.
August (15 th – 28 th Aug)	05.49 – 06.10 20.26 – 19:58	0615 – 1945	Restricted by 5hrs. No overlap.
Aug/September (29 th Aug – 11 th Sept)	06.12 – 06.33 19.56 – 19.26	0630 - 1915	Restricted by 5.75hrs. No overlap.
September (12 th – 25 th Sept)	06.35 – 06.56 19.24 – 18.53	0700 - 1845	Restricted by 6.75hrs. No overlap.
Sept/October	06.58 – 07.20	0700 - 1830	Restricted by 7hrs. Operation

Period	Sunrise and Sunset times¹	Revised Operating Time – Option B	Notes
(26 th Sept – 9 th Oct)	18.51 – 16.36	0700 - 1830	commences 1 min to 20 mins before sunrise and continues for 2 mins to 9 mins after sunset
October (10 th – 29 th *)	06.58 – 07.55 18.19 – 17:39	0700 - 1830	Restricted by 7hrs. Operation commences between 21 mins and 55 mins before sunrise Operation continues for between 51 mins and 11 mins after sunset
November (30 th Oct – 30 th Nov)	07.25 16.11	0430 - 2300	Bats not active – no restrictions necessary
December	08.06 15.52	0430 - 2300	Bats not active – no restrictions necessary

1 – www.sunrisesunsetmap.com. Sunrise and sunset times in January, February, November and December are presented for 15th of each month for 2016. Other times are presented as the range of sunrise and sunset times during the period.

* Accounts for change between GMT and BST. Note this date will vary from year to year.

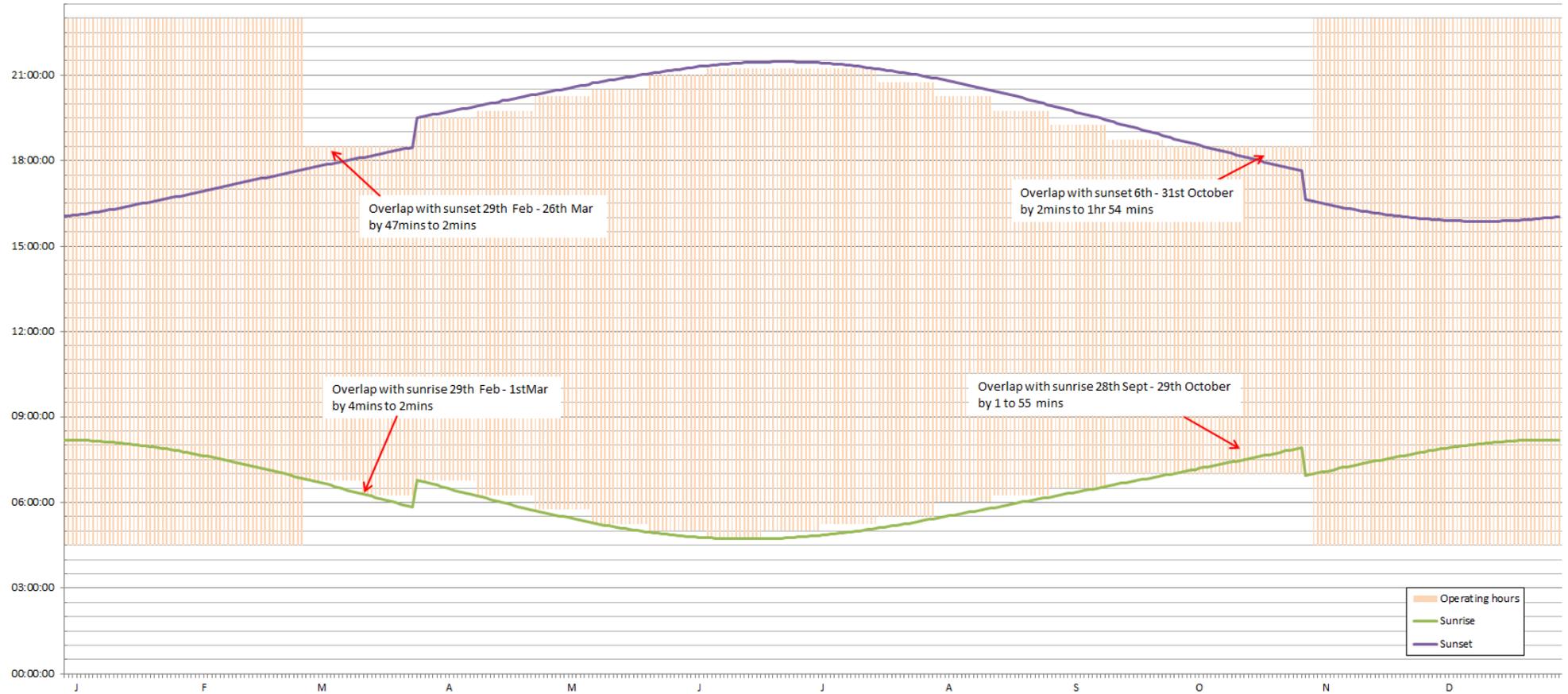


Figure 2 – Sunset and Sunrise Against Option B Proposed Operating Hours

4.0 DISCUSSION

Both Option A and Option B avoid any material overlap with sunrise or sunset between the critical bat maternity season of April – September inclusive. Restricted operating hours in March and October to a minimum of 0700 and 1830, means that the sunrise/sunset overlap in these months is less than 1 hour at its maximum (notwithstanding the clock change between Greenwich Mean Time and British Summer Time). The months of March and October are considered to be less critical to bats as fewer bats are active during these months than during the spring and summer months of April – September, inclusive. Figures 1 and 2 illustrate the extent of the overlap with sunrise and sunset, notably that the largest overlaps are at the very start of March and the end of October.

The details have not been established, but it is assumed that outside of the operating hours of the facility: operational and task lighting would be switched off or minimised to the appropriate security/safety requirements; HGVs, plant and machinery would stop working and personnel numbers would fall to those required for security. It is possible that engine drivers and other train staff would still be working at the sidings, depending upon specific train paths.

The benefit to bats from restricting the operating hours of the rail sidings is untested and testing the efficacy of this measure is not currently proposed. The main benefit of this measure is that the Green Overbridge GUN/28 will not be used by FCC's operational traffic when it is likely to be needed by commuting bats as a safe crossing point of the HS2 tracks. With operating hours restricted in the manner described above, it can be assumed that the risk of any impact upon bats resulting from the operation of the facility would be negligible as bats would not typically be active whilst the facility is operating. The lack of operational traffic would also remove the risk of collisions between FCC vehicles and bats; although this is not considered to be a significant risk as this traffic is typically large and slow moving and therefore bats are predicted to avoid these collisions.

Either option may allow a reduction in the size of the proposed green overbridge at GUN/28, as it has been designed to minimise the risk that bats using the green corridor part of the crossing are disturbed or discouraged from using it at the same time as operational traffic. Details of any proposed re-design of this bridge and its predicted impacts are beyond the scope of this report.

Both options restrict the operating hours of the terminal by up to 7 hours for up to 3 months. In order for the capacity of the terminal not to be affected, such a restriction may require additional rail infrastructure, loading/unloading gantries and grabs and additional vehicles for moving spoil and waste. It may also require an intensification of activity during the operational hours. Details regarding the infrastructure requirements and use of the facility are beyond the scope of this report. The relative benefits and potential impacts of the construction and operation of the facility with a restriction to operating hours as proposed would need to be considered in a detailed assessment and suitable mitigation implemented for any identified impacts to bats or other environmental receptors.

4.1 Conclusion

FCC has concluded that it would prefer to operate the facility in line with Option B, i.e. fortnightly changes in operating hours between March – October. FCC may also choose to operate shorter hours than this maximum would allow. FCC is prepared to commit to Option B as a condition of the operation of the proposed new sidings facility. It is considered that such a restriction would avoid overlap with the time when bats are most likely to be active and therefore avoids any impacts to bat foraging and commuting in the vicinity of the facility that may occur through its operation.

5.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of FCC Waste Services (UK) Ltd; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

APPENDIX A

Red text indicates overlap with sunrise or sunset

Proposed operating times - monthly changes

Proposed operating times - ~fortnightly changes

GMT-BST clock change

See Figure 1

See Figure 2

Week beginning	Sunrise	Sunset	Day length	Work start	Work end	Operating hours	Week	Work start	Work end	Operating hours	
	Fri 01/01/2016	08:11	16:03	07:51	04:30	23:00	18:30		04:30	23:00	18:30
	Sat 02/01/2016	08:11	16:04	07:52	04:30	23:00	18:30		04:30	23:00	18:30
	Sun 03/01/2016	08:11	16:05	07:53	04:30	23:00	18:30		04:30	23:00	18:30
04/01/2016	Mon 04/01/2016	08:11	16:06	07:55	04:30	23:00	18:30	1	04:30	23:00	18:30
	Tue 05/01/2016	08:10	16:07	07:56	04:30	23:00	18:30		04:30	23:00	18:30
	Wed 06/01/2016	08:10	16:08	07:58	04:30	23:00	18:30		04:30	23:00	18:30
	Thu 07/01/2016	08:10	16:10	08:00	04:30	23:00	18:30		04:30	23:00	18:30
	Fri 08/01/2016	08:09	16:11	08:01	04:30	23:00	18:30		04:30	23:00	18:30
	Sat 09/01/2016	08:09	16:12	08:03	04:30	23:00	18:30		04:30	23:00	18:30
	Sun 10/01/2016	08:08	16:14	08:05	04:30	23:00	18:30		04:30	23:00	18:30
11/01/2016	Mon 11/01/2016	08:07	16:15	08:07	04:30	23:00	18:30	2	04:30	23:00	18:30
	Tue 12/01/2016	08:07	16:17	08:10	04:30	23:00	18:30		04:30	23:00	18:30
	Wed 13/01/2016	08:06	16:18	08:12	04:30	23:00	18:30		04:30	23:00	18:30
	Thu 14/01/2016	08:05	16:20	08:14	04:30	23:00	18:30		04:30	23:00	18:30
	Fri 15/01/2016	08:04	16:21	08:17	04:30	23:00	18:30		04:30	23:00	18:30
	Sat 16/01/2016	08:03	16:23	08:19	04:30	23:00	18:30		04:30	23:00	18:30
	Sun 17/01/2016	08:02	16:25	08:22	04:30	23:00	18:30		04:30	23:00	18:30
18/01/2016	Mon 18/01/2016	08:01	16:26	08:24	04:30	23:00	18:30	3	04:30	23:00	18:30
	Tue 19/01/2016	08:00	16:28	08:27	04:30	23:00	18:30		04:30	23:00	18:30
	Wed 20/01/2016	07:59	16:30	08:30	04:30	23:00	18:30		04:30	23:00	18:30
	Thu 21/01/2016	07:58	16:31	08:33	04:30	23:00	18:30		04:30	23:00	18:30
	Fri 22/01/2016	07:57	16:33	08:35	04:30	23:00	18:30		04:30	23:00	18:30
	Sat 23/01/2016	07:56	16:35	08:38	04:30	23:00	18:30		04:30	23:00	18:30
	Sun 24/01/2016	07:55	16:36	08:41	04:30	23:00	18:30		04:30	23:00	18:30
25/01/2016	Mon 25/01/2016	07:53	16:38	08:44	04:30	23:00	18:30	4	04:30	23:00	18:30
	Tue 26/01/2016	07:52	16:40	08:48	04:30	23:00	18:30		04:30	23:00	18:30
	Wed 27/01/2016	07:51	16:42	08:51	04:30	23:00	18:30		04:30	23:00	18:30
	Thu 28/01/2016	07:49	16:44	08:54	04:30	23:00	18:30		04:30	23:00	18:30
	Fri 29/01/2016	07:48	16:45	08:57	04:30	23:00	18:30		04:30	23:00	18:30

	Sat	30/01/2016	07:46	16:47	09:01	04:30	23:00	18:30		04:30	23:00	18:30
	Sun	31/01/2016	07:45	16:49	09:04	04:30	23:00	18:30		04:30	23:00	18:30
01/02/2016	Mon	01/02/2016	07:43	16:51	09:07	04:30	23:00	18:30	5	04:30	23:00	18:30
	Tue	02/02/2016	07:41	16:53	09:11	04:30	23:00	18:30		04:30	23:00	18:30
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	Thu	04/02/2016	07:38	16:56	09:18	04:30	23:00	18:30		04:30	23:00	18:30
	Fri	05/02/2016	07:37	16:58	09:21	04:30	23:00	18:30		04:30	23:00	18:30
	Sat	06/02/2016	07:35	17:00	09:25	04:30	23:00	18:30		04:30	23:00	18:30
	Sun	07/02/2016	07:33	17:02	09:29	04:30	23:00	18:30		04:30	23:00	18:30
08/02/2016	Mon	08/02/2016	07:31	17:04	09:32	04:30	23:00	18:30	6	04:30	23:00	18:30
	Tue	09/02/2016	07:29	17:06	09:36	04:30	23:00	18:30		04:30	23:00	18:30
	Wed	10/02/2016	07:28	17:08	09:40	04:30	23:00	18:30		04:30	23:00	18:30
	Thu	11/02/2016	07:26	17:10	09:43	04:30	23:00	18:30		04:30	23:00	18:30
	Fri	12/02/2016	07:24	17:11	09:47	04:30	23:00	18:30		04:30	23:00	18:30
	Sat	13/02/2016	07:22	17:13	09:51	04:30	23:00	18:30		04:30	23:00	18:30
	Sun	14/02/2016	07:20	17:15	09:55	04:30	23:00	18:30		04:30	23:00	18:30
15/02/2016	Mon	15/02/2016	07:18	17:17	09:58	04:30	23:00	18:30	7	04:30	23:00	18:30
	Tue	16/02/2016	07:16	17:19	10:02	04:30	23:00	18:30		04:30	23:00	18:30
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	Thu	18/02/2016	07:12	17:23	10:10	04:30	23:00	18:30		04:30	23:00	18:30
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	Sun	21/02/2016	07:06	17:28	10:22	04:30	23:00	18:30		04:30	23:00	18:30
22/02/2016	Mon	22/02/2016	07:04	17:30	10:25	04:30	23:00	18:30	8	04:30	23:00	18:30
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	Thu	25/02/2016	06:58	17:35	10:37	04:30	23:00	18:30		04:30	23:00	18:30
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	Sat	27/02/2016	06:53	17:39	10:45	04:30	23:00	18:30		04:30	23:00	18:30
	Sun	28/02/2016	06:51	17:41	10:49	04:30	23:00	18:30		04:30	23:00	18:30
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	Thu	03/03/2016	06:42	17:48	11:05	07:00	18:30	11:30		06:45	18:30	11:45
	Fri	04/03/2016	06:40	17:50	11:09	07:00	18:30	11:30		06:45	18:30	11:45
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	Sun	06/03/2016	06:36	17:53	11:17	07:00	18:30	11:30		06:45	18:30	11:45
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	Wed	09/03/2016	06:29	17:59	11:29	07:00	18:30	11:30		06:45	18:30	11:45
	Thu	10/03/2016	06:26	18:00	11:33	07:00	18:30	11:30		06:45	18:30	11:45
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	Sun	13/03/2016	06:20	18:06	11:46	07:00	18:30	11:30		06:45	18:30	11:45
14/03/2016	Mon	14/03/2016	06:17	18:07	11:50	07:00	18:30	11:30	11	06:15	18:30	12:15
	Tue	15/03/2016	06:15	18:09	11:54	07:00	18:30	11:30		06:15	18:30	12:15
	Wed	16/03/2016	06:13	18:11	11:58	07:00	18:30	11:30		06:15	18:30	12:15
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	Sun	20/03/2016	06:03	18:18	12:14	07:00	18:30	11:30		06:15	18:30	12:15
21/03/2016	Mon	21/03/2016	06:01	18:20	12:18	07:00	18:30	11:30	12	06:15	18:30	12:15
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	Sun	03/04/2016	06:31	19:42	13:10	06:45	19:30	12:45		06:45	19:30	12:45
04/04/2016	Mon	04/04/2016	06:29	19:44	13:14	06:45	19:30	12:45	14	06:45	19:30	12:45
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11/04/2016	Mon	11/04/2016	06:13	19:55	13:42	06:45	19:30	12:45	15	06:15	19:45	13:30
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18/04/2016	Mon	18/04/2016	05:58	20:07	14:09	06:45	19:30	12:45	16	06:15	19:45	13:30
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	Sun	24/04/2016	05:45	20:18	14:32	06:45	19:30	12:45		06:15	19:45	13:30
25/04/2016	Mon	25/04/2016	05:43	20:19	14:36	06:45	19:30	12:45	17	05:45	20:15	14:30
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02/05/2016	Mon	02/05/2016	05:30	20:31	15:01	05:30	20:30	15:00	18	05:45	20:15	14:30
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09/05/2016	Mon	09/05/2016	05:17	20:43	15:25	05:30	20:30	15:00	19	05:15	20:30	15:15
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16/05/2016	Mon	16/05/2016	05:06	20:53	15:47	05:30	20:30	15:00	20	05:15	20:30	15:15

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06/06/2016	Mon	06/06/2016	04:45	21:19	16:34	05:00	21:15	16:15	23	04:45	21:15	16:30
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	Sun	26/06/2016	04:45	21:28	16:42	05:00	21:15	16:15		05:00	21:15	16:15
27/06/2016	Mon	27/06/2016	04:46	21:28	16:41	05:00	21:15	16:15	26	05:00	21:15	16:15
	Tue	28/06/2016	04:47	21:27	16:40	05:00	21:15	16:15		05:00	21:15	16:15
	Wed	29/06/2016	04:47	21:27	16:39	05:00	21:15	16:15		05:00	21:15	16:15
	Thu	30/06/2016	04:48	21:27	16:38	05:00	21:15	16:15		05:00	21:15	16:15
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	Sun	03/07/2016	04:50	21:26	16:35	05:30	20:45	15:15		05:00	21:15	16:15
04/07/2016	Mon	04/07/2016	04:51	21:25	16:34	05:30	20:45	15:15	27	05:15	21:15	16:00
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	Thu	14/07/2016	05:02	21:17	16:15	05:30	20:45	15:15		05:15	21:15	16:00
	Fri	15/07/2016	05:03	21:16	16:13	05:30	20:45	15:15		05:15	21:15	16:00
	Sat	16/07/2016	05:04	21:15	16:11	05:30	20:45	15:15		05:15	21:15	16:00
	Sun	17/07/2016	05:05	21:14	16:08	05:30	20:45	15:15		05:15	21:15	16:00
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	Thu	21/07/2016	05:11	21:09	15:58	05:30	20:45	15:15		05:30	20:45	15:15
	Fri	22/07/2016	05:12	21:08	15:55	05:30	20:45	15:15		05:30	20:45	15:15
	Sat	23/07/2016	05:13	21:06	15:52	05:30	20:45	15:15		05:30	20:45	15:15
	Sun	24/07/2016	05:15	21:05	15:50	05:30	20:45	15:15		05:30	20:45	15:15
25/07/2016	Mon	25/07/2016	05:16	21:04	15:47	05:30	20:45	15:15	30	05:30	20:45	15:15
	Tue	26/07/2016	05:18	21:02	15:44	05:30	20:45	15:15		05:30	20:45	15:15
	Wed	27/07/2016	05:19	21:01	15:41	05:30	20:45	15:15		05:30	20:45	15:15

	Thu	28/07/2016	05:21	20:59	15:38	05:30	20:45	15:15		05:30	20:45	15:15
	Fri	29/07/2016	05:22	20:57	15:35	05:30	20:45	15:15		05:30	20:45	15:15
	Sat	30/07/2016	05:24	20:56	15:31	05:30	20:45	15:15		05:30	20:45	15:15
	Sun	31/07/2016	05:25	20:54	15:28	05:30	20:45	15:15		05:30	20:45	15:15
01/08/2016	Mon	01/08/2016	05:27	20:53	15:25	06:15	19:45	13:30	31	06:00	20:15	14:15
	Tue	02/08/2016	05:28	20:51	15:22	06:15	19:45	13:30		06:00	20:15	14:15
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	Fri	05/08/2016	05:33	20:45	15:12	06:15	19:45	13:30		06:00	20:15	14:15
	Sat	06/08/2016	05:35	20:44	15:08	06:15	19:45	13:30		06:00	20:15	14:15
	Sun	07/08/2016	05:36	20:42	15:05	06:15	19:45	13:30		06:00	20:15	14:15
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	Wed	10/08/2016	05:41	20:36	14:54	06:15	19:45	13:30		06:00	20:15	14:15
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	Sun	21/08/2016	05:59	20:14	14:14	06:15	19:45	13:30		06:15	19:45	13:30
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	Thu	25/08/2016	06:06	20:05	13:59	06:15	19:45	13:30		06:15	19:45	13:30
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	Fri	02/09/2016	06:19	19:47	13:28	07:00	18:30	11:30		06:30	19:15	12:45
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10/10/2016	Mon	10/10/2016	07:21	18:19	10:57	07:00	18:30	11:30	41	07:00	18:30	11:30
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	Thu	20/10/2016	07:39	17:57	10:18	07:00	18:30	11:30		07:00	18:30	11:30
	Fri	21/10/2016	07:40	17:55	10:14	07:00	18:30	11:30		07:00	18:30	11:30
	Sat	22/10/2016	07:42	17:53	10:11	07:00	18:30	11:30		07:00	18:30	11:30
	Sun	23/10/2016	07:44	17:51	10:07	07:00	18:30	11:30		07:00	18:30	11:30
24/10/2016	Mon	24/10/2016	07:46	17:49	10:03	07:00	18:30	11:30	43	07:00	18:30	11:30
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	Wed	26/10/2016	07:49	17:45	09:55	07:00	18:30	11:30		07:00	18:30	11:30
	Thu	27/10/2016	07:51	17:43	09:52	07:00	18:30	11:30		07:00	18:30	11:30
	Fri	28/10/2016	07:53	17:41	09:48	07:00	18:30	11:30		07:00	18:30	11:30
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	Wed	02/11/2016	07:02	16:32	09:30	04:30	23:00	18:30		04:30	23:00	18:30
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07/11/2016	Mon	07/11/2016	07:11	16:23	09:12	04:30	23:00	18:30	45	04:30	23:00	18:30
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21/11/2016	Mon	21/11/2016	07:35	16:04	08:28	04:30	23:00	18:30	47	04:30	23:00	18:30
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	Thu	24/11/2016	07:40	16:01	08:20	04:30	23:00	18:30		04:30	23:00	18:30
	Fri	25/11/2016	07:42	16:00	08:18	04:30	23:00	18:30		04:30	23:00	18:30
	Sat	26/11/2016	07:43	15:59	08:15	04:30	23:00	18:30		04:30	23:00	18:30
	Sun	27/11/2016	07:45	15:58	08:13	04:30	23:00	18:30		04:30	23:00	18:30
28/11/2016	Mon	28/11/2016	07:46	15:57	08:11	04:30	23:00	18:30	48	04:30	23:00	18:30
	Tue	29/11/2016	07:48	15:57	08:09	04:30	23:00	18:30		04:30	23:00	18:30
	Wed	30/11/2016	07:49	15:56	08:07	04:30	23:00	18:30		04:30	23:00	18:30
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	Sun	11/12/2016	08:02	15:52	07:49	04:30	23:00	18:30		04:30	23:00	18:30
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	Sun	18/12/2016	08:08	15:53	07:45	04:30	23:00	18:30		04:30	23:00	18:30

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	Sun	25/12/2016	08:11	15:57	07:45	04:30	23:00	18:30		04:30	23:00	18:30
26/12/2016	Mon	26/12/2016	08:11	15:58	07:46	04:30	23:00	18:30	52	04:30	23:00	18:30
	Tue	27/12/2016	08:11	15:59	07:47	04:30	23:00	18:30		04:30	23:00	18:30
	Wed	28/12/2016	08:11	15:59	07:47	04:30	23:00	18:30		04:30	23:00	18:30
	Thu	29/12/2016	08:11	16:00	07:48	04:30	23:00	18:30		04:30	23:00	18:30
	Fri	30/12/2016	08:11	16:01	07:49	04:30	23:00	18:30		04:30	23:00	18:30
	Sat	31/12/2016	08:11	16:02	07:50	04:30	23:00	18:30		04:30	23:00	18:30

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4 Scoping Opinion

4.1.1 A Scoping Opinion was received from the TWA Unit of the Department for Transport on 29th June 2016. The full Scoping Opinion letter is included within the following 32 pages.

4.1.2 In forming the Scoping Opinions, views were requested and received from the below environmental bodies:

- Buckinghamshire County Council;
- Aylesbury Vale District Council;
- Environment Agency;
- Historic England; and
- Natural England.



Department
for Transport

Darren White
Eversheds LLP
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London
EC2V 7WS

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TWA ORDERS UNIT
DEPARTMENT FOR TRANSPORT
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Our Ref: TWA/2/2/138

28 June 2016

Dear Darren White

**TRANSPORT AND WORKS (APPLICATIONS AND OBJECTIONS PROCEDURE)
(ENGLAND AND WALES) RULES 2006: REQUEST FOR A SCOPING OPINION**

**PROPOSED HIGH SPEED RAIL (LONDON-WEST MIDLANDS) (GREATMOOR
RAILWAY SIDINGS ETC.) ORDER**

Please see attached the scoping opinion in connection with the above proposed Order.

As required by Rule 7(8) of the Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006 we consulted Aylesbury Vale District Council, Buckinghamshire County Council, Natural England, Historic England and the Environment Agency. Copies of the responses are enclosed.

Yours sincerely

Colin Dunn



Department for Transport

Eversheds LLP
1 Wood Street
London
EC2V 7WS

For the attention of: Darren White

Martin Woods
Head of TWA Orders Unit
Department for Transport
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Web Site: www.gov.uk/dfi/twa

Our Ref: TWA 2/2/138

28 June 2016

Dear Mr White,

TRANSPORT AND WORKS (APPLICATION AND OBJECTIONS PROCEDURE) (ENGLAND AND WALES) RULES 2006: REQUEST FOR A SCOPING OPINION

PROPOSED HIGH SPEED RAIL (LONDON-WEST MIDLANDS) (GREATMOOR RAILWAY SIDINGS ETC.) ORDER

1. I refer to your email of 16 May 2016 requesting a scoping opinion under rule 8 of the above Rules in relation to the proposed relocation of the Calvert Waste Transfer Terminal operated by FCC Waste Services (UK) Limited from its current location to Greatmoor, Buckinghamshire, in connection with the construction of the HS2 line between London and Birmingham.

2. You enclosed with your email an EIA Scoping Report, produced by ETM and Arup/Aecom for High Speed Two (HS2) Limited (document number C252-ETM-EV-REP-020-000224). The Scoping Report describes the proposed scope and methodology for the Environmental Impact Assessment ("EIA"), which will be reported in the Environmental Statement ("ES") to accompany an application for the above proposed Order.

3. We have considered your request for an opinion on the proposed scope of the EIA in accordance with rule 8 of the above Rules. In formulating the scoping opinion, we have consulted the following -

- Aylesbury Vale District Council
- Buckinghamshire County Council
- Natural England
- Environment Agency
- Historic England.

Scoping Opinion

4. The Secretary of State has considered the assessment of the potentially significant environmental effects of the proposed development as set out in the Scoping Report and the responses of those consulted. Subject to the comments set out in paragraphs 6 to 12 below, he agrees that the scope of the EIA described in the Scoping Report is appropriate and agrees with the conclusions on the topics to be scoped in and out as summarised in Table 12 of the Scoping Report (a copy of which is annexed to this letter). In the following comments, numbers in **bold** are references to paragraphs of the Scoping Report.

5. Please note that this scoping opinion is given without prejudice to our consideration of the above proposed Order application. The giving of the opinion implies no view on the Department's part about the merits or otherwise of the scheme.

Ecology

6. **9.1.3** In relation to protected sites, and having regard to Natural England's Impact Risk Zones, the EIA should additionally consider the potential for effects from the proposed development on the following Sites of Specific Scientific Interest ("SSSIs"):

- Grendon and Doddershall Woods SSSI;
- Ham Home-cum-Hamgreen Woods SSSI; and
- Long Herdon Meadow SSSI, in view of the hydrological connectivity between the Muxwell Brook adjacent to the development site and the River Ray which runs into this SSSI.

7. **9.1.25-27** In relation to protected species, the EIA should also consider the potential effects of vibration during construction of the development and the killing or injury of any species which are present during the construction period. The impacts of increased human activity during both construction and operation should also be considered.

Landscape and Visual Assessment

8. **11.1.3** In relation to the impact of lighting, the ES should include an assessment of the night-time impacts of the proposed development. The significance thresholds for this assessment should be discussed with the Landscape Officer of Aylesbury Vale District Council.

Traffic and Transport

9. **13.1.6** In relation to the impacts of the proposed development on public rights of way, the EIA should consider the issues raised by Buckinghamshire County Council identified in Appendix B to its letter of 14 June 2016 commenting on the Scoping Report (attached).

10. **13.2.9-10** For the purposes of assessing construction traffic impacts, the Transport Assessment should establish existing traffic conditions in accordance with National Planning Policy Guidance and in consultation with Buckinghamshire County Council.

Water Resources and Flood Risk Assessment

11. **15.1.3-4** The screening distance for identifying surface water and groundwater features that may be affected by the proposed development should take into account activities which may affect sites more than 1 kilometre from the development having regard to the nature of those sites for example as a result of water dependency, and taking into account Natural England's Impact Risk Zones.

12. **15.2.3** The ES should explain the criteria used for deciding whether to undertake hydraulic modelling. In carrying out the assessment of the impacts of the proposed development on water resources and flood risk, the promoter should address the issues raised by Buckinghamshire County Council identified in Appendix A to its letter of 14 June 2016 commenting on the Scoping Report (attached).

Distribution

13. Copies of this letter are being sent to those organisations which were consulted on the request for a scoping opinion, as listed at the beginning of this letter.

Yours sincerely,



Martin Woods

Table 12: Summary of Environmental Topic Scoping Outcomes (shaded cells indicate topic scoped out)

Discipline	Construction	Operation
Agriculture	Potential permanent loss of BMV agricultural land and permanent displacement of soils.	Operation of the Proposed Scheme is not considered to result in any likely significant effects on agriculture, forestry and soils.
Air quality	Temporary traffic impacts scoped in.	Traffic impacts scoped in (permanent effect only) due to generation of vehicle traffic by the use of the sidings, in the form of transfer trucks taking waste from trains to the EfV plant and landfill site.
	Dust impacts scoped out (temporary and permanent effects), as the mitigation set out in the draft CoCP will render all residual impacts as no worse than minor impact, and therefore no significant effect.	
Climatic factors (carbon)	Construction GHG emissions are considered unlikely to have a significant effect on climate change. Scoped out.	Operational net GHG emissions are considered unlikely to have a significant effect on climate change. Scoped out.
Community	Scoped in (temporary effect only).	Scoped out (temporary and permanent effects)
Cultural heritage	Potential impact on the significance of the designated heritage assets and non-designated heritage assets. Scoped in.	Potential impact on the significance of the designated heritage assets. Scoped in.
Ecology	Potential permanent loss and fragmentation of habitats; Potential noise visual and light disturbance to species; Potential hydrological changes, and Air and waterborne pollution to wood and watercourse. Scoped in.	Potential noise and light disturbance on bat activity; and Potential for bat mortality from train strike. Scoped in.
Equalities	Protected characteristic groups are unlikely to be affected disproportionately and/or differentially by impacts arising as a result of construction. Scoped out.	Protected characteristic groups are unlikely to be affected disproportionately and/or differentially by impacts arising as a result of operation. Scoped out.
Health	Construction of the Proposed Scheme is considered unlikely to have an impact on health. Scoped out.	Operation of the Proposed Scheme is considered unlikely to have any impact on health. Scoped out.

Land quality	Scoped in. In the absence of ground investigation information the potential for encountering land contamination during construction cannot be discounted.	Scoped in. In the absence of ground investigation information the potential for effects from land contamination during operation cannot be discounted.
	In the absence of any geo-conservation sites, this aspect of the Land Quality topic is proposed to be scoped out.	In the absence of any geo-conservation sites, this aspect of the Land Quality topic is proposed to be scoped out.
Landscape and visual	Potentially significant permanent and temporary effects on landscape and visual receptors are anticipated during construction of the Proposed Scheme.	Potentially significant permanent and temporary effects on landscape and visual receptors are anticipated during operation of the Proposed Scheme.
Socio-Economics	No businesses within the area are expected to experience significant effects as a result of the construction of the Proposed Scheme.	No businesses within the area are expected to experience significant effects as a result of the operation of the Proposed Scheme.
Sound, noise and vibration	Potential temporary effects, which may be significant, are likely during construction. Scoped in	Potential permanent effects, which may be significant, are likely during operation due to operational airborne noise and vibration from on-site activities.
Traffic and Transport	Scoped in due to potential temporary increase in HGV movements on some roads	Operational impacts are not expected to result in any likely significant effects. Scoped out.
Waste	Scoped out due to the limited quantities of waste materials anticipated to be generated during construction	Scoped out due to the limited quantities of waste materials anticipated to be generated during operation
Water resources and flood risk assessment	Potential significant effects on surface water and flood risk arising from construction of the Proposed Scheme.	Potential significant effects on surface water and flood risk arising from operation of the Proposed Scheme.

14 June 2016

BY EMAIL AND POST
The TWA Orders Unit
Department for Transport Zone
1/18 Great Minster House
33 Horseferry Road
London
SW1P 4DR.

To whom it may concern,

Ref: Scoping Report on the Transport and Works Act for FCC Railway Sidings

Thank you for your letter of the 13 May 2016 that offers the County Council the opportunity to comment on the proposals for the FCC Railway Sidings. The Council was only presented this report on the 8 June and for this reason has been unable to respond before this point. As you are aware Buckinghamshire County Council is in principle supportive of this scheme having supported these proposals throughout the HS2 House of Commons Select Committee process and is keen to see the proposal progress. However the Council does have some concerns that it would like to see addressed as the scheme progresses which are set out below.

1. East West Rail and HS2 Integration

In this area a number of schemes will be brought forward around the same time. These are the High Speed 2 railway line, the East West Rail (EWR) line Aylesbury spur and the FCC Railway Sidings. An integration study for EWR and HS2 was presented to the Council in May 2016 but this does not include the FCC Sidings Proposals. The Council understands that this proposal is relatively recent and therefore would not have fitted within the original integration study. However the Council would like to express its concerns that these schemes could be looked at in isolation. A joint up approach is required both to ensure timely delivery and minimal disruption to the local communities.

2. Flood Water

Based on the information provided in the High Speed 2 Transport and Works Act Order for FCC waste transfer siding south of Sheephouse Wood EIA scoping report (document number: C252-ETM-EV-REP-020-000224), the Council's Strategic Flood Management Team are pleased that Water Resources and Flood Risk Assessment will be scoped into the Environmental Impact Assessment (EIA).

The Council are happy with the method of assessment suggested in Chapter 15 Water Resources and Flood Risk Assessment, Section 15.2 Method of Assessment, Paragraph 15.2.3; however we expect to see clarification within the EIA of the criteria for undertaking hydraulic modelling.

The Council also has a number of Flood and Water specific concerns (based on the plans provided) that need to be addressed by the promoter. These are set out on the plan (Appendix A).

3. Archaeology

The Council's Archaeology team has consulted the Buckinghamshire Historical Environment Records. A number of archaeological features have been recorded to the South of the proposed Sidings and the Council would therefore expect to see the appropriate archaeological assessment, evaluation and recording take place.

4. Public Rights of Way

The Council's Public Rights of Way team have set out a number of concerns in Appendix B (1) this is accompanied by a plan of the area Appendix B (2).

5. Minerals and Waste Development Management Comments

The Council's Minerals and Waste Development Management team have the following specific concerns:

- The operational effects on agriculture have been scoped out, although paragraph 5.2.2 states "The potential nature of impacts on farm holdings will comprise primarily the loss of land, the loss of key farm infrastructure and the imposition of disruptive effects (such as noise and dust) on land uses and the holding's operations." Consideration has not been given to the longer term effects on the disruption of the proposed development upon neighbouring / remaining agricultural uses. It might be that there will not be continued agricultural uses immediately adjoining or in close proximity to the site due to the proposed extensive landscaping, and any potential effects may be very small when considered in the wider context of the adjacent Calvert Landfill site and the Energy for Waste plant, but this hasn't been made clear in the Scoping Report.
- The report has scoped out dust impacts associated with construction, due to mitigation measures as set out within the Code of Construction Practice (CoCP) resulting in no significant effect. The Council would like to be provided a copy of the CoCP (it would have been useful if a draft version of this was attached to the Scoping Report along with the HS2 Phase One Volume 5 document which is referred to throughout), without it one cannot confirm if such mitigation would be acceptable. The Council would like to see Aylesbury Vale District view on this to be considered.
- The proposed study area for the Air Quality Assessment is 200 meters. The Council would like it to be considered whether this is sufficient. Input from Aylesbury Vale District should be sought by the project on this.

6. Highways Development Management

The Council's Highways Development Management team have assessed the scoping note and understand that the proposal is seeking to relocate operational sidings. As part of this work a new overbridge will be provided over the HS2 Phase one line that will connect to the internal road network serving the FCC site and connecting to the A41.

The Council agrees with the scoping that a Transport Assessment is required to consider the implications of the scheme. The routing of additional construction traffic is a key issue and the highway authority will need to be satisfied that routes are safe and suitable. The Council are concerned about the suggestion that construction traffic could route via A41 and then Station Road resulting in goods vehicle traffic along perhaps unsuitable rural roads and through villages. The preference at this stage would be the alternative of routing along the FCC access road which was built with the purpose of carrying commercial traffic to the site, provided that it is demonstrated that the geometry is suitable for the intensified use. The

impact on the operation of the A41 is also a key issue and the Transport Assessment must demonstrate that the roundabout junction between the A41 and the site will continue to operate within acceptable limits

The Council agree with the 5% change threshold for triggering the need for junction assessments in the network peak hours suggested at para 13.2.5 on page 51. It is also agreed, as suggested at para 13.2.6, that separate discussions should be had regarding highway matters with the Council to ensure that the Transport Assessment is in line with requirements.

The use of baseline year traffic data from 2012 set out in para 13.2.9 is not acceptable. Traffic data should be recent and not normally more than 3 years old. Factoring data is not an acceptable method of deriving 2016 traffic data and new surveys should be undertaken where necessary. The future year should be clarified.

In summary full details of the access arrangements should be provided on plans to a scale 1:500. The Council would strongly recommend the use of the existing purpose built FCC access to the A41 to serve the site as this will minimise impact on rural roads. However an assessment of the suitability of those access arrangements for intensified use must be provided. A full Transport Assessment should be prepared to set out the implications of the proposals and the document should be prepared in consultation with the Highway Authority and in accordance with the National Planning Policy Guidance on Transport Assessment and having regard to the previous 2007 guidance. The Transport Assessment will need to demonstrate that the impact of the proposals on the highway network are not severe in the context of National Planning Policy Framework requirements.

The Council looks forward to working with HS2 to bring this scheme forward.

Yours faithfully



Ian Boll
Director of Regeneration and Infrastructure

Officer Contacts: Thomas Fitzpatrick and Laura Martin-Leech
Email: tfitzpatrick@buckscc.gov.uk lmartin@buckscc.gov.uk

Appendix A- Document with plan from Flood Management



160601 FCCsidings
plan with Flood mana

Appendix B (1)- Document with information from Public Rights of Way



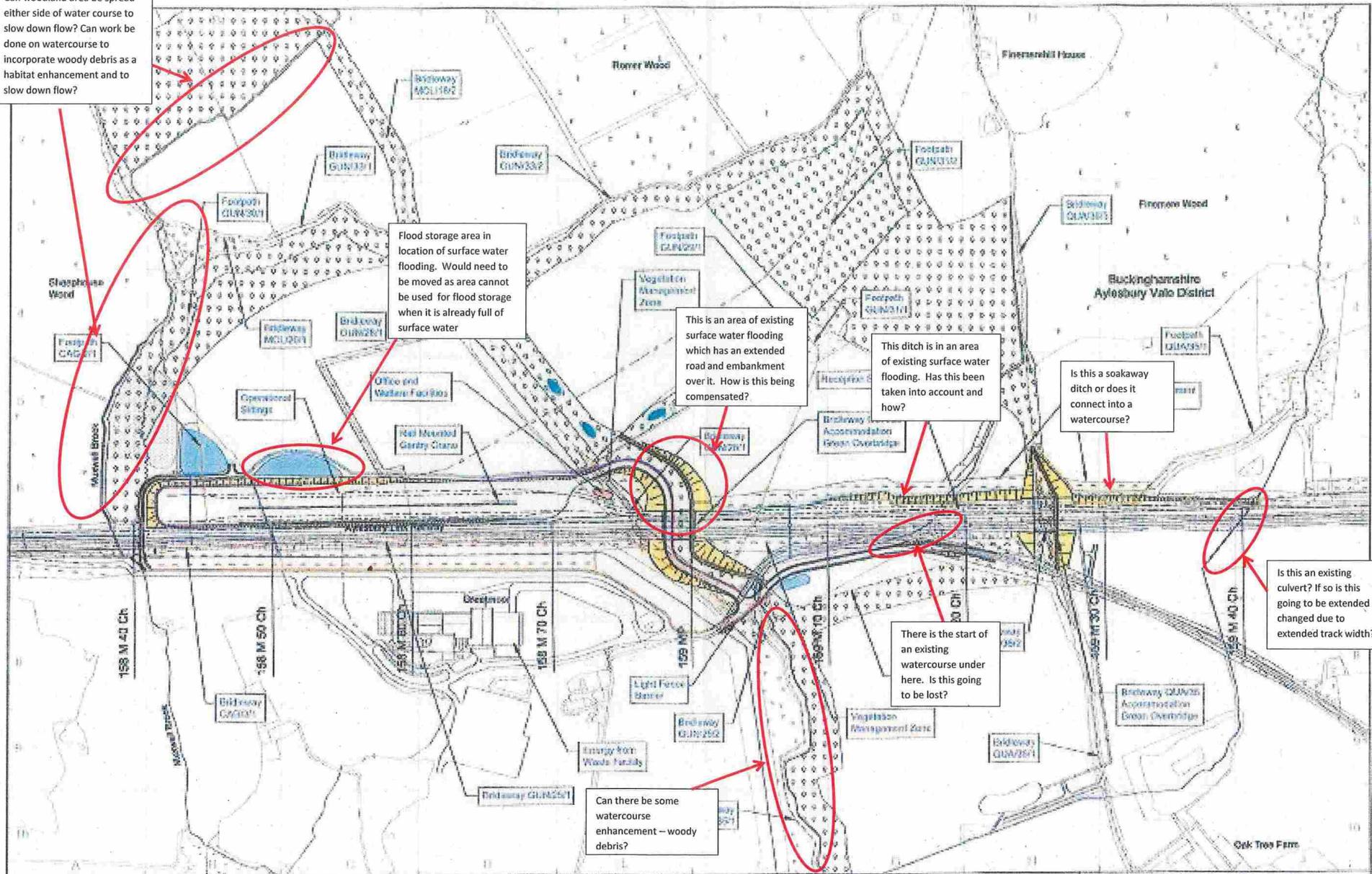
PRoW TWAO
response.doc

Appendix B (2)- Accompanying plan for Public Rights of Way



calvert response -
annotated plan.pdf

Can woodland area be spread either side of water course to slow down flow? Can work be done on watercourse to incorporate woody debris as a habitat enhancement and to slow down flow?



Flood storage area in location of surface water flooding. Would need to be moved as area cannot be used for flood storage when it is already full of surface water

This is an area of existing surface water flooding which has an extended road and embankment over it. How is this being compensated?

This ditch is in an area of existing surface water flooding. Has this been taken into account and how?

Is this a soakaway ditch or does it connect into a watercourse?

Is this an existing culvert? If so is this going to be extended or changed due to extended track width?

There is the start of an existing watercourse under here. Is this going to be lost?

Can there be some watercourse enhancement - woody debris?

Legend		Changes (e.g. 12M 10Ch)	
	Building		New, diverted or realigned PtW
	Ecological mitigation pond		Stopped-up PtW
	Subsiding pond		Rail alignment
	Replacement foodstore storage		Noise fence barrier
	Woodland habitat creation		Community town boundary
	Grassland habitat creation		Watercourse diversion
	H52 Hybrid B&W Woodland habitat creation		Existing watercourse
	H52 Hybrid B&W Grassland habitat creation		Ditches - new
			Meadow habitat creation
			Main utility works
			Existing public right of way (PtW)

CT-06-052-TWAO

Proposed Scheme
TWAO - High Speed Rail (London - West Midlands) (Grazmoor Railway Sidings)

Scale at A3: 1:5000

Dec 2014

Rights of way comments

Please see attached annotated plan.

- 1) Definitive footpath is not accurately recorded; does it need diverting (see 7)?
- 2) Definitive footpath is not accurately recorded;
- 3) Definitive footpath is not accurately recorded
- 4) It would be useful to upgrade this route to bridleway in order to connect walkers and cyclists between the bridleway to the north and the 'footpath and cycleway' to the south;
- 5) In light of 4) this should be a bridge suitable for walkers and cyclists;
- 6) Alternative continuation of the footpath and cycleway is not shown, though the original is shown as deleted on the plan; and
- 7) Possible alternative route for footpath that seems to make sense on the map: definitive path probably reflects the (now changed) historical land use and boundaries; and this suggestion could be more attractive to the landowner.

In addition, in light of the feasibility paper submitted to DfT on the National Cycleway, see Extract 1, plans need to cross-reference these proposals and the suggested route through the area (see Extract 1 and comments by HS2 in their presentation 11/11/15 in Extract 2).

National Cycleway in association with HS2: Preliminary Feasibility Study

Stakeholder Information Pack: HS2 Rail REVISED September 2015



HS2 Rail runs adjacent to former Great Central Railway crossing Buckingham and Brackley Railway

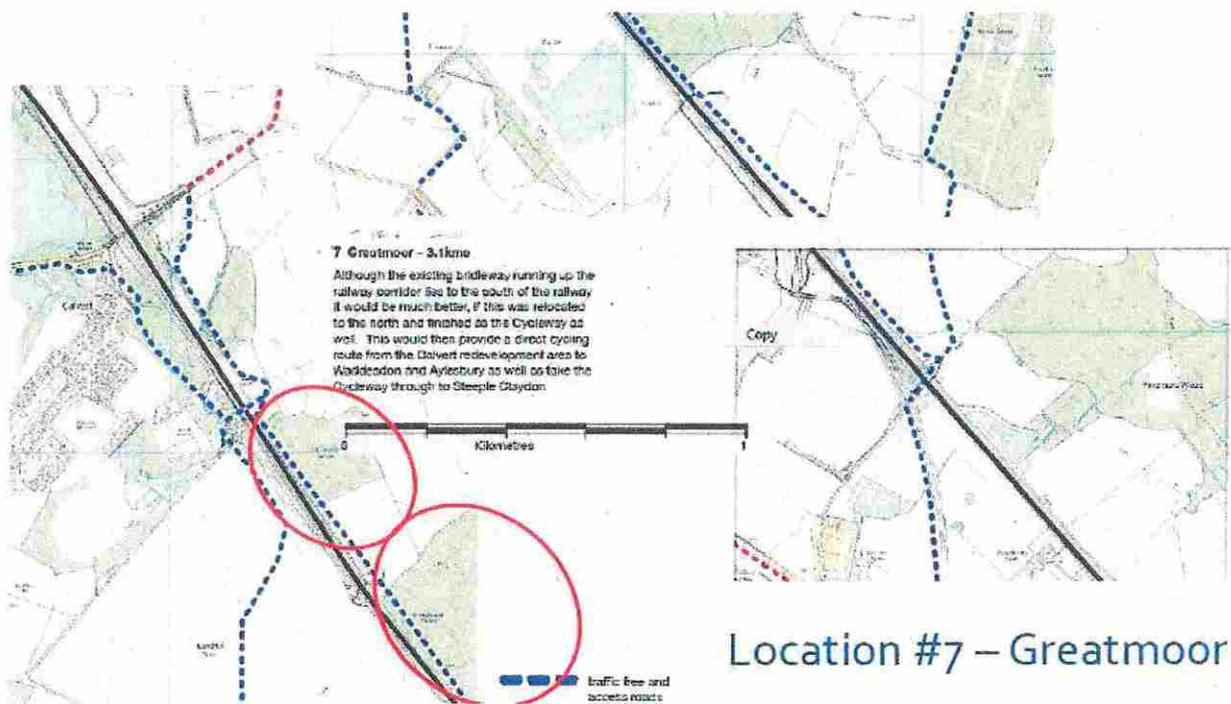
A summary of possible sections on lands associated with HS2 Rail

With detailed plans for each site enclosed in the second part of this document

HS2 comments on National Cycleway interactions – dated Sep 2015

Presentation: 11 November 2015

www.gov.uk/hs2

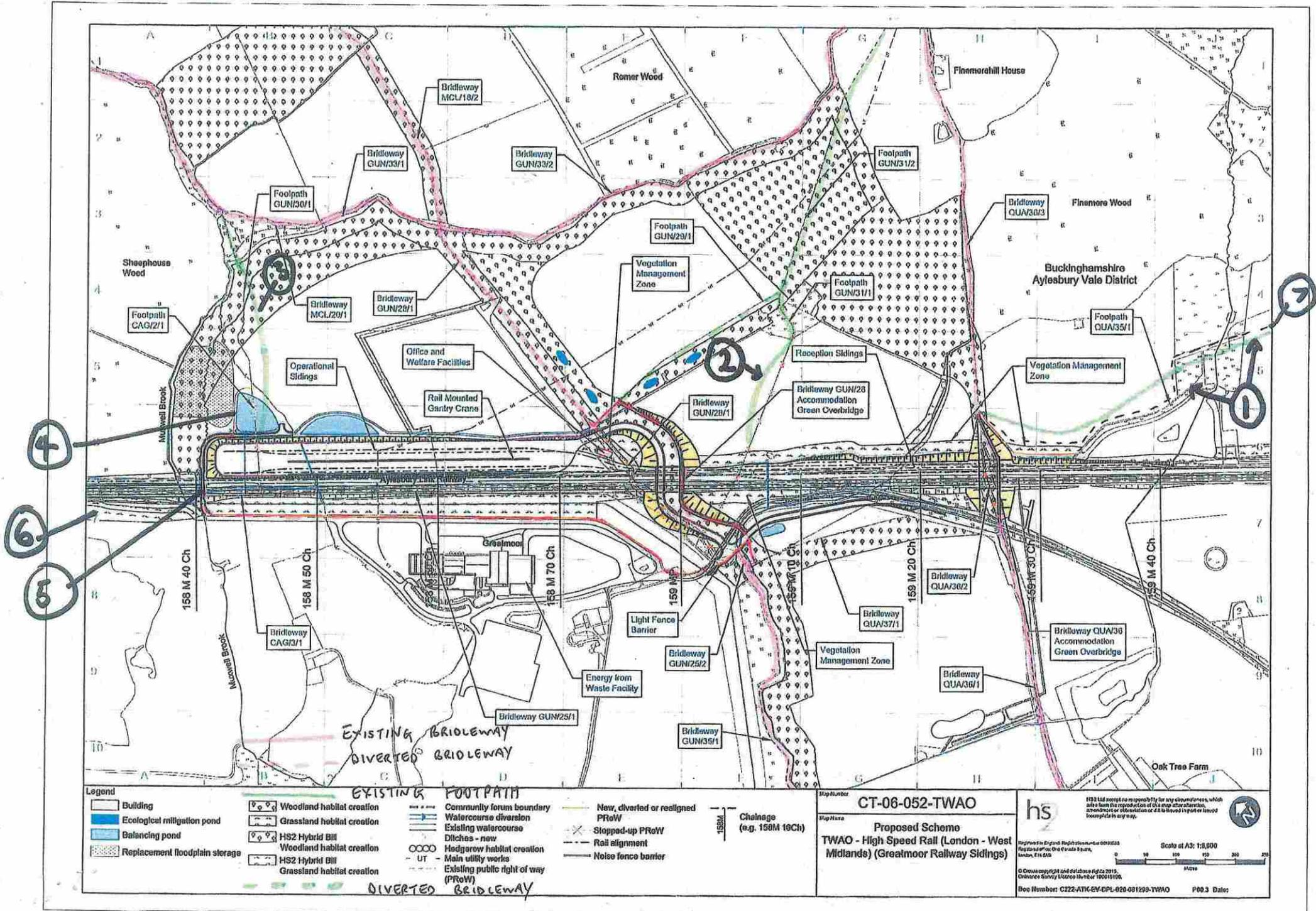


Location #7 – Greatmoor

7 Greatmoor – 3.1kms

Although the existing bridleway running up the railway corridor lies to the south of the railway it would be much better, if this was relocated to the north and finished as the Cycleway as well. This would then provide a direct cycling route from the Calvert redevelopment area to Waddesdon and Aylesbury as well as take the Cycleway through to Steeple Claydon.

Extract 3



- Legend**
- Building
 - Ecological mitigation pond
 - Balancing pond
 - Replacement floodplain storage
 - Woodland habitat creation
 - Grassland habitat creation
 - HS2 Hybrid Bill Woodland habitat creation
 - HS2 Hybrid Bill Grassland habitat creation
 - Community forum boundary
 - Watercourse diversion
 - Existing watercourse
 - Ditches - new
 - Hedgerow habitat creation
 - Main utility works
 - Existing public right of way (PRoW)
 - New, diverted or realigned PRoW
 - Stopped-up PRoW
 - Rail alignment
 - Noise fence barrier

EXISTING BRIDLEWAY
DIVERTED BRIDLEWAY

EXISTING FOOTPATH

EXISTING BRIDLEWAY
DIVERTED BRIDLEWAY

Map Number
CT-06-052-TWAO

Map Name
**Proposed Scheme
TWAO - High Speed Rail (London - West Midlands) (Greatmoor Railway Sidings)**

hs

1:8,900 Scale at A3: 1:8,900

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Doc Number: C222-ATK-EV-01-020-01-TWAO P00.3 Date:

AYLESBURY VALE DISTRICT COUNCIL

Planning

Please ask for: Mrs Claire Bayley
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Switchboard: (01296) 585858
Text Relay: prefix telephone number with 18001
Email: devcon@aylesburyvaledc.gov.uk
Our Ref: 16/02034/INF1
Your Ref:



15 June 2016

Caroline O'Neill
TWA Orders Unit
Department For Transport
Zone 1/14-18
Great Minster House
33 Horseferry Road
London
SW1P 4DR

Dear Ms O'Neill

**Greatmoor Railway Sidings South Of Sheephouse Wood Calvert
Application for: Proposed Scoping Opinion under the EIA Regulations for proposed
High Speed Rail.**

I refer to the above scoping report received 19 May 2016 for the proposed development by HS2 Limited, for the railway and ancillary works for the relocation of Calvert Waste Transfer Terminal

To assist the Council forming a Scoping Opinion pursuant to Rule 8 of the Applications Rules, consultations have been carried out on the document submitted and copies of the responses received are available to view on the Councils website under the reference numbers above and which in our view will be relevant to the final format and content of the Environmental Statement.

To confirm, the scoping methodology is considered acceptable and generally the structure of the chapters in the ES is acceptable as scoped. However, an additional chapter is also required on lighting.

Policies and plans

AVDC are currently preparing a new local plan; The Vale of Aylesbury Local Plan (VALP) and the draft is due for publication in June 2016 and out for consultation from the 7th July 2016.

Agriculture, forestry and soils

The methodology and range of assessment in this Chapter is considered appropriate.



Air Quality

The Council's Environmental Health Officer has reviewed the EIA scoping report and is satisfied that the correct air quality impacts have been identified and the methods/guidance to assess such impacts as part of any full EIA are suitable.

Community

The methodology and range of assessment in this Chapter is considered appropriate.

Cultural heritage

Accept the proposed assessment methodology to provide an adequate assessment on the potential impacts of the proposal. AVDC heritage officer advises that it does not appear that the proposed development area includes any listed buildings and it does not run through any conservation areas.

Although there are a number of listed buildings close to the proposed line, for example Collett Farm and Lower Greatmoor Farm, it appears that the revised HS2 proposals will not result in any further harm to nearby heritage assets or their settings than was likely to arise from the previous proposal. As such, the Heritage Team has no substantive comments to make upon the revised proposals.

The Heritage Team has already been consulted separately and directly regarding the recording of historic railway buildings that are to be affected by the East-West rail line. Similarly, the Team are in dialogue with HS2 Ltd regarding heritage assets which are to be affected by HS2. The applicant (or their agents) are encouraged to seek advice from the Heritage Team in the event that any further historic buildings are to be affected as a result of this revised proposal.

Archaeology comments will be addressed in the consultation response from Buckinghamshire County Council, whom you have consulted directly.

Ecology

The details provided within the EIA scoping report list within the ecology section those features on site that require ecological mitigation. The sensitive nature of the ecology issues on the land where the proposed sidings are to be located are clearly known and referenced on many occasions within the documents provided. Due to the presence of protected species on site and the proximity of protected habitat adjacent to the proposed sidings Natural England will need to be consulted throughout this process. The Local Wildlife Trust, BBOWT will also need to be consulted as the proposals impact on land they manage.

A detailed Environmental Statement is being prepared to address the issues raised in the EIA. This report will need to be submitted and approved by both NE and BBOWT along with the AVDC Ecologist and the Bucks County Council Ecologist.

Full consideration on the effects the proposed scheme has and the measures proposed to mitigate these will need to be comprehensively set out in the Environmental Statement being prepared.

The AVDC Ecologist can be contacted on countryside@aylesburyvaledc.gov.uk

Land quality

The Council's Contaminated Land Officer has reviewed the EIA Scoping Report (document reference: C252-ETM-EV-REP-020-000224) submitted and confirm that they have no comments to make in relation to contaminated land.

Landscape and visual assessment

The AVDC Landscape Officer, has confirmed that the contents to be included in this chapter is acceptable as far as the scoping report goes. Impact of lighting and night assessment should also be included in this chapter. I understand that direct discussions have taken place with the Landscape Officer which is welcomed and it is advisable to continue discuss and agree the significance thresholds if possible. Please contact Jonathan Bellars on 01296 585367 for any follow up discussions.

Sound, noise and vibration

The Council's Environmental Health Officer has reviewed the EIA scoping report and is satisfied that the correct noise impacts have been identified and the methods/guidance to assess such impacts as part of any full EIA are suitable.

Traffic and transport

This is a matter which will be addressed in the consultation response from Buckinghamshire County Council, whom you have consulted directly.

Waste and material resources

This is a matter which will be addressed in the consultation response from Buckinghamshire County Council, whom you have consulted directly.

Water resources and flood risk assessment

This is a matter which will be addressed in the consultation response from Buckinghamshire County Council, whom you have consulted directly.

Cumulative Effects

The methodology and range of assessment in this Chapter is considered appropriate.

This letter constitutes the Local Planning Authority's formal "scoping opinion" under the Transport and Works (Applications and Objections Procedure) (England and Wales Rules 2006) In respect of the development proposed. I hope this is of help although you will appreciate that this opinion is without prejudice to the final decision or recommendation about the development or the adequacy of the Statement in its completed form.

16

Yours sincerely,

Mrs Claire Bayley

Clare Bayley
Principal Planning Officer (Large Development Team)

Caroline O'Neill

From: Smith, Sara [REDACTED]
Sent: 06 June 2016 11:04
To: Caroline O'Neill
Cc: Kitchen, Jim; 'Simon.Dale-Lace' [REDACTED]
Subject: FW: TWAO Calvert Sidings

Caroline

Please find attached our response which I send to Simon Dale-Lace in error.

Sara

Sara Smith
Integrated Planning Specialist
Environment Agency
[REDACTED]
[REDACTED]

From: Smith, Sara
Sent: 31 May 2016 10:38
To: 'Simon.Dale-Lace' [REDACTED]
Cc: Kitchen, Jim; Planning-Wallingford
Subject: TWAO Calvert Sidings

Simon

I have reviewed the Scoping Opinion for the Calvert Sidings. I am happy that the data being used and the assessment of levels of risk and impact is correct.

My only comment relates to FCC's permit. As the boundary of the permitted area is changing, FCC will need to apply to vary its permit or for a new permit.

Sara

Sara Smith
Integrated Planning Specialist
Environment Agency
[REDACTED]

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Historic England

SOUTH EAST OFFICE

Ms Caroline O'Neill
Department for Transport (TWA Orders Unit,
Legal Service)
Zone 1/14-18, Great Minster House
33 Horseferry Road
London
SW1P 4DR

Direct Dial: 01483 252027

Our ref: PA00430965
Your ref: TWA/2/2/138

13 June 2016

Dear Ms O'Neill

Request for Advice

**LAND SOUTH OF SHEEPHOUSE WOOD, CALVERT, AYLESBURY, BUCKS, MK18
2HF**

Thank you for contacting us on 18 May 2016 regarding an EIA screening/scoping opinion in relation to the above site.

Advice

I note from the attached EIA scoping report that Cultural Heritage has been scoped in and that the designated assets in the area which might be affected by the Proposed Scheme have been identified.

We are therefore content that that the relevant information relating to the historic environment will be included in the Environmental Statement.

Recommendation

The Environmental Impact assessment should now be carried out in accordance with the Phase 1 Scoping Methodology Report and the SMR Addendum. The local authority conservation officer should be involved in the process, along with the County Archaeological Service.

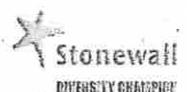
Yours sincerely

Chris Welch



EASTGATE COURT 195-205 HIGH STREET GUILDFORD SURREY GU1 3EH

Telephone 01483 252020
HistoricEngland.org.uk



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Historic England will use the information provided by you to evaluate any applications you make for statutory or quasi-statutory consent, or for grant or other funding. Information provided by you and any information obtained from other sources will be retained in all cases in hard copy form and/or on computer for administration purposes and future consideration where applicable.

Date: 22 June 2016
Our ref: Click here to enter text.
Your ref: TWA/2/2/138



Transport and worksact@dft.gsi.gov.uk
BY EMAIL ONLY

Customer Services
Hornbeam House
Crewe Business Park
Electra Way
Crewe
Cheshire
CW1 6GJ

T 0300 060 3900

Dear Ms O'Neill

Transport and Works Act 1992 ("TWA") Transport and Works (applications and objections procedure) (England and Wales Rules 2006)

The proposed High Speed Rail (London –West Midlands) (Greatmoor Railway Sidings etc) Order

Thank you for seeking our advice on the scope of the Environmental Statement in your consultation dated 18 May 2016 which we received on 19 May 2016.

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

Case law¹ and guidance² has stressed the need for a full set of environmental information to be available for consideration prior to a decision being taken on whether or not to grant planning permission. Annex A to this letter provides Natural England's advice on the scope of the Environmental Impact Assessment (EIA) for this development.

Should the proposal be amended in a way which significantly affects its impact on the natural environment then, in accordance with Section 4 of the Natural Environment and Rural Communities Act 2006, Natural England should be consulted again.

We would be happy to comment further should the need arise but if in the meantime you have any queries please do not hesitate to contact us. For any queries relating to the specific advice in this letter only please contact Kathleen Covill on Kathleen.covill@naturalengland.org.uk. For any new consultations, or to provide further information on this consultation please send your correspondences to consultations@naturalengland.org.uk.

We really value your feedback to help us improve the service we offer. We have attached a feedback form to this letter and welcome any comments you might have about our service.

Yours faithfully

¹ Harrison, J in *R. v. Cornwall County Council ex parte Hardy* (2001)

² *Note on Environmental Impact Assessment Directive for Local Planning Authorities* Office of the Deputy Prime Minister (April 2004) available from <http://webarchive.nationalarchives.gov.uk/+http://www.communities.gov.uk/planningandbuilding/planning/sustainableenvironmental/environmentalimpactassessment/noteenvironmental/>



Kathleen Covill

Kathleen Covill
HS2 Project Manager, Natural England



Annex A – Advice related to the Greatmoor TWA EIA Scoping Report

Section numbers in this Annex reflect the numbering in the EIA scoping report

1. Project background

No comment.

2. Proposed scheme

2.2.1 The description of the scheme location should fully reflect the landscape and setting. The description of the scheme in the EIA report needs to be sufficiently detailed to enable consideration of its construction and operational impacts.

2.3.2 The proposed scheme is within an area that is important for both nationally and regionally significant bat populations. It must be demonstrated that the scheme can avoid committing offences under the Conservation of Habitats and Species Regulations, 2010 (as amended in 2012) or that failing this, a derogation in the form of a licence is needed, in which case the three licensing tests must be satisfied. These tests must ensure not only the maintenance of Favourable Conservation Status (FCS), but that there is a licensing purpose and no satisfactory alternative to the proposed scheme.

Figure 2 This figure indicates a 'welfare and office facilities' building adjacent to the green bridge which is proposed as part of the mitigation package for bats impacts from both Greatmoor and HS2. The design and impact of this building at construction and operation phases should be scoped into the EIA process as it has the potential to reduce the effectiveness of the bat mitigation features due to increased noise, lighting and disturbance from human activity.

Figure 3 As above, this figure indicates the presence of a satellite compound adjacent to the green bridge. The design and impact from the siting and operation of the satellite compound during construction should be scoped into the EIA given the importance of this crossing point for bats.

3. Approach to the Environmental Assessment

The EIA must include the following information to assess impacts on the natural environment:

- A description of the development – including physical characteristics and the full land use requirements of the site during construction and operational phases.
- Expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed development.
- An assessment of alternatives and clear reasoning as to why the preferred option has been chosen.
- A description of the aspects of the environment likely to be significantly affected by the development, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the interrelationship between the above factors.
- A description of the likely significant effects of the development on the environment – this should cover direct effects but also any indirect, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative effects. Effects should relate to the existence of the development, the use of natural resources and the emissions from pollutants. This should also include a description of the forecasting methods to predict the likely effects on the environment.
- A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.
- A non-technical summary of the information.

- An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the applicant in compiling the required information.

It will be particularly important for the Greatmoor sidings EIA to consider the potential cumulative and in-combination effects of this proposal, including all supporting infrastructure, at construction and operational phases, with other relevant proposals – namely HS2 Phase 1, the East West Rail upgrade and the Greatmoor energy from waste facility. We provide some additional comments on this issue below under section 16.

3.3.1 The reference to two baselines (2016 and 2018) requires further clarification.

4. Policies and plans

4.2.2 The National Planning Policy Framework sets out guidance in S.118 on how to take account of biodiversity interests in planning decisions and the framework that decision makers should provide to assist developers.

5. Agriculture, forestry and soils

The applicant should consider the following issues as part of the EIA:

The degree to which soils are going to be disturbed/harmed as part of this development and whether 'best and most versatile' agricultural land is involved.

This may require a detailed survey if one is not already available. For further information on the availability of existing agricultural land classification (ALC) information see www.magic.gov.uk. Natural England Technical Information Note 049 - Agricultural Land Classification: protecting the best and most versatile agricultural land also contains useful background information.

If required, an agricultural land classification and soil survey of the land should be undertaken. This should normally be at a detailed level, eg one auger boring per hectare, (or more detailed for a small site) supported by pits dug in each main soil type to confirm the physical characteristics of the full depth of the soil resource, ie 1.2 metres.

The Environmental Statement should provide details of how any adverse impacts on soils can be minimised. Further guidance is contained in the Defra Construction Code of Practice for the Sustainable Use of Soil on Development Sites.

6. Air Quality

The scoping report scopes in Sheephouse Wood SSSI as a sensitive ecological receptor. It should also clarify whether other non-SSSI ancient woodland is within the 200m boundary for assessment during the construction and operation phases.

Air quality in the UK has improved over recent decades but air pollution remains a significant issue; for example over 97% of sensitive habitat area in England is predicted to exceed the critical loads for ecosystem protection from atmospheric nitrogen deposition ([England Biodiversity Strategy](#), Defra 2011). A priority action in the England Biodiversity Strategy is to reduce air pollution impacts on biodiversity. The planning system plays a key role in determining the location of developments which may give rise to pollution, either directly or from traffic generation, and hence planning decisions can have a significant impact on the quality of air, water and land. The assessment should take account of the risks of air pollution and how these can be managed or reduced. Further information on air pollution impacts and the sensitivity of different habitats/designated sites can be found on the Air Pollution Information System (www.apis.ac.uk). Further information on air pollution modelling and assessment can be found on the Environment Agency website.

7. Community

Natural England encourages any proposal to incorporate measures to help encourage people to access the countryside for quiet enjoyment. Measures such as reinstating existing footpaths together with the creation of new footpaths and bridleways are to be encouraged. Links to other green networks and, where appropriate, urban fringe areas should also be explored to help promote the creation of wider green infrastructure. Relevant aspects of local authority green infrastructure strategies should be incorporated where appropriate.

In addition to PRoW, the EIA should consider potential impacts on access land and public open land in the vicinity of the development. Appropriate mitigation measures should be incorporated for any adverse impacts. We also recommend reference to the relevant Right of Way Improvement Plans (ROWIP) to identify public rights of way within or adjacent to the proposed site that should be maintained or enhanced.

8. Cultural Heritage

We advise that HS2 seek the advice of Historic England for detailed advice on this chapter.

With regard to heritage landscapes, the EIA should consider whether there is land in the area affected by the development which qualifies for conditional exemption from capital taxes on the grounds of outstanding scenic, scientific or historic interest. An up-to-date list may be obtained at www.hmrc.gov.uk/heritage/lbsearch.htm and further information can be found on Natural England's landscape pages [here](#).

9. Ecology

Protected sites

We can confirm that there are no sites of European importance affected by the proposals.

9.1.3 We welcome the use of Natural England's Impact Risk Zones (IRZs) to inform the EIA scoping for statutory sites of nature conservation and agree that Sheephouse Wood SSSI should be scoped in. However, it appears that the scoping report has scoped in SSSIs within 500m based on potential effects from air quality associated with waste management activities. Additional IRZs are triggered for the following development category which seems relevant to the proposed scheme: *3. All planning applications outside or extending outside existing settlements/urban areas affecting greenspace, farmland, semi natural habitats or landscape features such as trees, hedges, streams, rural buildings/structures.*

On this basis the following SSSIs should be scoped in, or the reasons for scoping them out set out in the scoping document:

- Sheephouse Wood
- Finemere Wood
- Grendon & Doddershall Woods
- Ham Home-cum-Hamgreen Woods

The Long Herdon Meadow SSSI IRZ is also triggered due to potential impacts from discharges. There does appear to be hydrological connectivity between the Muxwell Brook adjacent to the proposed scheme and the River Ray which flows into the SSSI. However there is considerable distance between the application site and the Long Herdon Meadow SSSI, and assuming mitigation measures are in place to minimise contamination of surface water then the risk would appear very low. We note that the land quality and water resources and flood risk chapters include consideration

of impacts to groundwater and surface water and identify the Muxwell Brook as a sensitive receptor. Any evidence to demonstrate the potential effects on the Brook will be helpful in determining the potential effects on the Long Herdon SSSI.

The EIA scoping should ensure that all impact pathways to relevant SSSIs are considered and reasons for scoping sites out are explained.

Further information on these SSSIs and their special interest features can be found at www.magic.gov

9.1.4 We support the scoping in of "*relevant areas of woodland, grassland and arable habitats within the former Bernwood Forest*" dependent on their use by protected species.

9.1.8 and 9.1.9 Hedgerows and the Muxwell Brook provide important foraging and commuting routes for the bat assemblages present. Effects on these receptors will need to be considered in this context.

Local wildlife sites

The Local Wildlife Sites listed at **2.2.5** should also be referenced in the ecology chapter as many of these sites are used by the bat assemblages and other notified species listed in the ecology chapter.

Local Sites are identified by the local wildlife trust, geoconservation group or a local forum established for the purposes of identifying and selecting local sites. They are of county importance for wildlife or geodiversity. The ES should therefore include an assessment of the likely impacts on the wildlife and geodiversity interests of such sites. The assessment should include proposals for mitigation of any impacts and if appropriate, compensation measures. The applicant should contact the local wildlife trust, geoconservation group or local sites body in this area for further information.

Protected species

9.1.12 – 9.1.15 These paragraphs rightly acknowledge the significance of the area for a large number of bat species, including one of the largest populations of Bechstein's in the UK. The Environmental Statement will need to set out a detailed assessment of impacts and mitigation proposals, alone and in combination with the other major schemes proposed in this area, on each of these bat species, to ensure that all impacts at all stages of the project are considered and addressed.

9.1.17 Black hairstreak butterfly are a notified feature of Sheephouse Wood SSSI.

9.1.25 – 9.1.27 This section should include effects from vibration and from temporary damage and loss, degradation of habitats and killing/injury of any species which are present during the construction period. Increased human activity during the construction and operational phases should be considered. The operational phase could also impact on barn owls and this should be considered in the ES.

9.3 Compensation measures will also be required for impacts on habitats (e.g. loss of or damage to habitat). The ES should also set out the necessary monitoring, management and maintenance proposals to ensure no detriment and that mitigation is effective.

9.3.2 Mitigation will be needed to prevent licensable impacts during operation, not just to address the most significant adverse effects.

The EIA will need to provide a detailed picture of the scheme proposals and mitigation measures, including (but not limited to):

- planting schemes and timings,
- maturity of vegetation to be planted,
- locations of temporary barriers/fencing,
- the lighting regime for the truck movements and sidings operations,
- sound proofing,
- detail on the offloading procedure,
- green bridge design principles,
- interactions between different mitigation elements.

This data should be presented in combination with the bat survey data in a coherent and coordinated way. The EIA should show clearly how impacts on sensitive receptors from the different stages of the sidings scheme will be addressed at both construction and operation stages, and how the cumulative and in combination effects with other projects will also be addressed.

The ES should assess the impact of all phases of the proposal on protected species (including, great crested newts, reptiles, birds, water voles, badgers and bats). Natural England does not hold comprehensive information regarding the locations of species protected by law, but advises on the procedures and legislation relevant to such species. Records of protected species should be sought from appropriate local biological record centres, nature conservation organisations, groups and individuals; and consideration should be given to the wider context of the site for example in terms of habitat linkages and protected species populations in the wider area, to assist in the impact assessment.

The conservation of species protected by law is explained in Part IV and Annex A of Government Circular 06/2005 *Biodiversity and Geological Conservation: Statutory Obligations and their Impact within the Planning System*. The area likely to be affected by the proposal should be thoroughly surveyed by competent ecologists at appropriate times of year for relevant species and the survey results, impact assessments and appropriate accompanying mitigation strategies included as part of the ES.

In order to provide this information there may be a requirement for a survey at a particular time of year. Surveys should always be carried out in optimal survey time periods and to current guidance by suitably qualified and where necessary, licensed, consultants. Natural England has adopted standing advice for protected species which includes links to guidance on survey and mitigation.

Ancient Woodland

The Bernwood Forest area includes a number of ancient woodland blocks both within and outwith designated site boundaries, all of which will provide important roosting and foraging habitat for the woodland bat assemblages and other protected species present. It is important that impacts on ancient woodland are considered in the EIA for the proposed scheme.

Information about ancient woodland can be found in Natural England's standing advice http://www.naturalengland.org.uk/Images/standing-advice-ancient-woodland_tcm6-32633.pdf.

Ancient woodland is an irreplaceable resource of great importance for its wildlife, its history and the contribution it makes to our diverse landscapes. The ES should have regard to the requirements under the NPPF (Para. 118)² which states:

"Planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss."

Habitats and Species of Principal Importance

The ES should thoroughly assess the impact of the proposals on habitats and/or species listed as 'Habitats and Species of Principal Importance' within the England Biodiversity List, published under the requirements of S41 of the Natural Environment and Rural Communities (NERC) Act 2006. Section 40 of the NERC Act 2006 places a general duty on all public authorities, including local planning authorities, to conserve and enhance biodiversity. Further information on this duty is available in the Defra publication 'Guidance for Local Authorities on Implementing the Biodiversity Duty'.

Government Circular 06/2005 states that Biodiversity Action Plan (BAP) species and habitats, "*are capable of being a material consideration...in the making of planning decisions*". Natural England therefore advises that survey, impact assessment and mitigation proposals for Habitats and Species of Principal Importance should be included in the ES. Consideration should also be given to those species and habitats included in the relevant Local BAP.

Natural England advises that a habitat survey (equivalent to Phase 2) is carried out on the site, in order to identify any important habitats present. In addition, ornithological, botanical and invertebrate surveys should be carried out at appropriate times in the year, to establish whether any scarce or priority species are present. The Environmental Statement should include details of:

- Any historical data for the site affected by the proposal (eg from previous surveys);
- Additional surveys carried out as part of this proposal;
- The habitats and species present;
- The status of these habitats and species (eg whether priority species or habitat);
- The direct and indirect effects of the development upon those habitats and species;
- Full details of any mitigation or compensation that might be required.

The proposed scheme should seek to avoid adverse impact on sensitive areas for wildlife within the site, and if possible provide opportunities for overall wildlife gain.

The record centre for the relevant Local Authorities should be able to provide the relevant information on the location and type of priority habitat for the area under consideration.

Natural England does not hold local information on local sites, local landscape character and local or national biodiversity priority habitats and species. We recommend that the applicant seeks further information from the appropriate bodies (which may include the local records centre, the local wildlife trust, local geoconservation group or other recording society and a local landscape characterisation document).

10. Land quality

No comments.

11. Landscape and visual assessment

There are no nationally designated landscapes affected by the proposals.

Natural England would wish to see details of local landscape character areas mapped at a scale appropriate to the development site as well as any relevant management plans or strategies pertaining to the area. The EIA should include assessments of visual effects on the surrounding area and landscape together with any physical effects of the development, such as changes in topography. The European Landscape Convention places a duty on Local Planning Authorities to consider the impacts of landscape when exercising their functions.

The EIA should include a full assessment of the potential impacts of the development on local landscape character using landscape assessment methodologies. We encourage the use of

Landscape Character Assessment (LCA), based on the good practice guidelines produced jointly by the Landscape Institute and Institute of Environmental Assessment in 2013. LCA provides a sound basis for guiding, informing and understanding the ability of any location to accommodate change and to make positive proposals for conserving, enhancing or regenerating character, as detailed proposals are developed.

Natural England supports the publication *Guidelines for Landscape and Visual Impact Assessment*, produced by the Landscape Institute and the Institute of Environmental Assessment and Management in 2013 (3rd edition). The methodology set out is almost universally used for landscape and visual impact assessment.

In order to foster high quality development that respects, maintains, or enhances, local landscape character and distinctiveness, Natural England encourages all new development to consider the character and distinctiveness of the area, with the siting and design of the proposed development reflecting local design characteristics and, wherever possible, using local materials. The Environmental Impact Assessment process should detail the measures to be taken to ensure the building design will be of a high standard, as well as detail of layout alternatives together with justification of the selected option in terms of landscape impact and benefit.

The assessment should also include the cumulative effect of the development with other relevant existing or proposed developments in the area. In this context Natural England advises that the cumulative impact assessment should include other proposals currently at Scoping stage. Due to the overlapping timescale of their progress through the planning system, cumulative impact of the proposed development with those proposals currently at Scoping stage would be likely to be a material consideration at the time of determination of the planning application.

The assessment should refer to the relevant National Character Areas which can be found on our website. Links for Landscape Character Assessment at a local level are also available on the same page.

12. Sound, noise and vibration

No comments.

13. Traffic and transport

No comments.

14. Waste and material resources

No comments.

15. Water resources and flood risk assessment

15.1.3 and 15.1.4 state that the EIA will look at surface water and groundwater features within 1km of the proposed scheme. However, the screening distance should be informed by the activities that will take place in the vicinity of these sites and the nature of the sites themselves (e.g. water dependency). It is important that the screening out does not result in potential impacts being missed. Natural England's Impact Risk Zones can extend up to 3km for water dependant sites.

As highlighted in section 9 above, the Muxwell Brook may be hydrologically connected to the Long Herdon Meadow SSSI. The EIA should explore this and ensure cross referencing where necessary between the water resources and ecology sections of the ES.

The EIA should consider the full effects on water mechanisms and natural systems in the catchment of water dependent sites; this may include loss of floodplain, diversions of water sources, and changes to flow, geomorphology and biology.

We advise consultation with the Environment Agency on this chapter.

16. Cumulative and in-combination effects

The assessment of cumulative effects will be a crucial part of the EIA given the interaction between HS2, the proposed sidings, the EWR upgrade and the Greatmoor energy from waste plant. The assessment will be particularly relevant to the bat populations present in the Bernwood Forest area and to looking at impacts from the construction phase of the sidings and HS2 combined with the operational phase of the efw plant. As highlighted at 3.3.1 above, the reference to two baselines (2016 and 2018) requires further explanation as we would expect any cumulative and in-combination effects from the operation of the efw plant to be assessed.

The cumulative effects chapter of the EIA scoping should set out which receptors and impacts will be scoped into the assessment of cumulative effects. Evidently this should include all bat species within the area plus the effects on air quality, noise, lighting etc.

In addition to HS2 and EWR, the following types of projects should be included in the cumulative effects assessment:

- a. existing completed projects;
- b. approved but uncompleted projects;
- c. ongoing activities;
- d. plans or projects for which an application has been made and which are under consideration by the consenting authorities; and
- e. plans and projects which are reasonably foreseeable, ie projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects.

16.3.6 As the sidings, HS2 and EWR projects are interconnected, there should be a Masterplan covering all the impacts, through all the phases of each project, showing how relevant mitigation and compensation will address the impacts as each scheme develops. The ES should make clear what mitigation is required for and being delivered as part of each project, and the roles and responsibilities each party has (e.g. in regard to management, maintenance and monitoring of the mitigation and compensatory measures).

Other issues

Climate Change Adaptation

The England Biodiversity Strategy published by Defra establishes principles for the consideration of biodiversity and the effects of climate change. The ES should reflect these principles and identify how the development's effects on the natural environment will be influenced by climate change, and how ecological networks will be maintained. The NPPF requires that the planning system should contribute to the enhancement of the natural environment 'by establishing coherent ecological networks that are more resilient to current and future pressures' (NPPF Para 109), which should be demonstrated through the ES.

- ends -

5 Scoping opinion response

5.1.1 Table 1 presents a summary of the key Scoping Opinions received and the resulting action.

Table 1: Key scoping responses received and resulting actions

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
Pg.2 DfT Scoping Opinion (9.1.3 in scoping report)	DfT	Ecology/FRA	<p>Ecology/FRA in relation to protected sites, and having regard to Natural England's Impact Risk Zones, the EIA should additionally consider the potential for effects from the proposed development on the following SSSI's:</p> <ul style="list-style-type: none"> - Grendon and Doddershall Woods SSSI; - Ham Home-cum-Hamgreen Woods SSSI; and - Long Herdon Meadow SSSI, in view of the hydrological connectivity between the Muxwell Brook adjacent to the development site and the River Ray which runs into this SSSI. 	<p>Potential ecological effects of the Proposed Scheme on the following SSSI's have been considered in Volume 2: the Main ES, Section 9, Ecology:</p> <ul style="list-style-type: none"> - Sheephouse Wood SSSI; - Finemere Wood SSSI; - Grendon & Doddershall Woods SSSI; and - Ham Home-cum-Woods SSSI. <p>The effect on the following potentially water dependent ecological sites have been considered in Volume 2: the Main ES, Section 14, Water resources and flood risk:</p> <ul style="list-style-type: none"> - Finemere Wood SSSI - Grendon and Doddershall Woods SSSI - Sheephouse Wood SSSI - Grendon and Doddershall Meadows LWS <p>Long Herdon Meadow is not currently included in the ES. It is downstream of the Proposed Scheme and its botanical/bird interest is to some extent dependent on winter flooding. Adverse effects due to hydrological connectivity such as pollution can be assumed to be avoided through the implementation of the draft CoCP, it is assumed that pollution during operation would be controlled through FCC's environmental management systems.</p>
Pg.2 DfT Scoping Opinion (Section 9.1.25-27 of Scoping	DfT	Ecology	<p>Ecology In relation to protected species, the EIA should also consider the potential effects of vibration during construction of the development and the killing or injury of any species which are present during the construction period.</p> <p>The impacts of increased human activity during both construction and operation should also be</p>	<p>Potential vibration effects on ecological receptors during construction has been considered in Volume 2: the Main ES, Section 9, Ecology and Section 12, Sound , noise and vibration. Potential effects of increased human activity during construction and operation on ecological receptors has been considered in Volume 2: the Main ES, Section 9, Ecology.</p>

Reference in Scoping Opinion Report)	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
Pg.2 DfT Scoping Opinion (Section 11.1.3 of Scoping Report)	DfT	Landscape and visual	In relation to the impact of lighting, the ES should include an assessment of the night-time impacts of the proposed development. The significance thresholds for this assessment should be discussed with the Landscape Officer of AVDC.	<p>Potential effects of lighting on ecological receptors during operation has been considered in Volume 2: the Main ES, Section 9, Ecology. Potential effects of lighting on landscape and visual during operation has been considered in Volume 2: the Main ES, Section 11, Landscape and Visual.</p> <p>The AVDC landscape officer has been consulted regarding the Proposed Scheme. Thresholds were not discussed during consultation with AVDC landscape officer.</p>
Pg.2 DfT Scoping Opinion (Section 13.1.6 of Scoping Report)	DfT	Traffic and transport public rights of way	<p>The Councils Public Rights of Way team have a number of concerns on the PRow and supplied a plan detailing these concerns.</p> <p>PRow comments - Appendix B</p> <ol style="list-style-type: none"> 1) Definitive footpath is not accurately recorded; does it need diverting (see 7)? 2) Definitive footpath is not accurately recorded; 3) Definitive footpath is not accurately recorded 4) It would be useful to upgrade this route to bridleway in order to connect walkers and cyclists between the bridleway to the north and the 'footpath and cycleway' to the south; 5) In light of 4) this should be a bridge suitable for walkers and cyclists; 6) Alternative continuation of the footpath and cycleway is not shown, though the original is shown as deleted on the plan; and 7) Possible alternative route for footpath that seems to make sense on the map: definitive path probably reflects the (now changed) historical land use and boundaries; and this suggestion could be more attractive to the 	<p>Temporary and permanent effects of the Proposed Scheme on Traffic, including PRow and non-motorised users have been considered in Volume 2: the Main ES, Section 13, Traffic and transport.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			landowner.	
Pg.2 DfT Scoping Opinion (Section 13.2.9-10 of Scoping Report)	DfT	Traffic and transport	For the purposes of assessing construction traffic impacts, the Transport Assessment should establish existing traffic conditions in accordance with National Planning Policy Guidance and in consultation with BCC.	Automatic Traffic Counters (ATC) data to determine existing baseline traffic flows has been derived from 2012 and 2015 traffic surveys, commissioned as part of the HS2 Phase One ES. The effects of construction traffic generated by the Proposed Scheme have been considered in Section 13, Traffic and transport and in Volume 4.10: Environmental Statement Technical Appendix: Transport Assessment.
Pg. 3 DfT Scoping Opinion (Section 15.1.3-4 of Scoping Report)	DfT	Water Resources and Flood Risk Assessment	The screening distance for identifying surface water and groundwater features that may be affected by the proposed development should take into account activities which may affect sites more than 1km from the development having regard to the nature of those sites for example as a result of water dependency, and taking into account Natural England's Impact Risk Zones.	This approach is consistent with the HS2 main ES for the hybrid Bill. Sites outside of the 1km area would be considered if an impact was identified in a surface water or groundwater body which could impact on downstream sites. In the case of the Greatmoor Railway Sidings Proposed Scheme no impacts have been identified to surface water or groundwater bodies and as such no other impacts are expected outside of the 1km study area.
Pg. 3 DfT Scoping Opinion (Section 15.2.3 of Scoping Report)	DfT	Water Resources and Flood Risk Assessment	The ES should explain the criteria used for deciding whether to undertake hydraulic modelling. In carrying out the assessment of the impacts of the proposed development on water resources and flood risk, the promoter should address the issues raised by BCC identified in Appendix A to its letter of 14 June 2016 commenting on the Scoping Report.	The approach is consistent with the HS2 Phase One ES. Targeted modelling in the HS2 Phase One ES was undertaken where there was potential for a significant effect on a sensitive receptor. The basis of modelling was undertaken on the presumption that modelling was not done unless specifically required. Replacement floodplain storage has already been provided for HS2 Phase One. This compensation can be refined if necessary to take into account the sidings. The following has been taken from the Greatmoor Railway Sidings ES: Replacement flood storage will be provided for any losses arising due to structures, built volume or ground raising within the modelled 1 in 100 years return period floodplain, including an appropriate allowance for climate change. Storage will be replaced by volume at the same level from which it was removed in 100mm increments as per standard Environment Agency methodology. Replacement storage in all cases will be provided prior to construction. No works will be undertaken within the flood zones of the Muxwell Brook. However, the Proposed Scheme sidings fall within the area proposed for

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
				replacement flood storage for the proposed HS2 Phase One scheme. Consequently, the proposed HS2 Phase One mitigation will be modified to ensure sufficient mitigation is provided.
Pg. 1	AVDC	General	The scoping methodology is considered acceptable, and generally the structure of the chapters in the ES is acceptable as scoping. However, an additional chapter is also required on lighting.	Lighting has been considered in in Volume 2: the Main ES. The visual impact of lighting has been considered and reported in Section 11, Landscape and Visual. The effects of lighting on other receptors, such as ecology has been reported in Section 9, Ecology.
Pg. 1	AVDC	Policies and Plans	AVDC are currently preparing a new local plan; The Vale of Aylesbury Local Plan and the draft is due for publication in June 2016 and out for consultation from the 7th July 2016.	Reference to the draft Vale of Aylesbury Local Plan, which is currently out for consultation, will be included in the ES.
Pg.2	AVDC	Cultural heritage	<p>Accept the proposed assessment methodology to provide an adequate assessment on the potential impacts of the proposal. AVDC heritage officer advises that it does not appear that the proposed development area includes any listed buildings and it does not run through any conservation area.</p> <p>Although there are a number of listed buildings close to the proposed line, for example Collett Farm and Lower Greatmoor Farm, it does appear that the revised HS2 proposals will not result in any further harm to nearby heritage assets of their settings than was likely to arise from the previous proposal. As such, the Heritage Team has no substantive comments to make upon the revised proposals.</p> <p>The Heritage Team has already been consulted separately and directly regarding the recording</p>	Noted. The requirement for evaluation may have to be dealt with separately to the ES. Ongoing discussions are taking place with BCC Archaeology.

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>of historic railway buildings that are to be affected by the EWR line. Similarly, the Team are in dialogue with HS2 Ltd. regarding heritage assets which are to be affected by HS2. The applicant (or their agents) are encouraged to seek advise on from the Heritage Team in the event that any historic buildings are to be affected as a result of this revised proposal.</p> <p>The Council's Archaeology team has consulted the Buckinghamshire Historical Environment Records. A number of archaeological features have been recorded to the South of the proposed Sidings and the Council would therefore expect to see the appropriate archaeological assessment, evaluation and recording take place.</p>	
Pg.3	AVDC	Landscape and visual	<p>The AVDC Landscape Officer, has confirmed that contents to be included in this chapter is acceptable as far as the scoping report goes. Impact on lighting and night assessment should also be included in this chapter. I understand that direct discussions with the Landscape Officer have taken place which is welcomed and it is advisable to continue to discuss and agree the significance thresholds if possible.</p>	<p>Potential effects of lighting on ecological receptors during operation has been considered in Volume 2: the Main ES, Section 9, Ecology. Potential effects of lighting on landscape and visual during operation has been considered in Volume 2: the Main ES, Section 11, Landscape and Visual.</p> <p>The AVDC landscape officer has been consulted regarding the Scoping Report and the proposed EIA landscape and visual methodology for the Proposed Scheme, including the identification of viewpoints and photomontage locations.</p>
Pg.3	AVDC	Traffic and transport - Highways Development Management	<p>The Council agrees with the scoping that a Transport Assessment is required to consider the implications of the scheme. The routing of additional construction traffic is a key issue and the highway authority will need to be satisfied that routes are safe and suitable. The Council are concerned about the suggestion that</p>	<p>A Transport Assessment will be included in Volume 4.11: Environmental Statement Technical Appendix: Transport Assessment. Please also refer to Volume 2: the Main ES, Section 13, Traffic and transport.</p> <p>As discussed in Volume 2, Section 13 of the ES, Traffic and Transport, as the Proposed Scheme is intrinsically linked to the HS2 Phase One scheme, assessment of impacts within this EIA have been undertaken against two baselines: one with</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>construction traffic could route via A41 and then Station Road resulting in goods vehicle traffic along perhaps unsuitable rural roads and through villages. The preference at this stage would be the alternative of routing along the FCC access road which was built with the purpose of carrying commercial traffic to the site, provided that it is demonstrated that the geometry is suitable for the intensified use. The impact on the operation of the A41 is also a key issue and the Transport Assessment must demonstrate that the roundabout junction between the A41 and the site will continue to operate within acceptable limits.</p> <p>The use of baseline year traffic data from 2012 is not acceptable. Traffic data should be recent and not normally more than 3 years old. Factoring data is not an acceptable method of deriving 2016 traffic data and new surveys should be undertaken where necessary. The future year should be clarified.</p> <p>In summary full details of the access arrangements should be provided on plans to a scale 1:500. The Council would strongly recommend the use of the existing purpose built FCC access to the A41 to serve the site as this will minimise impact on rural roads. However an assessment of the suitability of those access arrangements for intensified use must be provided. A full Transport Assessment should be prepared to set out the implications of the proposals and the document should be prepared in consultation with the Highway Authority and in accordance with the National</p>	<p>and one without the HS2 Phase One scheme. This allows impacts for the Proposed Scheme alone, and also cumulatively with the HS2 Phase One scheme, to be determined.</p> <p>The design of the Proposed Scheme has been adapted to make use of the access road along the Akeman Street Disused Railway (now Greatmoor Road) which forms the access road to the Greatmoor EfW facility.</p> <p><u>Assumptions:</u></p> <ul style="list-style-type: none"> • The Assessment assumes that construction traffic will be routed on the A41, then Station Road (from the A41 to the HS2 Phase One scheme compound - Station Road overbridge satellite compound). Construction traffic will then utilise the internal HS2 haul road to access the construction site. Consideration has been given to the use of the Greatmoor EfW facility haul road from the A41, although the TA has assumed use of Station Road in absence of guidance as to whether allowing additional HGVs onto the haul road than permitted in the Greatmoor EfW facility planning permission is acceptable, or not. In response to the scoping note, BCC stated that they would prefer the haul road to be used rather than Station Road; however we can demonstrate that use of Station Road will still enable the road (and the junction with the A41) to operate satisfactorily. Also, construction traffic is to be routed only as far as the Station Road overbridge satellite compound, and therefore does not directly impact the residential properties located further north and towards Quainton. • The Assessment assumes a highway network study area of the A41 between Bicester and Aylesbury and Station Road. Beyond the A41, construction traffic is diluted (due to choices in routes) and therefore the impact will not be significant to warrant detailed assessment. • ATC data to determine existing baseline traffic flows has been derived from both 2012 and 2015 HS2 Phase 1 traffic surveys. BCC has indicated that use of 2012 data is not suitable and therefore 2016 data is being collected to ratify the assessment, or determine any change in impacts following submission of the TWAO. • Baseline traffic flows has been factored to a future year using TEMPRO. • Future baseline traffic flows has accounted for operational traffic generated by the new Greatmoor EfW facility (operational traffic volumes obtained from the Greatmoor EfW facility TA). No other committed development (other than that assumed in TEMPRO, or HS2 as discussed in point below) has been accounted for. • Whilst the Proposed Scheme is intrinsically linked to the HS2 Phase One scheme

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>Planning Policy Guidance on Transport Assessment and having regard to the previous 2007 guidance. The Transport Assessment will need to demonstrate that the impact of the proposals on the highway network are not severe in the context of National Planning Policy Framework requirements.</p>	<p>(i.e. it is only being proposed due to, and on the basis of, delivery of HS2), assessment against two future baselines has been carried out for robustness: 1. Future baseline without HS2 construction traffic or HS2 related PROW impacts; 2. Future baseline with HS2 construction traffic and HS2 related PROW impacts.</p> <ul style="list-style-type: none"> • For construction, a future baseline year of 2019 has been used, to tie in with the end date of construction (i.e. represents a worst case scenario for background traffic growth). • For construction, assessment has been undertaken of highway (construction traffic) and PROW (temporary stopping up or diversions) impacts. • Junction modelling has been undertaken at A41/ Station Road only, as per BCC guidance/ agreement that only a 5% peak hour increase warrants detailed assessment (traffic flows on A41 are less than 5% increase). Modelling has used HS2 Phase 1 turning count data at this junction from 2015. • Assessment of theoretical link capacity has been made based on DfT Guidance Note TA 79/99. • For operation, the Proposed Scheme will only generate a negligible number of ad hoc trips on the public highway, relating to staff and maintenance. Furthermore, these represent a redistribution of existing operational trips (which will remain routed on the A41 as at present) rather than new or additional trips. Therefore traffic is not assessed for an operational scenario. • For operation, only impacts upon PROW (permanent realignments) has been assessed. • The Proposed Scheme is deemed to have no material impact on public transport or other transport modes and consequently has not been assessed in the TA (apart from details of existing infrastructure/ services in the existing background section).
Pg.3	AVDC	Minerals and Waste Development Management Comments	<p>The operational effects on agriculture have been scoped out. Consideration has not been given to the longer term effects on the disruption of the Proposed Scheme upon neighbouring / remaining agricultural uses. It might be that there will not be continued agricultural uses immediately adjoining or in close proximity to the site due to the proposed extensive landscaping, and any potential effects may be very small when considered in the wider</p>	<p>Section 5, Agriculture, forestry and soils of the Volume 2: Main Environmental Statement states that "Insofar as the Proposed Scheme is simply a relocation of an existing facility that operates close to agricultural land it is not considered that there will be any significant impacts on agriculture or soil arising from the operation of the Proposed Scheme".</p> <p>The draft CoCP is included in Volume 4.14: Environmental Statement Technical Appendix: Draft CoCP.</p> <p>Section 6, Air quality of the Volume 2: Main Environmental Statement confirms</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>context of the adjacent Calvert landfill site and the Greatmoor EfW facility, but this hasn't been made clear in the Scoping Report.</p> <p>The report has scoped out dust impacts associated with construction, due to mitigation measures as set out within the Code of Construction Practice (CoCP) resulting in no significant effect. The Council would like to be provided a copy of the CoCP (it would have been useful if a draft version of this was attached to the Scoping Report along with the HS2 Phase One Volume 5 document which is referred to throughout), without it one cannot confirm if such mitigation would be acceptable. The Council would like to see Aylesbury Vale District view on this to be considered.</p> <p>The proposed study area for the Air Quality Assessment is 200 meters. The Council would like it to be considered whether this is sufficient. Input from Aylesbury Vale District should be sought by the project on this.</p>	<p>"The study area comprises an area of approximately 500m around the proposed sidings, access roads, Greatmoor EfW facility, and highways including the A41 and Station Road. This study area ensures that impacts are captured within the context of the changing baseline, and given that the sources are not all roads".</p> <p>This is considered to be an adequate distance for assessment of a scheme of this size and magnitude.</p>
Pg.3	AVDC	2. Flood Water	<p>The Council are happy with the method of assessment suggested for the Water Resources and Flood Risk Assessment, however we expect to see clarification within the EIA of the criteria for undertaking hydraulic modelling. The Council also has a number of Flood and Water specific concerns (based on the plans provided) that need to be addressed by the promoter.</p> <p><u>Queries on Appendix A plan:</u></p> <p>1) Flood storage area in location of surface</p>	<p>Details of the Hydraulic Modelling are included in Volume 4.13: Environmental Statement Technical Appendix: Flood Risk Assessment. The flood and water specific concerns have been addressed in Volume 2: Main Environmental Statement, Section 14, Water resources and flood risk assessment, and in Volume 4.13: Environmental Statement Technical Appendix: Flood Risk Assessment.</p> <p><u>Responses to scoping comments on Appendix A plan:</u></p> <p>1) The watercourse diversion isolates the attenuation pond and prevents surface water from adjacent land to flood the pond. Future stages of design will need to ensure that the overall flood risk downstream is not increased.</p> <p>2) The existing ditch that generates the flooding area is intercepted and diverted to</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>water flooding. Would need to be moved as area cannot be used for flood storage when it is already full of surface water.</p> <p>2) This is an area of existing water flooding which has an extended road and embankment over it. How is this being compensated?</p> <p>3) This ditch is an area of existing surface water flooding. Has this been taken into account and how? There is the start of an existing watercourse under here. Is this going to be lost?</p> <p>4) Is this a soakaway ditch or does it connect into a watercourse?</p> <p>5) Is this an existing culvert? If so is this going to be extended or changed due to extended track width?</p> <p>6a) can woodland area be spread either side of watercourse to slow down flow?</p> <p>b) can work be done one watercourse to incorporate woody debris as a habitat enhancement and slow down flow?</p> <p>7) can there be some watercourse enhancement - woody debris?</p>	<p>the culvert crossing at 158M 50Ch. Surface water floodplain compensation is not shown anywhere on HS2 maps, however future stages of design will need to ensure that the overall flood risk downstream is not increased.</p> <p>3) It has not been possible to identify a ditch or watercourse in the land east of the existing railway, however any surface water collected in that location will be diverted to the next culvert crossing. Future stages of design should make sure that the watercourse on the West side of the existing railway will be preserved as much as possible</p> <p>4) The proposed ditch connects to the existing pond</p> <p>5) It is an existing culvert, and it is not proposed to be extended. It will partially be replaced by an upsized culvert, but part of it may be protected rather than increase in size, in order to preserve the existing hydraulic performance. Future stages of design will assess to which extent the culvert can be rebuilt and upsized.</p> <p>6a) Mitigation dependent not only on FRA, but Ecology and Landscape.</p> <p>b) No, this will be considered at the detailed design stage.</p> <p>7) Any work to Mega Ditch or Muxwell Brook should be left to the Greatmoor EFW facility restoration plan.</p>
N/A	Environment Agency	General	<p>Happy that the data being used and the assessment of levels of risk and impact is correct. One comment relates to FCC's permit. As the boundary of the permitted area is changing, FCC will need to apply to vary its permit or for a new permit.</p>	Noted
N/A	Historic England	Cultural heritage	<p>Historic England are content that the relevant information relation to the historic environment will be included in the ES.</p>	<p>The EIA has been carried out in accordance with the HS2 Phase One Scope and Methodology Report and the SMR Addendum. The local conservation officer has been involved in the EIA process.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>Recommendation: The EIA should now be carried out in accordance with the Phase 1 Scoping Methodology and the SMR Addendum. The local authority conservation officer should be involved in the process, along with the County Archaeological Service.</p>	
Section 2.2.1 of Scoping Report	Natural England	General - Proposed Scheme	The description of the scheme location should fully reflect the landscape and setting. The description of the scheme in the EIA report needs to be sufficiently detailed to enable consideration of its construction and operational impacts.	The description of the scheme location will fully reflect the landscape and setting. This is described in Volume 2: Main Environmental Statement, Section 2: 2 The Proposed Scheme.
Section 2.3.2 of Scoping Report	Natural England	General - Proposed Scheme	The proposed scheme is within an area that is important for both nationally and regionally significant bat populations. It must be demonstrated that the scheme can avoid committing offences under the Conservation of Habitats and Species Regulations, 2010 (as amended in 2012) or that failing this, a derogation in the form of a licence is needed, in which case the three licencing tests must be satisfied. These tests must ensure not only the maintenance of Favourable Conservation Status (FCS), but that there is a licencing purpose and no satisfactory alternative to the proposed scheme.	In addition to the ES, a derogation report and separate bat licence will be prepared. The derogation report will document the operational impacts and the draft bat licence will document the construction impacts.
Figure 2	Natural England	General - Proposed Scheme	This figure indicates a 'welfare and offices facilities' building adjacent to the green bridge which is proposed as part of the mitigation package for bats impacts from both Greatmoor and HS2. The design and impact of this building	The proposed office and welfare facilities have been included in the assessment for ecology in Volume 2: Main Environmental Statement, Section 9, Ecology.

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			at construction and operation phases should be scoped into the EIA process as it has the potential to reduce the effectiveness of the bat mitigation features due to increased noise, lighting and disturbance from human activity.	
Figure 3	Natural England	General - Proposed Scheme	As above, this figure indicates the presence of a satellite compound adjacent to the green bridge. The design and impact from the siting and operation of the satellite compound during construction should be scoped into the EIA given the importance of this crossing point for bats.	The proposed Greatmoor Railway Sidings Rail Systems satellite compound has been included in the assessment for ecology in Volume 2: Main Environmental Statement, Section 9, Ecology and shown in the Volume 3: Environmental Statement Maps.
Section 3	Natural England	Approach to the EIA	<p>The EIA must include the following information to assess impacts on the natural environment:</p> <ul style="list-style-type: none"> • A description of the development - including physical characteristics and the full land use requirements of the site during construction and operational phases; • Expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation etc.) resulting from the operation of the proposed development; • An assessment of alternatives and clear reasoning as to why the preferred option has been chosen; • description of the aspects of the environment likely to be significantly affected by the development, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the interrelationship between above factors; 	<p>The Greatmoor Railway Sidings ES provides the following information:</p> <ul style="list-style-type: none"> - description of the Proposed Scheme (the development); - construction and operational effect section; - assessment of main alternatives considered by the Promoter; - description of the aspects of the environment likely to be significantly affected by the Proposed Scheme; - description of the likely significant effects of the Proposed Scheme on the environment; - mitigation measures to prevent, reduce where possible offset any significant adverse effects on the environment; - non-technical summary (refer to Volume 1: Non-Technical Summary); and - any deficiencies in compiling the required information.

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<ul style="list-style-type: none"> • A description of the likely significant effects of the development on the environment - this should cover direct effects but also any indirect effects, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative effects. Effects should relate to the existence of the development, the use of natural resources and the emissions from pollutants. This should also include a description of the forecasting methods to predict the likely effects on the environment; • A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment; • A non-technical summary of the information; and • An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the applicant in compiling the required information. 	
Section 3	Natural England	Approach to the EIA	It will be particularly important for the Greatmoor Sidings EIA to consider the potential cumulative and in-combination effects of this proposal, including all supporting infrastructure, at construction and operational phases, with other relevant proposals - namely HS2 Phase 1, the EWR upgrade and the Greatmoor energy from waste facility. We provide some additional comments on this issue below under Section 16.	The developments included in the cumulative effects assessment are detailed in Volume 2: Main Environmental Statement, Section 4.8, Cumulative effects. The developments noted by Natural England have been included. EWR has been assumed to be East West Rail Phase 2, which has been described as EWR2 throughout the ES.
Section 4.2.2	Natural England	Policies and Plans / Ecology	The National Planning Policy Framework sets out guidance in S.118 on how to take account of biodiversity interests in planning decisions and the framework that decisions makers should	Guidance in the National Planning Policy Framework has been taken account of in the assessment for ecology in Volume 2: Main Environmental Statement, Section 9, Ecology.

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			provide to assist developers.	
Section 5	Natural England	Agriculture, forestry and soils	<p>The applicant should consider the following issues as part of the EIA:</p> <ul style="list-style-type: none"> •The degree to which soils are going to be disturbed/harmed as part of this development and whether 'best and most versatile' agricultural land is involved. •This may require a detailed survey if one is not already available. •If required, an agricultural land classification and soil survey of the land should undertaken. 	<p>Potential effects of the Proposed Scheme on soils and 'best and most versatile' agricultural land has been considered in Volume 2: Main Environmental Statement, Section 5, Agriculture, forestry and soils.</p> <p>A desk-based study was undertaken as part of the HS2 Phase One ES in 2012/2013 to establish the likely baseline soil and ALC of the site. The results of this study have been used for this assessment</p> <p>A detailed soil and ALC field survey will be undertaken to inform soil handling and restoration after the TWAO is made.</p>
Section 6	Natural England	Air Quality	<p>The scoping report scopes in Sheephouse Wood SSSI as a sensitive ecological receptor. It should also clarify whether other non-SSSI ancient woodland is within the zoom boundary for assessment during the construction and operation phases.</p> <p>The assessment should take account of the risks of air pollution and how these can be managed or reduced.</p>	<p>Potential effects of the Proposed Scheme on SSSI's and ancient woodlands within the study area during the construction and operation phases have been considered in Volume 2: Main Environmental Statement, Section 6, Air Quality and Section 9, Ecology. Air pollution has also been considered.</p>
Section 7	Natural England	Community	<p>Natural England encourages any proposal to incorporate measures to help encourage people to access the countryside for quiet enjoyment. Measures such as reinstating existing footpath together with the creation of new footpaths and bridleways are to be encouraged. Links to other green networks and, where appropriate, urban fringe areas should also be explored to help promote the creation of wider green infrastructure. Relevant aspects of local authority green infrastructure should be</p>	<p>Reference to impacts on PRow can be found in Volume 2: Main Environmental Statement, Section 13, Traffic and transport of the ES.</p> <p>The Community assessment will consider any potential impacts on access land and public open land and also promoted PRowS. None were identified as part of the ES assessment.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>incorporated where appropriate.</p> <p>In addition to PRow, the EIA should consider potential impacts on access land and public open land in the vicinity of the development. Appropriate measures should be incorporated for any adverse impacts. We also recommend reference to the relevant Rights of Way Improvement Plans (ROWIP) to identify public rights of way within or adjacent to the proposed site that should be maintained or enhanced.</p>	
Section 8	Natural England	Cultural heritage	<p>We advise that HS2 seek the advice of Historic England for detailed advice on this chapter. With regard to the heritage landscapes, the EIA should consider whether there is land in the area affected by the development which qualifies, for conditional exemption from capital taxes on the grounds of outstanding scenic, scientific or historic interest. An up-to-date list may be obtained at www.hmrc.gov.uk/heritage/ibsearch.htm</p>	None of the land in the area affected by the Proposed Scheme falls within this category
Section 9	Natural England	Ecology - Protected Sites	<p>We can confirm that there are no sites of European Importance affected by the proposals. We welcome the use of IRZs to inform the EIA scoping for statutory sites of nature conservation and agree that Sheepphouse Wood SSSI should be scoped in. However, it appears that the scoping report has scoped in SSSIs within 500m based on potential effects from air quality associated with waste management activities. Additional IRZs are triggered for the following development category which seems relevant to the proposed scheme. <i>All planning</i></p>	<p>Potential effects of the Proposed Scheme on the following SSSI's have been considered :</p> <ul style="list-style-type: none"> - Sheepphouse Wood SSSI; - Finemere Wood SSSI; - Grendon & Diddershall Woods SSSI; and - Ham Home-cum-Woods SSSI. <p>The effect on the following potentially water dependent ecological sites have been considered in Volume 2: the Main ES, Section 14, Water resources and flood risk:</p> <ul style="list-style-type: none"> - Finemere Wood SSSI - Grendon and Diddershall Woods SSSI - Sheepphouse Wood SSSI

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p><i>applications outside or extending outside existing settlements/urban areas affecting greenspace, farmland, semi natural habitats or landscape features such as trees, hedges, streams, rural buildings/structures.</i></p> <p>On this basis the following should be scoped in: Sheephouse Wood SSSI; Finemere Wood; Grendon and Doddershall Woods; and Ham Home-cum-Hamgreen Woods.</p> <p>The Long Herdon Meadow SSSI IRZ is also triggered due to potential impacts from discharges. There does appear to be hydrological connectivity between the Muxwell Brook adjacent to the proposed scheme and the River Ray which flows into the SSSI. However, there is considerable distance between the application site and the Long Herdon Meadow SSSI, and assuming mitigation measures are in place to minimise contamination of surface water then the risk would appear very low. We note that the land quality and water resources and flood risk chapters include considerations of impacts to groundwater and surface water and identify the Muxwell Brook as a sensitive receptors. Any evidence to demonstrate the potential effects on the Brook will be helpful in determining the potential effects on Long Herdon SSSI.</p> <p>The EIA scoping should ensure that all impact pathways to relevant SSSIs are considered and reasons for scoping sites out are explained.</p>	<p>- Grendon and Doddershall Meadows LWS</p> <p>Long Herdon Meadow is not currently included in the ES. It is downstream of the Proposed Scheme and its botanical/bird interest is to some extent dependent on winter flooding. Adverse effects due to hydrological connectivity such as pollution can be assumed to be avoided through the implementation of the draft CoCP, it is assumed that pollution during operation would be controlled through FCC's environmental management systems.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
Section 9.1.8 and 9.1.9	Natural England	Ecology - Protected Sites	Hedgerows and Muxwell Brook provide important foraging and commuting routes for the bat assemblages present. Effects on these receptors will need to be considered in this context.	This will be considered as part of the ES assessment in Volume 2: Main Environmental Statement, Section 9: Ecology.
Section 9	Natural England	Ecology - Local Wildlife Sites	<p>The Local Wildlife Sites listed at 2.2.5 should also be referenced in the ecology chapter as many of these sites are used by the bat assemblages and other notified species listed in the ecology chapter.</p> <p>Local Sites are identified by the local wildlife trust, geoconservation group or local forum established for the purposes of identifying and selecting local sites. They are of county importance for wildlife or geodiversity. The ES should therefore include an assessment of the likely impacts on the wildlife and geodiversity interests of such sites. The assessment should include proposals for mitigation of any impacts and if appropriate, compensation measures. The applicant should contact the local wildlife trust, geoconservation group or local sites body in this area for further information.</p>	<p>Potential effects of the Proposed Scheme on Local Wildlife Sites has been considered in Volume 2: Main Environmental Statement, Section 9, Ecology.</p> <p>Meetings have been undertaken to present the scheme proposals with key statutory stakeholders such as BCC, Aylesbury Vale District Council (AVDC), Natural England and the Environment Agency (EA). Meetings were also arranged to present the proposals and scheme development with key non-statutory stakeholders and amenity groups including BBOWT and the Bernwood Bechstein's Bat Project.</p>
Section 9	Natural England	Ecology - Protected Species	9.1.12 - 9.1.15. These paragraphs rightly acknowledge the significance of the area for a large number of bat species, including Bechstein's. The ES will need to set out a detailed assessment of impacts and mitigation proposals, alone and in combination with the other major schemes proposed in this area, on each of these bat species, to ensure that all	<p>Potential effects of the Proposed Scheme on ecological receptors are reported in Volume 2: Main Environmental Statement, Section 9, Ecology.</p> <p>The assessment of the effects on woodland bats is included;</p> <p>The invertebrate assemblages at Finemere and Sheephouse wood are noted, no adverse effects are likely during construction due to the implementation of the draft CoCP, it is assumed that dust emissions during operation would be controlled through FCCs environmental management systems;</p> <p>The effects of vibration and disturbance have been considered, assessment of</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>impacts at all stages of the project are considered and addressed.</p> <p>9.1.17. Black hairstreak butterfly are a notified feature of Sheephouse Wood SSI.</p> <p>9.1.25-9.1.27. This section should include effects from vibration and from temporary damage and loss, degradation of habitats and killing/injury of any species which are present during the construction period. Increased human activity during construction and operation should be considered. The operational phase could also impact on barn owls and this should be considered in the ES.</p> <p>9.3. Compensation measures will also be required for impacts on habitats (e.g. loss of habitats). The ES should also set out the necessary monitoring, management and maintenance proposals to ensure no detriment and that mitigation effective.</p> <p>9.3.2. Mitigation will be needed to prevent licensable impacts during operation, not just to address the most significant adverse effects.</p>	<p>effects on barn owl included;</p> <p>The extent and nature of compensation is described, the latter in terms of the objective for habitat condition which would form a basis for monitoring for which HS2 Information Paper E26: Indicative Periods for the Management and Monitoring of Habitats Created for HS2 Phase One is a suitable reference; and Licenceable impacts in terms of disturbance, fragmentation etc. are addressed.</p>
Section 9	Natural England	Ecology - Protected Species	<p>The EIA will need to provide a more detailed picture of the scheme proposals and mitigation measures including (but not limited to):</p> <ul style="list-style-type: none"> - planting schemes and timings; - maturity of vegetation to be planted; - locations of temporary barriers/fencing; - the lighting regime for the truck movements and sidings operations; - sound proofing; 	<p>Potential effects of the Proposed Scheme on ecological receptors are reported in Volume 2: Main Environmental Statement, Section 9, Ecology. Please refer to HS2 Phase One Ecology Technical Standards for detail on planting.</p> <p>We have no updated record from 3rd parties;</p> <p>We are not aware of information on offloading procedures;</p> <p>We have not included information on green bridge design principles; and</p> <p>The multifunctionality of the mitigation elements is noted.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<ul style="list-style-type: none"> - detail on the offloading procedure; - green bridge design principles; and - interactions between different mitigation elements. <p>This data should be presented in combination with the bat survey data in a coherent and coordinated way. The EIA should show clearly how impacts on sensitive receptors from the different stages of the sidings scheme will be addressed at both construction and operation stages, and how the cumulative and in combination effect with other projects will also be addressed.</p> <p>The ES should assess impacts of all phases of the proposal on protected species (including great crested newts, reptiles, birds, water voles, badgers, bats). NE does not hold comprehensive information regarding the locations of species protected by law, but advises on the procedures and legislation relevant to such species. Records of protected species should be sought from appropriate local biological record entries, nature conservation organisations, groups and individuals; and consideration should be given to the wider context of the site for examples habitat linkages and protected species populations in the wider area, to assess the impact assessment.</p>	
Section 9	Natural England	Ecology - Protected Species	The conservation of species protected by law is explained in Part IV and Annex A of Government Circular 06/2005 <i>Biodiversity and Geological Conservation: Statutory Obligations and their impacts within the Planning System</i> .	The ecological baseline for the assessment takes into account baseline information collected in support of HS2 Phase One, which included field survey data starting in 2012, aerial photography and relevant existing information gathered from national organisations and from regional and local sources. This includes records received from BCC; AVDC; BBOWT; North Bucks Bat Group and the Bernwood Forest

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>The area likely to be affected by the proposal should be thoroughly surveyed by competent ecologists at appropriate times of year for relevant species and the survey results, impact assessments and appropriate accompanying mitigation strategies included as part of ES.</p> <p>In order to provide this information there may be a requirement for a survey at a particular time of year. Surveys should also be carried out in optimal survey time periods and to current guidance by suitably qualified and where necessary, licensed, consultants.</p>	<p>Bechstein's Project</p> <p>Baseline data for the Proposed Scheme includes the results of surveys undertaken as part of HS2 Phase One in 2014 for amphibians, bats, and white-clawed crayfish; and surveys undertaken in 2015 for amphibians.</p>
Section 9	Natural England	Ecology - Ancient Woodland	<p>The Bernwood Forest area includes a number of ancient woodland blocks both within and outwith designated site boundaries, all of which will provide important roosting and foraging habitat for the woodland bat assemblages and other protected species present. It is important on ancient woodland are considered in the EIA for the proposed scheme.</p> <p>The ES should have regard to the requirements under the NPPF (para 118) which states:</p> <p><i>"Planning permission should be refused for development resulting in loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of ages or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss".</i></p>	<p>Potential effects of the Proposed Scheme on ancient woodlands during the construction and operation phases have been considered in Volume 2: Main Environmental Statement, Section 9, Ecology.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
Section 9	Natural England	Ecology - Habitats and Species of Principal Importance	<p>The ES should thoroughly assess the impact of the proposals on habitat and/or species listed as 'Habitats and Species of Principal Importance' within the England Biodiversity List, published under the requirements of S41 of the Natural Environment and Rural Communities (NERC) Act 2006. Section 40 of the NERC Act 2006 places general duty on all public authorities, including local planning authorities, to conserve and enhance biodiversity.</p> <p>Government Circular 06/2005 states that BAP species and habitats "<i>are capable of being a material consideration...in the making of planning decisions</i>". NR therefore advises that survey, impacts assessment and mitigation proposals for Habitats and Species of Principal Importance should be included in the ES. Consideration should be given to species and habitats included in the relevant Local BAP.</p>	<p>Potential effects of the Proposed Scheme on 'Habitats and Species of Principal Importance' during the construction and operation phases have been considered in Volume 2: Main Environmental Statement, Section 9, Ecology.</p>
Section 9	Natural England	Ecology - Habitats and Species of Principal Importance	<p>NE advises that a habitat survey (equivalent to Phase 2) is carried out on site, in order to identify any important habitats present. In addition, ornithological, botanical and invertebrate surveys should be carried out at appropriate times in the year, to establish whether any scarce or priority species are present. The ES should include:</p> <ul style="list-style-type: none"> - any historical data for the site affected by the proposal (e.g. from previous surveys); - additional surveys carried out as part of this proposal; - the habitats and species present; - the status of these habitats and species (e.g. 	<p>The ecological baseline for the assessment takes into account baseline information collected in support of HS2 Phase One, which included field survey data starting in 2012, aerial photography and relevant existing information gathered from national organisations and from regional and local sources. This includes records received from BCC; AVDC; BBOWT; North Bucks Bat Group and the Bernwood Forest Bechstein's Project.</p> <p>Baseline data for the Proposed Scheme includes the results of surveys undertaken as part of HS2 Phase One in 2014 for amphibians, bats, and white-clawed crayfish; and surveys undertaken in 2015 for amphibians.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>whether priority species or habitat);</p> <ul style="list-style-type: none"> - the direct and indirect effects of the development upon those habitats and species; and - full details of any mitigation or compensation that might be required. 	
Section 9	Natural England	Ecology - Habitats and Species of Principal Importance	<p>The proposed scheme should seek to avoid adverse impact on sensitive areas for wildlife within the site, and if possible provide opportunities for overall wildlife gain.</p> <p>The record centre for the relevant Local Authorities should be able to provide the relevant information on the location and type of priority habitat for the area under construction.</p> <p>Natural England does not hold local information on local site, local landscape character and local or national biodiversity priority habitats or species. We recommend that the applicant seeks further information from the appropriate bodies (which may include local records centre, the local wildlife trust, local geoconservation group or other recording society and local landscape characterisation document).</p>	<p>The ecological baseline for the assessment takes into account baseline information collected in support of HS2 Phase One, which included field survey data starting in 2012, aerial photography and relevant existing information gathered from national organisations and from regional and local sources. This includes records received from BCC; AVDC; BBOWT; North Bucks Bat Group and the Bernwood Forest Bechstein's Project.</p> <p>Baseline data for the Proposed Scheme includes the results of surveys undertaken as part of HS2 Phase One in 2014 for amphibians, bats, and white-clawed crayfish; and surveys undertaken in 2015 for amphibians.</p>
Section 11	Natural England	Landscape and visual	<p>Natural England would wish to see details of local landscape character areas mapped at a scale appropriate to the development site as well as any relevant management plans or strategies pertaining to the area. The EIA should include assessments of visual effects on surrounding area and landscape altogether with any physical effects of the development, such as</p>	<p>A Landscape Character Area assessment is included in Volume 2: Main Environmental Statement, Section 11, Landscape and Visual. Map ES-20: Landscape Character Areas (Volume 3: Environmental Statement Maps) is produced at a scale of 1:10,000.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>changes in topography. The European Landscape Convention places a duty on Local Planning Authorities to consider the impacts of landscape when exercising their functions.</p> <p>The EIA should include a full assessment of potential impacts of the development on local landscape character using landscape assessment methodologies. We encourage the use of Landscape Character Assessment (LCA), based on good practice guidelines produced jointly by the Landscape Institute and Institute of Environmental Assessment in 2013. LCA provides a sound basis for guiding, informing and understanding the ability of any location to accommodate change and to make positive proposals conserving, enhancing or regenerating character, as detailed proposals are developed.</p>	
Section 11	Natural England	Landscape and visual / cumulative impact assessment	<p>The assessment should also include the cumulative effect of the development with other relevant existing or proposed developments in the area. In this context, NE advises that the cumulative impact assessment should include other proposals currently at scoping stage. Due to the overlapping timescale of their progress through the planning system, cumulative impact of the proposed development with those proposals currently at Scoping stage would be likely to be a material consideration at the time of determination of the planning application.</p>	<p>A Landscape Character Area assessment is included in Volume 2: Main Environmental Statement, Section 11, Landscape and Visual.</p> <p>The developments included in the cumulative effects assessment are detailed in Volume 2: Main Environmental Statement, Section 4.8, Cumulative effects.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			The assessment should refer to the relevant National Character Areas, which can be found on the Natural England website.	
Section 15	Natural England	Water Resources and Flood Risk Assessment	<p>15.1.3 and 15.1.4 state that the EIA will look at surface water and groundwater features within 1km of the proposed scheme. However, the screening distance should be informed by the activities that will take place in the vicinity of these sites and the nature of the sites themselves (e.g. water dependency). It is important that the screening out does not result in potential impacts being missed. Natural England's IRZs can extend up to 3km for water dependent sites.</p> <p>The Muxwell Brook may be hydrologically connect to the Long Herdon Meadow SSSI. The EIA should explore this and ensure cross referencing where necessary between the water resources and ecology sections in the ES.</p> <p>The EIA should consider the full effects on water mechanisms and natural systems in the catchment of water dependent sites; this may include loss of floodplain, diversions of water sources, and changes to flow, geomorphology and biology.</p> <p>We advise consultation with the EA on this chapter.</p>	<p>This approach is consistent with the HS2 Phase One main ES. Sites outside of the 1km area would only be considered if an impact was identified in a surface water or groundwater body which could impact on downstream sites. In the case of FCC, no impacts have been identified to surface water or groundwater bodies and as such no other impacts are expected outside of the 1km study area. In the specific example given the Long Herdon Meadow SSSI is more than 5km downstream of construction. No impact has been identified on the Muxwell brook and therefore no further consideration has been given to downstream sites.</p> <p>A WFD assessment which looks at the impacts on the watercourses has been provided in the ES, but again as no impacts have been identified in the surface water or groundwater bodies within the 1km study area, it is not considered necessary to assess downstream water bodies further.</p>
Section 16	Natural England	Cumulative and in-combination	The assessment of cumulative effects will be crucial part of the EIA given the interaction between HS2, the proposed sidings, the EWR	The developments included in the cumulative effects assessment are detailed in Volume 2: Main Environmental Statement, Section 4.8, Cumulative effects.

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
		effects	<p>upgrade and the Greatmoor EfW facility. The assessment will be particularly relevant to the bat populations present in the Bernwood Forest area and to looking at impacts from the construction phase of the sidings and HS2 combined with the operational phase of the Greatmoor EfW facility plan. The reference to two baselines (2016 and 2018) requires further explanation as we would expect any cumulative and in-combination effects from the operation of the Greatmoor EfW facility to be assessed.</p> <p>The cumulative effects chapter of the EIA scoping should set out which receptors and impacts will be scoped into the assessment of cumulative effects. Evidently this should include all bat species within the area plus the effects on air quality, noise, lighting etc.</p> <p>In addition to HS2 and EWR, the following types of projects should be included in the cumulative effects assessment:</p> <ol style="list-style-type: none"> a. existing completed projects; b. approved by uncompleted projects; c. ongoing activities; d. plans or projects for which an application has been made and which are under consideration by the consenting authorities; and e. plans and projects which are reasonably foreseeable i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects. 	<p>The committed developments have been identified through consultation with BCC and AVDC include developments that are:</p> <ul style="list-style-type: none"> • approved and under construction (yet to be completed); and • permitted application (s) but not yet implemented. <p>For the purposes of this ES, account has also been take of the following potential future developments:</p> <ul style="list-style-type: none"> • submitted application (s) not yet determined; and • certain projects which are reasonably foreseeable and reasonably likely to come forward (i.e. they have a promoter, project team and/or funding) and for which sufficient information is available to assess the likelihood of cumulative effects. <p>Map ES-05: Mitigation context plan, and Map ES-06: Mitigation Plan (Volume 3: Environmental Statement Maps) depict the mitigation incorporated into the Proposed Scheme.</p> <p>Mitigation measures are discussed in the relevant section of Sections 5-14 of Volume 2: Main Environmental Statement.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>16.3.6 As the siding, HS2 and EWR projects are interconnected, there should be a Masterplan covering all impacts, through all the phases of each project should how relevant mitigation and compensation will address the impacts as each scheme develops. The ES should make clear what mitigation is required for and being delivered as part of each project, and the roles and responsibilities each party has (e.g. in regard to management, maintenance and monitoring of the mitigation and compensatory measures).</p>	
n/a	Natural England	Other Issues - Climate Change Adaptation	<p>The England Biodiversity Strategy published by Defra establishes principles for the consideration of biodiversity and the effects of climate change. The ES should reflect these principles and identify how the development's effects on the natural environment will be influenced by climate change, and how ecological networks will be maintained. The NPPF requires that the planning system should contribute to the enhancement of the natural environment 'by establishing coherent ecological networks that are more resilient to current and future pressures' (NPPF para 109), which should be demonstrated through the ES.</p>	<p>The HS2 Phase One Information Paper E2, Ecological Impacts sets out the objective of seeking to ensure no net loss to biodiversity: <i>'To measure losses and gains of habitats an adapted version of the Department for Environment, Food and Rural Affairs (Defra) Biodiversity Offsetting Metric was developed in consultation with Defra and Natural England. It will be used to compare the biodiversity value of the habitats created and the habitats lost. Details of the methodology and metric are set out in the Scope and Methodology Report (SMR) addendum (Volume 5 Appendix CT-001-000/2) of the Environmental Statement (ES) submitted with the Bill'.</i></p>
n/a	BCC	East West Rail and HS2 Integration	<p>In this area a number of schemes will be brought forward around the same time. These are the High Speed 2 railway line, the East West Rail (EWR) line Aylesbury spur and the FCC Railway Sidings. An integration study for EWR and HS2 was presented to the Council in May 2016 but this does not include the FCC Sidings</p>	<p>A cumulative assessment has been included within each of the specialist topic sections of this ES. This assessment includes the effect of the Proposed Scheme considered in combination with other proposals including HS2 Phase One and EWR2 upgrade. Full details of the schemes included in the cumulative assessment can be found in Volume 2: Main Environmental Statement, Section 4.8.</p>

Reference in Scoping Opinion	Request from	Topic	Summary of Request/ Issue	Response from relevant topic
			<p>Proposals. The Council understands that this proposal is relatively recent and therefore would not have fitted within the original integration study. However the Council would like to express its concerns that these schemes could be looked at in isolation. A joint up approach is required both to ensure timely delivery and minimal disruption to the local communities.</p>	

6 Assessment scope, key assumptions and limitations

- 6.1.1 The scope, key assumptions and limitations for the technical assessments are as set out in the HS2 Phase One Environmental Statement (HS2 Phase One ES), Volume 5, Scoping and Methodology report (the SMR) (Appendix CT-001 -000/1), and the SMR Addendum (Appendix CT-001-000/2). Additional updates for certain environmental topics were made during the Supplementary Environmental Statement and Additional Provisions (SES and AP) process.
- 6.1.2 The SMR and SMR addendum can be found on the HS2 Phase One website at: <https://www.gov.uk/government/publications/hs2-phase-one-environmental-statement-scope-and-methodology>.
- 6.1.3 If you're viewing this document online, the SMR is included in the following 247 pages. If you're viewing a print copy, the SMR is published separately in 'Part B'.
- 6.1.4 If you're viewing this document online, the SMR addendum follows the SMR. If you're viewing a print copy, the SMR addendum is published separately in 'Part C'.



HS2 London to West Midlands EIA Scope and Methodology Report

A report to HS2 Ltd by Arup/URS

Condition A – FINAL
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Part A

Executive summary

- This Scope and Methodology Report (SMR) outlines the proposed approach to the development of the Environmental Impact Assessment (EIA), and subsequent Environmental Statement (ES), for Phase 1 (London to West Midlands) (the 'Proposed Scheme') of the proposed high speed rail network (HS2). The ES will be submitted to Parliament along with the hybrid bill and considered alongside the draft legislation in order to authorise the Proposed Scheme.
- The EIA is required by European Union Directive¹ and on the assessment of the effects of certain public and private projects on the environment (Directive 2011/92/EU) and Parliament's Private Business Standing Order 27A (SO27A)² which require the preparation of an ES to inform the decision-maker of the likely significant effects of the Proposed Scheme on the environment.
- This SMR also sets out the methodology that is proposed for determining the likely environmental impacts and effects; and for assigning values of magnitude and significance to them. It also sets out the approach to the reporting of alternatives in the ES.
- In April 2012, HS2 Ltd consulted on a draft of this SMR (see Annex A for List of Consultees), to enable consultees to comment on the approach proposed. Following consultation, the SMR has been revised, taking into account the comments received where appropriate.
- This SMR sets out, in Part A, the general EIA methodology and scope of assessment, covering temporal, geographic and technical scope; approach to mitigation; cumulative effects; defining significant effects; and notes assumptions in undertaking the EIA. It provides an overview of the main alternatives to be described in the ES, including strategic, route alignment, and design alternatives.
- In Part B of the SMR, the scope and methodology for each environmental topic section is described. The topics addressed are:
 - Agriculture, forestry and soils;
 - Air quality;
 - Climate;
 - Community;
 - Cultural heritage;
 - Ecology;

¹ European Commission (EC), 1985, *Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment*; 85/337/EEC (as amended), EC

² House of Commons, *Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment)*, House of Commons

- Electromagnetic interference;
 - Land quality;
 - Landscape and visual assessment;
 - Socio-economics;
 - Sound, noise and vibration;
 - Traffic and transport;
 - Waste and material resources; and
 - Water resources and flood risk assessment.
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- An outline of the proposed structure of the ES is set out in Part C of this Report.

1 Introduction

1.1 Purpose of this report

- 1.1.1 This Report outlines the proposed scope and methodology for the Environmental Impact Assessment (EIA) and subsequent Environmental Statement (ES) for Phase 1 (London to West Midlands) (the 'Proposed Scheme') of the proposed high speed rail network (HS2).
- 1.1.2 This Scope and Methodology Report (SMR) provides an outline description of the Proposed Scheme and sets out the proposed scope of the environmental effects to be considered during the EIA. For each environmental topic to be covered, issues to be addressed, the distance from the proposed works to be considered (i.e. the spatial scope) and the periods in time when the issues would be assessed (i.e. the temporal scope) are set out. Consideration is given to effects that would arise during construction and operation including temporary, permanent, direct, indirect and cumulative effects.
- 1.1.3 This SMR also sets out the methodology that is proposed for determining the likely environmental impacts and effects; and for assigning values of magnitude and significance to them. It also sets out the approach to the reporting of alternatives in the ES.
- 1.1.4 In April 2012, HS2 Ltd consulted on a draft of this SMR (see Annex A for List of Consultees) to enable consultees to comment on the proposed approach.
- 1.1.5 Following consultation, the SMR has been revised, taking into account the comments received where appropriate.
- 1.1.6 HS2 Ltd will be consulting on the draft ES (currently expected in Spring 2013). The final ES will be submitted to parliament to accompany the hybrid bill and the public will have the opportunity to comment on it at that stage.
- 1.1.7 This SMR does not define the project in detail in any location, nor the construction works and ancillary features associated with the project. The afore mentioned details of the Proposed Scheme are currently being developed and will be available for consultation within the draft ES which is currently expected to be consulted upon in Spring 2013.

1.2 Structure of this report

- 1.2.1 This Report is divided into three main parts:
- Part A - an introduction to the HS2 Scheme, the background from the HS2 London to West Midlands Appraisal of Sustainability (AoS)³, an outline of

³ Booz & Co. (UK) Ltd and Temple Group Ltd (February 2011), *HS2 London to the West Midlands Appraisal of Sustainability*

the applicable legislation and the hybrid bill process, a general description of the EIA assessment process, including the overall scope of the assessment and a description of the main alternatives considered;

- Part B - the environmental topic sections, describing the proposed scope and methodology for each topic; and
- Part C - an outline of the proposed structure of the ES.

1.2.2 The annexes to the Report include a list of consultees and a series of maps showing the Proposed Scheme.

1.3 Introduction to HS2

1.3.1 HS2 is planned to be a Y-shaped rail network with stations in London, Birmingham, Leeds, Manchester, South Yorkshire and the East Midlands; linked by high speed trains with a capacity to convey up to 18 trains per hour, at speeds of up to 225 miles per hour (mph) (360 kilometres per hour). On some sections of the route speeds would be lower than 225 mph and speeds above 225 mph would not be allowed unless the impacts of operation could be demonstrated to be no worse than assumed for operation at 225 mph. Beyond the dedicated high speed track high speed trains would also connect seamlessly with the existing West Coast Main Line (WCML) and East Coast Main Line (ECML) to serve passengers beyond the HS2 network in Wigan, Liverpool, Lancaster, Preston, Glasgow, York, Darlington, Durham, Newcastle, and Edinburgh.

1.3.2 HS2 would be built in two phases. The Proposed Scheme (Phase 1) would involve construction of a new railway line of approximately 230 kilometres (km) (143 miles) between London and Birmingham by 2026; with a connection to the WCML near Lichfield. Phase 2 would involve lines built from Birmingham to Leeds and Manchester; with construction commencing in or around 2027 and planned to be operational by 2033.

1.3.3 The Proposed Scheme would include a connection to Europe via the Channel Tunnel. On completion of Phase 2, the HS2 network would include a direct link to Heathrow Airport. HS2 trains would be up to 400 metres (m) long with 1,100 seats during peak hours. Double decker trains (e.g. TGV Duplex) could be introduced to run on the HS2 network and would be compatible with services to Europe through the Channel Tunnel. Services using both the HS2 network and existing rail lines, will use standard-size non double decker high speed trains.

1.3.4 In January 2012, the Government announced the intention to proceed with HS2, along with the preferred line of route from London to the West Midlands (i.e. Phase 1); with stations at Euston, Old Oak Common, Birmingham Interchange and Birmingham Curzon Street. Some of the services would continue past Birmingham on the existing rail network (known as classic compatible trains) to serve directly the North West and Scotland, through a connection with the WCML near Lichfield. When running

on the existing rail network, the HS2 classic compatible trains will run at speeds achievable on this network.

- 1.3.5 HS2 Ltd is a company wholly owned by the Department for Transport (DfT) and is charged with the development and promotion of the high speed rail project on behalf of the Government. HS2 Ltd has now begun to take forward Phase 1 of the project, including the next stage of engineering, design and environmental work. The Government aims to deposit a hybrid bill in Parliament by the end of 2013 to seek the powers to construct and operate the Proposed Scheme. The powers sought are described in Section 1.9 (Hybrid bill powers) of the SMR.
- 1.3.6 HS2 Ltd is also continuing to work on proposals for Phase 2 (the line of route to Leeds and Manchester), and delivered options on the routes for Phase 2 to the Government in March 2012. A formal consultation on Phase 2 is planned to begin in early 2014, with a final route expected to be chosen by the end of 2014. However, the Government has asked HS2 Ltd to consider how the formal consultation could be brought forward to 2013 and an announcement on this is expected in autumn 2012.

1.4 Regulatory requirements

- 1.4.1 As the Proposed Scheme will be authorised by a hybrid bill, the objectives of EIA will be pursued through the Parliamentary process. Parliament's Standing Order 27A requires the Project's promoter to prepare and deposit an ES, the contents of which are specified in Standing Order 27A. Standing Order 27A requires the ES to cover the information set out in Part 1 of Schedule 4 to the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, since revoked and replaced by the Town and Country Planning (Environmental Impact Assessment) Regulations 2011⁴; and so much of the information in Part 2 of that Schedule as is reasonably required to assess the environmental effect of the works and as the Project's promoters can reasonably be expected to compile.
- 1.4.2 HS2 Ltd will prepare the ES for the Proposed Scheme, in accordance with the requirements of Standing Order 27A and the EIA Directive 2011/92/EU.

1.5 HS2 Phase 1 route description

- 1.5.1 The following sections provide a summary description of the route of the Proposed Scheme. Annex B of this Report contains a series of route maps. Further detailed maps of the Proposed Scheme are available on the HS2 Ltd consultation website.⁵

⁴ Department for Communities and Local Government, 2011 No. 1824, *Town and Country Planning (Environmental Impact Assessment) Regulations 2011*, The Stationery Office

⁵ Department for Transport (DfT) and HS2 Ltd; In Your Area; <http://highspeedrail.dft.gov.uk/in-your-area>

Greater London

- 1.5.2 HS2's London terminus would be an expanded station at Euston. The station would be entirely rebuilt over a single level with 10 platforms for high speed trains alongside 14 classic platforms, two of which would be capable of being used by high speed classic-compatible services. The station would need to be extended to the south and the west and, to obtain the necessary clearance under Hampstead Road bridge, the platforms would need to be built below the current track level. This would allow new development over the platforms and open up east-west routes for local people across the site.
- 1.5.3 Leaving Euston, the route would descend into tunnel for 7km curving round to the west, broadly in line with the West Coast Main Line, to a new interchange station at Old Oak Common. Here, passengers from the West Midlands and North would be able to change onto Crossrail, the Heathrow Express, the Great Western Main Line or other local public transport. There would be a link from Old Oak Common to High Speed 1 (HS1), partially in tunnel and in part along an upgraded section of the North London Line to an existing junction with HS1 just north of St Pancras.
- 1.5.4 The Proposed Scheme would leave Old Oak Common in a short tunnel, emerging at North Acton to run alongside the Central Line. The route would enter a further tunnel in the Northolt area for 4km to reduce impacts on people living near the railway, and to avoid major disruption to the Chiltern Railways line and the West London Waste Authority transfer station. It would emerge from tunnel at West Ruislip alongside the Chiltern Line and would curve northwards from the Chiltern Railways corridor to cross the Colne Valley on a viaduct, heading to a tunnel portal just inside the M25.

Country

- 1.5.5 The route would enter a 13km long tunnel just before crossing the M25 to pass underneath a section of the Chiltern Hills. It would pass under Chalfont St Giles and the edge of Amersham to surface within the Chilterns Area of Outstanding Natural Beauty (AONB) near Little Missenden. From there the alignment would be in cutting to pass between South Heath and Great Missenden within a 1.1km green tunnel (where earth is built up around and over a section of the route to screen the village from noise and visual impacts) as it passes South Heath. The route would then cross Wendover Dean on a 500m long viaduct before following the corridor of the A413 to pass Wendover in a 1.3km green tunnel.
- 1.5.6 Leaving the AONB beyond Wendover, the route would then pass to the south-west of Stoke Mandeville and Aylesbury, and then to the north-east of Waddesdon, largely at surface level. The route would follow the corridor of an existing freight line along the former Great Central Line railway. At Calvert it would cross the East-West Rail Line where the infrastructure maintenance depot would be located. It would continue broadly to follow the corridor of the former Great Central Line railway, largely at surface level

or in shallow cutting. It would diverge away from that corridor as it approaches Brackley, passing Turweston in deep cutting with a short section of green tunnel.

- 1.5.7 It would then head north-west through open countryside, largely in cutting but with a 2.1km green tunnel past Greatworth. The route would then curve to avoid the site of Edgcote Roman villa, the likely location of the Battle of Edgcote Moor, and Edgcote House and its Park and Garden. It would enter a 2.5km green tunnel past Chipping Warden and Aston le Walls, before running largely on the surface towards Ladbroke and Southam. At Southam the route would enter a green tunnel merging into a bored tunnel to pass under the hill at Long Itchington Wood for nearly 1.5km. From the tunnel at Southam the route would head towards the gap between Kenilworth and Coventry, passing Offchurch and Cubbington, and through part of the National Agricultural Centre at Stoneleigh.
- 1.5.8 Through the gap between Kenilworth and Coventry, the route would then pass through Burton Green on the alignment of the disused Berkswell to Kenilworth railway cutting in a 520m green tunnel.

West Midlands

- 1.5.9 From Burton Green the line would head north-west to cross the Rugby to Birmingham branch of the WCML and the A452 near Balsall Common. The route would then curve to the north to head past Hampton-in-Arden towards a new interchange station close to Birmingham Airport and the National Exhibition Centre.
- 1.5.10 Leaving the new Birmingham interchange station the line would head north to a triangular junction located to the west of Coleshill. The junction would provide north and south facing spurs into Birmingham city centre.
- 1.5.11 Heading north the line would run to the east of the M6 and M42, before curving to the north-west to pass close to Middleton near Tamworth. From Middleton the route would curve past Tamworth and to the east of Lichfield connecting with the WCML to the south of Handsacre which will enable services to run onwards to the north-west.
- 1.5.12 The spur into Birmingham city centre would follow the Water Orton rail corridor in the east of the city, past a new rolling stock depot located at Washwood Heath, to a new dedicated high speed station at Curzon Street in the city centre. The station entrance would be adjacent to Moor Street station.

1.6 Previous environmental assessment work on this project

- 1.6.1 In February 2011, the Government published the HS2 London to the West Midlands Appraisal of Sustainability as part of a public consultation on the

strategy for high speed rail and to inform the Government's decision on the preferred route for HS2. The AoS report provided a strategic appraisal of the key impacts of the proposals for high speed rail between London and the West Midlands. The AoS approach was devised to determine the extent to which Phase 1 would support objectives for sustainable development. Four sustainable development priorities were used for the assessment:

- Reducing greenhouse gas emissions and combating climate change;
- Protecting natural and cultural resources and providing environmental enhancement;
- Creating sustainable communities; and
- Enabling sustainable consumption and production.

1.6.2 The AoS considered and compared various route options for Phase 1, taking into account wider transport and economic objectives, operational requirements, cost and practicality. This was incorporated into decision making, regarding the development of the route, which helped refine the number of options down to a preferred route. The process is described in full in the AoS.⁶

1.6.3 Almost 55,000 responses to the 2011 public consultation were received, with 36,918 responses including comments addressing matters related to the report. A summary of the responses received is contained within the consultation report *High Speed Rail: Investing in Britain's Future*, available from the DfT website.⁷

1.6.4 In response to the consultation feedback HS2 Ltd published in January 2012:

- Review of possible refinements to the proposed HS2 London to West Midlands Route⁸;
- Review of HS2 London to West Midlands AoS⁹; and
- Review of HS2 London to West Midlands route selection and speed.

1.6.5 The AoS process has been taken into account in developing the SMR for the EIA of the Proposed Scheme. Issues raised during consultation on the AoS have helped to define the scope of the EIA topics, as described in the Consultation section of each topic (see Sections 4 to 17).

⁶ Department for Transport (DfT) and HS2 Ltd; *High Speed Rail: Investing in Britain's Future – Consultation*; HS2 London to the West Midlands Appraisal of Sustainability; <http://webarchive.nationalarchives.gov.uk/20111005090740/http://highspeedrail.dft.gov.uk/library/documents/appraisal-sustainability>

⁷ Department for Transport, February 2011, *High Speed Rail: Investing in Britain's Future Consultation*, DfT

⁸ Department for Transport (DfT), 2012, *Review of possible refinements to the proposed HS2 London to West Midlands Route: A Report to Government by HS2 Ltd*, DfT

⁹ Department for Transport (DfT), 2012, *Review of HS2 London to West Midlands Appraisal of Sustainability: A Report to Government by HS2 Ltd*, DfT

1.7 Consultation on the Environmental Impact Assessment

- 1.7.1 Consultation on the draft ES is currently expected in spring 2013 and will give people and organisations the opportunity to comment on the documents.
- 1.7.2 During preparation of the EIA, ongoing consultation on the scope, methodology and proposed mitigation and nature of resultant impacts within environmental topic areas will occur with the key consultees relevant to those topics.
- 1.7.3 Engagement with the community and interested organisations will be undertaken throughout the EIA process as it will enable the project to understand local issues and to consider local concerns. This will include engagement with three forums as described below.

Environment Forum

- 1.7.4 The Environment Forum involves national representatives of environmental statutory authorities and government departments. The forum advises HS2 Ltd on environmental policy for the Proposed Scheme, including project-wide mitigation strategies and principles.

Planning Forums

- 1.7.5 Planning Forums facilitate discussion between HS2 Ltd and local authority officers on technical matters such as design development, planning issues, environmental impacts and mitigation principles. They provide a focal point to HS2 Ltd's ongoing engagement with local authorities and their communities through HS2 Ltd's area based teams.

Community Forums

- 1.7.6 The Community Forums will meet to:
- Inform local people about developing HS2 proposals and consultations;
 - Consider local issues and discuss potential ways to avoid and mitigate impacts of the Proposed Scheme, such as screening views of the railway, managing noise and reinstating highways; and
 - Identify possible community benefits.

- 1.7.7 These forums provide the formal mechanism for HS2 Ltd's engagement moving towards the deposit of the hybrid bill. They will be supplemented by meetings and engagement with organisations and individuals as necessary (including those represented on the Forums), particularly in relation to specially affected groups.

1.8 Monitoring of performance against sustainability and environmental goals

- 1.8.1 As described in Section 1.6 (Previous environmental assessment work on this project), the AoS reported on the extent to which the 2011 consultation scheme would satisfy sustainable development objectives and identified some potential significant effects. During the EIA process, the potential significant effects identified in the AoS will be monitored.
- 1.8.2 The ES will report on how the predicted effects may have changed as a result of scheme development. To facilitate the reduction of such effects HS2 Ltd is preparing Environmental Design Aims to guide the project development teams. These draw upon the knowledge gained through the AoS; and will be applied and monitored during the EIA process. Practicable measures will be considered further to avoid or reduce the potential environmental effects of the Proposed Scheme as part of a continuing effort to improve the sustainability performance of the new railway during construction and operation.
- 1.8.3 The EIA will identify the likely significant environmental effects of the Proposed Scheme and determine options for further mitigation. This process is described further in Section 2.3 (Approach to mitigation). The mitigation proposals will include provisions for monitoring the effectiveness of the mitigation to be provided in avoiding or controlling significant environmental effects. For example this would include a Code of Construction Practice; a document that will set out the principles for the management and monitoring of the environmental aspects arising out of construction to ensure that such effects will be managed effectively on site, and would include measures such as sound, noise and water quality monitoring, as necessary.
- 1.8.4 After construction is complete, HS2 Ltd would provide guidance to ensure that the effectiveness of the mitigation defined in the legislation authorising the Proposed Scheme and in appropriate management, monitoring and remedial response plans, would be established as required for the new railway. As part of this process, HS2 Ltd will work with the relevant responsible authorities to develop the necessary monitoring and management plans.

1.9 Hybrid bill powers

1.9.1 The Government will deposit a hybrid bill for consideration by Parliament. If passed, it becomes an Act of Parliament conferring powers, including deemed planning permission, to build the railway line and thereafter to operate and maintain it. The powers would include:

- Authority to nominate an undertaker to build the railway line, and any other ancillary powers needed to operate and maintain it;
- A planning regime necessary for the nominated undertaker to make applications for approval of details for certain matters defined by the Act, to local planning authorities;
- Giving the nominated undertaker the rights to construct, operate and maintain the railway and associated major works as described in the Act (and its accompanying plans and sections) and other ancillary works;
- Powers of compulsory acquisition or temporary possession of land and properties required for the Proposed Scheme;
- Powers to protect gas, water, telecommunications and electricity infrastructure which might be affected by the Proposed Scheme; and
- Powers over rights of way.

1.10 EIA Programme

1.10.1 The EIA process commenced in early 2012. The draft SMR report was issued in April 2012 for consultation and it is expected that the draft ES will be published for consultation in Spring 2013. The final ES will be prepared to accompany the hybrid bill in late 2013. The baseline data gathering and EIA processes are programmed to enable the draft ES to describe the significant effects of the project. However, baseline data gathering will continue as appropriate throughout 2013 to supplement where necessary the assessment in the draft ES and ensure that the ES assesses the Proposed Scheme in the form applied for.

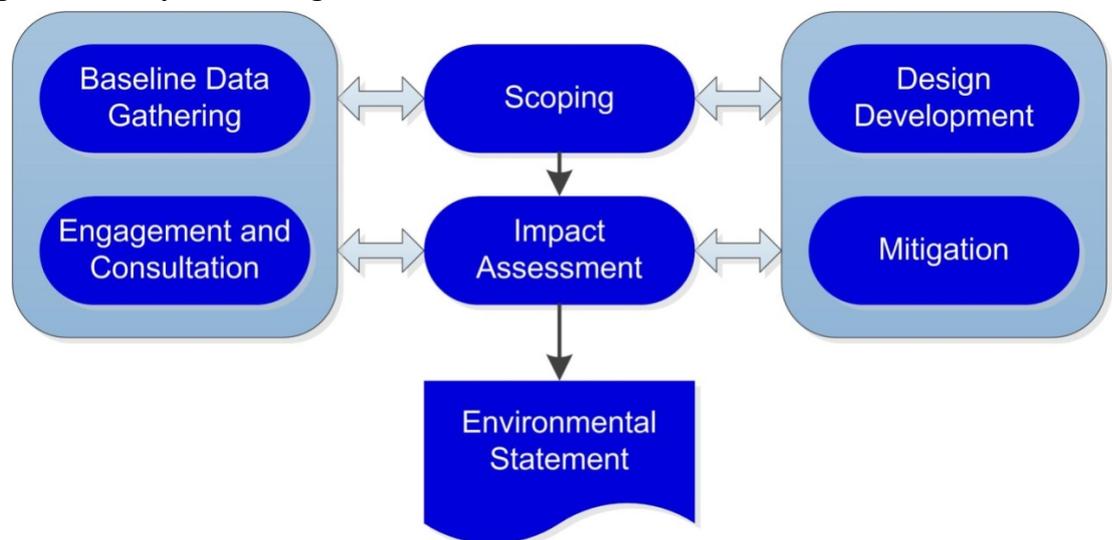
2 EIA methodology

2.1 Introduction

2.1.1 The EIA is the process that leads to the production of the ES to be submitted in support of the hybrid bill. It will be carried out in accordance with applicable legal requirements and with current best practice, and will be carried out in accordance with the requirements of the EIA Directive 2011/92/EU and SO27A.

2.1.2 The EIA process will comprise a number of related activities, as illustrated in Figure 1.

Figure 1 – EIA process diagram



2.1.3 As Figure 1 shows, the main stages in the EIA process comprise:

- Initial EIA scoping to establish the broad scope and methodology of environmental studies to be carried out for each environmental topic and identify the potentially significant environmental effects and, engaging and consulting with stakeholders to take account of their views;
- Establishing current baseline conditions (i.e. the environmental conditions that currently exist in the vicinity of the Proposed Scheme). These will be determined from desk-top studies, previous environmental studies, publicly available information, focussed environmental surveys of the area and consultation with groups that have specialist local knowledge;
- Projecting future baseline conditions (i.e. the future conditions without the Proposed Scheme in place). The current baseline will be extrapolated to take account of predicted or anticipated change factors including, but not limited to, changes caused by changing climatic conditions, policy,

legislation, urban development, advances in technology and by other planned infrastructure projects;

- Establishing the potential for other schemes to be under construction before or during the construction of the Proposed Scheme;
- Consideration of policies, guidelines and legislation and best practice relevant to EIA;
- Assessment of the design of the Proposed Scheme in accordance with the methodology outlined per environmental topic within this Report, to identify the local extent of potential impacts and the practicable design measures to avoid, reduce or otherwise mitigate significant adverse environmental effects;
- Assessment of significant environmental effects after the provision of mitigation, with reference to recognised criteria and using professional judgement in the absence of recognised criteria;
- Engagement and consultation through the Environment, Planning and Community Forums, and more informally where appropriate, throughout the engineering design and assessment process;
- Preparation of the draft ES;
- Public consultation on the draft ES (planned for Spring 2013);
- Further assessment in the light of consultation responses and ongoing design development and baseline surveys; and
- Preparation of the final ES.

2.1.4 The ES is then submitted to Parliament alongside the hybrid bill for the Proposed Scheme and allows Parliament to make an informed decision on whether the Proposed Scheme should proceed. The provision of further information to Parliament and further consultation may be required during this legislative process.

2.1.5 In addition to describing the main alternatives considered, broadly, the EIA will consider the following two scenarios:

- The effects of the construction, existence and operation of the Proposed Scheme at various times [see temporal scope in Section 2.2 (Scope of assessment)]; and
- The effects of the Proposed Scheme in addition to other schemes that are either consented or under construction at that time (but are not included in the projected future baseline, see paragraph 2.1.3) and are identified as having the potential to result in significant cumulative impacts and resultant effects [see Section 2.4 (Cumulative effects)].

2.1.6 The EIA will consider both the beneficial and adverse environmental effects of the Proposed Scheme in the short, medium and long term. It will consider both temporary and permanent effects caused directly and indirectly by the Proposed Scheme. It will also address cumulative effects.

- 2.1.7 A description of the mitigation measures envisaged in order to prevent, reduce and where possible remedy any significant adverse effects will be provided in the ES.
- 2.1.8 The methodologies for the assessments provided in this Report vary from topic to topic. In general, however, all of the assessments will involve a process of interaction between engineering design, planning and environmental considerations with a view to avoiding or reducing significant adverse effects on the environment during construction and operation. Mitigation measures would be considered and incorporated within the Proposed Scheme wherever appropriate and practicable. The extent and scale of mitigation will be designed to control and minimise significant adverse environmental effects; as well as identify opportunities to promote positive environmental effects.
- 2.1.9 There will inevitably be some uncertainties in predicting future impacts and effects, especially given that operations would not be due to commence until 2026. In such situations, the ES would report the range of magnitude of the impact under consideration. In this way there would be upper and lower boundaries projected.

2.2 Scope of the assessment

- 2.2.1 The following section defines the temporal, geographic and technical scope of the assessment of the Proposed Scheme.

Temporal scope

- 2.2.2 The main construction works for the Proposed Scheme are anticipated to take place between 2017 and 2026 (including a period of commissioning), with the intensity and scale of construction along the route varying over this period. The ES will set out the anticipated construction programme in order to establish the likely duration of works in each location. The assessment of construction effects will then relate to the programme described.
- 2.2.3 Trains are currently expected to start operating on the London to the West Midlands section in 2026. The ES will describe the predicted frequency, speed and length of trains and how that is estimated to change after 2026. The effects of services operating prior to the opening of Phase 2 will be addressed in the ES. It is expected that, once Phase 2 is operational, the use of the Phase 1 railway will intensify. Therefore, effects arising from the operational rail traffic on the Phase 1 section will be assessed taking account of the anticipated services that would be expected when HS2 reaches maximum capacity (anticipated to be up to 18 trains per hour at peak times in each direction in Phase 2).

- 2.2.4 The ES will describe those elements of Phase 2 such that the relationship between Phase 1 and Phase 2 is understood to enable the impacts on the Phase 1 receptors to be described and assessed.
- 2.2.5 Effects arising from passenger usage of the Phase 1 railway, such as those that would arise at Euston station and Curzon Street station, and Birmingham and Old Oak Common interchanges, and on journeys to and from these stations/interchanges, would be assessed at both the maximum anticipated use of Phase 1 and of Phase 2.
- 2.2.6 Other effects would also be dependent on longer term considerations after opening of Phase 1, such as the progressive growth in background road traffic or the maturing of mitigation (e.g. growth of planting or habitat creation). Where this applies, the topic sections in Part B of this Report identify the appropriate temporal scope that would be adopted, taking account of these factors.
- 2.2.7 The EIA will establish the baseline environment as it exists at present, and then take account of likely changes to the baseline for the future scenarios defined within this section.

Geographic scope

- 2.2.8 The term geographic scope (also called spatial scope) means the area over which the EIA will consider effects. In general, this will take into account the distance from the Proposed Scheme over which changes to the environment are likely to occur as a result of the construction or operation of the Proposed Scheme. In addition to the permanent land take requirements it will also address land taken for construction (both for short and long term periods) and then returned in an agreed condition afterwards. In addition to the physical extent of the works, this is influenced by two principal factors:
- The nature of the baseline environment; and
 - The manner in which the effects are likely to be propagated.
- 2.2.9 In addition, the EIA will consider any significant effects caused by effects caused by activities such as:
- HS2 services on the 'classic network' north of Birmingham;
 - Consequential changes to rail traffic on other lines, especially on the WCML between London and Birmingham and the Chiltern Line, and disruption at stations/interchanges during construction;
 - Passenger access to and from stations and interchanges; and
 - Consequential development around stations and interchanges.
- 2.2.10 Transboundary effects are significant environmental effects caused in other countries (i.e. other than the United Kingdom (UK)). The most likely transboundary effects caused by HS2 are additional services to mainland Europe via the existing HS1 line. However, the existing railway lines across mainland Europe are designed for interoperability and will readily

accommodate these additional services. Therefore, it is considered unlikely that the Proposed Scheme will result in any significant effects on the environment of another country and thus transboundary effects are not proposed to be considered further.

Technical scope

2.2.11 The environmental topic areas to be considered and the extent of the assessment work proposed for each is referred to as the technical scope. Schedule 4 of the 2011 EIA Regulations¹⁰ requires the ES to describe the likely significant effects of the project on aspects of the environment including:

- Human beings;
- Fauna;
- Flora;
- Soil;
- Water;
- Air;
- Climatic factors;
- Material assets (including architectural and archaeological heritage);
- Landscape; and
- The inter-relationships between the above factors.

2.2.12 These aspects have been refined and adapted with reference to current EIA practice for rail and other linear transport infrastructure projects. As a result, the environmental topic areas proposed for inclusion in the EIA are as follows:

- Agriculture, forestry and soils;
- Air quality;
- Climate;
- Community;
- Cultural heritage;
- Ecology;
- Electromagnetic interference;
- Land quality;
- Landscape and visual assessment;
- Socio-economics;
- Sound, noise and vibration;
- Traffic and transport;
- Waste and material resources; and
- Water resources and flood risk assessment.

2.2.13 These environmental topics have been evaluated as part of this scoping exercise in order to determine the extent to which they should be included in the EIA, having regard to whether there are likely to be significant effects

¹⁰ HM Government, 2011, *Town and Country Planning (Environmental Impact Assessment) Regulations 2011*, The Stationery Office

that relate to them. Part B of this Report provides further details for each environmental topic regarding the assessment approach to be applied during the EIA.

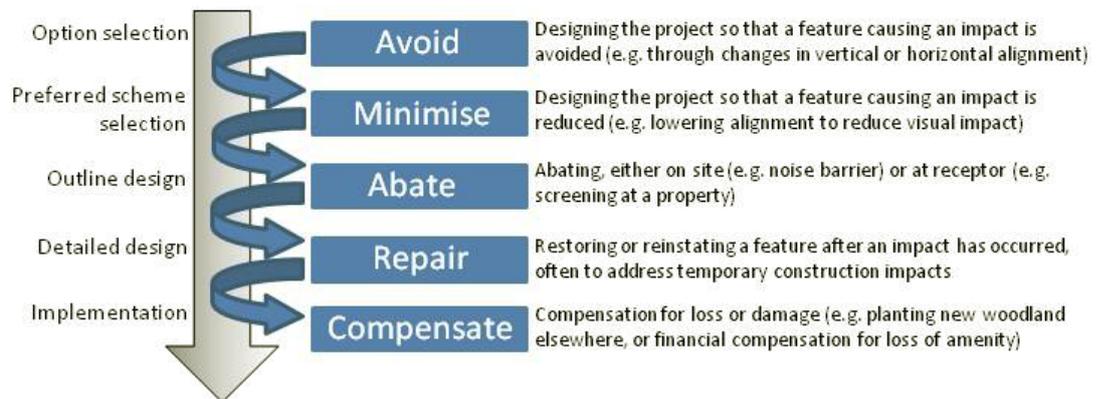
2.2.14 The content of the topics is defined in the topic chapters. They are generally quite broad that amongst them they cover all potential impacts. So for example the impact of lighting during construction and operation is covered under landscape. Likewise the impact of power generation to support the power needs would be included under Climate, but the impact of distribution of the power would fall under Electromagnetic Interference.

2.3 Approach to mitigation

2.3.1 The EIA will identify mitigation measures that would help to avoid, reduce or, where appropriate, offset significant adverse effects.

2.3.2 Figure 2 (taken from the HS2 London to West Midlands AoS) illustrates the hierarchy that will be used to consider mitigation and compensation measures.

Figure 2 – Mitigation Hierarchy



2.3.3 Mitigation opportunities will continue to be identified during development of the Proposed Scheme prior to the submission of the hybrid bill. The EIA process is iterative, which is likely to enable further refinement of the Proposed Scheme, with the objective of avoiding or reducing significant adverse environmental effects. Mitigation measures will be identified by regularly reviewing the likely significant adverse environmental effects identified during the ongoing assessment process and considering these at design workshops within the HS2 project teams. Where practicable, design modifications will be considered to avoid or reduce significant adverse effects.

2.3.4 During the EIA process, HS2 Ltd intends to develop the mitigation incorporated into the Proposed Scheme through:

- Environmental Design Aims - an HS2 Ltd document to set environmental standards which the Proposed Scheme should achieve or endeavour to achieve, thereby structuring and guiding the design;
- Collaborative working between environmental assessment and engineering design teams - to achieve improved design outcomes;
- Community engagement and consultation - to allow local people, environmental organisations and responsible authorities to raise issues and propose design and mitigation changes to be considered within the Proposed Scheme;
- Mitigation report - an HS2 Ltd document that records proposed mitigation along the route and will enable HS2 Ltd to demonstrate the mitigation that it has committed to within the Proposed Scheme. It also acts as a mechanism for gauging the consistency of approach applied along the route; and
- Code of Construction Practice - an HS2 Ltd document to describe the approach to be taken during construction to reduce adverse effects on communities and the environment, including through the use of Local Environmental Plans.

2.3.5 The proposed mitigation measures will be described in the ES, together with the significant effects remaining after mitigation (termed the residual effects). Where the Proposed Scheme is likely to improve environmental conditions (over and above the baseline), these effects will be identified as enhancements.

2.4 Cumulative effects

2.4.1 Cumulative effects are broadly defined as incremental effects that result from the accumulation of a number of individual effects, either caused by the Proposed Scheme (intra-project effects) or by other reasonably foreseeable developments which would be under construction at the same time as HS2 or built later (inter-project effects). Where it is identified that other schemes are expected to be complete before construction of HS2, their effects will be considered through the extrapolation of the future baseline.

2.4.2 The assessment of cumulative effects will therefore consider the following:

- The combined effects on a single receptor of a number of individual environmental impacts, for example noise, dust and traffic;
- The effects of other developments in the vicinity of the Proposed Scheme which are under construction or have been consented, which when combined with the effects of the Proposed Scheme may have an incremental significant effect; and
- The cumulation of individual effects on a receptor which when summed (including in a regional context or over the length of the Proposed Scheme), result in an effect of greater significance than the sum of the individual effects (i.e. synergistic effects).

- 2.4.3 The list of other proposed schemes that should be considered as having a cumulative effect in combination with HS2 will be considered during the EIA. As an example, however, it is expected that the EIA should consider carefully the effects of construction of Phase 2 in the vicinity of receptors of impacts from the Proposed Scheme.
- 2.4.4 The geographical scope of other schemes to be included in the cumulative assessment depends on the context (e.g. rural or urban) and on the characteristics of the topic concerned. This will be defined for each scheme and for each environmental topic in the course of the EIA process in consultation with appropriate stakeholders.
- 2.4.5 Where relevant, potential cumulative effects arising will be identified in each topic assessment, which will include details of the cumulative assessment methodology and results.

2.5 Defining significant effects

- 2.5.1 This Report refers to both environmental impacts and environmental effects. The general approach taken is that the Proposed Scheme has the potential to cause an impact on the receiving environment or its neighbours either through physical change (such as the land used for the project, or change in land form) or through changes in sound or noise levels, air quality, or socio economic factors. The extent to which an impact causes a significant environmental or socio economic effect to occur will depend on a number of factors. In the main, it is significant effects that are reported in the ES, but in the EIA process much of the attention is on assessing the level of impacts that give rise to the effects and determining how to avoid or reduce them.
- 2.5.2 The predicted impacts will be classified according to whether they are considered to be major, moderate or minor; and beneficial or adverse. This will provide a consistent approach to expressing the results of the assessments undertaken as part of the EIA. The terms used are defined as follows:
- Beneficial - advantageous or positive change to an environmental resource or receptor;
 - Adverse - detrimental or negative change to an environmental resource or receptor;
 - Minor - slight, very short term or highly localised impact;
 - Moderate - limited impact (by extent, duration or magnitude); and
 - Major - considerable impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation.
- 2.5.3 The duration of impacts will be categorised as short, medium or long term, where they are not permanent. There is no definition of these terms in EIA practice and it is recognised that the use of the terms would depend on the

viewpoint of the user, especially where the user is subjected to the impact or effect. It is therefore important that in addition to using these descriptors, the EIA also gives an indication of the duration. In general, and given the length of the construction programme, the EIA will consider those impacts that last a matter of months to be 'short term' and those that continue through to the commencement of operations as 'long term'.

- 2.5.4 Some impacts would arise directly from construction or operation of the Proposed Scheme and others would arise more indirectly from activities associated with the scheme or resulting as a consequence of it. Whether an impact arises directly or indirectly does not affect whether the resulting effects are considered to be significant or not.
- 2.5.5 Potential variants to the foregoing approach are described as appropriate in the environmental topic sections in Part B of this Report.
- 2.5.6 Where it is not possible to quantify impacts or their consequential effects, qualitative assessments will be carried out, based on professional experience and judgement. Where uncertainty exists this, together with any assumptions relied upon, will be noted in the relevant assessment and any limitations to the EIA work will be reported in the ES.
- 2.5.7 The significance of effects will be evaluated with reference to recognised standards and accepted criteria for each assessment topic, where these are available. Where no recognised standards or criteria exist, professional judgement will be used to develop an appropriate approach to undertake a robust and appropriate assessment, as explained below. Each environmental topic section in this Report describes the approach to be taken. In determining whether a resulting effect is significant due consideration will be given to:
- Spatial extent (e.g. local, district, regional, national or international);
 - Magnitude;
 - Duration (whether short, medium or long term);
 - Frequency of occurrence;
 - Nature of the effect (whether direct or indirect, permanent or reversible);
 - Whether it occurs in isolation, is cumulative or interactive;
 - Sensitivity and number of receptors affected;
 - Value of a resource affected;
 - Performance against environmental quality standards; and
 - Compatibility with environmental policies.
- 2.5.8 Where effects are considered to be significant, the ES will show the geographic (or spatial) level at which they are viewed as significant (for example, at a community level or a regional or national level).
- 2.5.9 The EIA is being undertaken by a number of consultancies who are considered to be amongst the leaders in their profession in the UK. The leads

for each environmental topic, from the appointed consultancies, meet regularly to discuss the methodology being applied, the issues, impacts and effects arising, and the solutions available. National representatives of environmental statutory authorities and government departments are also involved in these discussions. This approach enables experienced EIA Practitioners to apply expert professional judgement where appropriate on consistent basis.

2.6 Assumptions

- 2.6.1 Each topic chapter of the ES will include a section to explain key assumptions made in undertaking the assessments.
- 2.6.2 During the preparation of the EIA there could be some circumstances that result in factors that may limit the information available to inform the assessment process. Any limitations, and the consequences on the completeness or potential accuracy of conclusions, will be described in the relevant environmental topic chapter within the ES.

3 Reporting of alternatives in the ES

- 3.1.1 This section outlines the background to the Government's decision to proceed with development of a hybrid bill submission for HS2 and outlines the alternatives that will be reported in the ES.
- 3.1.2 The Government considers that a continuing increase in demand will create a need over the next 20 to 30 years for additional capacity to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. It does not, however, believe transferring rail demand to road or domestic aviation to be an appropriate solution. If the increases in demand for inter-urban travel that would be expected as the UK economy returns to a pattern of long-term and sustainable growth are to be accommodated, then the Government considers that it is the rail network which needs to be in a position to play the lead role in delivering new capacity and that a clear case exists for this new capacity to be a new high speed rail network.
- 3.1.3 The Government does not consider that yet more rounds of incremental enhancements to existing lines will be sufficient to meet long-term capacity needs for passengers or freight. It is the Government's view that analysis by Network Rail has indicated that even very major enhancement packages simply cannot resolve the pressures on capacity anticipated on the WCML over the coming decades. The strong likelihood is that even by pushing the WCML to the absolute limit, as the alternatives that have been considered do, it would only delay rather than eliminate the need for new lines in the future. In the meantime, substantial disruption would have been imposed on passengers over a number of years as works were carried out and the additional strategic, economic and connectivity benefits that high speed rail is particularly capable of delivering, would have been foregone.
- 3.1.4 Given the opinion that upgrading the existing north-south lines is not a viable long-term solution, HS2 Ltd considers that the real choice, therefore, is not between high speed rail and further incremental upgrades; rather a new line capable of providing the capacity that is required. It is recognised that building new conventional rail lines would not be significantly cheaper, nor would their impacts on the environment and communities be significantly less than those of new high speed rail lines. However, new conventional rail lines would deliver far fewer benefits in terms of enhanced connectivity and support for long-term economic growth. The additional benefits generated by designing a new line to accommodate high speed services, compared to a new conventional speed line, would outweigh the additional costs by a factor of more than four to one. These matters are described in more detail within the report High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed 'Y' Network¹¹.

¹¹ Atkins, February 2011, High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed 'Y' Network

- 3.1.5 The Proposed Scheme is the product of some two years of work by HS2 Ltd to examine a substantial number of possible alternative routes and stations. The main alternatives that have been considered are reported in the consultation report High Speed Rail: Investing in Britain's Future.

Reporting of alternatives in the ES

- 3.1.6 The ES will provide an outline of the main alternatives studied by HS2 Ltd and DfT and the main reasons for the choice taking environmental effects into account. The main alternatives to be described will include the following main groups:

Strategic alternatives

- 3.1.7 In outline, other alternatives described in the report High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed 'Y' Network.
- 3.1.8 Alternatives to constructing HS2 (including those addressed by DfT) e.g. consideration of enhancement/capacity improvements on the existing classic lines such as the WCML and Chiltern Railway.

Route alignment alternatives

- 3.1.9 These would include alternatives such as route corridor alternatives between London and the West Midlands, location of the stations, and means of connecting to other rail networks including HS1 and the WCML that were considered to determine the Government's preferred route for consultation.
- 3.1.10 It will also include an outline of route corridors and design speed alternatives that were considered following the consultation held in spring 2011. These included refinements to alternative routes following existing transport corridors, together with reduced design speeds and associated line curvature (along with the Government's preferred route that had been consulted upon.)

Design alternatives on the proposed route

- 3.1.11 The ES will also describe, in outline, the appraisal of route refinements that were considered for the Government's preferred route following the consultation held in spring 2011.
- 3.1.12 These included options for stations/interchanges and infrastructure maintenance depot options and locations, alternative alignments considered on the preferred route post-consultation (e.g. capturing changes to the scheme such as extended and new bored tunnels; extended and new green tunnels, and surface alignment changes to accommodate community and environmental concerns expressed at consultation).

Other alternatives

3.1.13 There will continue to be design refinements in response to the EIA and the local engagement planned by HS2 Ltd, to respond to local environmental sensitivities and local issues raised through consultations. These would include, for example, the location of construction site compounds, the access routes to and from construction sites and vent shafts. Localised alternatives for these types of features will be considered in order to determine their most suitable location.

Part B

4 Agriculture, forestry and soils

4.1 Introduction

- 4.1.1 This section of the Report covers agriculture, forestry and soils which includes the environmental topic areas of soil, agricultural and forestry land, and farm and farm-based enterprises. In particular, it considers the potential impacts of the loss of land in terms of agricultural land quality, soil resources, local farm businesses and on-farm enterprises, and agri-environment schemes.
- 4.1.2 The approach that will be adopted to assess agricultural impacts is derived from national planning policy. This approach accords with the advice given in various good practice guides for the preparation of EIAs.^{12 13}
- 4.1.3 The principal feature of national policies regarding agricultural land use is the emphasis on safeguarding scarce natural resources in the long-term national interest. Consequently, policies for development in the countryside give a measure of protection to the “best and most versatile” agricultural land (defined as Grades 1, 2 and 3a in the Agricultural Land Classification (ALC) system).
- 4.1.4 Policy advises that the economic and other benefits of the best and most versatile agricultural land should be taken into account in decisions on development. Where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land in Grades 3b, 4 and 5 should be used in preference to higher quality land.
- 4.1.5 ALC is not the sole consideration in assessing how development proposals affect agriculture. Other factors to be considered include the impact on farm size and structure, the use of buildings and other fixed equipment (including irrigation and drainage), or any stimulus the development might give to rural economic activity.

4.2 Establishment of baseline and definition of survey

- 4.2.1 A description of the baseline environment in relation to the 2011 consultation scheme is contained within the AoS. Section 8.17 of the AoS describes the baseline environment in relation to soil and land resources.
- 4.2.2 There is a well-established methodology for classifying the quality of agricultural land, contained within guidance issued by the then Ministry of Agriculture, Fisheries and Food (MAFF) in 1988.¹⁴

¹² Highways Agency, 2001, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 6 Land Use – Amendment No. 1*, The Stationery Office

¹³ Department of Environment (DoE), 1995, *Preparation of Environmental Statements for Planning Projects that require Environmental Impact Assessment: A Good Practice Guide*, DoE

- 4.2.3 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. Grade 1 land is 'excellent quality' agricultural land with very minor or no limitations to agricultural use, and Grade 5 is 'very poor quality' land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a ('good quality' land) and Subgrade 3b ('moderate quality' land).
- 4.2.4 MAFF produced a Provisional ALC of England and Wales in the late 1960s/early 1970s at a scale of 1:63,360 (1 inch to 1 mile). This information is now shown on magic.gov.uk (at a scale of 1:250,000) and was used to inform the AoS. However, this ALC information was based on reconnaissance field surveys and was intended to provide general strategic guidance on agricultural land quality. It is not, however, sufficiently accurate for use in the assessment of individual developments and should not be used other than as general guidance. In addition to limitations of scale, this classification was undertaken using a system that has since undergone two fundamental revisions and does not distinguish between the subgrades of Grade 3, which has important policy implications.
- 4.2.5 Since the publication of the Provisional ALC, certain areas of the country (usually those proposed for non-agricultural development) have been surveyed in greater detail. Those surveys carried out by MAFF and its successors are available from Natural England, and are also shown on magic.gov.uk.
- 4.2.6 The approach to the ALC survey of all land to be acquired or used for the Proposed Scheme will be undertaken in two parts. Firstly, an interpretation of published geological, topographical, soil and agro-climatic information will be undertaken in the light of the ALC guidelines. Then the predictive ALC will be augmented with the results of detailed ALC surveys undertaken by MAFF or Department for Environment, Food and Rural Affairs (Defra) and by other recognised sources within or adjacent to the route corridor of the Proposed Scheme. The predictive ALC survey will be augmented by field survey to validate its findings, where required.
- 4.2.7 The site survey will involve the examination of soil profiles using hand-held augers and spades. Samples may be taken for laboratory analysis. The soil characteristics will then be described and analysed in terms of the MAFF guidelines to verify or inform the predicted grade of agricultural land.

¹⁴ Ministry of Agriculture, Fisheries and Food, 1988, *Agricultural Land Classification of England and Wales: Revised guidelines and criteria for grading the quality of agricultural land*, MAFF

- 4.2.8 A risk assessment will be prepared to ensure that health and safety hazards relating to the ALC and soil surveys are taken into account. Defra guidance on biosecurity for visits to premises with farm animals will be followed¹⁵.
- 4.2.9 Information on the existing agricultural use and circumstances of all land to be acquired or used will be obtained primarily from the owners and occupiers of the land. Where land is within a written tenancy, this information will be obtained mostly from the tenant. This will involve face-to-face interviews based on a standard set of questions which will be agreed first with relevant consultees (i.e. National Farmers Union /Country Land and Business Association and Central Association of Agricultural Valuers) but will be likely to cover:
- A description of the existing size, location and use of farm holdings;
 - A description of the existing scale and nature of agricultural and non-agricultural enterprises based on farm holdings and their associated capital and labour inputs;
 - A discussion of the physical impacts on the structure and operation of the farm holding; and
 - A discussion about potential options to mitigate such impacts.
- 4.2.10 Where practicable, a representative of the HS2 project design team will attend the interviews alongside the agricultural surveyor. In order to minimise the number of visits to individual farm holdings, specific questions relating to other environmental disciplines (such as Community) may be included within the interview as appropriate.
- 4.2.11 The term 'farm holding' is used in a wide sense and is taken to include land associated with arable cropping, livestock rearing, field-scale and glasshouse horticulture (of edible and non-edible crops), farm woodland enterprises such as charcoal-making, and private and commercial equestrian enterprises. Non-agricultural, land-based enterprises will be those within the control of the main occupier of the farm holding.
- 4.2.12 Information on the presence of any agri-environment schemes (such as Environmental Stewardship) will be obtained from magic.gov.uk, the Natural England website¹⁶ and from individual land owners and occupiers, who will also be asked for details of the nature, requirements and duration of such schemes on the whole farm.
- 4.2.13 In addition to data collected from land owners and occupiers, information on woodlands affected by the Proposed Scheme will be obtained from the National Forest Inventory.¹⁷

¹⁵ Department for Environment, Food and Rural Affairs (Defra), 2008, Biosecurity Guidance to Prevent the Spread of Animal Diseases, Defra

¹⁶ Natural England; Our Work; Farming and Land Stewardship; Funding for Land Management; <http://www.naturalengland.org.uk/ourwork/farming/funding/default.aspx>

¹⁷ The National Forest Inventory; <http://www.forestry.gov.uk/inventory>

4.3 Consultation

Consultation on the AoS

- 4.3.1 The principal issues for the assessment of the effects on agricultural interests arising from consultation on the AoS were:
- The EIA should include a detailed ALC and soil resources field survey;
 - The AoS did not consider farmland other than that shown as Grades 1 and 2, nor the implications of the loss of this land for food production; and
 - The EIA should consider the impact of severance on farming communities.
- 4.3.2 These issues were raised by farmers' and landowners' representative groups, and by individual members of the public.

Consultation as part of the EIA process

- 4.3.3 It is intended to continue this engagement with representative groups of farmers, landowners and other rural enterprises, and particularly (but not exclusively) with the following:
- The National Farmers' Union at regional and national levels;
 - The Country Land and Business Association at regional and national levels;
 - The Central Association of Agricultural Valuers;
 - Campaign for the Protection of Rural England ;
 - Confor (representing woodland owners and forestry businesses);
 - The British Horse Society; and
 - Hunting Groups.
- 4.3.4 At the strategic level, it will be necessary to continue consultation with Defra and Natural England, particularly in respect of appropriate assessment methodologies and significance criteria. Natural England will also be consulted in respect of the availability of existing detailed ALC information and existing agri-environment schemes along and within 1km either side of the route alignment of the Proposed Scheme.
- 4.3.5 The owners and occupiers of land to be acquired or used for the construction and operation of the Proposed Scheme would form the basis of consultation in relation to the undertaking of the EIA.

4.4 Key aspects of the Proposed Scheme for the topic

- 4.4.1 The key aspects of the Proposed Scheme that will affect agricultural and forestry interests will involve:
- Permanent and temporary land-take of all grades of agricultural land;
 - permanent land-take will affect the nation's stock of agricultural land, which may include areas of high quality land used for food and fibre production; and

- temporary land-take that is not restored to its pre-existing condition will similarly involve a loss of a finite resource;
- Permanent and temporary loss of soils in other land uses (e.g. woodland and land in agri-environment schemes); permanent loss of such soils will reduce the ability to support particular habitats (the biodiversity effects of such loss will be assessed within the Ecology chapter of the ES) and will effect their carbon storage properties;
- The sustainable re-use of soils displaced by the Proposed Scheme; soil is a finite resource which fulfils a number of functions and services including food and fibre production, environmental interaction with air and water (particularly marked with peats and highly organic soils), support of ecological habitats and biodiversity; support for the landscape; protection of cultural heritage and provision of raw materials;
- Permanent and temporary severance of agricultural land and loss of agricultural access (the severance of land may affect the continued ability to farm or otherwise use the land to its potential);
- Loss of farm dwellings, farm buildings and other on-farm infrastructure; farm capital may support significant areas of land and the loss of this capital may affect the continued ability to farm or otherwise use this land to its potential;
- Permanent and temporary disruption to drainage, irrigation and water supplies (such disruption will affect land quality (if permanent) and hence land use; or lead to short-term land use change); and
- Construction effects (e.g. dust and pollution) on adjacent agricultural land which may affect the ability of that land to continue in its present land use; the likelihood of such effects will be assessed, in the first instance, under the relevant topics (e.g. the Air Quality chapter of the ES).

4.5 Scope of assessment

Spatial scope

- 4.5.1 The study area will need to be defined for the agricultural assessment. For most of the key issues identified, the study area is likely to be restricted to the limits of the land to be acquired or used for the construction and operation of the Proposed Scheme, although there may be the potential for effects on neighbouring farmland during the construction and operational phases.
- 4.5.2 The scope of the assessment will be guided by relevant legislation, planning policy and best practice guidelines.

Temporal scope

- 4.5.3 The temporal scope for this topic is outlined in Section 2.2 (Scope of the assessment) of this Report. Agriculture and soil effects will be assessed for the construction period (2017 – 2026) and the year of opening in 2026. The temporal scope will be extended for areas of re-instated agricultural land; typically, agricultural aftercare on restored land lasts for five years following

soil placement in order to ensure that soil structure has stabilised satisfactorily.

Technical scope

- 4.5.4 National planning policy will form the basis of the assessment of effects of the Proposed Scheme on agriculture, forestry and soils, and will define the scope of the assessment, namely:
- The quantity and quality of agricultural and forestry land that would be affected, both temporarily and permanently;
 - The nature and use of the agricultural and non-agricultural soil resource that would be affected (and displaced) by the Proposed Scheme;
 - The physical impact of land loss and severance and other impacts on agricultural enterprises and farm-based non-agricultural enterprises; and
 - The loss or degradation of features within agri-environment schemes.

4.6 Assessment methodology

Legislation

- 4.6.1 In 2006, the European Commission adopted a comprehensive '*Thematic Strategy*'¹⁸ specifically dedicated to soil protection which included a proposal for a '*Soil Framework Directive*'¹⁹ to promote the sustainable use of soil and protect soil as a natural resource. However, to date, a European Commission Soil Framework Directive has not been implemented.
- 4.6.2 Although there remains no specific legislation for the protection of soil and agricultural land, Defra issued the '*Soil Strategy for England – Safeguarding our Soils*'²⁰ in 2009. The aims of the Strategy have been incorporated into the Natural Environment White Paper: The natural choice: securing the value of nature²¹ and set out Defra's vision that by 2030 all England's soils will be managed sustainably and degradation threats tackled successfully in order to improve the quality of England's soils and safeguard their ability to provide essential services for future generations.
- 4.6.3 The Strategy sets out priorities for action in respect of:
- Better protection of agricultural soils;
 - Protecting and enhancing stores of soil carbon;
 - Building the resilience of soils to a changing climate;
 - Preventing soil pollution;
 - Effective soil protection during construction and development; and
 - Dealing with the legacy of contaminated land.

¹⁸ European Commission (EC), 2006, *Soil Thematic Strategy* (COM (2006) 231), EC

¹⁹ European Commission (EC), 2006, *Proposal for a Soil Framework Directive* (COM (2006) 232), EC

²⁰ Department for Environment, Food and Rural Affairs (Defra), 2009, *Safeguarding our Soils: A Strategy for England*, Defra

²¹ HM Government; 2011, *The Natural Environment White Paper, The natural choice: securing the value of nature*, The Stationery Office

Planning Policy

- 4.6.4 The National Planning Policy Framework²² (NPPF) advises at paragraph 109 that the planning system should contribute to and enhance the natural and local environment by, amongst other matters, protecting and enhancing soils.
- 4.6.5 Paragraph 112 of the NPPF indicates that the economic and other benefits of the best and most versatile agricultural land should be taken into account in development decisions. Where significant development of agricultural land is demonstrated to be necessary, poorer quality land in Grades 3b, 4 and 5 should be used in preference to higher quality land.
- 4.6.6 There is no guidance in policy with regard to the effects of development proposals on farm holdings, although Natural England's Technical Information Note (TIN) 049²³ indicates that land quality is not the sole consideration in how development proposals affect agriculture in the planning system, with other factors, such as the impact on farm size and structure, the use of buildings and other fixed equipment, or any stimulus a development might give to rural economic activity, also being relevant.

Guidance

- 4.6.7 Guidance on classifying agricultural land is contained in 'Agricultural Land Classification of England and Wales, Revised guidelines and criteria for grading the quality of agricultural land, prepared by MAFF in 1988 and summarised in Natural England's TIN 049.
- 4.6.8 Best practice guidance on soil handling and management during the construction phase, to minimise potential adverse impacts on the soil resource, is found in MAFF's '*Good Practice Guide for Handling Soils*'²⁴, Defra's '*Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*'²⁵ and Defra's '*Guidance for Successful Reclamation of Mineral and Waste Sites*'.²⁶

Significance criteria

- 4.6.9 In order to assess the effects of the Proposed Scheme on agricultural resources, significance criteria will need to be adopted relating to the effects on agricultural land and soils, on farming and other farm-based enterprises, and on agri-environment schemes.

²² Department for Communities and Local Government (DCLG), 2012, *National Planning Policy Framework*, The Stationery Office

²³ Natural England, 2009, *Technical Information Note (TIN) 049, Agricultural Land Classification: protecting the best and most versatile agricultural land*, Natural England

²⁴ Ministry of Agriculture, Fisheries and Food (MAFF), 2000, *Good Practice Guide for Handling Soils*, MAFF

²⁵ Defra, 2009, *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*, Defra

²⁶ Defra, 2004, *Guidance for Successful Reclamation of Mineral and Waste Sites*, Defra

- 4.6.10 The significance level attributed to each effect will be assessed based on the magnitude of change due to the Proposed Scheme, the sensitivity of the affected receptor/receiving environment to change, and the relative scarcity or abundance of the resource/receptor in the locality, as well as in a wider context, given that some receptors or features may group or converge in a particular locality.
- 4.6.11 The significance criteria will be based on interpretation of best practice guidance, and will be developed in consultation with Defra and Natural England.
- 4.6.12 The ALC survey will provide a statement of the amount and quality of agricultural land within the land to be acquired or used for the construction and operation of the Proposed Scheme. The magnitude of change will be reflected in the land required permanently and temporarily for the Proposed Scheme and the sensitivity of the agricultural land resource will be reflected in its grading. The sustainable reuse of displaced agricultural and non-agricultural soil resources will also be considered and is discussed further in Section 16 (Waste and Material Resources) of this Report.
- 4.6.13 It is common practice for EIA significance criteria to set an absolute threshold for the loss of a certain area of best and most versatile land (typically 20 or 50 hectares). However, such an approach will be inappropriate for a project of this scale; instead the significance of loss of best and most versatile land will be related to the abundance or special value of such land in the locality. The methodology will set out a reasoned definition of 'locality' that reflects the geographical scale at which effects will be reported.
- 4.6.14 The assessment will set out the predicted physical impacts on individual farm holdings, including the land lost by each holding during the construction phase, the area of land severed, the area to be restored to agriculture and the resulting residual permanent land loss to each holding. The effects identified will be assessed in accordance with the established significance criteria, which will be expressed primarily in physical terms and will reflect the degree of operational change required following construction of the Proposed Scheme.
- 4.6.15 The potential implications for food production and security arising from the loss of agricultural land will also be assessed.

Construction effects

- 4.6.16 Construction effects on agricultural and forestry land and farm and farm-based enterprises may include temporary land-take and the use of the soil resource displaced by the construction of the Proposed Scheme.

- 4.6.17 Other construction effects may include the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; unintentional pollution of soil and watercourses or bodies (used for crop irrigation or livestock drinking water supplies); spread of injurious weeds to adjacent agricultural land from soil and material stockpiles; and construction noise on farm and farm-based enterprises.

Operational effects

- 4.6.18 Operational effects on agricultural and forestry land and farm and farm-based enterprises will include permanent land-take, the loss and severance of land to farm and farm-based businesses, and the loss of agricultural capital.
- 4.6.19 Other potential operational effects may include noise on farm and farm-based enterprises, such as on housed livestock and on farm-based tourist or visitor attractions.

Cumulative effects

- 4.6.20 The construction of the Proposed Scheme, combined with developments that are already taking place or anticipated within the route of the Proposed Scheme, may result in increased pressure on agricultural and forestry land and farm businesses. Cumulative effects will be assessed in relation to other nationally significant projects that have received consent at the time of the assessment.

4.7 Assumptions

- 4.7.1 The assessment within this topic area considers soils as a medium for food and fibre production, and excludes an assessment of soil quality from the perspective of contamination, which is detailed in Section 11 (Land Quality) of this Report. Soil also fulfils a number of functions, such as environmental interaction with air and water; support for ecological habitats and biodiversity; support for the landscape; and protection of cultural heritage. These aspects will be assessed under the relevant environmental topics within the ES.
- 4.7.2 This assessment also considers the effects on all farms (including horticulture), equestrian units, farm woodland and forestry enterprises, farm-based recreational and tourist uses and farm diversification projects that are either ancillary to the main agricultural use or within the control of the farm business. Other rural enterprises are assessed in Sections 7 (Community) and 13 (Socio-economics) of this Report.
- 4.7.3 Projections of future climate change on agriculture, forestry and soils will be incorporated in the definition of the future baseline. The methodology for assessing the significance of impacts on climate change adaptation within

the Agriculture, Forestry and Soils topic area will be developed in conjunction with the climate change specialists on the EIA team.

5 Air quality

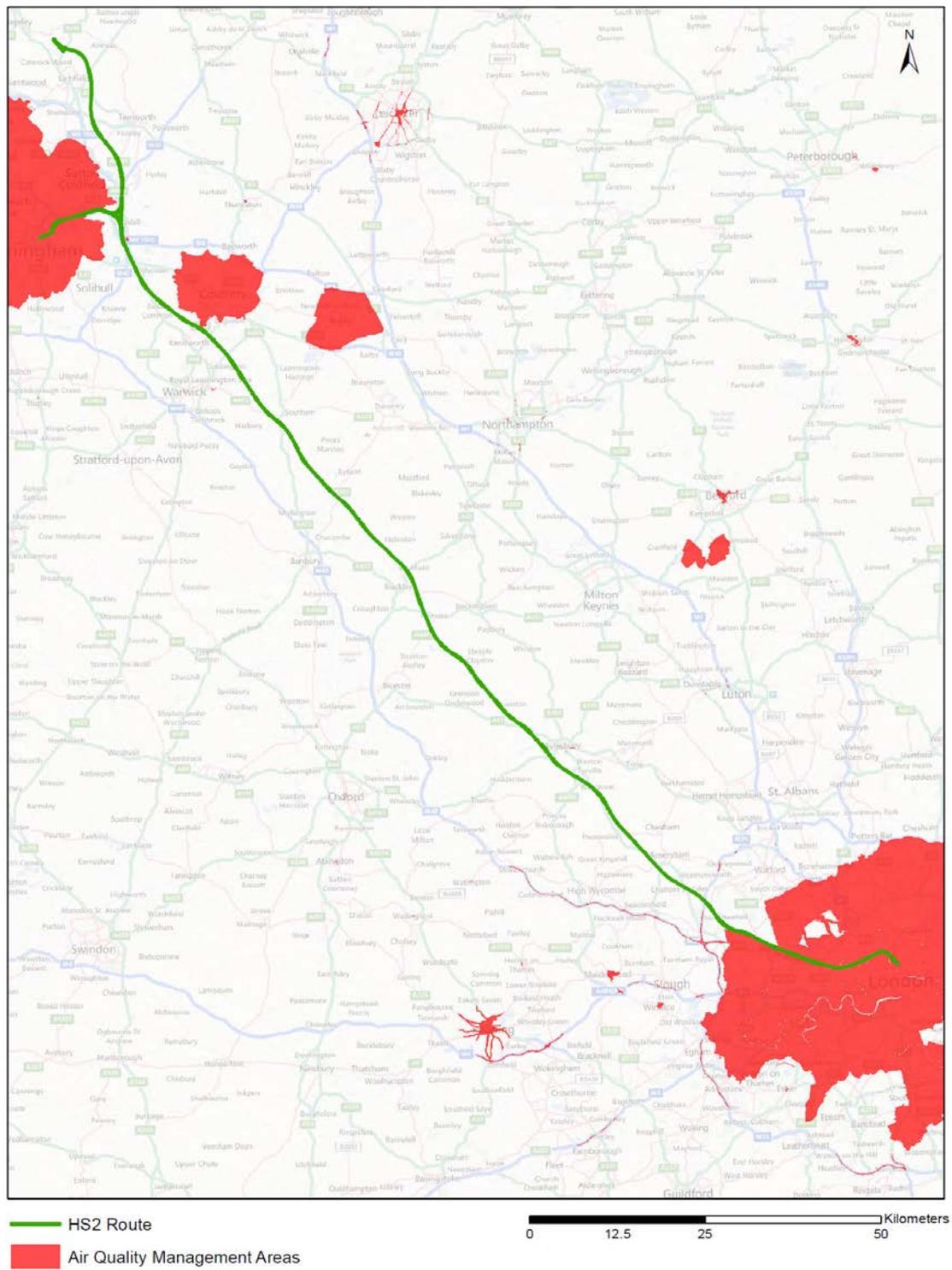
5.1 Introduction

5.1.1 This section of the Report sets out the scope and methodology for assessing the impacts and effects of the Proposed Scheme on air quality during its construction and operation. These activities could result in changes in air quality and therefore need to be assessed in the ES. Air quality changes would occur during construction as a result of the construction activities and associated traffic movements. During operation, the main changes in air quality would arise as a result of changes to road layouts and traffic flows near the stations/interchanges and where road diversions are required. In addition, changes to air quality during operation are likely to arise from any atmospheric emissions from new buildings (e.g. stations/interchanges and infrastructure maintenance depots) built as part of the Proposed Scheme and potentially from modal shift. The assessment would focus on air pollutants that are likely to arise from the construction and operation of the Proposed Scheme. These pollutants are nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}) and dust.

5.2 Establishment of baseline and definition of survey

- 5.2.1 The stations/interchanges and small sections of the route (in London and Birmingham) are located within or in proximity to Air Quality Management Areas (AQMA). The majority of the Proposed Scheme runs through a predominantly rural setting where air quality is generally good; and in these sections the route alignment does not pass through AQMAs. Figure 3 shows the Proposed Scheme route map in relation to existing AQMAs.
- 5.2.2 The vast majority of AQMAs in the UK are designated where NO₂ and PM₁₀ concentrations are elevated. This is mostly related to vehicle emissions from heavily trafficked roads. The London Borough of Camden has declared the whole borough as an AQMA for NO₂ and PM₁₀; and Birmingham City Council has declared its entire local authority area as an AQMA for NO₂. Local authorities review the need for AQMAs on a regular basis and therefore, during the assessment process, it is possible that AQMAs that are no longer required are revoked. Similarly, new AQMAs may be declared, or extensions made to existing AQMAs; therefore this will be reviewed throughout the air quality assessment.

Figure 3 HS2 route map in relation to Air Quality Management Areas



- 5.2.3 Under Part 4, Section 82 of the Environment Act 1995 (Local Air Quality Management)²⁷, local authorities in the UK are required to review and assess local air quality in their areas of jurisdiction and accordingly, they are required to produce annual reports detailing the outcomes of these reviews and assessments. Information relating to existing ambient air quality at the stations/interchanges and along the route alignment of the Proposed Scheme is available from a series of air quality review and assessment reports prepared by local authorities under the Local Air Quality Management regime. The baseline assessment would include collation of local air quality monitoring and modelling data from these reports with a focus on NO₂, PM₁₀ and PM_{2.5}.
- 5.2.4 The assessment will review air quality monitoring data available from the national Automatic Urban and Rural Network (AURN) available on Defra's website.²⁸ The AURN is the UK's largest automatic monitoring network and is the main network used for compliance reporting against the EU's Ambient Air Quality Directives. These sites provide high resolution hourly information which can be downloaded from the website. Some of the AURN sites are located in Greater London; however, the main air quality monitoring network in London is the London Air Quality Network (LAQN) which is managed by the Environmental Research Group, King's College London. Hourly air quality data can be downloaded from the website.²⁹ The West Midlands Air Quality Group website³⁰ also contains information relevant to the West Midlands area. It is possible that other local authorities run their own monitoring networks and hold results not available elsewhere, this will be established and dated collected during the baseline assessment.
- 5.2.5 Further background air pollutant concentration data is available on Defra's Air Information Resource (AIR) website.³¹ These data comprise estimated background air pollution data for 2008 and projections for future years for a one square kilometre (km²) grid for every local authority in the UK.
- 5.2.6 With respect to potential air quality effects on vegetation and ecosystems, critical loads for pollutant deposition and critical levels of gaseous pollutant concentrations for the whole of the UK network of protected sites are available from the UK Air Pollution Information System (APIS).³²
- 5.2.7 Data will be gathered from the above listed sources covering pollutants that are likely to arise from the construction and operation of the Proposed Scheme. These pollutants are NO₂, PM₁₀ and PM_{2.5}. With regard to the effect

²⁷ Department for Environment, Food and Rural Affairs (Defra), 1995, *The Environment Act 1995*, The Stationery Office

²⁸ Department for Environment, Food and Rural Affairs (Defra); UK-Air; Monitoring Networks; <http://uk-air.defra.gov.uk/networks/>

²⁹ King's College London; Environmental Research Group; London Air; www.londonair.org.uk

³⁰ West Midlands Air Quality Group; <http://www.wmair.org>

³¹ Department for Environment, Food and Rural Affairs (Defra); UK-Air; Air Information Resource; <http://uk-air.defra.gov.uk>

³² Air Pollution Information System; <http://www.apis.ac.uk>

on vegetation and ecosystems, baseline data for nitrogen oxides (NO_x) and nitrogen deposition would be collated.

- 5.2.8 Additional air quality monitoring data might be required for model verification although it is expected that sufficient data will already be available [see Section 5.7 (Assumptions) of this Report].

5.3 Consultation

Consultation on the AoS

5.3.1 The consultation undertaken during the preparation of the AoS indicated that some consultees provided responses related to the air quality effects of the 2011 consultation scheme. The main points highlighted during this consultation were the direct potential effects of the scheme during construction and the direct/indirect effects during operation. Comments regarding air quality were received from two of the local authorities consulted. No other comments directly related to the air quality assessment were received. A summary of the comments are as follows:

- London Borough of Camden responded that the 2011 consultation scheme would result in a number of negative environmental effects including air quality. The Council indicated that the air quality effects during construction were the main concern and it required a detailed quantitative assessment of local air quality and traffic effects of the scheme during construction. These effects would be specifically related to dust and PM₁₀ emissions associated with the demolition and construction works as well as NO_x and PM₁₀ vehicle emissions during that phase of works.
- London Borough of Hillingdon's main concern was with regard to potential air quality effects during the operation phase and whether the 2011 consultation scheme would improve air quality as a result of modal shift. The Council highlighted that the AoS recognised that local air quality improvements from a modal shift from car to rail is not expected to be significant. The Council stated that the AoS did not assess the alternative options to ensure that this modal shift was significant and led to improvement in air quality. The Council also raised concerns regarding local air quality around Heathrow Airport which would suffer from increased passengers accessing the airport by road vehicles, as freed up slots (currently used by short-haul flights) are used by larger planes with larger passenger numbers. Finally, the Council stated that it was unacceptable to propose a high traffic generating scheme in a location where air quality is poor.

Consultation as part of the EIA process

5.3.2 The key consultees to be consulted in relation to air quality assessment methodology are environmental health departments at local authorities where:

- The Proposed Scheme stations/interchanges and infrastructure maintenance depots would be located;
- The Proposed Scheme would pass through;
- Significant changes in operational or construction traffic would occur; and
- There are construction activities in general.

5.3.3 In addition, the Greater London Authority (GLA) will be consulted in relation to the air quality assessment methodology and Natural England with respect to ecological effects of changes in air quality.

5.4 Key aspects of the Proposed Scheme for the topic

5.4.1 The main air quality effects from the Proposed Scheme during its construction would arise from:

- Emissions associated with site plant and vehicles;
- Emissions from construction traffic;
- Changes in emissions arising from local diversions; and
- Dust arising from activities such as use of haul roads, wind erosion of temporary stockpiles, earth moving operations, and demolition activities.

5.4.2 The above aspects would have the potential to cause changes in NO₂, PM₁₀ and PM_{2.5} concentrations and may cause dust deposition at sensitive human receptor locations. In addition, some have the potential to cause changes in NO_x concentrations at ecologically sensitive habitats. Ozone will not be considered in this assessment as it is formed at a regional level and the expected changes in pollutant emissions are unlikely to have a significant effect on its formation in the atmosphere.

5.4.3 Air quality effects from the operation of the Proposed Scheme will be categorised into direct and indirect effects. Direct effects would arise from the changes in traffic flows at the Proposed Scheme stations/interchanges and along the route. In addition, there would be potential air quality effects from emissions from buildings.

5.4.4 Indirect effects would arise from changes in emissions brought about by a modal shift from car to rail services, which may have a beneficial effect on air quality.

5.5 Scope of assessment

Spatial scope

5.5.1 Assessment of the effects of emissions arising from local traffic diversions and construction traffic around worksites would be limited to receptors located along roads that meet any of the criteria specified in the Design Manual for Roads and Bridges (DMRB).³³ These criteria will be applied along

³³ Highways Agency, 2007, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, HA207/07*, The Stationery Office

the length of the route of the Proposed Scheme to identify where further assessment is required, and comprise:

- Road alignment change by 5m or more;
- Daily traffic flows change by 1,000 annual average daily traffic (AADT) or more;
- Heavy Duty Vehicle (HDV) flows change by 200 AADT or more;
- Daily average traffic speed change by 10 kph or more; or
- Peak hour traffic speed change by 20 kph or more.

5.5.2 The assessment of dust emissions arising from construction sites associated with the Proposed Scheme will be carried out in accordance with the Institute of Air Quality Management (IAQM) Guidance.³⁴ These include areas around worksites where there are sensitive receptors within 350m from the construction site boundary and/or within 100m of the routes used by construction vehicles on the public highway and up to 500m from construction site entrances.

5.5.3 Assessment of nitrogen deposition will be required if there are significant changes in traffic flows within 200m of ecologically sensitive sites. Ecological resources and other ecological issues are contained in Section 9 (Ecology) of this Report.

Temporal scope

5.5.4 The assessment of air quality effects of construction traffic will be undertaken for the following scenarios:

- Future baseline traffic emissions during each year of construction without the Proposed Scheme construction traffic emissions; and
- Future baseline traffic emissions during each year of construction with the Proposed Scheme construction traffic emissions.

5.5.5 The assessment of air quality effects due to change in traffic during operation will be undertaken for the following scenarios:

- Future baseline traffic emissions during the year of operation without the Proposed Scheme; and
- Future baseline traffic emissions during the year of operation with the Proposed Scheme.

Technical scope

5.5.6 The assessment will not include the transboundary effects of the Proposed Scheme on air quality, as the likely changes in atmospheric emissions would be negligible in this context. The air quality effects arising from the modal shift will only be assessed in terms of change in regional emissions.

³⁴ Institute of Air Quality Management (IAQM), 2012, *Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance*, IAQM

5.6 Assessment methodology

Legislation

5.6.1 The assessment will take into account the following legislation, and any subsequent changes to the legislation:

- Part 4 of the Environment Act 1995;
- The Air Quality (England) (Amendment) Regulations 2002³⁵; and
- The Air Quality Standards Regulations 2010³⁶;
- Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe³⁷; and
- NPPF, 2012.

Guidance

5.6.2 The assessment will take into account the following guidance:

- Local Air Quality Management Technical Guidance LAQM.TG(09)³⁸;
- Design Manual for Roads and Bridges. Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, HA207/07;
- Environmental Protection UK (EPUK) Guidance – Development Control: Planning for Air Quality³⁹;
- IAQM Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance; and
- GLA's Best Practice Guidance: The Control of Dust and Emissions from Construction and Demolition published in 2006 (due to be revised in 2012).⁴⁰

Significance criteria

5.6.3 Air quality limit values and objectives are quality standards for clean air and to protect human health. These limit values and objectives will be used as assessment criteria for determining the significance of any potential changes in local air quality resulting from the Proposed Scheme. Some pollutants have standards expressed as annual average concentrations and others have standards expressed as 24-hour, 1-hour or 15-minute average concentrations. Some pollutants have standards expressed in terms of both long-term and short-term concentrations.

5.6.4 Table 1 sets out these European Union (EU) air quality limit values and UK national air quality objectives for the pollutants relevant to this study (NO₂, PM₁₀ and PM_{2.5}).

³⁵ Department for Environment, Food and Rural Affairs, 2002, *The Air Quality (England) (Amendment) Regulations 2002*, The Stationery Office

³⁶ Department for Environment, Food and Rural Affairs, 2010, *The Air Quality Standards Regulations 2010*, The Stationery Office

³⁷ Official Journal of the European Union, 2008, *Directive 2008/50/EC of the European Parliament and of the Council of the 21 May 2008 on ambient air quality and cleaner air for Europe*, EU

³⁸ Defra, 2009, *Local Air Quality Management Technical Guidance LAQM.TG(09)*, Defra

³⁹ Environmental Protection UK, 2010, *Development Control: Planning for Air Quality*, Environmental Protection UK

⁴⁰ Greater London Authority (GLA) and London Councils, 2006, *The Control of Dust and Emissions from Construction and Demolition - Best Practice Guidance*, GLA

Table 1 – UK and EU Air Quality Standards and Guidelines

Pollutant	Averaging Period	Limit Value/Objective	Date for Compliance	Basis
Nitrogen dioxide (NO ₂)	1 hour mean	200 µg/m ³ , not to be exceeded more than 18 times a year (99.8 th percentile)	31 st Dec 2005	UK
			1 st Jan 2015*	EU
	Annual mean	40 µg/m ³	31 st Dec 2005	UK
			1 st Jan 2015*	EU
Particulates (PM ₁₀) Measurement technique: Gravimetric	Daily mean	50 µg/m ³ , not to be exceeded more than 35 times a year (90.4 th percentile)	31 st Dec 2004	UK
			31 st Dec 2009*	EU
	Annual mean	40 µg/m ³	31 st Dec 2004	UK
			None Specified	EU
Particulates (PM _{2.5}) Measurement technique: Gravimetric	Annual mean	25 µg/m ³	2020	UK
			2010	*EU Target Value
			2015	*EU Limit Value
		Target of 15% reduction in concentrations in urban areas	Between 2010 and 2020	UK
		Target of 20% reduction in concentrations in urban areas		*EU Limit Value

* Not yet ratified.

Environmental Protection UK: Planning for Air Quality

- 5.6.5 The significance of effects resulting from the Proposed Scheme on local air quality for individual sensitive receptors will be determined using the approach described by the EPUK *Guidance Development Control: Planning for Air Quality*. The Guidance incorporates the latest position of the IAQM on impact significance.
- 5.6.6 The EPUK Guidance provides an approach to determining the significance of impacts resulting from a proposed development on local air quality both for

individual receptors and for a whole scheme. The Guidance provides a basis on how to describe the significance of the impacts predicted from an air quality modelling study, specifically for the pollutants NO₂ and PM₁₀.

- 5.6.7 The first step is to identify the descriptor of change in ambient concentrations for NO₂ and PM₁₀ according to the percentage change in annual mean concentrations (for both NO₂ and PM₁₀) and change in the forecast number of days greater than 50 micrograms (µg) per cubic metre (m³) for PM₁₀ (see Table 2 and Table 3). The descriptor can then be used to assess the impact significance for the two pollutants in relation to changes in the absolute concentration forecast from the modelling with a proposed development in place (see Table 4 and Table 5).

Table 2 - Descriptors for changes in ambient concentrations of NO₂ (taken from the EPUK 2010 guidance)

Magnitude of change	Absolute change in NO₂ concentrations (µg/m³)
Large	Increase/decrease > 4
Medium	Increase/decrease 2 – 4
Small	Increase/decrease 0.4 – 2
Imperceptible	Increase/decrease < 0.4

Table 3 - Descriptors for changes in ambient concentrations of PM₁₀ (taken from the EPUK 2010 guidance)

Magnitude of change	Equivalent absolute change in PM₁₀ concentrations (µg/m³)
Large	Increase/decrease > 4
Medium	Increase/decrease 2 – 4
Small	Increase/decrease 0.4 – 2
Imperceptible	Increase/decrease < 0.4

Table 4 - Descriptors for impact significance for annual mean NO₂ (taken from the EPUK 2010 guidance)

Absolute concentration in relation to objective/limit value	Change in concentration		
	Small	Medium	Large
Increase with Proposed Scheme			
Above Objective/Limit Value with scheme (> 40 µg/m ³)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just below Objective/Limit Value with scheme (36-40 µg/m ³)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with scheme (30-36 µg/m ³)	Negligible	Slight Adverse	Slight Adverse
Well below Objective/Limit Value with scheme (<30 µg/m ³)	Negligible	Negligible	Slight Adverse
Decrease with Proposed Scheme			
Above Objective/Limit Value without scheme (40 µg/m ³)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just below Objective/Limit Value without scheme (36-40 µg/m ³)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value without scheme (30-36 µg/m ³)	Negligible	Slight Beneficial	Slight Beneficial
Well below Objective/Limit Value without scheme (<30 µg/m ³)	Negligible	Negligible	Slight Beneficial

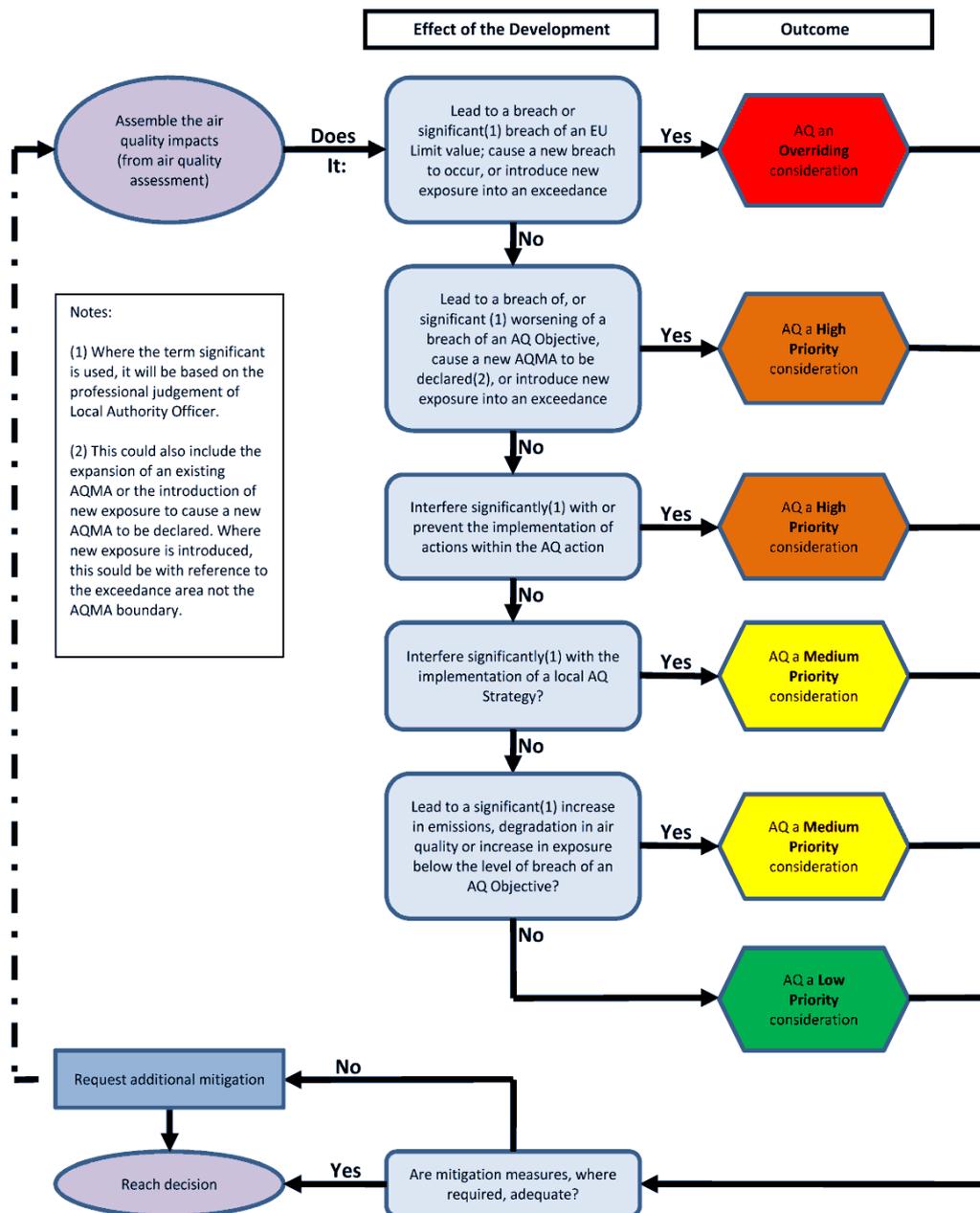
Table 5 - Descriptors for impact significance for annual mean PM10 (taken from the EPUK 2010 guidance)

Absolute concentration in relation to objective/limit value	Change in concentration		
	Small	Medium	Large
Increase with Proposed Scheme			
Above Objective/Limit Value with scheme (> 40 µg/m ³)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just below Objective/Limit Value with scheme (36-40 µg/m ³)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with scheme (30-36 µg/m ³)	Negligible	Slight Adverse	Slight Adverse
Well below Objective/Limit Value with scheme (<30 µg/m ³)	Negligible	Negligible	Slight Adverse
Decrease with Proposed Scheme			
Above Objective/Limit Value without scheme (40 µg/m ³)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just below Objective/Limit Value without scheme (36-40 µg/m ³)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value without scheme (30-36 µg/m ³)	Negligible	Slight Beneficial	Slight Beneficial
Well below Objective/Limit Value without scheme (<30 µg/m ³)	Negligible	Negligible	Slight Beneficial

5.6.8 In terms of overall operational impact, the EPUK Guidance provides an approach for assessing the significance of air quality impacts associated with a given development (see Figure 4). This approach suggests factors, listed below, which should be considered, before a suitably qualified professional can determine, with sufficient justification, whether the overall impact of a proposed development should be termed 'insignificant', 'minor', 'moderate' or 'major'.

- Number of people affected by slight, moderate or major air quality impacts and a judgement on the overall balance;
- Where new exposure is being introduced into an existing area of poor air quality, then the number of people exposed to levels above the objective or limit value will be relevant;
- The magnitudes of the changes and the descriptions of the impacts at the receptors;
- Whether or not an exceedence of an objective or limit value is predicted to arise in the study area where none existed before or an exceedence area is substantially increased;
- Whether or not the study area exceeds an objective or limit value and this exceedence is removed or the exceedence area is reduced;
- Uncertainty, including the extent to which worst-case assumptions have been made; and
- The extent to which an objective or limit value is exceeded e.g. an annual mean NO₂ of 41 µg/m³ should attract less significance than an annual mean of 51 µg/m³.

Figure 4 - EPUK Steps to assess the significance of impacts of a development proposal



IAQM: Guidance on the assessment of the impacts of construction on air quality and the determination of their significance

- 5.6.9 The impacts of dust emissions on sensitive receptors would be determined using the IAQM Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance.
- 5.6.10 The IAQM guidance was produced in concert with the GLA and gives guidance to development consultants and environmental health officers on how to assess air quality impacts from construction. The guidance provides a method for classifying the significance of effect from construction activities based on 'dust classes' (either high, medium or low) and proximity of the site to the closest receptors. The guidance gives suggested criteria for the classification of dust classes which are interpreted through professional judgement by air quality specialists.
- 5.6.11 The guidance considers the potential for dust emissions from the following activities:
- Demolition;
 - Earthworks⁴¹;
 - Construction; and
 - Trackout.⁴²
- 5.6.12 For each of the above activities, the guidance considers three separate dust effects:
- Annoyance due to dust soiling;
 - Harm to ecological receptors; and
 - The risk of health effects due to a significant increase in exposure to PM₁₀.

Construction effects

- 5.6.13 The construction effects will be assessed through an investigation of potential sources of air pollutant emissions from construction activities and through the formulation of appropriate mitigation and control measures. An environmental risk assessment of construction effects will be carried out using the risk-based approach and the significance criteria described in the IAQM Guidance on the assessment of construction impacts on air quality.
- 5.6.14 The assessment will identify where particular mitigation measures are required to address local issues. These mitigation measures will be detailed in the Local Environmental Plans being developed for each community forum area.

⁴¹ Covers the processes of soil stripping, ground-leveling, excavation and land capping.

⁴² The unintentional transfer of dust and dirt from construction/demolition sites onto public roads, where it may be deposited and then re-suspended by other vehicles.

- 5.6.15 The assessment will take into account the distance from the construction activities that may result in atmospheric emissions to the receptors that may experience adverse effects together with local meteorological conditions.
- 5.6.16 With regard to assessment of the effects of emissions arising from changes in traffic flows during construction, traffic data will be screened using the DMRB criteria described in paragraph 5.5.1. Following this screening exercise, roads meeting any of these criteria would be subject to further assessment using the air quality screening tool specified in DMRB. This tool will be used to forecast concentrations of traffic-related pollutants (NO₂ and PM₁₀) at receptors located within 10m from the kerbside of each of those roads. If this predicts significant change in pollutant concentrations, an appropriate atmospheric dispersion model (e.g. ADMS-Roads or ADMS-Urban) would be used to further investigate the effects of changes in traffic flows at those receptors. Dispersion modelling would use the latest available vehicle emission data from Defra and take into account information in the National Atmospheric Emission Inventory and the London Atmospheric Emissions Inventory as appropriate. Comparison of results with and without the construction traffic and local diversions in the future years would allow the effect to be determined.
- 5.6.17 This assessment would comply with the requirements of LAQM.TG(09) and would address the issues related to model verification and sensitivity analysis. This will only be considered in relation to areas where detailed air dispersion modelling is required and it will not be necessary elsewhere on the route of the Proposed Scheme.

Operational effects

- 5.6.18 Operational effects due to the diversion of traffic flows at stations/interchanges and along the route of the Proposed Scheme would be assessed using the methodology described in paragraph 5.6.13. The assessment of emissions from other sources, such as emissions from buildings, will be assessed using a detailed dispersion model such as ADMS if a significant impact is expected. An initial appraisal will be undertaken that will examine the magnitude and location of the emissions to determine whether dispersion modelling is required.
- 5.6.19 Where there is a need to carry out assessment of nitrogen deposition near to sensitive sites, this will follow the methodology detailed in Volume 11 of the DMRB. Any changes in nitrogen deposition will also be reported in terms of the percentage change relative to the critical load and level for ecosystem protection. Any potential impacts on ecological systems relating to air quality changes will be addressed in the ecological assessment [see Section 9 (Ecology)].
- 5.6.20 The assessment of indirect effects brought about by modal shift from car to rail will be undertaken by calculating the change in total emissions based on the change in vehicle kilometres travelled by vehicles.

Cumulative effects

5.6.21 Cumulative effects will be largely taken into account in the traffic data used for the assessment which will incorporate likely change brought about by other proposed developments both during and following construction. Where there is planned development that includes significant emissions to the atmosphere then these emissions would be included within the air quality modelling undertaken for the Proposed Scheme if these are likely to result in cumulative effects.

5.7 Assumptions

5.7.1 The air quality assessment assumes the following:

- There is available baseline data from the sources mentioned in Section 5.2 (Establishment of baseline and definition of survey);
- Transport information required will be provided in consultation with the Transport Consultants;
- Any significant ecological impacts from changes in pollutant levels will be identified in the Ecology chapter of the ES; and
- There is an adequate level of detail of construction activities at construction sites.

6 Climate

6.1 Introduction

6.1.1 This section of the Report addresses the effects of the Proposed Scheme on climate and climatic factors. It will set them in the context of the UK Climate Change Act 2008⁴³, Carbon 2050⁴⁴ as well as the UK Climate Change Risk Assessment⁴⁵. The assessment will determine the net greenhouse gas emissions (GHG) associated with the Proposed Scheme (i.e. any increases associated with the Proposed Scheme less any reductions).

6.1.2 The GHG project protocol⁴⁶ will be used to help structure the assessment approach. This is an internationally accepted protocol based on project level emissions. It ensures that both direct and indirect emissions are measured and assessed.

6.1.3 Assessments will be carried out for the following time periods:

- 2017 – start of construction;
- 2026 - Proposed Scheme opening;
- 2041 - 15 years after opening; and
- 2050 - in line with Government policy and national carbon reduction targets.

6.1.4 Climate Change Adaptation (CCA) will not be addressed in this section; rather it will be addressed in individual topics [for example, Section 17 (Water Resources and Flood Risk Assessment), Section 7 (Community), Section 9 (Ecology) and Section 4 (Agriculture, Forestry and Soils)]. Within the EIA CCA will be considered in relation to determining the impacts the development may have on aspects of the receiving environment (in combination effects of both the project and climate change on the receiving environment).

6.1.5 However, the impacts climate change may have on the development over its operating lifetime (the resilience to CCA of the project) such as design features, construction materials and planned operational or maintenance processes, will be excluded from the EIA.

6.1.6 There are no standard methodologies for addressing climate change adaptation in EIA for high speed rail. A methodology for assessing these impacts for HS2 will be developed for each relevant section of the EIA. They

⁴³ HM Government, 2008, *Climate Change Act 2008*, The Stationery Office

⁴⁴ European Commission (EC), 2011, *Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions, A Roadmap for Moving to a Competitive Low Carbon Economy in 2050*, EC

⁴⁵ Defra, 2012, *The UK Climate Change Risk Assessment 2012 Evidence Report*, Defra

⁴⁶ World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), 2003, *The Greenhouse Protocol for Project Accounting*, WBCSD and WRI

will include climate projections/scenarios, baseline information on historic weather conditions and risk assessment methodologies.

6.2 Establishment of baseline and definition of survey

- 6.2.1 A description of the baseline environment for the 2011 consultation scheme is contained within the AoS. Volume 1, Sections 8.2 and 8.3 of the AoS describes the baseline environment in relation to climatic factors, adaptability and GHGs (further details are provided in Appendix 2 of the AoS). This baseline covers current emissions in the UK, including the UK transport sector and sub sectors. The AoS also reviewed relevant policies.
- 6.2.2 The baseline GHG assessment will cover the following aspects:
- Changing travel patterns and modal shift;
 - Surface access to existing stations/interchanges;
 - Projected UK grid power emissions (for example, nuclear versus coal based projection); and
 - Assess the impact of planned associated developments. These will be identified through Local Development Frameworks and liaison with the relevant planning department within local authorities.
- 6.2.3 Baseline transport data will be derived from the HS2 transport model and the transport assessment. The model is expected to report on travel patterns by mode (road and rail) on the route of the Proposed Scheme, and will also consider air travel. Transport efficiency improvements over time will also be considered.
- 6.2.4 The baseline will not only consider the Proposed Scheme, but also commuter surface access movements to stations/interchanges that connect to the classic network, and how these travel patterns change over time.
- 6.2.5 Given that the Proposed Scheme will be electrically powered, the assessment will consider various UK grid mix projections for comparison against current factors. According to Defra⁴⁷, in 2010 the UK's grid carbon intensity factor was 0.49 kg of carbon dioxide per kWh of electricity consumed. Future UK grid emission factors will be based on reports by the Committee on Climate Change (CCC) and the Department of Energy and Climate Change (DECC).

6.3 Consultation

Consultation on the AoS

- 6.3.1 Of the four principles of Sustainable Development outlined in the AoS, the highest number of comments related to reducing GHG emissions and

⁴⁷ Department for Environment, Food and Rural Affairs (Defra) and Department of Energy and Climate Change (DECC), 2012, *GHG Conversion Factors for Company Reporting*, Version 1; <http://www.defra.gov.uk/publications/2012/05/30/pb13773-2012-ghg-conversion/>

combating climate change. Specifically, responses tended to focus on the following recurring themes:

- Energy consumption and power demand modelling;
- Carbon Intensity of fuel and decarbonisation of electricity;
- Modal shift;
- Comparative energy performance of high speed rail, aviation and road transport;
- Passenger demand modelling; and
- Construction emissions and embodied carbon.

6.3.2 Engagement undertaken as part of the EIA will seek to incorporate and investigate these themes.

Consultation as part of the EIA process

6.3.3 Key stakeholder groups are to be included during the engagement and consultation process. The consultees will be identified according to the geographic scope and nature of the issues. The key stakeholder groups include:

- Central Government departments and agencies;
- Local Government and agencies;
- Non-Governmental Organisations;
- Road industry stakeholders;
- Aviation industry stakeholders; and
- Rail industry stakeholders.

6.4 Key aspects of the Proposed Scheme for the topic

6.4.1 Key aspects of the Proposed Scheme for this topic include:

- Earthworks – includes all excavated material, backfill volumes and any soil treated throughout the construction process. Emissions will arise from the energy used by plant equipment in the extraction of material, as well from logistical operations transporting soil along the route of the Proposed Scheme;
- Land use, land use change and forestry (LULUCF) –includes emissions that are either captured or released, resulting from direct human-induced changes in land use during construction and operation;
- Demolition – to accommodate the Proposed Scheme, demolition and re-development of sites (e.g. local businesses and residential properties) will be required. Emissions associated with the plant equipment energy use will be included in the carbon assessment;
- Construction - Covers the embodied carbon of construction materials used in structures such as stations/interchanges, tunnels, bridges, viaducts, rail lines and supporting infrastructure. This will include the logistical impact of delivering materials to site and removal of waste from

site. Depending on data availability, fuel used by plant equipment during construction (such as tunnel boring machines) will also be included;

- Operation – covers energy consumption of station/interchanges and associated development and infrastructure maintenance depots covering, for example, lighting, heating, cooling, escalators, signalling, ventilation and lifts;
- Rolling stock - Energy use, and consequential GHG emissions, from the running of the trains will depend on, but not be limited to the following factors: train weight, acceleration, traction efficiency, braking performance, regenerative braking, train resistance, tunnel resistance aerodynamic factors, passenger loads and speed. The embodied impact of the rolling stock will also be included in the carbon assessment;
- Maintenance – covers the day-to-day upkeep of the railway (track, bridges, tunnels etc) and stations/interchanges as well as the trains. Maintenance activities, similar to construction, involve plant equipment, materials and transport;
- Energy supply - The construction and operational assessment will take account of grid decarbonisation projections and will be based on evidence from sources such as the UK's Low Carbon Transition Plan⁴⁸, the CCC reports^{49 50}, and DECC;
- Modal shift - one of the main objectives of the Proposed Scheme is to encourage modal shift, primarily from road and air onto rail. This assessment will consider road, rail and air efficiency improvements likely to have occurred by the time the Proposed Scheme is in operation, as well as the likely impact on road, conventional rail and domestic air travel emissions; and
- Induced travel – will capture how surface access to existing and new stations/interchanges are expected to change on a daily basis due to the Proposed Scheme. Any extra road travel due to construction related disruptions will be considered depending on transport modelling outputs.

⁴⁸ Department of Energy and Climate Change (DECC), 2009, *The UK Low Carbon Transition Plan: national strategy for climate and energy*, DECC; http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/lctp/lctp.aspx

⁴⁹ Committee on Climate Change (CCC), 2008, *Building a low-carbon economy – the UK's response to tackling climate change*, CCC

⁵⁰ Committee on Climate Change (CCC), 2009, *Meeting Carbon Budgets – the need for a step change*, CCC

6.5 Scope of assessment

GHG mitigation assessment

6.5.1 The assessment will cover both direct and indirect emissions associated with the key aspects set out in Section 6.4 (Key aspects of the Proposed Scheme for the topic). Direct emissions are defined as emissions that occur on-site, such as emissions from a diesel generator during the construction of the railway. Indirect emissions are emissions that occur further up the supply chain or off-site, such as the manufacturing of rail sleepers.

6.5.2 The proposed approach for the GHG assessment is summarised in Table 6.

Table 6 – Scope of GHG assessment

	Materials embodied emissions	Construction Logistics emissions	Construction site emissions	Operation and Maintenance
Earthworks	✓	✓	✓	✗
LULUCF	n/a	n/a	n/a	n/a
Demolition	✗	✗	✓	✗
Rail tracks	✓	✓	✓	✓
Bridges	✓	✓	✓	✓
Tunnels	✓	✓	✓	✓
Viaducts	✓	✓	✓	✓
Stations/interchanges	✓	✓	✓	✓
Tunnel Boring Machine	✓	✗	✓	n/a
Supporting Infrastructure	✓	✓	✓	n/a
Rolling stock	✓	✓	n/a	✓
Workers daily commute	✗	✓	✗	✓
Additional travel due to disruption from construction	✗	✓	✗	✗
Modal shift	n/a	n/a	n/a	✓
Maintenance	n/a	n/a	n/a	✓
Induced travel	n/a	n/a	n/a	✓
Associated development	✓	✓	✓	✓

- 6.5.3 For the purpose of this assessment, the following aspects have been scoped out:
- Design stage – existing literature⁵¹ shows that less than 1% of total emissions from high speed rail projects come from the design stage (paper and office energy consumption); and
 - Deconstruction – not considered to be appropriate for the Proposed Scheme due to the long design life of the project.

6.6 Assessment methodology

- 6.6.1 There is no officially recognised methodology for assessing the significance of GHG impact of a large infrastructure project in relation to EIA. However, existing protocols and guidance, such as the GHG Protocol for Project Accounting or ISO14064⁵², provide principles and requirements which are directly relevant to the Proposed Scheme. The Institute of Environmental Management and Assessment (IEMA) guidelines on climate change and EIA will also be referred to in determining levels of significance, as will The UK National Climate Change Risk⁵³ assessment conducted by Defra.
- 6.6.2 The GHG assessment will use the guiding principles of existing protocols and specifications. This will be supported by a combination of carbon modelling tools, lifecycle software and publically available information including the University of Bath's Inventory of Carbon and Energy^{54 55} on construction materials.
- 6.6.3 Emissions will be reported in line with the United Nations Framework Convention on Climate Change.⁵⁶ Depending on data availability the reporting unit will be in tonnes of carbon dioxide equivalents (tCO₂e) covering the six main GHGs.⁵⁷
- 6.6.4 The approach used will be to:
- Define emission sources;
 - Gather information and appropriate GHG coefficients;
 - Calculate GHG emissions; and
 - Report GHG emission of the Proposed Scheme over its lifetime in comparison to the baseline.
- 6.6.5 Construction related emissions will be based on the engineering design drawings and statements covering the key elements of the Proposed

⁵¹ Systra, 2011, *Carbon Footprint of High Speed Rail*, a report of the International Union of Railways, Systra

⁵² British Standard, 2006, *ISO14064 – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancement*, BSi

⁵³ Department for Environment, Food and Rural Affairs (Defra), 2012, *UK Climate Change Risk Assessment: Government Report*, The Stationery Office

⁵⁴ Hammond, G.P. and Jones, C.I., 2008, *Inventory of Carbon & Energy (ICE) Version 1.6a*, University of Bath

⁵⁵ Hammond, G.P. and Jones, C.I., 2011, *Inventory of Carbon and Energy (ICE) Version 2.0*, University of Bath

⁵⁶ United Nations Framework Convention on Climate Change (UNFCCC), *Greenhouse Gas Inventory Data*, http://unfccc.int/ghg_data/items/3800.php

⁵⁷ Direct GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF₆)

Scheme. During design development, carbon reduction measures will be considered.

6.6.6 Bespoke data collection templates will be developed to capture construction related data for the Proposed Scheme. These templates will capture the following information for design elements such as a viaduct or bridge:

- Volume of materials;
- Life span of design element;
- Carbon coefficients;
- Overall GHG emissions of each design element; and
- Functional units (e.g. tonnes of carbon dioxide CO₂ per metre and year of design element).

6.6.7 Construction site emissions relate to fuel and energy use by plant. Information on plant type and usage will be obtained from the Sound, Noise and Vibration (Section 14) assessment which, in the ES, is expected to report on:

- Plant equipment assumptions;
 - Type of equipment;
 - Number of equipment;
 - Percentage on-times for relevant construction periods;
 - Working hours;
- Materials and equipment haul;
- Programme; and
- Site plants.

6.6.8 Sound, noise and vibration information will be combined with published power rating (kW) data of plant equipment by the British Standards Institute (BSI).⁵⁸ By combining the percentage of time and duration plant equipment is used, with the power rating of machines, it is possible to estimate total fuel and energy consumption during construction. Fuel consumption will then be converted to GHG emissions.

6.6.9 Transport related emissions will be based on HS2's Demand Model outputs. Outputs from the transport modelling required for the GHG assessment include:

- Surface access: travel to and from each station by modal split, number of trips and average trip distance;
- Classic rail network: change in train movements on the classic network as a result of uptake of services on the Proposed Scheme. If modelling outputs permit, an analysis of the released capacity on the classic network for passenger or freight transport (outputs to be confirmed with transport modellers) will be undertaken;

⁵⁸ British Standards Institute (BSI), 2009, *BS 5228-1 Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 1: Noise*, BSI

- Modal shift: transfers from air to rail for domestic trips between London and Manchester/ Birmingham/ Glasgow and Leeds. Although there are no flights between London and Birmingham (the route of the Proposed Scheme), there are flights to Manchester, Leeds and other destinations further north. Phase 2 will indirectly impact the modal shift (road and rail) on the Proposed Scheme through, for example, planned increase in services on the London to Birmingham section). The impact that Phase 2 has on the Proposed Scheme will be considered in the assessment;
- Modal shift: transfer from road onto the Proposed Scheme (i.e. between London and Birmingham); and
- Construction transport: transport movements associated with construction activities such as movement of spoil and access to site; and
- Personal transport: any additional transport on existing routes caused by disruption associated with the Proposed Scheme in terms of construction activities and operation.

6.6.10 Operational emissions will cover energy use by stations/interchanges. This will include energy used by station/interchange design elements such as: lighting, lifts and escalators, heating, ventilation and air conditioning, communications.

6.6.11 Rolling stock related emissions will cover both operational and embodied aspects including:

- Weight and material composition of the trains;
- Speed;
- Seat capacity;
- Energy consumptions (kilo-watt hour (kWh) per train km); and
- Load factor (%).

6.7 Assumptions

6.7.1 Predictions of future GHG emissions from the Proposed Scheme and for the baseline will need to make assumptions in relation to the future carbon footprints of power generation and vehicle efficiencies. As such, the assessment will cover a range of predictions which will be set out in the ES.

7 Community

7.1 Introduction

- 7.1.1 This section of the Report sets out the scope and methodology to be adopted for the assessment of community impacts and effects.
- 7.1.2 Impacts relevant to the community assessment fall broadly within the following categories:
- Demolition/construction, direct land take and impacts on property;
 - Intrusion/disturbance to communities and community facilities caused by other environmental impacts.
- 7.1.3 Community resources and receptors are set out below against the themes of residential property and community infrastructure.

Residential property

- 7.1.4 This will include private, rented and shared ownership residential dwellings and their surrounding grounds/gardens, student accommodation, extra care/retirement housing, mobile homes (where there are established and recognised locations) and homes used in conjunction with a business or other function.
- 7.1.5 Receptors include the residents or tenants of properties. They also include employees who permanently reside in a residential property, for example, care givers and janitors.
- 7.1.6 Impacts on commercial and industrial property will be addressed as part of the socio-economic assessment within the ES. Impacts on farms and farm-based enterprises will be addressed as part of the agriculture, forestry and soils assessment within the ES.

Community infrastructure/organisations

- 7.1.7 This will include community facilities and infrastructure such as education, health, emergency services, places of worship, sports and recreational facilities, open spaces and public rights of way.
- 7.1.8 Receptors include users and beneficiaries of resources which can include local residents, organised (community) groups, pupils, patients, congregations and employees who use community infrastructure. Receptors also include owners and organisations running the resources.
- 7.1.9 The community assessment recognises the inter-relationship of community and economic effects. As well as covering direct community effects, it takes into account how economic and development impacts and effects identified by the socio-economic assessment will indirectly effect communities (the

socio-economic assessment being focused on economic rather than social impacts and effects). For example, this might include catalytic effects – such as impacts on property prices and blight which will be covered by the socio-economic assessment (as part of the ES) and could have effects on the local community.

7.2 Establishment of baseline and definition of survey

Characteristics of communities

- 7.2.1 The need to minimise adverse community effects has influenced the development of the Proposed Scheme, for example by realignment of the route to avoid the majority of communities between London and the West Midlands, further extension of tunnels, and the provision of green tunnels.
- 7.2.2 The route alignment nevertheless passes through and potentially effects, a diverse range of communities and people. The main centres of population comprise the Greater London and Greater Birmingham areas, but the route will pass close to a variety of settlements, including villages, hamlets and isolated farmsteads in the countryside. Some of these communities are more dispersed and rural/agricultural and potentially face issues such as ageing populations and social exclusion.
- 7.2.3 The key community characteristics of relevance include:
- Their physical layout and scale (e.g. in relation to land take, demolitions and severance);
 - The location, type and importance of community facilities, and
 - Their social vulnerability (i.e. whether they contain or serve a high proportion of vulnerable individuals).

Baseline data and methods

- 7.2.4 The baseline will include collecting information on both resources and receptors.
- 7.2.5 Potential resources include:
- Community infrastructure, including education, health, emergency services, community halls and places of worship;
 - Recreation infrastructure, including entertainment facilities, sports facilities, and other leisure activities;
 - Open space;
 - Residential properties (in terms of their occupation and amenity);
 - Public rights of way (and other access routes of local importance); and
 - Local communities as a whole.
- 7.2.6 Receptors include:
- Individuals using community resources;
 - Residents;

- Local workers;
- Community groups; and
- Owners and organisations with interests in the community resources.

7.2.7 Information on resources and receptors will draw on a variety of sources that include:

- Data collected during the preparation of the AoS, supplemented and updated as appropriate;
- Relevant national datasets such as: Index of Multiple Deprivation Access Domain; Ofsted reports and data; Census data; Office of National Statistics Neighbourhood Statistics; Sports England’s participation dataset; Land Registry information; Valuation Office Agency information; and Yellow Pages and/or similar data sets on local facilities;
- Existing local studies and information such as: open space surveys; land-use surveys; housing needs surveys; user surveys; membership lists; registered users etc.;
- Analysis and data from other relevant EIA topics such as: Sound, Noise and Vibration (Section 14); Air Quality (Section 5); Socio-Economics (Section 13); Agriculture, Forestry and Soils (Section 4); and Traffic and Transport (Section 15); and
- New studies and/or field surveys where appropriate, for example, relating to open spaces, public rights of way, and effects on community organisations.

7.3 Consultation

Consultation on the AoS

7.3.1 Key issues arising from the public consultation on the AoS related to:

- Equity in terms of both the distribution of costs and benefits of HS2 and affordability of fares;
- Concerns about amenity impacts and whether environmental aspects were adequately valued; and
- Impacts on property values and broader community impacts.⁵⁹

Consultation as part of the EIA process

7.3.2 In conjunction with the wider consultation process, including Community Forums, further engagement with relevant organisations and communities will be carried out as part of the assessment.

7.3.3 Stakeholders will be offered the opportunity to respond as part of a coordinated EIA approach. Relevant organisations include:

- National government departments and statutory organisations;

⁵⁹ Department for Transport (DfT), 2011 (Addendum 2012), *High speed rail: Investing in Britain's future consultation summary report: A report to Government by Dialogue by Design*, DfT

- Local and regional government including the GLA, Birmingham City Council, Local Enterprise Partnerships and local authorities on the line of route of the Proposed Scheme;
- Other relevant local non-governmental organisations including, for example, tourism boards; and
- Relevant voluntary and community sector organisations and other special interest groups.

7.3.4 Engagement will be appropriate to each organisation.

7.4 Key aspects of the Proposed Scheme for the topic

7.4.1 The assessment of community effects will consider impacts and effects during both construction and operation of the Proposed Scheme. Impacts can generate the following broadly defined effects on receptors and resources:

- **Loss or gain:** A loss or gain to a resource or receptor. For example, a decrease in housing stock as a result of demolitions;
- **Displacement:** The re-location of receptors and resources from one location to another within the study area. For example, people moved from their homes to replacement homes permanently or temporarily;
- **Change in amenity:** The benefits of enjoyment and wellbeing that receptors gain from a resource in line with its intended function. This is referred to as an amenity value. The amenity value that receptors give to resources may be effected by a combination of factors such as: noise and vibration; air pollution/odours; traffic/congestion; air and water quality; and visual impacts. As such, the amenity assessment will draw on the conclusions from other assessment topics which could lead to impacts on communities; and
- **Severance:** In the context of this assessment severance is measured by the barriers that pedestrians, equestrians and cyclists face in making their usual journeys, as well as potential isolation and islanding of communities (vehicular journeys will be covered by the Transport Assessment). This includes physical, psychological and social barriers (i.e. non-economic) and the effects of this on local communities. Severance of commercial and industrial buildings and land, and agricultural property and land, are addressed within the scope of assessments presented in Section 13 (Socio-economics) and Section 4 (Agriculture, Forestry and Soils).

7.4.2 In addition, community effects may result from the accumulation of impacts from other topics. Such impacts may occur both simultaneously (e.g. noise and severance during construction) and sequentially (e.g. where construction effects are followed by operational effects).

7.4.3 The key requirement is to identify whether combined effects on particular locations, resources or receptors (in this case, the local community) may give rise to any new or more significant effects. There is no established method

for comparing impacts from a range of topics, hence professional judgment will be required, based on an overall understanding of the sensitivity of the community resource or receptor, the way in which it is likely to respond to the predicted change and the effectiveness of proposed mitigation.

7.4.4 The work will also consider the wider HS2 business case with a high level overview of second round (catalytic) effects on communities (such as development associated with the Proposed Scheme) noted. These though are not considered to be directly within the scope of this assessment as they will be covered as part of impact assessments for other development proposals.

7.5 Scope of assessment

7.5.1 The scope for the community assessment draws on the AoS, experience and good practice from similar infrastructure projects elsewhere and professional judgment of a suitably qualified EIA practitioner.

Spatial and technical scope

7.5.2 The proposed spatial scope is summarised in Table 7. This scope will be refined as the assessment proceeds (e.g. to ensure consistency with other environmental topics).

Table 7– Impacts and Effects on Resources and Receptors and Spatial Scope

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
Residential property	Residential property (including gardens) lost to land take	Reduction in housing stock available for people	Displacement of home owners/tenants, inconvenience and loss of their assets	Direct land take by HS2 either for the Proposed Scheme itself or for construction
	Damage to residential property as a result of ground settlement	Repairs needed or value of property diminishes	Inconvenience/ disruption to landlords/owners/ residents	Properties up to 30m from boundary of outer edge of tunnel or excavation works
	Amenity value of residential property is changed	Character or quality of residential properties change as a result, for example due to noise and vibration; traffic/congestion; reduction in	Receptors' enjoyment of resource is changed	Relevant impact area from the edge of the route of the Proposed Scheme is a minimum of 250m in both

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
		air/water quality; visual impacts		urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of residential properties from other properties and infrastructure	Physical e.g. islanding or isolation of resource	Social and psychological e.g. community ties/integrity is damaged	Anticipated to cover some households up to 1km of route and construction sites and depending upon specific context and proposals ⁶⁰
Community Infrastructure, Recreation Infrastructure and Open/Play space	Infrastructure lost to land take	Decline in facilities available for community use or temporary impairment of use	Loss of facilities and benefits for users, workers owners, and groups/organisations	Direct land take by the Proposed Scheme
	Damage to property as a result of ground settlement	Repairs needed or value of property diminishes	Costs of repairs and inconvenience to landlords/owners/tenants/users	Properties up to 30m from boundary of tunnel or excavation works
	Presence of construction workers with consequent requirements	Increased demand from construction workers	Reduced availability for users, workers, owners, and groups/organisations	Distance to relevant infrastructure likely to be significantly used by construction workers
	Amenity value of infrastructure is	Character or quality of cities/towns/neighbourhoods changes	Receptors' enjoyment of resource is changed	Relevant impact area from the edge of the route of the

⁶⁰ The distance of the diversion and duration are factors in determining whether or not there is an impact

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
	changed	as a result of noise and vibration; traffic/congestion; reduction in air/water quality; visual impacts		Proposed Scheme is a minimum of 250m in urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure from receptors	Physical e.g. islanding or isolation of resource	Social and psychological e.g. community ties/integrity is damaged	Catchment area of effected resource where it is subject to severance ⁶¹
Existing community organisations	Community activities lost to land take	Loss or impairment of community activities	Loss or impairment of activities	Direct land take by the Proposed Scheme

⁶¹ The distance of the diversion and duration are factors in determining whether or not there is an impact

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
	Ground settlement and community facilities	Repairs needed or value of property diminishes	Inconvenience to landlords/owners/tenants/users	Properties up to 30m from boundary of tunnels or excavations
	Amenity value of infrastructure is changed resulting in an impact on organisations' operations	Character or quality of organisations' environment changes as a result of noise and vibration; traffic/congestion; reduction in air/water quality; visual impacts	Impact on community organisations	Relevant impact area from the edge of the route of the Proposed Scheme is a minimum of 250m in urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure from receptors resulting in an impact on organisations' operations	Physical e.g. islanding or isolation of resource results in change to organisations' environment	Impact on community organisations	Catchment area of effected resource where it is subject to severance ⁶²

Temporal scope

7.5.3 The temporal scope for this topic is outlined in Section 2.2 (Scope of the assessment) of the Report. Community effects will be assessed for the construction period (including a period of commissioning) (2018 - 2026) and for the year of opening in 2026. However, the assessment will also need to reflect the temporal scope of other topic assessments such as Socio-economics (Section 13) and Traffic and Transport (Section 15).

7.6 Assessment methodology

⁶² The distance of the diversion and duration are factors in determining whether or not there is an impact

7.6.1 There are no industry-wide accepted methods for assessing community effects for projects of this nature. Methods have been developed for predicting and assessing effects which draw existing guidance, analysis and methods established for other railway and large infrastructure projects.

Legislation and guidance

7.6.2 Relevant guidance includes:

- Highways Agency Interim Advice Notes⁶³ and DfT’s Transport Analysis Guidance Website (WebTAG)⁶⁴; and
- Industry accepted practice from other EIAs, for example Crossrail and Thames Tunnel.

Significance criteria

7.6.3 The significance of a community effect will be determined by assessing both the:

- Magnitude of the impact; and
- The sensitivity of the community resources or receptors.

Determining magnitude of impacts

7.6.4 To determine the magnitude of impact, the nature of the impact (beneficial or adverse) and characteristics (i.e. whether direct or indirect, secondary, cumulative, short or long-term, permanent or temporary, reversible or irreversible) will be assessed and classified as high, medium, low or negligible.

7.6.5 The magnitude of an impact is its severity or scale. The magnitude of an impact on a resource or receptor reflects consideration of information and analysis relating to the spatial extent (localised/isolated versus widespread with potential secondary effects); the extent (number of groups and/or people or households effected); and the duration (short, medium and long-term).

7.6.6 Guideline criteria have been established based on professional judgment and are presented in Table 8.

Table 8 - Community impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very adverse/beneficial, and very likely to effect large numbers of groups and/or people (with number depending on the local context and nature of the impact), and that will usually continue and effectively constitute a permanent, long-term impact on the baseline conditions

⁶³ Department for Transport (DfT) and the Highway’s Agency, various dates, Interim Advice Notes; <http://www.dft.gov.uk/ha/standards/ians/index.htm>

⁶⁴ Department for Transport (DfT), WebTAG Home, Transport Analysis Guidance; <http://www.dft.gov.uk/webtag/> and www.webtag.org.uk

Impact magnitude	Definition
Medium	An impact that is likely to effect a moderate number of groups and/or people (with number depending on the local context and nature of the impact)
Low	An impact that is likely or may effect a small number of groups and/or people (with number depending on the local context and nature of the impact) and/or that usually does not extend beyond the life of the project so that the base case is not effected beyond a short or medium-term duration
Negligible	An impact that is temporary in nature and/or is anticipated to have a slight or no effect on the well-being of groups and/or people

Determining receptor sensitivity

7.6.7 Sensitivity of resources will be defined by their importance, scarcity and size. Sensitivity of receptors will be determined by the extent to which individuals have the capacity to experience the effect without a significant loss or gain. Sensitivity will be classified as high, medium or low.

7.6.8 Guideline criteria have been established using professional judgment to determine the sensitivity of the receptors. These are presented in Table 9.

Table 9 - Community receptor value/sensitivity criteria

Receptor value and/or sensitivity	Definition
High	Individuals or groups who are at risk and that have little or no capacity to experience the impact without incurring a significant effect
Medium	Individuals or groups that have a limited or average capacity to experience the impact without incurring a significant effect
Low	Individuals or groups that generally have adequate capacity to experience impacts without incurring a significant effect

Determining the significance of effects

7.6.9 The significance of a community effect is a product of the magnitude of the impact and the sensitivity of the receptor and will be determined based on professional judgement.

7.6.10 The approach to determining the significance of community effects is summarised in Table 10.

Table 10 - Community - significance of effect criteria

Significance		Impact magnitude			
		High impact	Medium impact	Low impact	Negligible impact
Sensitivity of receptor	High	Major adverse /beneficial - significant	Major adverse /beneficial - significant	Moderate adverse /beneficial - significant	Minor adverse /beneficial - not significant
	Medium	Major adverse /beneficial - significant	Moderate adverse /beneficial - significant	Minor adverse /beneficial - not significant	Negligible - not significant
	Low	Moderate adverse/beneficial - significant	Minor adverse/beneficial - not significant	Negligible - not significant	Negligible - not significant

7.6.11 Effects are considered to be significant if both impact magnitude and receptor sensitivity is high or medium. Additionally, effects are considered to be significant if impact magnitude is high and receptor sensitivity is low, or alternatively if receptor sensitivity is high and impact magnitude is low. This equates to major and moderate adverse/beneficial effects.

7.6.12 Other effects, equating to minor adverse/beneficial and negligible effects, are not considered to be significant.

Construction effects

7.6.13 Construction effects will be assessed following the general EIA assessment process including:

- Establishment of the baseline with definition and collection of relevant data and information as outlined in Section 7.2 (Establishment of baseline and definition of survey);
- Consultations including those outlined in Section 7.3 (Consultation);
- Assessment of impacts and effects against key aspects of the Proposed Scheme as outlined in Section 7.4 (Key aspects of the Proposed Scheme for the topic), covering the scope outlined in Section 7.5 (Scope of assessment) and using the significance criteria outlined in this section; and
- Iterative further assessment of impacts identified through other EIA work, for example in relation to development covered in the Socio-economic Assessment within the ES.

Operational effects

7.6.14 The same process will be used for the assessment of operational effects as outlined for construction effects above.

Cumulative effects

7.6.15 As outlined in Section 2.4 (Cumulative Effects) of this Report, the EIA will consider the interaction between the Proposed Scheme, HS2 Phase 2 and other consented or completed development which may give rise to significant cumulative effects.

7.7 Assumptions

7.7.1 For assessment purposes it will be necessary to assume that the baseline characteristics established during the EIA process will remain largely unchanged. However, where it is possible to predict change, or to identify planned community facilities, these will be incorporated into the future baseline. Projections of future climate change will also be incorporated in the definition of the future baseline. The methodology for assessing the significance of impacts on climate change adaptation within Community will be developed in conjunction with the climate change specialists on the EIA team.

7.7.2 The assessment will take into account how uncertainty and variability of impacts could generate different effects. For example, variability in service frequency could have varying impacts on sound, noise and vibration and air quality, which in turn could have different effects on community enjoyment of amenity.

8 Cultural heritage

8.1 Introduction

- 8.1.1 This section of the Report describes the methodology to be used in the assessment of the likely significant impacts and effects upon heritage assets and the historic environment effected by the construction and operation of the Proposed Scheme.
- 8.1.2 Heritage assets are defined by the Government in the NPPF Annex 2 Glossary as 'A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions. Heritage asset includes designated heritage assets and assets identified by the local planning authority (including local listing)'.
- 8.1.3 Heritage assets include those that are designated under legislation (refer to the NPPF Annex 2 Glossary Designated heritage assets) as well as those that are undesignated assets. Undesignated assets are heritage assets identified as such by local authorities and evidence for these can be obtained through their inclusion within the local Historic Environment Record (HER) (refer to paragraph 15 of English Heritage's Historic Environment Planning Practice Guide, 2010). Undesignated assets may also include those that have been identified but have not been included in the HER. Undesignated heritage assets will also include assets revealed during the course of survey and research undertaken during EIA preparation.
- 8.1.4 The NPPF Annex 2 Glossary defines the historic environment as: All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.
- 8.1.5 Cultural Heritage is generally and most easily divided into three key areas, as follows:
- Archaeological and palaeo-environmental remains including geological deposits that may contain evidence of the human past;
 - Historic landscapes; and
 - Historic buildings and the built environment.

8.2 Establishment of baseline and definition of survey

- 8.2.1 The baseline to be assessed is that which is current as at the time of the publication of the ES.
- 8.2.2 The Proposed Scheme passes through both urban and rural environments of varied historical characteristics that help to inform the data gathering process. In the process of data gathering, it is recognised that there are interfaces with other disciplines, for example ecology, sound, noise and vibration, and landscape. These interfaces will be actively addressed as part of the EIA process to ensure that an integrated assessment is undertaken.
- 8.2.3 Data in respect of heritage assets will be collected for the following designated and undesignated assets:
- 8.2.4 Designated assets:
- World Heritage Sites;
 - Listed Buildings, Grade I, II* and Grade II;
 - Scheduled Monuments;
 - Registered Parks and Gardens, including London Squares;
 - Conservation Areas;
 - Registered Historic Battlefields;
 - Registered Commons (insofar as they contribute to historic landscape character); and
 - Ancient Woodlands.
- 8.2.5 Undesignated assets:
- Undesignated historic buildings, structures and built monuments including:
 - Locally listed buildings, buildings of local merit; and
 - Buildings, structures and monuments included in the HER.
 - Undesignated archaeological or historic landscape sites including:
 - Sites listed in the HER and the National Record of the Historic Environment (previously known as National Monuments Record)
 - Archaeological assets of schedulable quality and as identified in the NPPF paragraph 139;
 - Sites or areas predicted or known from desk based or fieldwork study;
 - Palaeo-environmental remains and geological deposits containing evidence for the human past;
 - Known historic settlements including those identified as being of archaeological interest in local planning authority documents;
 - Hedges protected under Hedgerow Regulations (*The Hedgerows Regulations, 1997*⁶⁵) and;

⁶⁵ HM Government, 1997 No. 1160, *The Hedgerows Regulations 1997*, The Stationery Office

- Non-designated historic parks, gardens and battlefields.

8.2.6 Baseline data sources will include:

8.2.7 Existing data

- Details of designated sites held by English Heritage;
- Local authority conservation area appraisal documents and statements (where available) and their mapping
- Records of Ancient Woodland maintained by Natural England, Defra and the Forestry Commission;
- Historic landscape character mapping;
- HER data, held by local planning authorities;
- Aerial photographs;
- Geological mapping and borehole information as held by British Geological Survey;
- Documentary, cartographic and other resources as deposited within local studies libraries, county and national records libraries and archives;
- Readily available published material, building surveys and gazetteers; and
- Data sets held by other bodies, such as British Waterways and the National Trust who have specific data on the assets for which they have a responsibility.

8.2.8 Data collected during the EIA process

- Data from preliminary works such as boreholes or test pits;
- Data from a programme of non-intrusive survey;
- Data from light detection and ranging (LiDAR) aerial survey;
- Data from intrusive techniques, for example trial trenching and building survey;
- Data in respect of the zone of theoretical visibility (ZTV) as identified by the Landscape and Visual Assessment [see Section 12 (Landscape and Visual Assessment)]; and
- Data obtained through site visit and walkover survey from public land, or from private land where access has been previously arranged and approved.

8.2.9 The requirement for and scope of non-intrusive and intrusive survey including building survey, is to be developed and agreed in consultation with English Heritage and other appropriate bodies including Local Authority Conservation Officers and Archaeological Officers (subject to land access). In determining the need and scope for such survey a character area, risk based approach will be adopted. This approach will use the evidence collected during the EIA process regarding the historic environment to predict the likelihood of the discovery of previously unknown heritage assets, particularly below ground archaeological sites. In developing the heritage baseline and assessing the impact and effects of the Proposed Scheme, character areas (as opposed to point specific assets) will be defined and used

to identify patterns of discovery, identify the risk of previously unknown archaeological remains to determine the type of field evaluation.

Study Area

8.2.10 The definition of the study area for heritage assets will vary between the metropolitan urban and country sections of the Proposed Scheme. The study area in urban London and Birmingham will comprise the entire land take required for construction (including permanent and temporary works), plus 250m either side of the full extent of the land take. In the Country South and Country North rural sections, the study area will encompass the entire land take plus 500m either side of the full extent of the land take. In addition for the appraisal of the setting of heritage assets, including historic landscapes, the study area will be defined by the ZTV, for both rural and urban sections of the route. The extent of the ZTV will be identified by the Landscape, and Visual Assessment within the ES.

London and West Midlands Metropolitan areas

8.2.11 The London Metropolitan section of the Proposed Scheme includes the London Euston and Old Oak Common stations/interchanges. It passes through predominantly urban areas and lies within the GLA administrative area. Substantial parts of this route will be in tunnel, therefore the potential for ground settlement will be considered. Developments around Euston station and other sections of the route, where excavation or development is required, may result in demolitions and ground disturbance and may impact upon heritage assets and their setting.

8.2.12 The West Midlands section of the Proposed Scheme passes through the suburban and urban areas of Solihull and Birmingham and includes the infrastructure maintenance depot at Washwood Heath, a station interchange at Birmingham International and a new station at Curzon Street, Birmingham. These developments may result in demolitions and ground disturbance and may impact upon heritage assets and their setting.

8.2.13 This section of the Proposed Scheme also passes through areas of a more rural character where there is potential for impacts to occur both to the setting of heritage assets and to historic landscape character areas.

8.2.14 To identify those heritage assets whose fabric may be affected, the urban study area including the full extent of the landtake for the Proposed Scheme plus 250m each side, will be established. Field visits will be carried out to all heritage assets (where access is permitted) within this study area.

8.2.15 Field visits within the study area will comprise field inspection to identify heritage assets and to examine the character and form of the historic urban landscape. The purpose of the survey will be to verify the baseline research, assess the nature and condition of known heritage assets and identify previously unidentified assets which may be affected by the Proposed Scheme. These activities will provide an understanding of the characteristics

of the landscape and the assets that are contained within it and their contribution to the overall historic landscape/urban landscape within the defined ZTV area.

- 8.2.16 The study area will be defined by the extent of the ZTV to be identified by the Landscape, Townscape and Visual Assessment within the ES. Within the ZTV area, the setting of all assets will be considered.

Country south and country north

- 8.2.17 The Country South section of the Proposed Scheme passes through a number of rural counties. Much of the Proposed Scheme will be in either tunnel or cutting, with some sections elevated on viaduct or embankment.
- 8.2.18 The Country North section of the Proposed Scheme passes through the rural and suburban areas of Warwickshire and Staffordshire and will be partly in cutting and on viaduct, with substantial sections at grade.
- 8.2.19 To identify those heritage assets whose fabric may be effected, a study area which includes the full extent of the landtake for the Proposed Scheme plus 500m to each side of the route will be established. Field visits will be carried out to all heritage assets (where access is permitted) within this study area.
- 8.2.20 Field visits within the study area will comprise field inspection to identify heritage assets and to examine the character and form of the historic landscape. The purpose of the survey will be to verify the baseline research, assess the nature and condition of known heritage assets and identify previously unidentified assets which may be affected by the Proposed Scheme. These activities will provide an understanding of the characteristics of the landscape and the assets that are contained within it and their contribution to the overall historic landscape within the defined ZTV area.
- 8.2.21 The study area will be defined by the extent of the ZTV to be identified by the Landscape, Townscape and Visual Assessment within the ES. Within the ZTV area, the setting of all assets will be considered.

8.3 Consultation

Consultation on the AoS

- 8.3.1 A large number of consultation responses were received regarding the AoS in respect of heritage assets. Responses included those from formal bodies including English Heritage, the National Trust, the Garden History Society and local planning authorities. Other responses were received from local amenity societies, specialist interest groups and other stakeholders.
- 8.3.2 The response from English Heritage in relation to heritage assets focused on matters affecting setting. English Heritage is of the opinion that a 350m study area either side of the route is inadequate to assess impacts upon setting. As a consequence of this response, and to provide a robust basis for

defining the area of survey, it is proposed that survey for analysis and assessment of the setting of assets will be determined primarily by the extent of ZTV defined for the area of assessment of visual impact [see Section 12 (Landscape and Visual Assessment)]. It is however, acknowledged that other factors such as noise and light impacts may extend beyond the ZTV, and these will be assessed within the respective chapters of the ES.

- 8.3.3 English Heritage was also concerned over the omission within the AoS of known but undesignated archaeological assets. They were concerned that this omission did not therefore take into account those undesignated archaeological assets of schedulable quality or other undesignated archaeological assets.
- 8.3.4 English Heritage acknowledges the distinction in gradation between Grade I and Grade II* buildings and those listed at Grade II. It is their view that a 'regionally important' classification does not reflect the national designation of Grade II listed buildings. A geographical based terminology is not part of government or English Heritage policy which, as embodied in the NPPF, is based on the significance/value of assets. A set of significance based criteria (refer to the NPPF Annex 2, Glossary) is therefore proposed as set out in Table 11.
- 8.3.5 Responses from both the National Trust and Garden History Society are concerned particularly with impacts that might arise to Hartwell House and gardens. The methodology for assessment acknowledges the impacts that can arise to the setting or fabric of designated assets (including Registered Parks and Gardens) and acknowledges the high sensitivity of those of Grade I or Grade II* such as at Hartwell.
- 8.3.6 In respect of the London Metropolitan area of the 2011 consultation scheme, the London Borough of Camden issued a consultation response opposing the scheme for reasons including the potential impact on built heritage assets, particularly around Euston station. The London Borough of Camden requested that proper consideration be given to the setting of heritage assets, including conservation areas, and that relocation of listed structures (monuments) be considered in mitigation.
- 8.3.7 The proposed scope and methodology of assessment allows all of these issues to be identified and addressed as part of the EIA.

Consultation as part of the EIA process

- 8.3.8 English Heritage, the National Trust and the Garden History Society are proposed consultees, and engagement with these organisations and others, such as the Society for the Protection of Ancient Buildings and the Historic Houses Association, will continue throughout the EIA process.
- 8.3.9 Consultation with local planning authorities along the route of the Proposed Scheme, including the Community Forums, will continue throughout the EIA

process. This will ensure that consultation comments are appropriately considered.

- 8.3.10 Other key consultees for the topic will include the Local Authority Archaeological Officers (or ‘Curators’) or their equivalents for Hertfordshire, Buckinghamshire, Oxfordshire, Northamptonshire, Warwickshire, Birmingham and Staffordshire. In London, this role is performed by English Heritage’s Greater London Archaeology Advisory Service. Local Authority Conservation Officers and, in London, English Heritage Historic Building Officers will also be key consultees.
- 8.3.11 It will be necessary to consult English Heritage’s regional scientific advisors where this consultation does not occur as part of the wider English Heritage consultation. This will be undertaken to ensure comprehensive consultation with all relevant parts of English Heritage who have an interest in the Proposed Scheme.

8.4 Key aspects of the Proposed Scheme for the topic

- 8.4.1 Key aspects of the Proposed Scheme for this topic include:
- Construction works which require the physical excavation of, demolition or removal of, or alteration to heritage assets;
 - Settlement of heritage assets resulting from tunnelling, deep excavations or construction of retaining walls;
 - Impacts upon the setting of heritage assets;
 - Loss of coherence or legibility of heritage assets, such as through severance;
 - Temporary setting effects on designated or other heritage assets;
 - Ground disturbance caused through the implementation of ecological and other mitigation measures;
 - Damage to waterlogged deposits through changes in groundwater regimes;
 - Increased noise effects upon heritage assets at some locations where tranquillity may be a consideration;
 - Vibration effects upon heritage assets during both construction and operation; and
 - Protection of heritage assets during construction activities.

8.5 Scope of assessment

- 8.5.1 Effects to be assessed are direct and indirect, temporary, permanent and cumulative. Each of these is examined below in the context of the Cultural Heritage assessment to be presented in the ES.
- 8.5.2 A direct effect is one that will occur to the physical fabric or land of an asset and its curtilage, and will include any effect upon the setting of that asset arising directly from the Proposed Scheme.
- 8.5.3 An indirect effect is one that might arise as a consequence of the operation or construction of the railway by, for example, affecting viability of land leading to dereliction of buildings and land leading to changes in the management or land use of archaeological or historic landscape features. These can also affect the availability of land for future research in cases where archaeological sites may be buried by earth bunding.
- 8.5.4 A permanent effect will occur for example as a result of the construction and operation of the railway including the permanent works for the railway, some temporary activities and mitigation areas. A permanent effect is not reversible and will (by definition) involve the permanent loss of, or harm to a heritage asset including its setting.
- 8.5.5 A temporary effect will occur for example as a result of soil storage, contractor's site compounds and access routes and erection of other facilities and structures associated with the construction of the railway. These developments are to be removed following construction and prior to the operation of the railway and their effect on, for example, the setting from a range of sources is therefore reversible. Such developments may also have permanent effects as identified in paragraph 8.5.4.
- 8.5.6 A cumulative effect is one arising from the incremental effects of multiple developments on heritage assets.

Spatial scope

- 8.5.7 Within both the rural and metropolitan sections of the Proposed Scheme, an area of survey as defined by the ZTV will be set. Within the area of survey, designated and undesignated heritage assets will be identified and assessed in accordance with the methodology defined in Section 8.2 (Establishment of baseline and definition of survey). This will allow for identification and assessment of setting and other impacts to assets.
- 8.5.8 Further detailed assessment of Proposed Scheme impacts will be carried forward only for those heritage assets where the Proposed Scheme would impact upon the physical characteristics and setting of the asset, such that significance (archaeological, architectural, artistic or historic) would be effected. It is acknowledged that setting could be effected by other scheme factors including but not limited to light and noise; and these will be

considered as part of the assessment process. An outline of the characteristics of the historic landscape zones, through which the route of the Proposed Scheme passes, is provided in Section 8.2 (Establishment of baseline and definition of survey).

Temporal scope

- 8.5.9 The assessment will consider both temporary and permanent impacts on heritage assets and their setting. The assessment will identify impacts which are temporary in nature for example impacts on setting derived from construction-related sites. It is however recognised that these impacts may be permanent for some classes of assets, for instance buried archaeological assets.
- 8.5.10 The temporal scope of the assessment assumes a baseline with current conditions as of the date of publication of the ES, with construction commencing in 2017 and the Proposed Scheme being operational by 2026.

Technical scope

- 8.5.11 The fabric and setting of all heritage assets will be considered, as described in 'Spatial scope' above. Further detailed assessment of Proposed Scheme impacts will be carried forward only for those assets where the Proposed Scheme would impact upon the setting or fabric of the asset such that significance (archaeological, architectural, artistic or historic) would be affected.

8.6 Assessment methodology

Legislation and guidance

- 8.6.1 Policy in respect of heritage assets is set out in the NPPF (Section 12 Conserving and enhancing the historic environment).
- 8.6.2 There is no specific national guidance on the methodology for the preparation of impact assessments for heritage assets. However, DMRB (Volume 11: Environmental Assessment) provides an approach for the assessment of impacts arising from highway schemes; and Section 3, Part 2 (HA 2008/07) covers Cultural Heritage including historic landscape (Annex 7).
- 8.6.3 In May 2010, the International Council on Monuments and Sites (ICOMOS) issued draft guidance on Heritage Impact Assessments for Cultural World Heritage Properties⁶⁶. Though specifically addressing World Heritage Sites and development impact on their Outstanding Universal Value, the document provides an approach to assessment and evaluation of impact.

⁶⁶ The International Council on Monuments and Sites (ICOMOS), 2010, *Guidance on Heritage Impact assessments for Cultural World Heritage Properties*, ICOMOS

8.6.4 In May 2011, English Heritage published its guidance '*Seeing History in the View*' (2011a)⁶⁷. This guidance, which deals specifically with assessing impact upon heritage views and multiple assets, contains an approach to baseline analysis and the assessment of impact; with a series of tables to assist the process. More recently, in 2011, English Heritage published its guidance on the Assessment of Setting which sets out an approach to the analysis and assessment of setting and its relationship to the heritage significance of an asset (2011b)⁶⁸.

8.6.5 Additional guidance in respect of the Historic Environment is set out in the English Heritage Historic Environment Practice Guide of March 2010 which remains current notwithstanding the introduction of the NPPF which replaced Planning Policy Statement 5 (PPS5): Planning for the Historic Environment in March 2012.⁶⁹

Approach

8.6.6 The methodology set out in the above legislation and guidance is summarised as follows:

- Identify the baseline heritage assets (defined as all data collected from a range of desk based sources and as appropriate, surveys) and their setting;
- Assess the significance/value of the baseline assets and their settings;
- Identify and define the magnitude of impact and the severity of the effects;
- Identify mitigation required and its methodology in terms of spatial extent and techniques to be deployed; and
- Assess the development impact and its effect on the significance of the asset taking into consideration any mitigation proposed.

Significance Criteria

8.6.7 The significance of a heritage asset is defined as 'The value of a heritage asset to this and future generations because of its heritage interest; that interest may be archaeological, architectural, artistic or historic' (the NPPF Annex 2, Glossary). Assets can be designated or un-designated. Designated assets are so designated in accordance with national or international criteria (conservation areas are a local authority designation, though determined through legislation) and have statutory protection. In assessing the significance of an asset, English Heritage has outlined a number of values which contribute to overall significance. These include evidential, historical, aesthetic and communal value [Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment

⁶⁷ English Heritage, 2011a, *Seeing History In The View; A Method For Assessing Heritage Significance Within Views*, English Heritage

⁶⁸ English Heritage, 2011b, *The Setting Of Heritage Assets, English Heritage Guidance*, English Heritage

⁶⁹ Communities and Local Government (CLG), 2010, *Planning Policy Statement 5 (PPS5): Planning for the historic Environment*, The Stationary Office

(2008)].⁷⁰ Non-designated heritage assets may exhibit equivalent values to those which have been granted statutory protection.

- 8.6.8 Setting can also contribute to significance. Setting is not simply a visual consideration and specific guidance on the analysis of setting is set out by English Heritage (2011a).
- 8.6.9 Taking these criteria into account, each identified baseline heritage asset will be assigned a level of significance in accordance with a five-point scale as shown in Table 11.

Table 11 - Factors for assessing the significance/value of heritage assets

Significance (value)	Asset Categories
High	Remains of inscribed international importance, such as World Heritage Sites Grade I and Grade II* Listed Buildings Grade I and Grade II* Registered Parks and Gardens Scheduled Monuments Registered battlefields Undesignated archaeological assets of schedulable quality and importance Undesignated buildings, monuments, sites or landscapes that can be shown to have particularly important qualities in their fabric or historical association Areas of Ancient Woodland (Ancient semi-natural woodland) as mapped and designated by Natural England Cemeteries
Moderate	Grade II listed Buildings Conservation Areas Grade II Registered Parks and Gardens Sites of high archaeological resource value as identified through consultation Locally listed buildings as recorded on a local authority list Undesignated buildings, monuments, sites or landscapes that can be shown to have important qualities in their fabric or historical association Registered Common Land Historic Hedgerows Historic Townscapes with historic integrity in that the assets that constitute their make-up are clearly legible
Low	Undesignated buildings, monuments, sites or landscapes of local importance and of modest quality Locally important historic or archaeological sites, sites with a local value for education or cultural appreciation Assets that are so badly damaged that too little remains to

⁷⁰ English Heritage, 2008, *Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment*, English Heritage

Significance (value)	Asset Categories
	justify inclusion into a higher grade Parks and gardens of local interest
Not Significant	Assets identified as being of no historic, evidential, aesthetic or communal interest Assets whose values are compromised by poor preservation or survival or of contextual associations to justify inclusion into a higher grade

Magnitude of impact

- 8.6.10 Impacts can be direct or indirect, and can be characterised in terms of timing, scale, duration, reversibility and the likelihood of the impact occurring. Impacts can be short, medium or long-term, permanent or temporary and can be positive or negative.
- 8.6.11 An impact can occur to the setting of a heritage asset such that significance is affected. Guidance on how to establish impact on an asset's setting is set out by English Heritage (2011a).
- 8.6.12 The magnitude of an impact can vary from 'high' to 'no change' as set out in Table 12, and can be beneficial or adverse.

Table 12 - Factors influencing the assessment of magnitude of impacts

Impact Rating	Description of Impact
High	Change such that the significance of the asset is totally altered or destroyed. Comprehensive change to setting effecting significance, resulting in changes in our ability to understand and appreciate the resource and its historical context and setting
Medium	Change such that the significance of the asset is affected. Changes such that the setting of the asset is noticeably different, effecting significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting
Low	Change such that the significance of the asset is slightly affected. Changes to the setting that have a slight impact on significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting
Minimal	Changes to the asset that hardly affect significance. Changes to the setting of an asset that have little effect on significance and no real change in our ability to understand and appreciate the resource and its historical context and setting
No change	The development does not affect the significance of the asset. Changes to the setting that do not affect the significance of the asset or our appreciation of it

Significance of effects

- 8.6.13 Only those heritage assets where there is a potential for impact, as determined following a review and analysis of available data including site visits, will be assessed. Assessment of the significance of effects will take into consideration mitigation associated with the Proposed Scheme, for example landscape planting, ecological compensation and noise barriers. It should be recognised that some mitigation measures can themselves be a source of impact.
- 8.6.14 The assessment of the level of overall significance of the effect, taking into consideration mitigation, is determined by cross referencing the significance value of the asset (Table 11) and the magnitude of impact (Table 12), as shown in Table 13.
- 8.6.15 Major and moderate impacts may be considered to be significant effects. The assessment of overall effect can be either adverse or beneficial.

Table 13 - Matrix for establishing overall significance of effect

Significance and value of asset	Magnitude of impact				
	No Change	Minimal	Low	Medium	High
High	Neutral	Minor	Moderate	Major	Major
Moderate	Neutral	Minor	Minor	Moderate	Major
Low	Neutral	Negligible	Minor/ Negligible	Minor	Moderate
Not Significant	Neutral	Negligible	Negligible	Negligible	Negligible

Construction effects

- 8.6.16 Construction effects will be assessed following the general EIA assessment process including the establishment of the baseline, consultations, assessment of impacts and effects against key aspects of the Proposed Scheme, the scope of the assessment and using the significance criteria outlined in this section. Further assessment of impacts identified through other EIA work, for example the assessments for sound, noise and vibration, landscape and visual, and ecology will be undertaken.

Operational effects

- 8.6.17 The same process will be used for the assessment of operational effects as outlined for construction effects above.

Cumulative effects

- 8.6.18 The construction of the Proposed Scheme will generate economic stimulus for development within its corridor and particularly at stations to take advantage of the economic benefits such a location will bring. This, combined with developments that are already taking place or anticipated along the route of the Proposed Scheme, will result in increased pressure on

heritage assets through total or partial loss, impacts on significance value or increased urbanisation resulting in adverse impacts on the setting of heritage assets. The criteria for the selection of developments included in the cumulative impact assessment are provided in Section 2.4 (Cumulative effects) of this Report.

8.7 Assumptions

- 8.7.1 Key assumptions for this topic are that relevant data will be available from the various archive and record holding bodies consulted (i.e. HERs, English Heritage, the National Record of the Historic Environment), records of designated sites (including the National Heritage list for England); and that collections of historic maps and other sources held by external record offices (such as local studies libraries, county and national archives) will be available.
- 8.7.2 The assessment within this section considers heritage assets from the perspective of the historic environment. The value of heritage assets – such as historic buildings, archaeological earthworks and deposits, elements of historic landscape survival - from amenity, ecological and landscape points of view is considered in Section 7 (Community), Section 9 (Ecology) and Section 12 (Landscape and Visual Assessment) of this Report, respectively. Effects on geology and geomorphology are considered in Section 11 (Land Quality), while effects on sound, noise and vibration are considered in Section 14 (Sound, Noise and Vibration).

9 Ecology

9.1 Introduction

- 9.1.1 This section of the Report sets out the scope for the ecology component of the EIA of the Proposed Scheme.
- 9.1.2 It describes the methodologies that will be used to identify the potential for impacts and effects upon species and habitats, including sites recognised or designated for their significance for nature conservation that are found along the route of the Proposed Scheme.

9.2 Establishment of baseline and definition of survey

- 9.2.1 The baseline conditions for the EIA will be established through a combination of desk study, field survey and consultation.
- 9.2.2 Existing biological data for the route of the Proposed Scheme will be obtained from relevant Biological Records Centres and from national and local specialist data sources, such as Bat Groups. The data to be collated will include:
- Statutory designated sites within 10km of the route⁷¹;
 - Non-statutory designated sites within 5km of the route;
 - Records of protected, priority or otherwise notable species within 5km of the route (in some locations and for some species including bats, the corridor of search will be extended up to 10km from the route to ensure that a complete baseline for the assessment is gathered); and
 - Priority or otherwise notable habitats or features within 500m of the route.
- 9.2.3 Other relevant sources of ecological data such as national and local Biodiversity Action Plans, ancient woodland inventories⁷², existing Phase 1 habitat surveys and Habitat Biodiversity Audits, Biodiversity Opportunity Mapping and Green Infrastructure studies will be consulted.
- 9.2.4 In addition, existing ecological data available from other sources, such as ESs associated with other relevant developments or Nature Reserve monitoring records, will be consulted where available.
- 9.2.5 As with the area of search for the desk study, the width of the survey corridor will be defined by the potential area of ecological impact. This will vary depending on a number of factors, including the engineering of the route, the topography and ecological connectivity of the landscape, and the

⁷¹ Desk study searches encompass corridors either side of the centreline of the proposed route.

⁷² It is noted that some ancient woodland may be omitted from ancient woodland inventories, for a number of reasons including the size of the woodland block.

ecological receptor. In rural sections, the survey corridor for some species, such as Great Crested Newt, could extend up to 500m either side of the route⁷³; in urban sections, the survey corridor will, in general, be much narrower as the zone of impact will be more restricted.

9.2.6 Phase 1 habitat surveys will be carried out. On the basis of the habitats present, and on the basis of professional judgement by an ecologist as to the potential for the presence of protected or otherwise notable species, further detailed specialist surveys will be undertaken where possible.

9.2.7 Specialist surveys will include:

- Detailed botanical surveys (including National Vegetation Classification);
- Surveys of invasive non-native species;
- River Habitat Surveys and River Corridor Surveys;
- Hedgerow surveys;
- Ditch surveys;
- Pond surveys;
- Amphibian Habitat Suitability Index (HSI) surveys of water bodies;
- Amphibian surveys of water bodies;
- Reptile surveys;
- Breeding bird surveys;
- Wintering and passage bird surveys;
- Badger surveys;
- Hazel dormouse surveys;
- Bat surveys of suitable features, to determine suitability as bat roosts, and emergence and activity surveys to determine presence and patterns of use by bats (where Habitats Directive Annex II⁷⁴ species are thought to be present, additional surveys will be agreed with Natural England);
- Otter surveys;
- Water vole surveys;
- Terrestrial invertebrate surveys;
- Aquatic macro-invertebrate surveys;
- White-clawed crayfish surveys; and
- Fish surveys.

9.2.8 Further details on the survey methodologies will be set out in the ES. The methods set out in this Report follow recognised methodologies (deviating only where considered appropriate); and have been determined in consultation with Natural England.

9.2.9 The desk study and field surveys, aided by consultation, will support the identification of sites and features of value. In addition, the assessment will identify landscape-scale ecological features, such as linear features (e.g.

⁷³ Such surveys will extend 500m beyond the outer limit of the area of land required for permanent and temporary works.

⁷⁴ Council Directive 92/43/EEC On the conservation of natural habitats and of wild fauna and flora. Annex II – species requiring designation of Special Areas of Conservation

hedgerows, watercourses, and disused railway lines) that have additional value in providing habitat connectivity and potential migration corridors.

9.3 Consultation

Consultation on the AoS

9.3.1 In response to the findings of the AoS a number of organisations raised ecology matters. These included:

- Natural England;
- Environment Agency;
- Local planning authorities;
- Bat Conservation Trust;
- Royal Society for the Protection of Birds;
- Wildlife Trusts; and
- Defra.

9.3.2 Natural England comments included the following:

- The AoS could not conclude that an Appropriate Assessment is not necessary for the South West London Waterbodies Special Protection Area;
- The impacts on three Sites of Special Scientific Interest (SSSI) were underestimated in the AoS;
- Further investigation is required to understand the likely impacts on groundwater-dependent habitats, including three SSSIs;
- Impacts on veteran trees, wood pasture/parkland sites and small ancient woodlands should be assessed; and
- The requirements of national policy should be fully addressed (e.g. in respect of ancient woodland, Local Wildlife Sites, Local Geological Sites, wider habitat networks and Biodiversity Action Plan habitats).

9.3.3 The Wildlife Trusts also emphasised the importance of looking at the landscape-scale ecological networks, as promoted within the Government's White Paper on the natural environment (2011).

Consultation as part of the EIA process

9.3.4 During the EIA, the above organisations will remain key consultees, along with (although not limited to) the National Trust, Amphibian and Reptile Conservation, Butterfly Conservation, the Forestry Commission, the Woodland Trust and the Deer Initiative.

9.3.5 In addition, at a local level, other organisations and individuals will be consulted to provide existing data and contribute context to the assessment. These will include:

- Local bat groups;
- Local badger groups;
- Local amphibian and reptile groups;

- Local ornithological groups;
- Local groups associated with individual nature reserves and other sites; and
- The Chilterns Conservation Board and the Chiltern Society.

9.4 Key aspects of the Proposed Scheme for the topic

- 9.4.1 Adverse effects on nature conservation could arise most obviously through direct land-take, resulting in habitat loss, fragmentation and barriers, and affecting the ability of habitats and populations to maintain conservation status. Loss or degradation of ecological corridors and networks, with a resulting decline in 'habitat connectivity', is recognised as an issue. At least in the short to medium-term, temporary land-take may give rise to effects as significant as permanent land-take, due to the slow recovery of species, populations and habitats. Some habitats, such as ancient woodland, are recognised as being essentially irreplaceable and where such habitats are affected, mitigation is not practicable, with a focus, instead, on avoidance or compensation measures.
- 9.4.2 Disturbance as a result of sound, noise, movement and/or light during site clearance, construction and operation could give rise to effects on some species. Ecological effects can also result from air and water pollution, arising once again during site clearance and construction, and from changes in water levels or flows.
- 9.4.3 In addition, there is the potential for the Proposed Scheme to have beneficial effects, for example as a consequence of habitat creation designed to extend and link fragments of semi-natural habitat.
- 9.4.4 Key potential ecological impacts are listed in Section 9.6 (Assessment methodology).

9.5 Scope of assessment

Temporal scope

- 9.5.1 The main construction works for the Proposed Scheme are anticipated to take place between 2017 and 2026. The assessment of construction effects will relate to the construction programme set out in the ES. Effects arising from the operation of the Proposed Scheme will be assessed taking account of the services that are expected when HS2 reaches maximum capacity (anticipated to be up to 18 trains per hour at peak times in each direction) (i.e. both Phase 1 and Phase 2 are operational).
- 9.5.2 The baseline for the assessment will be taken as conditions at the time of the 2012 and 2013 surveys. Where the baseline is considered likely to change between the date of the surveys and the future scenarios described

in paragraph 9.5.1, this will be made clear in the ES⁷⁵. In particular, the assessment will consider the influence of other factors, such as climate change and how those might affect the baseline conditions.

Geographic scope

- 9.5.3 The geographic scope of the ecological assessment will be defined by the potential area of ecological impact. More details are provided in Section 9.2 (Establishment of baseline and definition of survey). In summary, the area of search for existing information will extend up to and potentially beyond 10km from the route of the Proposed Scheme. Field survey will be less extensive, varying according to the species and/ or habitat under study and the potential area of impact.
- 9.5.4 The geographic scope will include not only the physical extent of the works, including land-take associated with construction sites, road improvements and off-site works, but also indirect or secondary effects such as changes to rail traffic on other lines, consequential development around stations/interchanges, temporary and permanent changes in road traffic etc.

Technical scope

- 9.5.5 The assessment will consider all ecological receptors with the potential to be directly or indirectly affected by the Proposed Scheme, including sites designated for their nature conservation value, legally protected or otherwise notable species, and habitats. It will include all species and habitats of nature conservation value, not only those listed in Section 9.2 (Establishment of baseline and definition of survey) as requiring targeted survey; thus, for example, brown hare, deer, veteran trees and wood pasture/parkland habitat will all be included in the assessment.
- 9.5.6 The assessment will include effects on individual sites or receptors, and the cumulative effects of the works on the ecology of the length of the Proposed Scheme [see Section 9.6 (Assessment methodology)]. It will also consider the effects on landscape-scale ecological features, including habitat connectivity.
- 9.5.7 Impacts on relevant European designated sites will be described within the ES. Technical studies relating specifically to Habitats Regulation Assessment will be presented in a separate, standalone document, since such assessment requires a distinct methodology. The HRA will not form part of the ES, but the conclusions of the HRA would be incorporated within the Ecology Chapter of the ES.

9.6 Assessment methodology

- 9.6.1 The impact assessment methodology for the Proposed Scheme follows the standard method for ecology as set out by the Institute of Ecology and

⁷⁵ In addition, there will be a need for a programme of repeating and updating ecological surveys to continue beyond the deposition of the hybrid bill, up to the point of site clearance, with monitoring beyond that time.

Environmental Management (IEEM) in their Guidelines for Ecological Impact Assessment (2006)⁷⁶. It is also influenced by the principles in DfT's DMRB Volume 11 (Ecology and Nature Conservation) and Interim Advice Note 130/10 (Ecology and Nature Conservation: Criteria for Impact Assessment).⁷⁷

Legislation

9.6.2 The assessment will take into account relevant national and international legislation. Legislation of relevance to consideration of the ecological resources includes:

- The Wildlife and Countryside Act 1981 (as amended)⁷⁸;
- The Conservation of Habitats and Species Regulations 2010 (Amended 2012)⁷⁹;
- Protection of Badgers Act 1992⁸⁰;
- The Hedgerows Regulations 1997⁸¹;
- Countryside and Rights of Way Act 2000⁸²; and
- Natural Environment and Rural Communities Act 2006.⁸³

Guidance

9.6.3 The assessment also takes into account relevant guidance set out in national, regional and local planning policy and other guidance, such as:

- NPPF (2012);
- Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system⁸⁴;
- Natural Environment White Paper - The Natural Choice: securing the value of nature (2011);
- Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network (2010; the 'Lawton Report')⁸⁵; and
- Biodiversity 2020: A strategy for England's wildlife and ecosystem services (2011).⁸⁶

⁷⁶ Institute of Ecology and Environmental Management (IEEM), 2006, *Guidelines for Ecological Impact Assessment*, IEEM

⁷⁷ Department for Transport (DfT), 2010, *Interim Advice Note 130/10, Ecology and Nature Conservation: Criteria for Impact Assessment*, DfT

⁷⁸ HM Government, 1981, *The Wildlife and Countryside Act 1981* (as amended), The Stationery Office

⁷⁹ Defra, 2010, *The Conservation of Habitats and Species Regulations (Amended 2012)*, Defra

⁸⁰ HM Government, 1992, *The Protection of Badgers Act*, The Stationery Office

⁸¹ HM Government, 1997, *The Hedgerows Regulations 1997*, The Stationery Office

⁸² HM Government, 2000, *Countryside and Rights of Way Act 2000*, The Stationery Office

⁸³ HM Government, 2006, *Natural Environment and Rural Communities Act 2006*, The Stationery Office

⁸⁴ Office of the Deputy Prime Minister (ODPM) and Defra, 2005, ODPM Circular 06/2005 and Defra Circular 01/05, *Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system*, ODPM

⁸⁵ Defra, 2010, *Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network*, Defra

⁸⁶ Defra, 2011, *Biodiversity 2020: A strategy for England's wildlife and ecosystem services*, Defra

9.6.4 As well as taking account of nature conservation policies in Local Development Frameworks, the assessment will consider other local plans such as The Chilterns AONB Management Plan 2008 – 2013: A Framework for Action.⁸⁷

Significance criteria

9.6.5 In the IEEM Guidelines, an effect on the integrity of a defined site or ecosystem and/or the conservation status of a habitat or species is deemed to be significant. The value of any feature that will be significantly affected is then used to identify the geographical scale at which the effect is significant. This reflects the consequences of the predicted effect in terms of legislation or policy.

9.6.6 In order to test whether or not there will be an effect on the integrity of a site or ecosystem, it is necessary to understand whether the changes arising from the Proposed Scheme are predicted to move the baseline conditions at the site or ecosystem closer to, or further away from, the condition which constitutes 'integrity' for that system. The integrity of a site may be defined as "the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified".⁸⁸ A site or ecosystem that achieves this level of integrity is described as being at favourable condition.

9.6.7 In terms of assessing whether there will be a significant effect on a habitat or species, the concept of conservation status is used. This is particularly relevant where there are formal targets for the conservation status of a species or habitat in a particular geographical context, in respect of distribution, numbers etc.

9.6.8 Relevant information on policy relating to the conservation status of species and habitats will be identified through reference to Biodiversity Action Plans, published conservation notes (where available) from Natural England, and relevant local planning policies.

9.6.9 The importance of ecological features will be determined according to their value for biodiversity on a geographic scale, namely International, National, Regional, County or Metropolitan, Borough or District, and Local.

9.6.10 It is important that there is a consistent approach to the definition of significance across the different environmental topics reported in the ES. Significant ecological effects on receptors at different geographical scales will therefore be related to the overall significance categories used by other environmental topic areas. This process will also ensure that the overall

⁸⁷ The Chilterns Conservation Board, 2007, *Chilterns Area of Outstanding Natural Beauty Management Plan 2008-2013: A Framework for Action*, The Chilterns Conservation Board

⁸⁸ Office of the Deputy Prime Minister (ODPM) and Defra, 2005, ODPM Circular 06/2005 and Defra Circular 01/05, *Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system*, ODPM

assessment focuses on the key significant ecological issues. This is usually achieved by identifying significant effects on sites of international or national value as being of 'greater significance' than significant effects on sites of county or district value.

Construction effects

9.6.11 Potential impacts resulting from construction activities include:

- Temporary and permanent land-take;
- Severance of ecological corridors and networks, resulting in a reduction in habitat connectivity;
- Fragmentation of habitats and sites;
- Barrier effects (to movement of fauna);
- Noise and visual disturbance;
- Disturbance from lighting;
- Dust deposition;
- Risk of water quality changes from surface water run-off;
- Hydrological effects, from changes in water levels and/or flows;
- Changes in management, often resulting in habitat degradation; and
- Introduction and spread of non-native invasive species.

9.6.12 The Proposed Scheme also offers opportunities for creation and enhancement of habitats. There are opportunities to restore, reconnect and to 're-naturalise' terrestrial and aquatic habitat, the value of which may be limited by existing modification. Both the landscape and drainage designs of the Proposed Scheme will be influenced by ecological opportunities, for example, through careful design of balancing ponds to promote biodiversity, or creation of more natural watercourses. Ensuring that the landscaping and habitat creation associated with the Proposed Scheme has a nature conservation legacy is reflected in the Environmental Design Aims.

Operational effects

9.6.13 Potential operational activities that could give rise to ecological effects include:

- Barrier effects (to movement of fauna);
- Mortality from collision;
- Noise and visual disturbance;
- Disturbance from lighting;
- Accidental pollution; and
- Introduction and spread of non-native invasive species.

Cumulative effects

9.6.14 Cumulative effects are those that result from a combination of a number of individual effects. In the context of the ecological assessment of the Proposed Scheme, these will include:

- The combined ecological effect on a single receptor of a number of individual environmental impacts, e.g. land-take, noise and airborne dust, arising from the Proposed Scheme;
- The cumulative effects of localised ecological impacts along the length of the railway, for example the potential of cumulative loss of certain habitat types; and
- Interaction between ecological effects arising from the Proposed Scheme and those from other relevant projects and plans (both on single receptors and along the length of the route of the Proposed Scheme).

9.7 Assumptions

- 9.7.1 The Ecology chapter of the ES will include a section to explain any assumptions made in undertaking the ecological assessment.
- 9.7.2 The assessment within this section considers the natural heritage from the perspective of nature conservation. The value of natural heritage features – such as trees, ancient woodlands, historic hedgerows and nature reserves – from social/recreational, heritage and landscape points of view is considered in Section 7 (Community), Section 8 (Cultural Heritage) and Section 12 (Landscape and Visual Assessment) of this Report, respectively. Effects on geology and geomorphology are considered in Section 11 (Land Quality).

10 Electromagnetic interference

10.1 Introduction

- 10.1.1 This section of the Report covers the impacts and effects of the Proposed Scheme on Electromagnetic Interference (EMI), including Electro Magnetic Compatibility (EMC).
- 10.1.2 EMI is disturbance that affects an electrical system due to magnetic and electric fields, electromagnetic induction or electromagnetic radiation emitted from an external source.
- 10.1.3 EMC is the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to other equipment in that environment.
- 10.1.4 The principal sources of EMI from the Proposed Scheme that may have an effect on third parties will be generated by either the traction power supply system or the traction units. Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system. In addition, equipment located within the infrastructure maintenance depot and the stations/interchanges contain similar control and communications systems, together with other EMI sources (such as lifts and escalators and other large items of plant). Each of these systems could also be susceptible to EMI together with any third party electrical and electronic infrastructure located adjacent to the Proposed Scheme.
- 10.1.5 The Proposed Scheme (particularly its nature as an electrified railway) is not unique, hence, there exists data from HS1 for example, that can be used to illustrate the minimal effects of EMI to the environment.
- 10.1.6 EMC is an issue that can normally be mitigated through the application of EMC industry accepted practice during design and installation.
- 10.1.7 Electromagnetic Field (EMF) limits are to be specified through the future EMF Directive, anticipated to be published during 2013. Currently, the limits provided by the International Commission on Non-Ionizing Radiation Protection⁸⁹ (ICNIRP) are applicable and can be used during design and installation.
- 10.1.8 The ICNIRP guidelines also require that the electromagnetic field exposure to workers and the general public be addressed.

⁸⁹ International Commission on Non-Ionising Radiation Protection (ICNIRP), 1998, *ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)*, Health Physics 74 (4):494-522

10.1.9 Many of the effects caused by EMI will be eliminated or reduced to acceptable standards during the design and installation period of the Proposed Scheme. Designs for which are covered by British and European Standards and industry accepted practice.

10.2 Establishment of baseline and definition of survey

10.2.1 A description of the baseline environment for the 2011 consultation scheme is contained within Section 8 of the AoS (Main Report).

10.2.2 In constructing and operating the Proposed Scheme, there will be key interface issues that require evaluation and management. A definitive list of interfaces will be established as part of the initial survey scope. The new infrastructure will have an impact on and be impacted upon by its surroundings, which will differ throughout the length of the route of the Proposed Scheme.

10.2.3 Where the Proposed Scheme is adjacent to an existing railway corridor, there will be a significant interface with the existing railway networks. Although the existing infrastructure may have systems and procedures to mitigate the effects of EMI, it is possible that the introduction of the Proposed Scheme's infrastructure may have an adverse effect on the existing railway infrastructure. Similarly, the existing railway infrastructure may have an effect on the Proposed Scheme (both infrastructure and rolling stock).

10.2.4 It is therefore important to obtain available relevant records for the existing railway network and identify possible interface issues, which can then be assessed as a desk-based exercise for risk within an EMC hazard log. The hazard log may have to consider the effect of potential future changes, such as advancements in transformer technology or changes to the existing infrastructure.

10.2.5 For the areas not adjacent to existing railway, the Proposed Scheme's infrastructure is likely to have a greater impact on its surroundings. It is therefore important to identify any key areas along the route where EMI could be an issue. These may include residential and business premises, hospitals and light industrial areas, telephone and communication systems.

10.2.6 The Proposed Scheme's rolling stock could be a major source of EMC issues and therefore it is necessary that the rolling stock specification is compatible with the operational limits of the infrastructure and the Technical Specification for Interoperability (TSI). The main impact of EMI resulting from the rolling stock is on the railway infrastructure itself.

10.3 Consultation

Consultation on the AoS

10.3.1 Electromagnetic interference was not considered as part of the AoS in relation to the 2011 consultation scheme.

Consultation as part of the EIA process

10.3.2 In producing the hazard log a list of interested parties will be developed including:

- Network Rail;
- Transport for London;
- London Underground;
- Electricity supply authorities;
- Electricity distribution companies;
- Data and telecommunication companies;
- Local authorities;
- Hospitals; and
- Airports.

10.4 Key aspects of the Proposed Scheme for the topic

10.4.1 The following are potential sources of EMI:

- Temporary sources: direct effects could be caused by construction from significant activities such as tunnelling, as a result of the use of electrical machinery, such as pumps, generators and compressors. Tunnel boring machines utilise high voltage electricity supplies. These activities will be supported from local work compounds close to the structure/tunnel being constructed, local worksites, or larger construction compounds where equipment may be used; and
- Permanent sources: direct effects could be caused by the operational railway and its supporting systems [e.g. Overhead line equipment (OLE) and traction distribution, stations/interchanges, infrastructure maintenance depots, ventilation shafts and other line side equipment, traction depots and rolling stock, both existing and proposed].

10.4.2 The main source of EMI will be the traction power system, as electromagnetic emissions are caused by the current flowing in an electrical system. The higher currents found in high voltage distribution have the potential to create larger electromagnetic fields, the strength of which diminish rapidly with the distance from the source.

10.5 Scope of assessment

10.5.1 A desk study will be undertaken to identify potential sources of EMI that exist or may be produced during both the construction and operational phases of the Proposed Scheme. The list will identify the potential risk and

the potential impact and effect, and form part of a hazard log. The desk-based study will also identify establishments where people are potentially at risk from the electromagnetic fields produced by the Proposed Scheme's 25 kilo Volts (kV) electrification traction power and its rolling stock.

- 10.5.2 The assessment will identify potentially sensitive receptor sites within a 20m corridor either side of the centreline of the nearest track within the Proposed Scheme, or from proposed power equipment (e.g. overhead lines and traction substations).
- 10.5.3 Once each receptor site has been identified, a risk assessment will be undertaken to categorise the perceived level of risk and to identify the potential mitigation for each receptor site.
- 10.5.4 The risk assessment will assess the impact of electromagnetic fields and EMC effects on nearby equipment, installations and people.
- 10.5.5 The EMI, EMC and EMF assessment will use existing data, particularly that of electrified railways, in undertaking the evaluation.

10.6 Assessment methodology

Legislation and guidance

- 10.6.1 The following standards are relevant:
 - British Standard (BS) EN 50121-1:2006 Railway applications - Electromagnetic compatibility - General;
 - BS EN 50121-2:2006 Railway applications - Electromagnetic compatibility - Emissions of the whole railway system to the outside world;
 - BS EN 50121- 3-1:2006 Railway applications - Electromagnetic compatibility - Rolling stock - Train & Complete Vehicle;
 - BS EN 50121- 3-2:2006 Railway applications - Electromagnetic compatibility - Rolling stock - Apparatus;
 - BS EN 50121-4:2006 Railway applications - Electromagnetic compatibility - Emission and immunity of the signalling and telecommunication apparatus;
 - BS EN 50121-5:2006 Railway applications - Electromagnetic compatibility - Fixed Power Supply Installations;
 - BS EN 61000-6-1:2007 Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments;
 - BS EN 61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments;
 - BS EN 61000-6-3:2007 Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments;
 - BS EN 61000-6-4:2007 Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments;

- BS EN 50122-1:1998 Railway applications. Fixed installations. Protective provisions relating to electrical safety and earthing;
- BS EN 50122-2:1999 Railway applications. Fixed installations. Protective provisions against the effects of stray currents caused by d.c. traction systems;
- BS EN 50122-3:2008 Railway applications. Fixed installations. Electrical safety, earthing and bonding. Mutual interaction of a.c. and d.c. traction systems;
- BS EN 61000-4-16:2009 Electromagnetic compatibility (EMC). Testing and measurement techniques. Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz;
- BS IEC 60000-2-7:1998 Electromagnetic compatibility (EMC). Low frequency magnetic fields in various environments; and
- ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz) (1998).

Significance criteria

EMC Zones

- 10.6.2 The definition of an EMC zone is a bounded area in which specific levels of electromagnetic (EM) energy exist. Some EMC zones contain higher levels of EM energy than others. In the railway environment, the zone containing most energy in these EMC zones exists on the trackside of the railway (where traction power is returned to the running rails) and close to traction or non-traction power distribution equipment.
- 10.6.3 The zoning principle will be used to determine the required test levels and control methods to be applied to equipment operating in this area. Essentially, three zones are identified each with its boundary determined from a reference point (the centre-line between the two running rails). As distance increases from this point, test level requirements become less onerous as a new EMC boundary zone is crossed. It must be noted that there may be special circumstances in which the zoning approach cannot guarantee compatibility. Each potential hazard that falls into this category will have additional methods adopted to ensure electromagnetic compatibility in its EM operating zone.
- 10.6.4 EM Zone 1: For equipment less than 10m from the centreline of the nearest track rails or from non-traction power equipment (i.e. cables transformers or switchgear). BS EN 50121-4:2006 (Signalling and Telecommunication Apparatus) and BS EN 50121-5:2006 (Fixed Power Supply Installations) will be applied in this zone. The emission and immunity levels are provided in the BS. BS EN 50121-4:2006 (Signalling and Telecommunication Apparatus) applies to any safety critical equipment located in this zone.
- 10.6.5 EM Zone 2: For equipment greater than 10m, but less than 20m from the centreline of the nearest track rails or from non-traction power equipment (i.e. cables, transformers or switchgear). BS EN 61000-6-2: 2005 (Generic

standards - Immunity for industrial environments) and BS EN 61000-6-4 (Generic standard - Emissions for Industrial Environments), will be applied in this zone. The emission and immunity levels are given in the BSs. Any safety critical equipment located in this zone would also apply to these BSs.

- 10.6.6 EM Zone 3: For equipment greater than 20m from the centreline of the nearest track rails or non-traction power equipment (i.e. cables transformers or switchgear). BS EN 61000-6-1: 2007 (Generic standard - Immunity for residential, commercial and light industrial environments) and BS EN 61000-6-3: 2007 (Generic standards - Emissions for residential, commercial and light industrial environments), will be applied in this zone. The emission and immunity levels are given in these BSs.
- 10.6.7 For emissions effecting people outside the 20m zone, ICNIRP guidelines will be followed.
- 10.6.8 Where risk is identified, calculations will be undertaken to assess the impact of EMC. Industry accepted practice will be used wherever possible to limit the effect; for example, the use of standard separation distances for cables of different voltage and screening techniques.
- 10.6.9 In creating the hazard log, the impact and risk levels will be established thereby identifying key areas for assessment. Base-line measurements will be taken to ensure that the existing environment is compliant with the relevant BSs. Preliminary calculations will be used to identify the potential impact of the Proposed Scheme's infrastructure, using industry standards and industry accepted practice.

Construction effects

- 10.6.10 In producing the hazard log, the effects of construction will be evaluated and mitigation measures implemented if required. On-going measurements and monitoring will be considered during construction, where significant risks are identified.

Operational effects

- 10.6.11 In producing the hazard log, the effects of operation will be evaluated and mitigation measures implemented if required.

Cumulative effects

- 10.6.12 It is possible that equipment that may comply with the relevant BSs individually will produce a cumulative effect once installed as part of a wider system, such as traction substations. The cumulative effect of the whole system must be considered when any evaluation or calculation is made.
- 10.6.13 Degradation of systems and equipment over a period of time, may contribute to a worsening effect of EMI, however this is usually confined to the effect on equipment within the railway boundary.

10.7 Assumptions

10.7.1 The following assumptions are made:

- No site visits will be conducted, rather a desk-based study will be undertaken;
- No modelling or detailed calculations will be undertaken;
- Where information is not available, professional judgement will be used to reach a conclusion. It may be possible, subject to review, to use information from other recent and similar railway construction projects such as HS1;
- The compilation of information from which to assess the baseline measurements will be dependent on the availability of recorded information; and
- In accordance with good safety management principles, it is assumed that risks due to EMI will be reduced using the 'as low as reasonably practicable' principle.

11 Land quality

11.1 Introduction

11.1.1 This section of the Report covers land quality which includes the environmental topic areas of land contamination and geology, which was considered within the AoS within the wider topic of 'Sustainable Consumption and Production'.

Land Contamination

11.1.2 Land and groundwater along the route of the Proposed Scheme may have become contaminated through previous industrial usage. Such land or groundwater could adversely affect people and the wider environment (including effects on groundwater quality, surface water quality and ecology). Contamination may be in topsoils, soil, deeper geology or as ground gases. Construction of the Proposed Scheme will require earthworks, cut and cover and bored tunnelling, deep foundations, temporary and permanent dewatering and other construction activities. Where the route crosses or lies close to existing sources of contamination, these activities could result in the disturbance of the contamination, which would need to be assessed and mitigated.

11.1.3 The Land Quality chapter of the ES will present the findings of the assessment identifying significant areas of contamination along the route and in associated developments, and where appropriate, present a range of mitigation measures that will need to be considered in order to remediate significant areas of contamination. It will also present a review of measures to prevent or mitigate land contamination arising from the construction and operational stages of the project.

11.1.4 It should be noted, that with respect to contamination issues, the contaminated land or groundwater which is already present at a site, may already be causing environmental impairment. The purpose of the land quality assessment is to ensure that construction and operation of the Proposed Scheme does not introduce new sources or pathways by which contamination can spread; and where there is a significant risk of this happening, to consider mitigation measures to prevent it. HS2 Ltd will be responsible for dealing with contamination on any land it acquires.

11.1.5 The Land Quality chapter will have significant interaction with the Water Resources and Flood Risk Assessment and Waste and Materials chapters of the ES.

Geological and Mining/Mineral Features

11.1.6 Along the route of the Proposed Scheme there may also be areas of land that have special geological significance, either from a scientific, mining or mineral resources point of view, such as:

- Geological SSSI or Local Geological Sites, also known as Regionally Important Geological Sites (RIGS);
- Areas of previous or current underground or opencast mining; and
- Areas of designated mineral resources.

11.2 Establishment of baseline and definition of survey

11.2.1 The AoS contained references to baseline conditions with respect to land quality and noted that the route of the 2011 consultation scheme would cross 16 old landfill sites, thereby giving rise to an opportunity to re-use currently disused land. This would also apply to other derelict areas of contaminated land.

11.2.2 The method for determining the baseline conditions will involve a combination of the following:

- Data collected for the AoS;
- Analysis of the results of previous investigations carried out in the immediate area of the Proposed Scheme;
- Historical Ordnance Survey mapping;
- Published geological and hydrogeological mapping/information;
- Data held by local authorities;
- Route wide site inspections, including depot areas;
- Unexploded ordnance data; and
- Other publicly available environmental data.

11.2.3 Documentary data are available from a number of governmental and non-governmental organisations including:

- Environment Agency;
- Water Companies;
- British Geological Survey; and
- County councils and district councils.

11.2.4 Much of the data is also held on commercial environmental databases. Site inspections will be used to supplement the documentary study data obtained.

11.2.5 Generally, a width of 250m either side of the Proposed Scheme, and land required for construction of stations/interchanges, depots, construction/storage sites and other land required for the works will be reviewed. This width has been developed using professional judgement on the basis that contamination migration beyond this distance is likely to be minimal or could be mitigated. This principle has been applied in assessing

previous railway projects such as Crossrail. The 250m width may be widened where evidence suggests that it is required. Groundwater resources over a much larger area will be considered for the Water Resources study and will be available for assessment of groundwater contamination effects.

- 11.2.6 A risk based approach in accordance with Defra and the Environment Agency guidance will be taken to identifying contamination which may have a significant impact upon the construction of the Proposed Scheme. Following a review of desk study data, the AoS and site inspections, where the identified past uses of land indicate a high risk of previous significant contamination and potential risk to receptors, intrusive investigations may be carried out (where practicable) at the same time as geotechnical investigations prior to works commencing on site, in order to provide additional data on which risks and impacts can be assessed. Such investigations would be carried out in line with *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11*⁹⁰ and BS10175: 2011⁹¹ and based on a developed conceptual site model (see paragraph 11.6.2).
- 11.2.7 With regards to other sites of geological interest, information will be obtained from Natural England, the British geological Society, the Coal Authority and from local authorities (usually county councils) who hold information on such sites.

11.3 Consultation

Consultation on the AoS

- 11.3.1 During the consultation on the AoS, both the Environment Agency and local authorities were consulted, although there were very few responses on the topic of Land Quality.

Consultation as part of the EIA process

- 11.3.2 During the preparation of the EIA, wider and more comprehensive consultation on the topic will be undertaken with the following organisations:
- Environment Agency;
 - Natural England (if 'geological SSSI' are affected);
 - GeoConservation UK and Geology Trusts (if RIGS are affected);
 - Network Rail;
 - Landfill and mineral abstraction companies;
 - Coal Authority;
 - Local authorities (primarily Environmental Health Officers and Contaminated Land Officers); and
 - Water companies.

⁹⁰ Defra and the Environment Agency, 2004, *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11*, Environment Agency

⁹¹ British Standards Institute (BSi), 2001, 10175 *Investigation of potentially contaminated sites. Code of practice*, BSi

11.4 Key aspects of the Proposed Scheme for the topic

- 11.4.1 Impacts from disturbance to contaminated land will principally arise where the works break such ground during the construction phase (e.g. construction of portals, ventilation shafts or stations/interchanges) or where the ground is disturbed (e.g. through removal of existing structures). Contaminated land and groundwater may be present as a result of historical activities at a particular location or as a result of current operations.
- 11.4.2 The urban areas of London and Birmingham are areas where existing contamination is likely to be most prevalent. In London, to the west of Old Oak Common, the proposed route passes adjacent to existing Network Rail and London Underground lines in an area with significant adjacent industry. Similarly in Birmingham the route will pass through the industrial areas adjacent to the M6, Washwood Heath and the route to Curzon Street terminus (Birmingham Eastside).
- 11.4.3 In the rural areas between the London and Birmingham conurbations, the incidence of existing contaminated land will be smaller. Nevertheless, there may be localised industries, old and existing landfill sites, old sewage farms and other issues that need to be assessed with respect to contaminative effects. For example, at Calvert (Buckinghamshire) the route of the Proposed Scheme runs adjacent to both old and operational landfill sites to the north and south of the village.
- 11.4.4 The impairment or destruction of geological sites of interest would be considered an adverse impact. Although new exposures of rock and soil may be created by the Proposed Scheme (e.g. within new cuttings) they would not necessarily be accessible to the public.
- 11.4.5 Mining issues (for example a requirement to treat or mitigate underground mining voids from previous mine workings) will be concentrated in two areas: the potential for old chalk mines in the Chiltern Hills and coal mining areas in the Midlands. Potential sterilisation of resources could affect both coal mining and mineral resources.

11.5 Scope of assessment

- 11.5.1 The EIA will identify the likelihood of existing contamination being encountered during the construction process, such that it could cause significant environmental or health effects if not addressed adequately at the construction stage. The construction of the railway will entail bringing materials on to site (such as fuel) which if spilt or leaked could result in land or groundwater contamination. Impairment and sterilisation of geological and mining/mineral resources will likewise be addressed.
- 11.5.2 Although the maintenance of the railway once it is operational will be required to be in compliance with appropriate environmental legislation in

order to prevent land, surface water or groundwater contamination, the major operational sources of contamination will be reviewed and appropriate mitigation measures proposed. In addition, during the operational period, monitoring works (such as for groundwater) may continue in order to demonstrate the effectiveness of any remedial works.

11.6 Assessment methodology

Legislation

11.6.1 Part 2A of the Environmental Protection Act 1990 (as amended)⁹² provides a statutory definition of contaminated land:

11.6.2 *“Contaminated Land is any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that significant harm is being caused or there is a significant possibility of such harm being caused; or pollution of controlled waters is being, or is likely to be caused.”*

Guidance

11.6.3 In the guidance⁹³ that accompanies the Environmental Protection Act 1990, there is advice on what constitutes significant harm and what constitutes a significant possibility. The following reports provide further guidance on the risk assessment process, and introduce the Contaminated Land Exposure Assessment (CLEA) model:

- *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11* (Defra and the Environment Agency);
- *Guidance on the legal definition of contaminated land*⁹⁴;
- *Human Health Toxicological Assessment of Contaminants in Soil*⁹⁵;
- *Updated Technical Background to the CLEA Model*⁹⁶; and
- *Guiding Principles on Land Contamination*⁹⁷.

11.6.4 The impacts associated with contaminated land are generally assessed by means of a source/hazard-pathway-receptor methodology in accordance with *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11* and BS10175: 2001, where the following definitions apply:

- **Source:** contamination that has the potential to cause adverse impacts to a receptor;

⁹² HM Government, 1990, *Environmental Protection Act 1990*, The Stationery Office

⁹³ HM Government, 2012, *Environmental Protection Act 1990, Part 2A: Contaminated Land Statutory Guidance*, The Stationery Office

⁹⁴ Department of Environment, Food and Rural Affairs (Defra), 2008, *Guidance on the legal definition of contaminated land*, Defra

⁹⁵ Environment Agency, 2008, *Science Report – SC050021/SR2 - Human Health Toxicological Assessment of Contaminants in Soil*, Environment Agency

⁹⁶ Environment Agency, 2008, *Science Report – SC050021/SR3 - Updated Technical Background to the CLEA Model*, Environment Agency

⁹⁷ Environment Agency, 2010, *Guiding Principles on Land Contamination*, Environment Agency

- *Receptor*: a target that may be affected by contamination; examples include human occupants or users of the site, water resources or structures; and
- *Pathway*: a route whereby a hazardous substance may come into contact with the receptor; examples include ingestion of contaminated soil and leaching of contaminants from soil into water resources.

Significance criteria

- 11.6.5 The previously described approach forms the basis of the methodology to be used in the assessment of Land Quality. For contamination to present a significant potential effect, it must be demonstrated that there is an identifiable source of contamination (be it an onsite or off site source), potential sensitive receptors and potential pathways through which the former may affect the latter (a contaminant linkage).
- 11.6.6 The sensitivity of potential receptors can be described qualitatively according to the categories shown in Table 14. However, the distance criteria quoted may be reduced if pathways between source and receptor are weak (for example, where underlying ground is impermeable to groundwater flow, the groundwater migration pathway can be negligible).

Table 14 - Criteria for assessing receptor sensitivity⁹⁸

Receptor sensitivity/ Value of Resource	Receptor/ Resource
High	Residential areas, schools and playing fields within 50m of groundwater disturbed by construction Nearby water bodies of high quality and/or route on Principal Aquifer Nationally designated areas e.g. SSSI Major mining or mineral resource areas
Moderate	Residential areas, schools and playing fields within 250m of ground disturbed by construction Allotments and market gardens Nearby water bodies of moderate quality, and/or route on Secondary Aquifer Regionally designated areas e.g. local nature reserves or RIGS Locally important mining or mineral resource areas
Low	Adjacent commercial or industrial development Forestry areas, ornamental plant nurseries Nearby water bodies of low quality, and/or route on unproductive strata Non-designated land

11.6.7 Construction workers are not included in the list of receptors, as it will be a fundamental requirement that any construction workers on the project are adequately protected from the effects of any contamination through project specific health and safety plans and procedures which will be put in place prior to the construction phase.

11.6.8 The magnitude of potential scheme impacts regarding contamination issues will be assessed using a four-point scale as shown in Table 15.

⁹⁸ Based on the Highways Agency, 2008, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects*, The Stationery Office

Table 15 - Impact magnitude criteria⁹⁹

Impact Magnitude	Criteria	Examples
High	Results in loss of attribute and/or likely to cause exceedance of statutory objectives and/or breach of legislation.	Likely significant contamination of a primary aquifer, major land remediation, or loss of major mineral resource.
Moderate	Results in impact on integrity of attribute/or loss of part of attribute, and/or possibly cause exceedance of statutory objectives and/or breach of legislation.	Reduction in the value of a feature, moderate remediation of land, loss of regional/local mineral resource.
Low	Results in minor impacts on attribute.	Measurable change in attribute, but of limited size/proportion.
Negligible	Results in no change or impact on attribute.	No significant loss in quality of feature.

11.6.9 The prediction of significance is based on the magnitude of the impact and the importance or sensitivity of the receptors. The significance of the potential effects is identified, as well as those of the residual effects for geological, mining and mineral impacts. Once remediated, there should be no residual effects with respect to land contamination issues.

11.6.10 Effects have the potential to be adverse, beneficial or negligible. For example, in terms of beneficial effects, the Proposed Scheme may remove a source of contamination or it may break a pathway that currently links a source to a receptor.

11.6.11 The significance of the effect will be affected by:

- The value of the resource;
- The sensitivity of the receptor;
- The strength and length of the pathway; and
- The size of the area affected.

11.6.12 Adverse and beneficial effects are further classified as being minor, moderate or major in significance.

⁹⁹ Based on the Highways Agency, 2008, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects*, The Stationery Office

11.6.13 Table 16 summarises the criteria for assessing effect significance.

Table 16 - Significance of effects criteria¹⁰⁰

Significance	Description
Major adverse	Considerable detrimental effect (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability/legislation/policy standards.
Moderate Adverse	Limited detrimental effect (by extent, duration or magnitude) that may be considered significant.
Minor Adverse	Slight, very short or highly localised detrimental effect.
Negligible	No appreciable effect.
Minor Beneficial	Minor reduction in risk (slight, short or highly localised effect).
Moderate Beneficial	Moderate reduction in risk.
Major Beneficial	Major reduction in risk.

Construction effects

11.6.14 The impact of existing land contamination will become manifest during the construction phase. A fundamental requirement of the project will be to carry out sufficient mitigation or remediation of any significant contamination such that, following construction, there are no continuing significant adverse effects from the contamination during the operational phase of the Proposed Scheme.

11.6.15 Remediation of contaminated land, and other construction activities, can lead to a number of secondary effects such as potential issues of dust migration and surface water impairment during the remediation and construction processes. Any such effects would be controlled through use of the Code of Construction Practice.

11.6.16 Where remediation of soil and groundwater is carried out for the Proposed Scheme, this would be regarded as a beneficial effect, as future risks to human health and the wider environment from the pre-existing contamination would have been reduced by the remedial works.

Operational effects

11.6.17 The major operational sources of contamination will be reviewed and appropriate mitigation measures proposed. In addition, during the operational period, monitoring works (such as for groundwater) may continue in order to demonstrate the effectiveness of any remedial works

¹⁰⁰ Generally based on the Highways Agency, 2008, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects*, The Stationery Office

Cumulative effects

- 11.6.18 The assessment of cumulative effects would be limited to those areas/sites at which contamination remediation is likely to be required and at which construction of the Proposed Scheme would be undertaken at the same time as other nearby construction work within an area of contaminated land.
- 11.6.19 Cumulative effects would also need to be taken into account, for example, when assessing the Proposed Scheme impact on mineral resources; effects at a local scale on a number of mineral resources may have a cumulative effect at a regional scale.

11.7 Assumptions

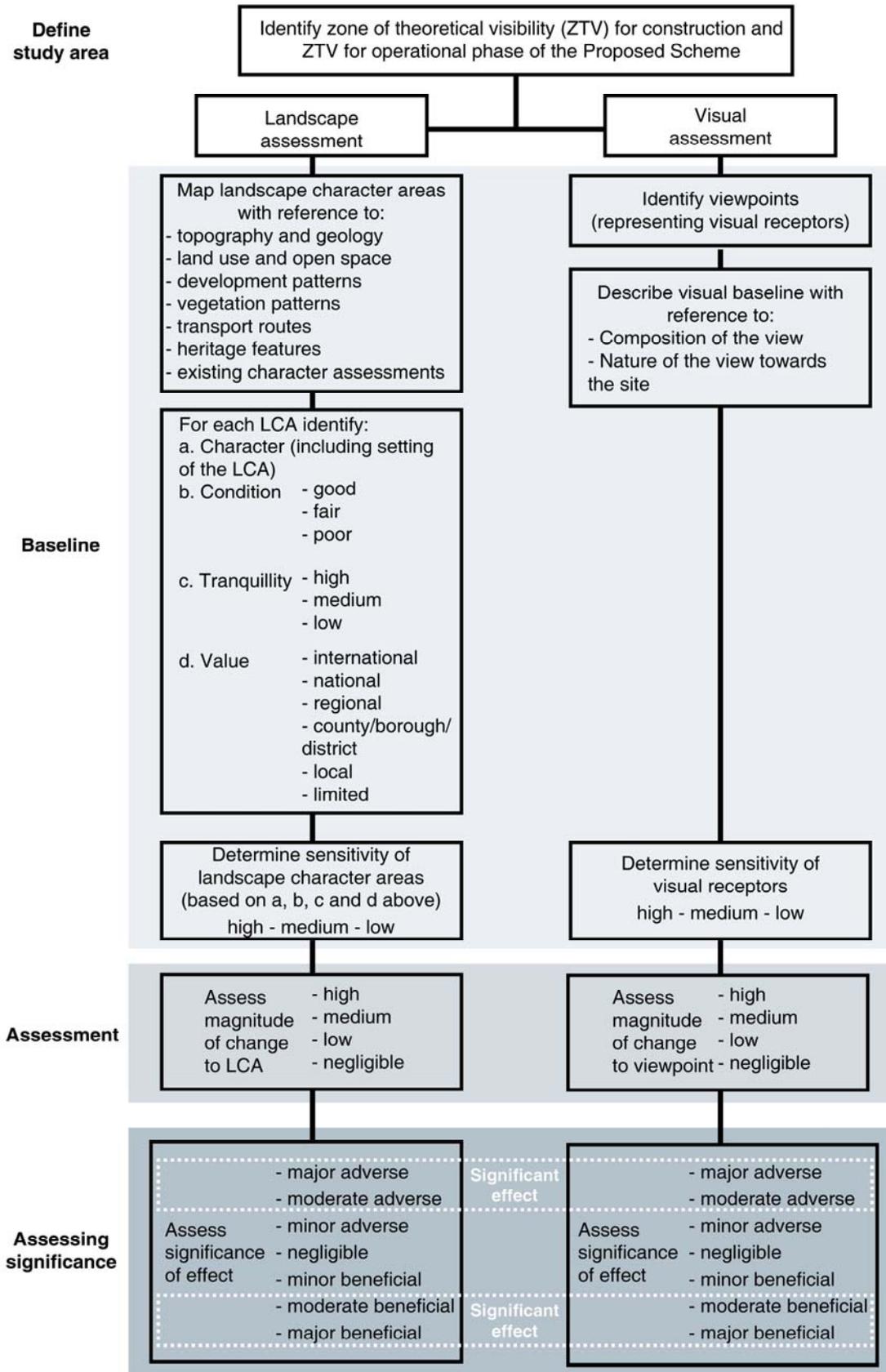
- 11.7.1 The assessment within this topic area considers land quality from the perspective of land contamination. It excludes soils quality from an agricultural or forestry perspective. Such an assessment will be found in Section 5 (Air Quality) of this Report.
- 11.7.2 Land contamination has the potential to affect groundwater resources. There will be significant inter-action between the Land Quality and Water Resources assessments in order to determine the potential effects on the quality of groundwater from any contaminated land. Wider issues of groundwater and surface water resources are contained within Section 17 (Water Resources and Flood Risk Assessment) of this Report.
- 11.7.3 Land contamination has the potential to affect ecological resources. Other ecological issues are contained in Section 9 (Ecology) of this Report.
- 11.7.4 Remediation of contamination can lead to a requirement for disposal of contaminated materials. Issues of onsite treatment and re-use of contaminated materials will be dealt with in the Land Quality assessment whereas issues of the disposal of contaminated soils off site are dealt with in Section 16 (Waste and Material Resources) of this Report.

12 Landscape and visual assessment

12.1 Introduction

- 12.1.1 This section of the Report sets out the methodology for assessing the likely significant effects of the Proposed Scheme on landscape and visual receptors.
- 12.1.2 The topic specific methodology presented in this section builds upon the general assessment methodology summarised in Section 2 (EIA Methodology) of this Report. This has been developed to take account of the range of likely significant environmental effects on the landscape and visual receptors arising from the construction and operation of the Proposed Scheme.
- 12.1.3 The definition of 'landscape' encompasses all types and forms of open space and development in the countryside, villages, towns and cities. To avoid the use of interchangeable terms (such as townscape), the term landscape has been used throughout.
- 12.1.4 The process for the landscape and visual assessment is illustrated in Figure 5. Each stage of the assessment process is then described in more detail through the following sections.

Figure 5 - Assessment process for the landscape and visual assessment



12.2 Establishment of baseline and definition of survey

- 12.2.1 A description of the baseline environment in relation to the 2011 consultation scheme is contained within the AoS (Volume 1, Section 8); particularly, Section 8.4 provides a description of the baseline environment in relation to landscape and visual receptors, with further details provided in Appendices 2, 3 and 5.
- 12.2.2 The Proposed Scheme would pass through a wide range of different landscape character areas between Central London and the West Midlands. The overall character of the proposed route from south to north is as follows:
- The landscape of central London from the urban centre around Euston station to the predominantly residential suburbs of the outer London boroughs;
 - The rural landscapes of Buckinghamshire, Oxfordshire, Northamptonshire and Warwickshire including the nationally important Chilterns AONB;
 - The rural, suburban and urban landscapes of Solihull District and Birmingham; and
 - The rural and agricultural landscape of Warwickshire and Staffordshire north of Birmingham, where the Proposed Scheme joins the WCML north of Lichfield.
- 12.2.3 The landscape character of the study area [see Section 12.5 (Scope of assessment – Spatial scope)] and the nature of existing views will be established through desk based research and field survey.
- 12.2.4 The landscape and visual surveys will be carried out by Chartered Landscape Architects experienced in EIA. Assessments made will be verified by at least two other Chartered Landscaped Architects experienced in EIA. Survey work will be carried out in both the summer and winter, in order for seasonal change to be considered in the assessment. The survey work will be carried out in a methodical order as follows:
- Verification of the zone of theoretical visibility (ZTV) i.e. the study area [see Section 12.5 (Scope of assessment - Spatial Scope)];
 - Definition of the landscape character areas (see paragraphs 12.2.7 and 12.2.8);
 - Assessment of the condition, tranquillity and value of each of the character areas (see paragraphs 12.2.9 to 12.2.12);
 - Establishment of the sensitivity of each of the character areas (see paragraph 12.2.14);
 - Definition of visual receptors (viewpoints) within the ZTV (see paragraph 12.2.15);
 - Definition of the type and nature of the view from each viewpoint (see paragraph 12.2.17); and
 - Determination of the magnitude of change for each character area (see paragraph 12.6.2) and visual receptor (see paragraph 12.6.9).

12.2.5 The field study will include a comprehensive photographic record carried out in both the summer and winter, to illustrate each character area and viewpoint (see paragraphs 12.2.15 to 12.2.18).

Landscape baseline

12.2.6 The landscape baseline will include an overview of the elements that form the baseline within the study area, using text and plans to describe:

- Topography and geology;
- Cover, distribution and type of land use and open space, including statutory and non-statutory designations relevant to the landscape and visual assessment (for example AONB and Areas of Great Landscape Value);
- Development patterns and scale, including age, massing and density of buildings, levels of enclosure, skyline characteristics, building materials and landmark features;
- Vegetation patterns and extents;
- Transport routes and Public Rights of Way, National Trails and other routes to include roads, railways, cycleways, bridleways, footpaths, historic green lanes and drovers roads and waterways;
- Heritage features, including conservation areas, listed buildings, registered parks and gardens and other historic components; and
- Existing landscape character assessments and/or local green infrastructure strategies or plans prepared by authorities, including the latest available National Character Assessment and Profiles from Natural England.

Landscape character assessment

12.2.7 The landscape baseline elements will be used to prepare a character area assessment covering the full extent of the study areas. Landscape character areas are defined as areas with broadly homogenous characteristics. The identification of character areas will be influenced by published character assessments, including those prepared at national, county and district scales. If these are sub-divided to create units of character appropriate to the scale of the Proposed Scheme, this will be clearly set out in the ES.

12.2.8 The character of each landscape character area would be described, influenced by existing documentation including local authority character assessments, historic landscape character assessments and Conservation Area character appraisals where available.

Condition

12.2.9 The condition of each character area will be described with reference to the following criteria:

- Good - components are regularly maintained to a high standard;
- Fair - components are relatively well maintained; and

- Poor - components are poorly maintained or damaged.

12.2.10 Professional judgements by landscape architects on the condition of the character areas will be based on the physical state of the landscape, including its intactness and the state of repair of individual features and elements.

Tranquillity

12.2.11 The tranquillity of each character area will be described with reference to the following criteria:

- Land use;
- Level of seclusion or isolation, including perception of nature;
- Extent and type of enclosure by surrounding land uses;
- Level of screening afforded by vegetation, ground level change or boundary treatments;
- Levels and types of vehicular traffic within, or close to the character area;
- Levels of pedestrian traffic within, or close to the character area;
- Level of light pollution; and
- The absence or presence of major infrastructure routes within or in the vicinity of the character area.

12.2.12 Tranquillity may be considered to be high, medium or low.

Landscape value

12.2.13 An assessment will be made of the likely scale at which the character areas are valued. This will be based on which users may value the areas and, where relevant, any statutory, non-statutory or local plan designations. The presence of any combination of attributes may be considered when assessing the value of a character area. Factors that influence the scale which a character area is valued at are described in Table 17. These criteria are based on guidance provided by the Landscape Institute.¹⁰¹

Table 17 - Landscape value

Scale of landscape value	Where the character area is:
International	Located within a World Heritage Site Considered an internationally important component of the country's character, experienced by significant numbers of international tourists
National	Located within an AONB

¹⁰¹ Landscape Institute and Institute of Environmental Management and Assessment (IEMA), 2002, *Guidelines for Landscape and Visual Impact Assessment Landscape* (2nd Edition), Landscape Institute and IEMA

Scale of landscape value	Where the character area is:
	<p>A nationally significant historic or cultural resource</p> <p>Considered a distinctive component of the country's character, experienced by significant numbers of tourists from around the country</p>
Regional	<p>Located within green belt, Metropolitan Open Land or a regional scale park</p> <p>Considered a distinctive component of the region's character, experienced by a large proportion of its population</p>
County/ Borough/District	<p>Designated open space within the local authority Unitary Development Plan or Local Development Framework</p> <p>Designated as a Conservation Area</p> <p>Experienced by a significant proportion of the county's, borough's or district's population</p>
Local	<p>A landscape of local significance (recognised at local authority level where criteria based assessments have been undertaken and locally adopted)</p> <p>A public, semi-public or private open space that serves the local community or residents</p> <p>A residential area, likely to be valued by the local community</p>
Limited	<p>A commercial, industrial or disused area that has limited landscape value to the local community or residents</p>

Sensitivity criteria

12.2.14 With reference to condition, tranquillity and landscape value, the sensitivity of the character areas to the nature of the Proposed Scheme will be assessed. The assessment of sensitivity requires the application of professional judgement, in line with guidance provided by the Landscape Institute. The presence of any combination of attributes may be considered when assessing the sensitivity of a character area, including published character assessments which attribute sensitivity to landscape character areas. This allows professional judgement to be used when determining the relative importance of different attributes. The attributes which influence the sensitivity of a character area are described in Table 18.

Table 18 - Landscape sensitivity

Sensitivity	Where the character area:
High	<p>Is valued at the international, national, regional or borough/district scale</p> <p>Is predominantly characterised by landscape components that are rare and distinctive and/or listed</p> <p>Is designated as a conservation area, registered park and garden or public open space</p> <p>Has an elevated tranquillity</p> <p>Has limited tolerance to change</p> <p>Has components that are not easily replaced or substituted (e.g., mature trees)</p> <p>Has limited scope for effective mitigation in character with the existing landscape</p> <p>Is well maintained and in a good condition</p>
Medium	<p>Is locally valued</p> <p>Has moderate levels of tranquillity</p> <p>Is fairly tolerant of change</p> <p>Has components that are easily replaced or substituted</p> <p>Has scope for effective mitigation in character with the existing landscape</p> <p>Is of a fair condition</p>
Low	<p>Has limited landscape value</p> <p>Has few or no distinctive components, or components that detract from the overall character of the site</p>

Sensitivity	Where the character area:
	Has limited tranquillity Is tolerant of change Has components that are easily replaced or substituted Has scope for effective mitigation in character with the existing landscape, and opportunities for an improvement in character Is in a poor condition

Visual baseline

Selection of viewpoints

12.2.15 Viewpoints would be selected to allow an assessment of effects [see Section 12.6 (Assessment methodology)] from receptors within the study area. Individual residential, hotel, healthcare, employment and educational receptors will be identified and those with the same or similar view grouped together. Representational viewpoints will be identified for recreational, transport and active sports receptors.

12.2.16 All viewpoints will be agreed with the community forums, local planning authorities and other relevant stakeholders, for example English Heritage, the National Trust, Natural England and the Chilterns Conservation Board.

12.2.17 Photos taken during both winter and summer periods will be included in the ES for each viewpoint. The composition of the view will be described, including foreground and background characteristics, the nature of the view towards the land to be acquired or used for the Proposed Development, that which obstructs the view (if anything) and whether a view is panoramic, framed, glimpsed or sequential.

12.2.18 The view at night will be described in cases where significant effects arising from lighting during construction or operation are likely.

Sensitivity

12.2.19 Within the study area, visual receptor types will be mapped by category according to the hierarchy shown in Table 19, based on people's level of interaction with the landscape. These categories are based on best practice guidance from the Landscape Institute.

Table 19 - Visual sensitivity

Sensitivity	Level of interaction with the landscape
High	Occupiers of residential properties Recreational users or tourists whose attention may be focussed on

Sensitivity	Level of interaction with the landscape
	the landscape Designated or protected views
Medium	People travelling through the landscape People staying in hotels and healthcare institutions
Low	People at work and in educational institutions People engaged in formal sports activities

12.3 Consultation

Consultation on the AoS

12.3.1 Effects on landscape and visual receptors were raised during consultation on the AoS, with reference also made to the AONB and other valued landscapes (including both designated and non-designated areas).¹⁰²

12.3.2 Any new large infrastructure project, especially road and railway routes could have effects on landscape receptors. In this respect, and following consultation on the AoS, a large number of changes along the route were incorporated that were driven by an approach to minimise the landscape effects and respond to other environmental concerns. This approach has included evolving the 2011 consultation scheme such that lower viaducts and embankments are used, along with the extensive use of cuttings and other landscape design to help blend into, or screen the railway within the landscape.

12.3.3 Substantial efforts have been made to avoid effects on the landscape by following the existing contours of the land or along existing transport corridors where possible. In addition, natural screening of the railway will be incorporated with the use of landscape earthworks, trees, hedgerows and other planting. The Government has committed to plant at least two million trees as a means of providing habitat and landscape benefits. The planting of these would be carefully considered to ensure they are appropriate to the character of the surrounding landscape.

12.3.4 The Chiltern Hills escarpment crosses a direct line between London and the West Midlands, much of which is designated as an AONB. Specific concerns were raised during consultation on the 2011 consultation scheme and the AoS relating to the AONB, asking whether it was appropriate for such a development to have effects on the landscape designation and associated features. Reference was made to policy and regulations in this respect. However, changes to the route following consultation ensured that in the AONB, 7.5 miles would be in tunnel and 3 miles would be hidden in deep

¹⁰² Department for Transport (DfT), 2012, *Review of HS2 London to West Midlands Appraisal of Sustainability: A Report to Government by HS2 Ltd*, DfT

cutting, meaning that only 1.5 miles of the route would be visible in the Chilterns.

Consultation as part of the EIA process

12.3.5 Consultees for this chapter of the ES will include (but not be limited to) local planning authorities, county councils, the GLA, Natural England, English Heritage, the National Trust, the Environment Agency, the Forestry Commission, the Chilterns Conservation Board and other groups with appropriate technical knowledge.

12.4 Key aspects of the Proposed Scheme for the topic

12.4.1 The main features of relevance to the landscape and visual assessment during construction include:

- Construction sites (including vehicles, construction lighting);
- Site compounds and storage areas, including temporary fencing and signage;
- Earthworks (including temporary stockpiles or earth bunds for screening);
- Construction of buildings, structures and electrical apparatus;
- Demolition and vegetation clearance;
- Construction traffic, including movement of excavated materials and movements on public roads; and
- Infrastructure and utility diversions.

12.4.2 The main features of relevance to the landscape and visual assessment during operation include:

- The track and track bed;
- Traffic (including trains and maintenance vehicles), and ‘arcing’ from trains;
- The overhead line equipment (OLE), lighting, communication masts and signage;
- Tunnel portals and ventilation shafts;
- Viaducts and bridges (including both road and pedestrian);
- Demolitions;
- Earthworks including cuttings, embankments, cut and cover “green tunnels” and earthworks such as earth bunding and regrading works, much of which would assist with screening and integrating the Proposed Scheme;
- Planting;
- Noise barriers and visual screens;
- New stations/interchanges and infrastructure maintenance depots, and associated development such as road widening, junction changes and increased traffic; and
- Associated developments, such as utility and permanent road diversions/upgrading.

12.5 Scope of assessment

- 12.5.1 The methodology for the landscape and visual assessment takes into account the guidance set out in the following documents:
- Guidelines for Landscape and Visual Impact Assessment Landscape (2nd Edition), Landscape Institute and IEMA; and
 - DMRB, Volume 11 Section 3 Part 5: Landscape Effects (1993).
- 12.5.2 There is no legislation or prescriptive guidance for undertaking landscape and visual assessments. Therefore, the methodology that has been developed for this assessment seeks to make reference to relevant guidance from both of the above documents, whilst also accommodating relevant developments in the assessment outlined in the Guidelines for Landscape and Visual Impact Assessment (GLVIA)¹⁰³ (3rd Edition Consultation Draft, 2012) (for example, through avoiding judgements on landscape quality).

Spatial scope

- 12.5.3 The landscape and visual assessment study area would be determined through the production of a zone of theoretical visibility plan (ZTV). Separate study areas would be established for:
- Construction – defined as the area over which the proposed construction activity would be visible; and
 - Operation year 1 – defined as the area over which the components of the proposed development (including trains) would be visible, taking into account the assumed Limits of Deviation within which the Proposed Scheme would be located.
- 12.5.4 The landscape assessment area would be defined by the maximum extent of all character areas located partially or entirely within the ZTV except in those locations where the Proposed Scheme during construction or operation would be barely perceptible. The visual assessment area would be defined by the maximum extents of the ZTV except in those locations where the Proposed Scheme during construction or operation would be barely perceptible.
- 12.5.5 The ZTVs would be based on the most recently available topographic data. A datum of 1.6m above ground level would be used to represent the eye level view of an average height person. The validity of the route wide ZTV would be checked on site, using professional judgement, to ensure the output is a fair representation of the theoretical visibility of the proposed development, in line with guidance provided by the Landscape Institute.
- 12.5.6 Aspects of landscape and visual assessment are important to consider in respect of the setting of historic buildings and landscapes. The methodology

¹⁰³ Landscape Institute, 2012, *Guidelines for Landscape and Visual Impact Assessment* (3rd Edition Consultation Draft), Landscape Institute

in this section has been made compatible with the heritage study in this respect. The methodology in this section describes the assessment process for effects on landscape character and on visual receptors. Section 8 (Cultural Heritage) of this Report will consider the effects of the Proposed Scheme on the setting of individual cultural and heritage assets. For example this may include effects on the setting of scheduled monuments, listed buildings and registered parks and gardens.

Temporal scope

12.5.7 The landscape and visual assessment will be undertaken for the following years:

- Construction - an assessment of effects in winter during the construction phase;
- Operation year 1 - an assessment of effects in winter and summer during operation year 1;
- Operation year 15 - an assessment of effects in summer during operation year 15, once any vegetation planted as part of the Proposed Scheme has matured or has achieved its design intention; and
- Operation year 60 - to consider the benefits and/or negative effects of maturity of screen planting, restoration or offsetting.

12.6 Assessment methodology

12.6.1 Physical changes to the landscape may give rise to effects on character. Effects may be direct (whereby landscape components are lost, damaged or altered by the construction or operation of the Proposed Scheme), or indirect (whereby the proposed development alters the setting of surrounding character areas).

Landscape assessment methodology

Determining magnitude of change

12.6.2 The likely nature and magnitude of changes to individual landscape components and characteristics are described together with the consequential effect on landscape character. Factors that would be considered in assessing the magnitude of change to the character areas surrounding the site are summarised in Table 20. These criteria are based on guidance provided by the Landscape Institute.

Table 20 - Landscape magnitude of change

Impact magnitude	Definition
High	Total loss of or major alteration to key characteristics of the character and/or setting of the character area

Impact magnitude	Definition
	<p>Addition of new features or components that substantially alter the character and/or setting of the character area</p> <p>Introduction of elements that markedly alter the tranquillity of the character area</p>
Medium	<p>Partial loss or alteration to one or more key characteristics of the character and/or setting of the character area</p> <p>Addition of new features or components that form prominent elements of the character and/or setting of the character area, but are largely characteristic of the existing setting</p> <p>Introduction of elements that noticeably alter the tranquillity of the character area</p>
Low	<p>Minor loss or alteration to one or more characteristics of the character and/or setting of the character area</p> <p>Addition of new features or components that form largely inconspicuous elements of the existing character and/or setting</p> <p>Introduction of elements that discernibly alter the tranquillity of the character area</p>
Negligible	<p>No change to, or very minor loss or alteration of inconspicuous characteristics of the character and/or setting of the character area</p> <p>Addition of new features or components that do not influence the overall character and/or setting of the character area, or are entirely characteristic of the existing setting</p> <p>Introduction of elements that make no perceptible change to the tranquillity of the character area</p>

Determining significance of effects

12.6.3 Determination of the significance of an effect requires the application of impartial professional judgement including experience of other major infrastructure schemes to weigh the findings of the sensitivity of the receptor and the magnitude of change. This approach is recommended by the Landscape Institute. The presence of any combination of factors may be considered when assessing the significance of effect. This allows professional judgement to be used when determining the relative importance of different factors, which varies on a site specific basis. Effects may be adverse or beneficial. The broad criteria that influence the level of significance of landscape effects are noted in Table 21. Both the major and moderate

categories are considered to comprise a significant effect. Any one aspect described may result in a categorisation within that significance level. These criteria are based on guidance provided by the Landscape Institute.

Table 21 - Landscape significance of effects

Significance of effect	Description The proposed development would result in effects that:
Major beneficial – significant	Would considerably and distinctly improve and enhance the existing character Would restore valued characteristic features substantially or entirely lost through other land uses
Moderate beneficial - significant	Would markedly improve and enhance the existing character Would restore valued characteristics substantially lost through other land uses
Minor beneficial	Would improve and enhance the existing character Would restore valued characteristic features partially lost through other land uses
Negligible	Would be compatible with the existing character
Minor adverse	Would be slightly at variance with the existing character
Moderate adverse -- significant	Would be at variance with the existing character Would be judged adverse at a local level Would not be wholly compatible with local environmental policies for the protection and enhancement of the landscape
Major adverse - significant	Would be at considerable variance with the existing character, degrading its integrity Would permanently degrade, diminish or destroy the integrity of valued characteristic features, elements and/or their setting Would be judged adverse at a national or regional level Would comprehensively conflict with national, regional or local environmental policies for the protection and enhancement of the landscape

Visual assessment methodology

12.6.4 Visual effects relate to:

- The changes that arise in the composition of available views as a result of changes arising from the proposed development; and

- People’s likely responses to changes.

12.6.5 For sites where substantial lighting is anticipated during construction or operation, an assessment of visual effects at night time arising from additional lighting, would also be made, in line with the methodology described for the day time assessment below.

12.6.6 The construction phase assessment would be undertaken during winter, when construction works are likely to be most visible.

12.6.7 The operation year 1 assessment would be undertaken during winter and summer to account for seasonal change in the visibility of the proposed development.

12.6.8 The purpose of the operation year 15 and 60 assessments would be to account for any vegetation planted as part of the project that has matured or has achieved its design intention, and would be in full leaf. Therefore, the assessment for these years would be undertaken during summer.

Determining magnitude of change

12.6.9 The factors that would be considered in assessing the magnitude of change on views and on visual amenity of the identified receptors are summarised in Table 22, based on guidance from the Landscape Institute.

Table 22 - Visual magnitude of change

Impact magnitude	Definition
High	Total loss of or major alteration to key characteristics of the view from a receptor Addition of new features or components that are continuously highly visible and incongruous with the existing view from a receptor Substantial changes in close proximity to the visual receptor, within the direct frame of view
Medium	Partial loss of or alteration to one or more key characteristics of the view from a receptor Addition of new features or components that may be continuously highly visible, but are largely characteristic of the existing view from a receptor Changes a relatively short distance from the receptor, but viewed as one of a series of components in the middle ground of the view Substantial change partially filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor

Impact magnitude	Definition
Low	<p>Minor loss of or alteration to one or more characteristics of the view from a receptor</p> <p>Addition of new features or landscape components that may be continuously or intermittently visible, but are largely characteristic of the existing view from a receptor</p> <p>Changes within the background of the view, viewed as one of a series of components in the wider panoramic view from a receptor</p> <p>Change largely filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor</p>
Negligible	<p>Very minor loss or alteration of inconspicuous characteristics of the view from a receptor</p> <p>Addition of new features or landscape components that are largely inconspicuous and characteristic of the existing site when viewed from a receptor</p> <p>Changes within the background of the view, viewed as an inconspicuous element within the wider panoramic view from a receptor</p> <p>Change from a visual receptor almost entirely obscured by intervening vegetation and/or built form</p>

Determining significance of effects

12.6.10 Determination of the significance of an effect requires the impartial application of professional judgement to weigh the sensitivity of the receptor with the magnitude of an impact. Effects may be adverse or beneficial. The broad criteria that influence the level of significance of visual effects are set out in Table 23. Both the major and moderate categories are considered to comprise a significant effect. The significance for visual effects follows the guidance provided by the Landscape Institute.

Table 23 - Significance of effects for visual assessment

Significance of effect	Description The proposed development would result in:
Major beneficial - significant	A marked improvement in the existing view
Moderate beneficial - significant	A noticeable improvement in the existing view

Significance of effect	Description The proposed development would result in:
Minor beneficial	A discernible improvement in the existing view
Negligible	No perceptible deterioration or improvement in the existing view
Minor adverse	A discernible deterioration in the existing view
Moderate adverse - significant	A noticeable deterioration in the existing view
Major adverse - significant	A marked deterioration in the existing view

Verifiable photomontage methodology

12.6.11 In some locations, to be agreed with statutory consultees, the assessment of visual effects would be supported by the production of verifiable photomontages. These would be prepared for viewpoints where:

- The receptor is highly sensitive to change and/or the viewpoint is identified in the London View Management Framework Supplementary Planning Guidance (SPG), Local authority Unitary Development Plans, Local Development Frameworks and SPGs, and Conservation Area character appraisals; or
- The magnitude of effect cannot be easily assessed with reference to plans, sections, elevations and 3D visualisations (e.g. where views may be partially filtered or screened by vegetation or built form, or where the precise position of elements has a particular importance in relation to the composition of a view).

12.6.12 Verifiable photomontages would be produced for construction, operation year 1, operation year 15 and operation year 60 as required.

Cumulative effects assessment

12.6.13 Cumulative effects arising from the Proposed Scheme in conjunction with other developments within the study area would be described with reference to how the findings of the main assessment would change. No magnitude of change or significance of effect would be described for cumulative effects.

12.6.14 The construction phase cumulative assessment would consider the effects of construction of the Proposed Scheme in conjunction with all other major developments likely to be under construction at the same time within the construction phase study area.

12.6.15 The operation year 1 cumulative assessment would consider the effects of the operation of the Proposed Scheme in conjunction with all other major developments in operation in year 1 within the operational phase study area.

12.7 Assumptions

12.7.1 The assessment is based on professional judgement and takes into account both the adverse and beneficial contribution that new development can have upon the existing landscape character and on the visual resource of surrounding receptors.

12.7.2 During the baseline survey there may be some areas which are inaccessible (such as private land, commercial premises and residential buildings). In these instances, professional judgement will be used to approximate the likely views from these locations. Where viewpoints are selected to reflect the visibility of the site from tall residential properties, a photo will be included from public land in close proximity to the property, taken at ground level, and a commentary included as to the likely appearance of the view from a higher elevation. In line with industry accepted guidance, in these instances, no photomontages will be included from an elevated perspective.

12.7.3 The ZTVs will be generated using LiDAR topographic data (where available) or Ordnance Survey Landform Profile data. It is acknowledged that changes in the assessment area through new development and/or demolition will not necessarily be picked up by this model. However, professional judgement will be used to verify the ZTVs on site as far as possible.

13 Socio-economics

13.1 Introduction

- 13.1.1 This section of the Report sets out the methodology for the socio-economic assessment, which focuses on identifying significant economic and employment effects during the construction and operational phases of the Proposed Scheme. The need for a socio-economic assessment results from the potential for the Proposed Scheme to generate impacts on:
- Existing businesses and organisations;
 - Local and sub regional economies, including employment;
 - Planned growth and development; and
 - Wider concentrations of economic activity.
- 13.1.2 The socio-economic assessment will feed into the community assessment chapter of the ES, for example, increases in property prices arising from catalytic effects may give rise to changes in access to housing. The assessment will also draw upon other assessments where relevant, such as agriculture, forestry and soils in relation to farm-based businesses. Specifically the socio-economic topic will focus on the implications for economic actors and development implications (The consequent community implications of these effects are covered in the Community Assessment).
- 13.1.3 The assessment will also complement the wider business case for HS2, focusing on the identifiable implications for jobs, skills and development, particularly along the route of the Proposed Scheme and elsewhere (e.g. relevant locations on the WCML). The assessment is distinguished from the wider business case in that it will identify direct and significant impacts on local and sub-regional economies. The wider business case is related to, but differs from, the socio-economic assessment in that it predicts overall benefits to the output of the national economy. Benefits to the national economy arise through the circulation of monies over a wide area, which may not have directly observable or significance consequences in the context of EIA.

13.2 Establishment of baseline and definition of survey

Characteristics of communities

- 13.2.1 The need to minimise negative socio-economic effects has influenced the design development of the Proposed Scheme, for example by alignment of the route's centreline to avoid the majority of communities between London and the West Midlands, further extension of tunnels, and provision of green tunnels.
- 13.2.2 However, the route passes through, and will potentially effect, a diverse range of communities. The main centres of population comprise the Greater

London and Greater Birmingham areas. Other key settlements near the Proposed Scheme include Amersham, Wendover, Aylesbury, Brackley and Kenilworth. The route will also pass close to a number of villages, hamlets and isolated farmsteads in the countryside. These communities are more dispersed, rural/agricultural communities.

Baseline data and methods

- 13.2.3 The assessment will rely on two general sources of information, namely technical evidence and stakeholder views. Stakeholder views will inform how best to approach the more qualitative aspects of the assessment.
- 13.2.4 Key data providers are likely to include local authorities, dedicated sub-regional bodies and specialist research organisations.
- 13.2.5 Baseline information will be presented against comparable performance statistics for areas associated with communities where impacts are being assessed, known as benchmark areas. Benchmark areas will include a local catchment, the host district and wider areas or a county where appropriate. The baseline for the benchmark areas will draw on a number of sources covering:
- Existing planning, economic and regeneration plans and strategies;
 - Population and migration;
 - Labour supply;
 - Employment and unemployment;
 - Enterprises;
 - Commuting patterns;
 - Development potential/capacity; and
 - Existing studies on wider economic effects during operation of the Proposed Scheme.
- 13.2.6 Data will be collected by a variety of methods including: accessing national data sets; requesting and accessing local information; exchange of information with other environmental topics; and carrying out and investigations into the character and nature of businesses in the area.

13.3 Consultation

Consultation on the AoS

- 13.3.1 Key stakeholders were consulted through a reference group in preparation for the AoS. Relevant stakeholders included: business of local, regional and national scale; Chambers of Commerce; other bodies representing business e.g. the Federation of Small Businesses; professional bodies; local government; and local enterprise partnerships and companies representing specific utility and transport infrastructure interests.
- 13.3.2 A wider consultation process was also undertaken in relation to the 2011 Consultation Scheme as part of the AoS, the responses to which focused on

jobs, social equity, local benefit and specific proposals. A total of 7,487 responses stated that the proposed network will create jobs across the UK, sustain the competitiveness of the economy, and positively affect regeneration and regional development. 4,163 respondents expressed doubt about the forecasted economic benefits including the reliability of the assumptions underpinning the figure, with some stating that only a few places will benefit and some may lose economic activity¹⁰⁴. Although numerous responses concentrated on the benefits to the UK as a whole, a recurring issue was the distribution of potential positive impacts and concerns that a north-south divide would be exacerbated. A total of 2,599 respondents were concerned that these benefits would be restricted to a few locations and that, for example, communities having to cope with disruption during the construction and operational phases would not see any benefits.

13.3.3 Specific consultation responses on the interchange proposals were divided on the merit of the interchange at Old Oak Common, with some focusing on the regeneration and economic benefits, whilst others contended that the area is not well connected. In the West Midlands, a common theme for respondents was whether or not the proposed Curzon Street station is close enough to Birmingham city centre to fully realise the benefits.

Consultation as part of the EIA process

13.3.4 Relevant formal and other stakeholders will be contacted as part of the EIA process, including:

- Local authorities with territory along the route of the Proposed Scheme as well as territories associated with proposed stations/ interchanges, junctions and infrastructure maintenance depots (and potentially local authorities affected by any secondary effects on the WCML and other routes);
- Major development interests around the stations etc, identified through dialogue with the local planning authorities;
- Local Enterprise Partnerships;
- Other business representative bodies including: Chambers of Commerce and the Federation of Small Businesses;
- Organisations involved with mitigation/enhancement measures, such as Job Centre Plus and specialist industry-based training bodies concerned with engineering and construction;
- The Homes and Communities Agency (HCA);
- Relevant local bodies established to promote enterprise and social enterprise; and
- Inward investment promotional bodies, e.g. UK Trade and Investment and other relevant local regeneration or economic development bodies.

¹⁰⁴ Department for Transport (DfT), 2011 (Addendum 2012), *High speed rail: Investing in Britain's future consultation summary report: A report to Government by Dialogue by Design*, DfT

13.4 Key aspects of the Proposed Scheme for the topic

13.4.1 Relevant aspects of the Proposed Scheme include:

- Direct, indirect and catalytic effects of construction and operation;
- Demand for labour, particularly during construction, including labour skills and sources;
- Relocation of businesses during construction, e.g. for development of new stations/interchanges;
- Economic effects of additional passengers and their travel to/from the stations, including effects on existing local transport and businesses;
- Indirect effects on businesses and labour markets served by the existing WCML and any other lines affected by the Proposed Scheme;
- The economic and land use effects of changes in accessibility;
- Catalytic effects on planned and anticipated development; and
- Wider catalytic effects¹⁰⁵ and city regeneration.¹⁰⁶

13.5 Scope of assessment

Spatial scope

13.5.1 The spatial scope of the assessment will vary according to the type of resource or receptor (see Table 24).

Table 24 – Socio-economic assessment: resources, receptors and spatial scope

Resource	Impacts	Effects:		Spatial scope
		On resources	On receptors	
Existing businesses and organisations – land take and amenity impacts	Businesses (non-community) lost to land take	Loss or impairment of business activities	Change in employment and skills mix	Direct land take by the Proposed Scheme
	Community activities lost to land take	Loss or impairment of community activities	Change in employment and skills mix	Direct land take by the Proposed Scheme
	Ground settlement and businesses (non community)	Repairs needed or value of property diminishes	Costs of repairs and inconvenience to landlords/owners/tenants/users	Properties up to 30m from boundary of tunnels or excavations
	Amenity value of infrastructure (used for employment purposes) is changed resulting in an impact on businesses and organisations'	Character or quality of businesses and organisations' environment changes as a result of noise; traffic/congestion, vibration; pollution;	Impact on (non-community) businesses	Relevant impact area from the edge of the Proposed Scheme is a minimum 250m in both urban and rural areas unless
		Change in employment and skills mix		

¹⁰⁵ The creation of station infrastructure may attract other investment activity – either to use its services directly or to exploit associated infrastructure. For example, firms may locate in close proximity to a station to use their services and/or in response to the changed investment climate and perceptions of the area.

¹⁰⁶ Regeneration is subset of wider catalytic effects where, for example, a station development encourages the development of a site which also delivers regeneration benefits where these are defined as such by local policy.

Resource	Impacts	Effects:		Spatial scope
		On resources	On receptors	
	operations	air/water quality; visual impacts		subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure (used for employment purposes) from receptors resulting in an impact on businesses and organisations' operations	Physical e.g. Islanding or isolation of resource results in change to business and organisations' environment	Impact on (non-community) businesses Change in employment and skills mix	All or part of the catchment area of affected resource where it is subject to severance ¹⁰⁷
Employment associated with construction	Direct employment opportunities associated with the construction phase	Demand for construction sector services	Demand for construction sector jobs and change in opportunities for local employment	Travel to Work Area of construction sites for daily commute workforce and UK wide for migrant workers
	Indirect impacts on the economy of the construction phase	Indirect impacts on other construction sector projects, multiplier impacts on the wider economy	Demand for construction sector jobs and change in opportunities for local employment	UK
Employment associated with operations	Direct employment opportunities associated with the operational phase	Demand for operational phase services	Demand for operational phase associated jobs and change in opportunities for local employment	Travel to Work Areas associated with the stations and depots during the operational phase employment locations
	Indirect impacts on the economy of the operational phase	Indirect impacts on sectors of the economy, multiplier impacts on the wider economy	Change in employment and skills and change in opportunities for local employment	Induced effects are most likely to occur within the Greater London and the West Midlands where the operational workforce is located. Indirect (supplier based) effects are likely to occur within the UK

Temporal scope

13.5.2 The temporal scope is outlined in Section 2.2 (Scope of assessment) of this Report. Socio-economic impacts will generally be assessed for the construction period (2018 – 2026) and operational capacity (based on operational services of, at peak, 18 trains per hour) in 2033. Impacts will also be assessed in the future against scenarios reflecting different service

¹⁰⁷ The distance of the diversion and duration are factors in determining whether or not there is an impact.

intensities. For socio-economic impacts, 10 years following completion is considered an appropriate timescale¹⁰⁸ for the 'future' assessment.

Uncertainty

13.5.3 The assessment of impacts will take into account how uncertainty and variability of impacts could generate different effects. For example, variability in service frequency could have varying impacts on locations experiencing changed accessibility due to the Proposed Scheme.

13.6 Assessment methodology

13.6.1 The effects of the Proposed Scheme will be considered at varying spatial levels according to the nature of the effect in each case, through comparison of the baseline conditions and those as a result of the Proposed Scheme.

Legislation and guidance

13.6.2 The available guidance on socio-economic assessment sets out the overarching principles, including the assessment of gross and net impacts and recognition of the wider economic impacts of transport schemes. The HCA employment densities guide¹⁰⁹ will be used where necessary to estimate employment in identified floorspace where it is not practical to undertake a direct survey. Other relevant guidance includes:

- *Treasury Green Book: Appraisal and Evaluation in Central Government*¹¹⁰;
- DfT WebTAG guidance (on wider economic effects of transport);
- English Partnerships (2008) *Additionality Guide, A standard approach to Assessing Additional Effects of Projects*¹¹¹; and
- Good practice from other infrastructure project EIAs, for example, Crossrail and Thames Tunnel.

Significance criteria

13.6.3 Since there is no definitive guidance on significance criteria for socio-economic effects, the assessment will draw on existing industry accepted practice. The significance of a socio-economic effect will be determined by assessing both the:

- Magnitude of the impact; and
- Sensitivity of receptors.

¹⁰⁸ Department for Business, Innovation and Skills (BIS), 2009, *Regional Development Agency (RDA) Evaluation: Practical Guidance on Implementing the Impact Evaluation Framework*, BIS. Suggests 10 years is an appropriate timescale for persistence effects of major infrastructure projects. This was based on PwC research into persistence effects of publicly funded infrastructure and regeneration projects.

¹⁰⁹ Homes and Communities Agency, Office of Project & Programme Advice & Training and Drivers Jonas Deloitte, 2010, *Employment Densities Guide*, 2nd Edition, HCA.

¹¹⁰ HM Treasury, 2003, *The Green Book: Appraisal and Evaluation in Central Government*, The Stationery Office

¹¹¹ English Partnerships, 2008, *Additionality Guide, A standard approach to Assessing Additional Effects of Projects* (3rd Edition), English Partnerships

Determining magnitude of impacts

13.6.4 The magnitude of an impact represents its severity or scale, and is influenced by:

- Spatial extent (localised/isolated versus widespread with potential secondary effects);
- Extent (number of groups and/or people, households or businesses affected);
- Duration;
- Conformity with standards for provision or accessibility (as set out in regional or local planning guidance);
- Permanence;
- Likelihood of occurrence;
- The scope for incorporated environmental design features or mitigation; and
- Value of the resource.

13.6.5 Based on the above considerations, guideline criteria will be used to determine the magnitude of the impacts on the basis of professional judgement and existing industry accepted practice (see Table 25).

Table 25 - Socio-economic impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very adverse/beneficial, and very likely to effect large numbers of businesses and/or people (with number depending on the local context and nature of the impact), and that will usually continue and effectively constitute a permanent, long-term impact on the baseline conditions
Moderate	An impact that is likely to effect a moderate number of businesses and/or people (with number depending on the local context and nature of the impact)
Low	An impact that is likely or may effect a small number of businesses and/or people (with number depending on the local context and nature of the impact) and/or that usually does not extend beyond the life of the project so that the baseline is not affected beyond a short or medium-term duration
Negligible	An impact that is temporary in nature and/or is anticipated to have a slight or no effect on the well-being of businesses and/or people

Determining receptor sensitivity

13.6.6 Guideline criteria have been established using professional judgement and existing industry accepted practice to determine the sensitivity of the receptors (see Table 26).

Table 26 - Socio-economic receptor value/sensitivity criteria

Receptor value and/or sensitivity	Definition
High	Businesses, workforces or economies that are at risk and that have little or no capacity to experience the impact without incurring a significant socio-economic loss (or gain) of an economic resource, or employment
Moderate	Businesses, workforces or economies that have a limited or average capacity to experience the impact without incurring a significant socio-economic loss (or gain) of an economic resource, or employment
Low	Businesses, workforces or economies that generally have adequate capacity to experience impacts without incurring a significant socio-economic loss (or gain) of an economic resource, or employment

Determining the significance of effects

13.6.7 The significance of a socio-economic effect is a product of the magnitude of the impact and the sensitivity of the receptor, and will be assessed on the basis of professional judgement and existing industry accepted practice.

13.6.8 The approach to determining significance is summarised in Table 27.

Table 27 - Socio-economic - significance of effect criteria

Significance		Impact magnitude			
		High impact	Medium impact	Low impact	Negligible impact
Sensitivity of receptor	High	Major adverse - significant	Major adverse - significant	Moderate adverse - significant	Minor adverse - not significant
	Moderate	Major adverse - significant	Moderate adverse - significant	Minor adverse - not significant	Negligible - not significant
	Low	Moderate adverse - significant	Minor adverse - not significant	Negligible - not significant	Negligible - not significant

13.6.9 Effects are considered to be significant if both impact magnitude and receptor sensitivity are high or medium. Additionally, effects are considered

to be significant if impact magnitude is high and receptor sensitivity is low, or alternatively, if receptor sensitivity is high and impact magnitude is low. This equates to major and moderate adverse/beneficial effects.

13.6.10 Other effects, equating to minor adverse/beneficial and negligible effects, are not considered to be significant.

Construction effects

13.6.11 Construction effects will be assessed following the accepted EIA assessment processes including:

- Establishment of the baseline with definition and collection of relevant data and information as outlined in Section 13.2 (Establishment of baseline and definition of survey);
- Consultations including those outlined in Section 13.3 (Consultation);
- Assessment of impacts and effects against key aspects of the Proposed Scheme as outlined in Section 13.4 (Key aspects of the Proposed Scheme for the topic), covering the scope outlined in Section 13.5 (Scope of assessment) and using the significance criteria outlined in Table 27; and
- Iterative further assessment of impacts identified through other environmental topics as part of the EIA.

Operational effects

13.6.12 The same process will be used for assessment of operational effects as outlined for construction effects above in paragraph 13.6.11.

Cumulative effects

13.6.13 Cumulative effects will be identified on the basis of a high level assessment of other developments individually or cumulatively in the planning pipeline that have the potential to interact significantly with the Proposed Scheme. Other developments will include major infrastructure projects such as HS2 Phase 2 and large scale urban development (e.g. urban extensions). The known characteristics of such developments will be converted into an employment effect using productivity assumptions and identified in relation to the Proposed Scheme's own timeline.

13.7 Assumptions

13.7.1 Key assumptions include:

- Construction labour productivity underpinning the construction labour demand curve remains constant over the life of the Proposed Scheme (e.g. no major changes in technology and method of work that lead to changes in the skills mix, etc); and
- Projections of the baseline/counterfactual (without HS2 economic trends) remain constant over the lifespan of the Proposed Scheme (in terms of known major projects, macro economic conditions, etc).

14 Sound, noise and vibration

14.1 Introduction

- 14.1.1 This section of the Report presents the proposed approach to assessing sound, noise and vibration impacts and effects. It has been divided into two parts, the first dealing with ground-borne sound, noise and vibration and the second dealing with airborne sound and noise.
- 14.1.2 The terms sound and noise are used in this section. 'Sound' is the neutral term used to describe the fluctuating pressure waves in the air that stimulate the sense of hearing. Noise is often defined as unwanted sound. The term sound is used in this scope and methodology for two reasons. Firstly, during consultation in 2011, communities along HS2's line of route requested that the 'sound quality' in their local area be taken into consideration when assessing the affects of HS2. Secondly, the Noise Policy Statement for England¹¹² notes "... sound only becomes noise ... when it exists in the wrong place or at the wrong time such that it causes or contributes to some harmful or otherwise unwanted effect, like annoyance or sleep disturbance". Therefore the term sound is used here until the assessment methodology evaluates that there is a potential adverse effect on a receptor, at which stage the term noise is used. Mitigation is therefore noise mitigation.

14.2 Ground-borne sound and vibration

Introduction

- 14.2.1 This section of the Report presents the proposed approach to assessing ground-borne sound and vibration associated with the construction and operation of the Proposed Scheme.
- 14.2.2 Without mitigation, ground-borne vibration created by either construction activities or train services can propagate through the ground to surrounding buildings where it may result in the vibration of floors, walls and ceilings; which could also be heard as a low frequency 'rumbling' sound (called ground-borne sound).
- 14.2.3 The assessment will cover all noise and vibration sensitive receptors (e.g. occupied buildings), including where appropriate properties for which planning permission has been granted before the safeguarding date but are not yet completed, subject to the screening distances discussed within the specific subject areas. Where a receptor has multiple uses, the assessment will be made based on the most sensitive use.

¹¹² Department for the Environment, Food and Rural Affairs (Defra), 2010, *Noise Policy Statement for England*, Defra

Establishment of baseline and definition of survey requirements

Ground-borne sound

14.2.4 Absolute criteria, rather than sound change criteria, apply for ground-borne sound for four main reasons, as follows:

- There is rarely any appreciable existing ground-borne sound at a receptor;
- The character and nature of ground-borne sound differs from other ambient sound heard inside buildings;
- The body of experience and research available with regard to human response to ground-borne sound has mostly been based on the assessment of the maximum sound level for each train pass-by (i.e. an absolute sound level); and
- Ground-borne sound can affect any room in a property so the criteria consider situations where existing internal background sound levels are at their lowest for a particular classification of receptor (e.g. rooms on a quiet façade of a residential receptor or new build concert hall or broadcast facility).

14.2.5 No ground-borne sound baseline survey is therefore proposed.

Ground-borne vibration

14.2.6 The majority of receptors adjacent to the route of the Proposed Scheme are not currently subject to appreciable levels of vibration and therefore, the ground-borne vibration assessment primarily considers absolute criteria.

14.2.7 The exceptions are receptors close to existing rail sources. Baseline vibration will be calculated in these locations and verified by focused surveys.

Consultation

14.2.8 Principal consultees on the approach to the assessment of ground-borne sound and vibration are the local and county authorities.

14.2.9 Dialogue with local stakeholder groups will be via Community Forums throughout the design and assessment of the Proposed Scheme as well as through public consultation on the draft ES.

14.2.10 Responses to the consultation undertaken in 2011 on the AoS (and in relation to the 2011 consultation scheme) indicated the need to consider ground-borne sound and vibration issues in relation to potential effects associated with vehicle movements and spoil.

Key aspects of the Proposed Scheme for the topic

14.2.11 The key aspects for ground-borne sound and vibration are the following generic types of potential significant adverse effect that could occur without mitigation:

- At very high levels, which very rarely occur adjacent to modern railways, vibration could give rise to a risk of cosmetic damage to buildings;
- Perceptible ground-borne sound and vibration in residential buildings;
- Low levels of ground-borne sound caused by imperceptible vibration could adversely affect buildings where low ambient sound levels are critical to their operation (e.g. recording and broadcast studios, concert halls and theatres); and
- Low levels of vibration that would be imperceptible to people can adversely affect buildings where low ambient vibration is critical to operations (e.g. nanotechnology laboratories).

14.2.12 The following are potential sources of ground-borne sound and vibration:

- Temporary sources: e.g. tunnel boring machine(s) and their supporting temporary construction railways, some types of piling and vibro-compaction; and
- Permanent sources: train operation and to a lesser extent other rail systems such as infrastructure maintenance depots.

14.2.13 During construction of the Proposed Scheme, 'best practicable means' will be used to control and mitigate temporary construction noise and vibration effects consistent with legislation and best practice. 'Best practicable means' will include consideration of working methods, working hours, selection of plant, logistical planning physical barriers and proactive community engagement. The framework for determining such mitigation on a site-by-site basis will be set out in the Code of Construction Practice.

14.2.14 For the operational railway, significant ground-borne noise and vibration effects may be reduced or removed through, for example, the performance specification and design of the rolling stock and infrastructure (especially the track system).

Scope of assessment

14.2.15 Temporal scope: the Proposed Scheme will be assessed at the year of opening and with the highest traffic patterns forecast for the first fifteen years of operation. These will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

14.2.16 Spatial scope for direct effects: there is very little national guidance available on identifying screening distances for operational ground-borne vibration. The application of the United States (US) Federal Railroad Administration

guidance¹¹³ and Federal Transit Administration guidance¹¹⁴ is consistent with the assessment of previous UK infrastructure projects. For a mitigated scheme, and taking account of reasonably foreseeable worst case assumptions, the US guidance sets the following screening distances for the assessment of the potential impact arising from the operation of a new rail system. A quantitative assessment will be undertaken for all receptors within the following areas:

- Residential and non-residential receptors (except as defined below) - whichever is the greater of either 85m from the centreline of the track or nearest construction activity or the area within which impacts from ground-borne sound and/or vibration from the Proposed Scheme are forecast; and
- Non-residential receptors / land uses where low ambient vibration or sound is critical to operations, for example, very sensitive laboratory equipment such as nanotechnology laboratories, sound recording / broadcast studios, large auditoria / theatres or concert halls - 200m from centreline of the track or nearest construction activity.

14.2.17 Spatial scope for indirect effects: a qualitative assessment will be made where the increase or decrease in rail traffic volumes or types caused by the Proposed Scheme would cause a change in the baseline Vibration Dose Value from existing railways greater than 25% (refer to Table 31).

Assessment methodology

Legislation and guidance

14.2.18 Relevant legislation includes the Control of Pollution Act 1974¹¹⁵, the Environmental Protection Act 1990, the Noise and Statutory Nuisance Act 1993¹¹⁶ and the Land Compensation Act 1973¹¹⁷ (all as amended).

14.2.19 The ground-borne sound and vibration potentially generated by the majority of construction activities will be calculated using the guidance in Transport Research Laboratory (TRL) Report 53¹¹⁸ and TRL Report 429¹¹⁹, and guidance in BS5228-2.¹²⁰

14.2.20 The ground-borne sound and vibration potentially generated by rail operations associated with the Proposed Scheme, both temporary operations during construction and permanent, will be calculated using the

¹¹³ U.S. Department of Transportation and the Federal Railroad Administration (Office of Railroad Development), 2005, *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, Federal Railroad Administration

¹¹⁴ U.S. Department of Transportation and the Federal Transport Administration, 2006, *Transit Noise and Vibration Impact Assessment Guidance Manual*, Federal Transit Administration

¹¹⁵ HM Government, 1974, *Control of Pollution Act 1974*, The Stationery Office

¹¹⁶ HM Government, 1993, *Noise and Statutory Nuisance Act*, The Stationery Office

¹¹⁷ HM Government, 1973, *Land Compensation Act 1973*, The Stationery Office

¹¹⁸ Transport Research Laboratory (TRL), 1986, *TRL Report 53: Ground vibration caused by civil engineering works*, TRL

¹¹⁹ Transport Research Laboratory (TRL), 2000, *TRL Report 429: Groundborne vibration caused by mechanised construction works*, TRL

¹²⁰ British Standards Institute (BSI), 2009, *BS 5228-2 Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 2: Vibration*, BSI

calculation method developed and validated initially for the design and construction of HS1.¹²¹ The method is empirical, developed from thousands of measurements, is fully consistent with ISO 14837¹²², and takes account of all key parameters, including train design, train speed, track design, tunnel design, tunnel depth, ground conditions, receiving building foundations and receiving building type. The method has been further tested, validated and scrutinised at public inquiry on many urban mass transit systems around the world.

Impact criteria - direct Impacts

Ground-borne sound - construction and operation

14.2.21 There are no relevant national or international standards setting criteria for ground-borne sound. The impact criteria set out in Table 28 and Table 29 have therefore been drawn from similar projects in the UK and Ireland (e.g. Crossrail, the Jubilee Line, DART Underground, Dublin Metro North and HS1). These projects assess ground-borne sound in terms of the absolute level of sound generated by a train passing by.

Table 28 - Ground-borne sound impact criteria for residential receptors

Impact classification	Ground-borne sound level dB L_{pASmax}, (measured indoors, near the centre of any dwelling room on the ground floor)
Negligible	< 35
Low	35-39
Medium	40-44
High	45-49
Very high	>49

Table 29 - Ground-borne sound impact criteria for non-residential receptors

Category of Building	Impact criterion dB L_{pASmax}
Theatres/large auditoria and concert halls	25
Sound recording/broadcast studios	30
Places of meeting for religious worship/courts/cinema /lecture theatres/museums/small auditoria or halls	35
Offices/schools/colleges/hospitals/hotels/libraries	40

¹²¹ Greer R, J., 1999, *Methods for Predicting Groundborne Noise and Vibration from Trains in Tunnels*, Proceedings of the LARIF and IoA Conference

¹²² International Standards Organisation (ISO), 2005, *14837 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General Guidance*, ISO

Ground-borne vibration: buildings - construction and operation

14.2.22 The impact criteria for building damage are based upon guidance within BS7385: Part 2.¹²³ The standard differentiates between transient and continuous vibration (refer to the footnotes within Table 30). For transient vibration the standard notes that the risk of cosmetic damage to residential buildings starts at a Peak Particle Velocity (PPV) of 15 millimetres per second (mm/s) at 4 hertz (Hz). The standard also notes that below 12.5 mm/s PPV, the risk of damage tends to zero. When considering continuous vibration, the standard recommends the guide values are reduced by 50%.

Ground-borne vibration: disturbance of occupants and users of buildings - construction and operation

14.2.23 Guidance on the impact of vibration on people in buildings is presented in BS6472: 2008.¹²⁴ Part 1 of the standard assesses the impact of vibration using the Vibration Dose Value (VDV). This is an indicator taking into account how people respond to vibration in terms of frequency content, vibration magnitude and the number of vibration events during an assessment period.

14.2.24 Vibration from the operation of the permanent railway and all construction will be assessed using the criteria presented in Table 30.

Table 30 - Vibration impact criteria for buildings¹²⁵

Category of building	Impact criterion: (Peak Particle Velocity - PPV - at building foundation)	
	Transient ¹²⁶ vibration	Continuous ¹²⁷ vibration
Potentially vulnerable buildings ¹²⁸	≥6 mm/s	≥3 mm/s
Structurally sound buildings	≥12 mm/s	≥6 mm/s

14.2.25 The change criteria presented in Table 31 have been developed using the guidance in BS6472 and are consistent with those applied to other projects such as HS1 and Crossrail.

14.2.26 In the majority of locations along the Proposed Scheme, no existing appreciable level of vibration exists and therefore an absolute criterion is

¹²³ British Standards Institute (BSi), 1993, 7385-2 *Evaluation and measurement for vibration in buildings – Guide to damage levels from groundborne vibration*, BSi

¹²⁴ British Standards Institute (BSi), 2008, 6472 *Guide to evaluation of human exposure to vibration in buildings Parts 1 and 2*, BSi

¹²⁵ Conservative criteria which there is no risk of cosmetic damage.

¹²⁶ Transient vibration relative to building response such as impulsive vibration from percussive piling.

¹²⁷ Continuous vibration relative to building response such as vibrating rollers.

¹²⁸ BS7385 highlights that the criteria for aged buildings may need to be lower if the buildings are structurally unsound. The standard also notes that criteria should not be set lower simply because a building is important or historic (e.g. listed). Where information about these structures is not currently known, the significance criteria for these receptors has been set at a lower level on a precautionary basis.

proposed. In certain locations, such as those close to an existing railway, a change-based criteria is used. This approach is consistent with the vibration assessment of other major railway schemes.

Table 31 - Vibration impact criteria for the disturbance (annoyance) of occupants and building users

Impact classification	In the absence of appreciable existing levels of vibration ^{129 130}		Appreciable existing levels of vibration ¹³¹
	VDV m/s ^{1.75} Daytime (0700-2300)	VDV m/s ^{1.75} Night time (2300 – 0700)	% increase or decrease in VDV
Negligible	≤ 0.2	≤ 0.1	≤ 25
Minor	> 0.2 - 0.4	>0.1 - 0.2	25 - 40
Moderate	> 0.4 - 0.8	> 0.2 - 0.4	> 40 - 100
Major	> 0.8	> 0.4	>100

Ground-borne vibration: particularly vibration-sensitive equipment and processes – construction and operation

14.2.27 As noted in ISO 14837-1, there are no standard criteria for assessing the potential impact of vibration on sensitive equipment or processes. Where a receptor within the study area is identified that is likely to be especially sensitive to ground-borne sound and/or vibration, a risk assessment will be undertaken for that receptor based on the information currently available for the relevant equipment/process, or information provided by the building owner or equipment manufacturer.

Impact criteria - indirect impacts

14.2.28 Changes in rail traffic flows on the existing network will be used to calculate changes in vibration, at source, in VDV. These changes will be compared with the criteria in Table 31 to indicate whether the change could result in a potential impact.

Significance criteria - residential receptors

14.2.29 For residential receptors, significant effects will be determined by taking into account:

- The type of effect being considered;
- The magnitude of the impacts and available dose-response information;

¹²⁹ Highest impact category used, daytime or night-time.

¹³⁰ Determined at the worst location on a normally loaded floor (usually the centre of the floor).

¹³¹ Where there is an appreciable existing level of vibration and daytime and night-time vibration dose vales (VDVs) exceed $0.2\text{ms}^{-1.75}$ and $0.1\text{ms}^{-1.75}$ respectively.

- The number and grouping of impacts;
- The potential combined impacts of airborne sound, ground-borne sound and ground-borne vibration;
- Any unique features of the Proposed Scheme's sound or vibration impacts in the area being considered (which may require secondary acoustic indicators/criteria);
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Significance criteria - non-residential receptors

14.2.30 For non-residential receptors, significant effects will be determined by taking into account:

- The type of effect being considered;
- The magnitude of the impact;
- The design of the receptor affected;
- The existing ambient sound and vibration levels in the receptor affected;
- The use and sensitivity of the receptor;
- The potential combined impacts of ground-borne sound and vibration;
- Any unique features of the Proposed Scheme's sound or vibration impacts in the area being considered (which may require secondary acoustic indicators/criteria);
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Cumulative Effects

14.2.31 Sound and vibration impacts, both permanent and temporary, will be identified for the Proposed Scheme and other developments, either under construction or consented as referred to in Section 2 (EIA Methodology) of this Report. The results of these assessments will then be used to qualitatively assess potential cumulative significant effects arising from the Proposed Scheme and any other developments having regard to, amongst other things, spatial and temporal overlap of the sound and vibration impacts.

14.2.32 Community, ecological or heritage effects arising from impacts and effects identified for ground-borne noise and vibration will be considered and reported in the relevant chapter of the ES.

Assumptions

14.2.33 Assumptions, relevant to scope and methodology, for the ground-borne sound and vibration assessment include:

- Design assumptions (e.g. train specification, revenue service speeds and timetables); and

- Maintenance specifications.

14.3 Airborne sound

Introduction

- 14.3.1 This section presents the proposed approach to assessing airborne sound associated with the construction and operation of the Proposed Scheme. Sound generated by the Proposed Scheme has the potential to cause disturbance to neighbouring sound sensitive receptors.
- 14.3.2 Without mitigation, during construction, airborne sound would be generated by equipment, construction worksites, construction vehicles on haul routes and local roads, and changes to road traffic.
- 14.3.3 During operation, airborne sound would be generated by trains and other (fixed) sources such as: line side equipment; ventilation shafts; depots and stations. The Proposed Scheme may also cause changes in road and rail traffic flow on the current road and rail networks.
- 14.3.4 The assessment will cover all sound sensitive receptors, including properties for which planning permission has been granted before the safeguarding date but are not yet completed, subject to the screening distances discussed within the specific subject areas. Where a receptor has multiple uses the assessment will be made based on the most sensitive use.

Establishment of baseline and definition of survey

- 14.3.5 To facilitate dialogue with stakeholders, baseline information will be gathered incrementally through field surveys focused on locations where likely significant effects are forecast. The baseline and impact assessment for the Proposed Scheme will be developed and refined in three stages.
- 14.3.6 Initially, existing data will be gathered to form the 'desk top' baseline (Baseline 1). Baseline 1 data will be used early in the programme to support initial dialogue, assessment work and design development. Initial field surveys will be undertaken during the summer of 2012 to fill gaps in Baseline 1 data and provide more detailed information at locations where significant effects are likely. Combined with Baseline 1, these data will form Baseline 2, to be used for the draft ES. Further, more targeted surveys will be undertaken in early 2013, responding to the findings of the draft ES assessments and ongoing stakeholder dialogue. Combined with Baseline 2, these data provide Baseline 3 for the ES.
- 14.3.7 The baseline data gathering will focus not just on collecting objective data that describes the ambient sound environment, but also information on the local sound environment, including indicators of its soundscape.

Consultation

14.3.8 Principal consultees on the approach to the assessment of airborne sound are the local and county authorities.

14.3.9 Engagement with local stakeholder groups will be via Community Forums throughout the design and assessment of the Proposed Scheme.

14.3.10 Responses to consultation on the 2011 consultation scheme raised the following recurring matters in respect of the acoustic assessment presented in the AoS. The manner in which each matter will be considered as part of the EIA, is as follows:

- Potential effects associated with vehicle movements and spoil disposal:
The potential indirect effect of such movements is being assessed as part of the EIA (e.g. refer to paragraph 14.3.11);
- Concern that the equivalent continuous sound (L_{pAeq}) indicator ‘averages out’ the impact associated with intermittent train sound:
The L_{pAeq} indicator is a proven and widely established indicator of community annoyance for railway sound and is therefore used in all relevant legislation, standards and guidelines. The EIA is also considering the maximum sound level for a train pass-by consistent with the assessment and design of HS1;
- A request to present contour maps:
Contour maps will be included within the ES;
- The need to consider pantograph sound particularly in respect of the height of the source above ground compared to the height of noise barriers:
Pantograph aerodynamic sound is being explicitly calculated and used as part of the determination of mitigation requirements as set out in this Report (refer to paragraph 14.3.20);
- That the assumed 3 dB reduction in train sound emission levels (compared to current high speed trains) may not be reasonable:
A reduction of 3 dB in train sound emission level is recommended in the High Speed Technical Specification for Interoperability and has been demonstrated to be reasonable in the AoS. Any residual uncertainty is being considered in the EIA; and
- The need to assess sound levels in terms of the long term expected usage of the Proposed Scheme:
Potential noise and vibration effects are being assessed using the highest traffic forecast during the first 15 years of operation (refer to paragraphs 14.2.15 and 14.3.14).

Key aspects of the Proposed Scheme for the topic

14.3.11 The following are potential sources of airborne sound:

- Temporary sources:

- Direct effects could be caused by airborne sound from significant construction activities such as tunnelling, demolition, earthworks, viaducts, bridges, road realignments, station construction, utility works and track works. These activities would be supported from local work compounds close to the structure or tunnel being constructed, local worksites, or larger worksites from where activities are coordinated;
- Indirect effects could be caused by temporary changes to road and rail traffic patterns on the existing networks during construction.
- Permanent sources:
 - Direct effects could be caused by the operational railway and its supporting systems (e.g. stations/interchanges, infrastructure maintenance depots, vent shafts, other line side equipment and maintenance; and
 - Indirect effects could be caused by long term changes to road and rail traffic pattern on the existing networks.

14.3.12 During construction of the Proposed Scheme, ‘best practicable means’ will be used to control and mitigate temporary construction noise effects consistent with legislation and best practice. ‘Best practicable means’ will include consideration of working methods, working hours, selection of plant, logistical planning, physical barriers and proactive community engagement. The framework for determining such mitigation on a site-by-site basis will be set out in the Code of Construction Practice.

14.3.13 Significant adverse noise effects from the operational railway may be reduced or removed through, for example, the performance specification and design of the rolling stock, infrastructure and noise barriers.

Scope of assessment

14.3.14 Temporal scope - the Proposed Scheme will be assessed in the short term at the year of opening; and in the long term with the highest rail traffic patterns forecast for the first 15 years of operation. These will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

14.3.15 Spatial scope for direct effects - for a mitigated Proposed Scheme and taking account of reasonably foreseeable worst case assumptions, the following screening distances will be used which are consistent with HS1 and in excess of guidance from sources such as US Federal Railroad Administration Guidance for high speed rail:

- Construction (from BS5228-1) - 300m from any construction activity or the area within which sound levels from the Proposed Scheme are forecast to give rise to potential impacts, whichever is the greater; and
- Operational Proposed Scheme - 500m and 1km from the centreline of the line of route in urban and rural areas respectively, or the area within

which sound levels from the Proposed Scheme are forecast to give rise to potential impacts, whichever is the greater.

14.3.16 Spatial scope for indirect effects - a qualitative assessment will be made where the increase or decrease in road or rail traffic volumes or traffic types caused by the Proposed Scheme would be likely to cause a change in the baseline sound level ($L_{pAeq,T}$) exceeding 1 dB during either the day (07:00 to 23:00) or night time periods (23:00 to 07:00).

Assessment methodology

Legislation and Guidance

14.3.17 Relevant legislation includes the Control of Pollution Act 1974, the Environmental Protection Act 1990, the Noise and Statutory Nuisance Act 1993, the Land Compensation Act 1973 (including the Noise Insulation Regulations¹³²) and the European Communities Act 1972¹³³ (including the Environmental Noise (England) Regulations 2006¹³⁴) (all as amended) and the NPPF including the Noise Policy Statement for England 2010.

14.3.18 Relevant guidance and standards include, in part, the Transport Analysis Guidance¹³⁵, the Mayor of London's Ambient Noise Strategy¹³⁶ and as identified in each of the following sections.

14.3.19 The airborne sound generated by construction activities will be calculated using the method set out in BS5228-1.

14.3.20 The airborne sound generated by rail operations associated with the Proposed Scheme, both mainlines and connecting chords, and classic lines will be calculated using the calculation method developed and validated initially for the environmental assessment, and then the design, of HS1¹³⁷. The method is empirical, developed from over a thousand measurements. The method has been further tested and verified since HS1; and calculates maximum sound levels for each train, as well as equivalent continuous sound levels. The method has been further refined for the Proposed Scheme to allow for aerodynamic sound sources at speeds over 300 kph.

14.3.21 The Calculation of Road Traffic Noise (CRTN) 1988¹³⁸ will be used to predict the airborne sound from road traffic with the spatial scope [see section 15 (Traffic and Transport)].

¹³² HM Government, 1996, *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996*, The Stationery Office; and HM Government, 1998, *The Noise Insulation (Amendment) Regulations 1998*, The Stationery Office

¹³³ HM Government, 1972, *European Communities Act 1972*, The Stationery Office

¹³⁴ These are the transposition in to English legislation of the Environmental Noise Directive 2002/49/EC as amended. HM Government, 2006 (Amendment 2010), *The Environmental Noise (England) Regulations 2006*, The Stationery Office

¹³⁵ Department for Transport (DfT), 2011, *Transport Analysis Guidance (TAG), Unit 3.3.2 The Noise Sub-Objective*, DfT

¹³⁶ Greater London Authority (GLA), 2004, *Souder City, The Mayor of London's Ambient Noise Strategy*, GLA

¹³⁷ Williams P, R et al., 1991, *Validation of the AEL Methodology for the Calculation of Train Noise*, Proceedings of the POLMET Conference 1991

¹³⁸ Department of Transport (Welsh Office), 1988, *Calculation of Road Traffic Noise*, HMSO

14.3.22 The airborne sound generated by the Proposed Scheme's rail supporting systems (e.g. stations/interchanges, depots, train stabling, vent shafts, etc.) will be calculated using appropriate national or international standards (e.g. ISO9613¹³⁹). Plant is generally not finalised until the detailed design phase. As such, where insufficient information is available on plant to be used, limits will be set based on baseline sound data.

14.3.23 The number and location of properties estimated to qualify under the Noise Insulation Regulations will be reported.

Impact criteria - direct impacts

Airborne sound – construction

14.3.24 The construction sound assessment categories for the Proposed Scheme are presented in Table 32. These are based upon the experience from other major infrastructure projects and BS5228-1. The criteria are guided by the prevailing baseline ambient sound levels in the locale of the receptor.

¹³⁹ International Standards Organisation (ISO), 1996, *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation*, ISO

Table 32 - Airborne sound from construction - impact criteria at dwellings (construction sound only)

Period	Assessment Category		
	A	B	C
Day: T=12hr, Weekdays, 07.00-19.00, T=6hr, Saturday, 07.00-13.00	>65 dB LpAeq,T	>70 dB LpAeq,T	>75 dB LpAeq,T
Evenings and weekends: T=1hr Weekdays 19.00–23.00, Saturdays 13.00-23.00, Sundays 07.00-23.00	>55 dB LpAeq,T	>60 dB LpAeq,T	>65 dB LpAeq,T
Night: T=1hr Every day 23.00-07.00	>45 dB LpAeq,T	>50 dB LpAeq,T	>55 dB LpAeq,T
<p>Notes:</p> <p>All sound levels are defined at the façade of the receptor</p> <p>Assessment Category A: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are less than these values;</p> <p>Assessment Category B: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are the same as category A values; and</p> <p>Assessment Category C: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are higher than category A values.</p> <p>If the ambient sound level exceeds the Assessment Category C threshold values given in the table (i.e. the ambient sound level is higher than the above values), then an impact is deemed to occur if the construction LpAeq,T sound level for the period is greater than the ambient noise level.</p>			

Airborne sound – operational train movements

14.3.25 The magnitude of an impact arising from a change in sound level due to the Proposed Scheme (road or rail, temporary or permanent, direct or indirect sources) will be quantified using the semantic scale in Table 33.

Table 33: Airborne sound from operational train movements - impact criteria¹⁴⁰

Long term Impact Classification	Short term Impact Classification	Sound level change dB $L_{pAeq, T}$ (positive or negative) T = either 16hr day or 8hr night
Negligible	Negligible	≥ 0 dB and < 1 dB
	Minor	≥ 1 dB and < 3 dB
Minor	Moderate	≥ 3 dB and < 5 dB
Moderate	Major	≥ 5 dB and < 10 dB
Major		≥ 10 dB

14.3.26 For residential receptors, direct long term operational sound impacts (positive and negative) will be identified where at the façade of the receptor the Proposed Scheme causes:

- A change in the day or night equivalent continuous sound level as defined in Table 33; or
- A maximum sound level (L_{pAFmax}) of 85 dB or greater; and
- Absolute sound levels that are above the values of 50 dB $L_{pAeq,16hr}$ during the daytime or 40 dB $L_{pAeq,8hr}$ at night.

Airborne sound – operational static sources

14.3.27 Static sources include a range of permanent works associated with the Proposed Scheme, such as fixed plant at stations and depots, line side equipment, tunnel ventilation shafts, tunnel pressure relief shafts.

14.3.28 Sound from static sources will be evaluated by comparing the rating level against background levels following the principles set out in BS4142.¹⁴¹ The background level used in the evaluation will be representative of those typically occurring at the receptor during the day and night depending on the source's hours of operation.

14.3.29 Operational static source impacts will be identified where the rating level of the new sound source exceeds the background level by a margin greater than 5 dB. The semantic descriptors used to describe the impact will be as described in Table 34.

¹⁴⁰ Based on the Highways Agency, 2011, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 Noise and Vibration document HD213/11*

¹⁴¹ British Standards Institute (BSI), 1997, *BS4142 Method for rating industrial noise affecting mixed residential and industrial areas*, BSI

Table 34 - Airborne sound from operational static sources - impact criteria

Impact Classification	Rating level – background level
No impact	< -10 dB
Negligible	≥ -10 dB and < 0 dB
Minor	≥ 0 dB and < 5 dB
Moderate	≥ 5 dB and < 10 dB
Major	≥ 10 dB

Impact criteria - indirect impacts

14.3.30 Changes in traffic flows on the existing road and rail network will be used to calculate changes, at source, in equivalent continuous sound levels ($L_{pAeq,16hr}$). A minor impact (3 dB or greater) will be taken as an indicator of a potential significant effect unless the area being considered is currently exposed to high levels of sound (refer to paragraph 14.3.31), in which case, a change of 1 dB or greater may be taken as an indicator of potential significance.

Significance Criteria - residential receptors

14.3.31 For residential receptors, significant effects will be determined for any source from the Proposed Scheme by taking account of the following factors:

- Type of effect being considered;
- The number and grouping of receptors subject to impacts¹⁴²;
- The magnitude of the impacts and available dose-response information;
- The existing sound environment in terms of the absolute level¹⁴³ and the character of the existing soundscape;
- Any unique features of the Proposed Scheme’s sound or impacts in the area being considered (which may require secondary acoustic indicators / criteria);
- The potential combined impacts of sound and vibration;
- The duration of impact for temporary sources; and
- The effectiveness of mitigation through design or other means.

¹⁴² Evaluated using the impact criteria set out earlier in this section.

¹⁴³ *As one example:* for operational rail sound, greater weight will be given to a sound level change between 1 dB and 3 dB if the area is already exposed to high levels of noise. High levels of noise exposure will be evaluated having regard to the criteria contained in the *Noise Insulation (Railway and Other Guided Transport Systems) Regulations 1996*, and the Noise Action Plans in England (Defra 2012) for ‘First Priority Locations’ and ‘Important Areas’.

Significance Criteria - non-residential receptors and land uses

14.3.32 For non-residential receptors and land uses, significant effects will be determined, on a receptor-by-receptor basis, by taking into account:

- The type of effect being considered;
- The use and sensitivity of the receptor or land use;
- The design of the receptor or land use affected;
- The existing sound environment in the receptor, or on the land use, effected;
- The magnitude of the forecast impact;
- The potential combined impacts of sound and vibration;
- Any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators / criteria);
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Significance Criteria - quiet areas

14.3.33 Effects on quiet areas or other resources which are prized for providing tranquillity will be assessed having regard to:

- The type of effect being considered;
- The criteria set out in the Noise Action Plans in England for 'Quiet Areas'¹⁴⁴;
- Tranquillity indicators (for land use) - refer also to Section 12 (Landscape and Visual Assessment) of this Report;
- Any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators / criteria);
- The duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Cumulative Effects

14.3.34 Community, ecological or heritage effects arising from impacts and effects identified for airborne sound will be considered and reported in the relevant chapter of the ES.

14.3.35 Secondary effects (e.g. on landscape) associated with mitigation (e.g. sound barriers) proposed to reduce or remove significant airborne sound effects will be considered under the relevant chapter of the ES.

¹⁴⁴ Department for Environment, Food and Rural Affairs (Defra); Environmental Noise; Noise Action Plans; <http://www.defra.gov.uk/environment/quality/noise/environmental-noise/action-plans/>

14.3.36 Sound and vibration impacts, both permanent and temporary, will be identified for the Proposed Scheme and other developments, either under construction or consented as referred to in Section 2.4 (Cumulative effects) of this Report. The results of these assessments will be used to qualitatively assess potentially significant cumulative effects arising from the Proposed Scheme and these committed developments having regard to, amongst other things, spatial and temporal overlap of the sound and vibration impacts.

Assumptions

14.3.37 Assumptions, relevant to scope and methodology, for the airborne sound assessment include:

- Design assumptions (e.g. train specification, revenue service speeds and timetables);
- Maintenance specifications; and
- Sound emission limits as set by the Technical Specification for Interoperability as amended.^{145 146}

¹⁴⁵ European Commission (EC), 2008, 2008/232/CE - *Command decision of 21 February 2008 concerning a technical specification for interoperability relating to the 'rolling stock' sub-system of the trans-European high-speed rail system*, EC

¹⁴⁶ European Commission (EC), 2011, 2011/229/EU - *Command decision of 4 April 2011 concerning the technical specifications of interoperability relating to the subsystem 'rolling stock – noise' of the trans-European conventional rail system*, EC

15 Traffic and transport

15.1 Introduction

15.1.1 The traffic and transport assessment will present an assessment of the impacts on pedestrians, cyclists, equestrians, mobility impaired people, highways, public transport, stations and interchanges and depots. It will cover the impacts that are likely to occur during both the construction and operational periods of the Proposed Scheme.

15.1.2 The Proposed Scheme is a transport project and therefore by its very nature will affect existing transport networks. A transport assessment including transport modelling is being undertaken which will inform the traffic and transport chapter of the ES. The development of the transport model may result in refinements to the proposed scope and criteria described in this section of the Report.

Issues to be Considered

15.1.3 The following key effects will be among those assessed:

- Changes in traffic (including lorries), public transport, pedestrian and cyclist flows;
- Alterations to road layout/closures/diversions/widening/alterations (including stopping and passing places)/junction improvements/diversion of rights of way;
- Changed access to properties and places of work;
- Changes to journey times and journey distances for private and commercial vehicle occupants;
- Changes in accessibility, journey times, distances or frequencies for stations, interchanges and public transport;
- Changes to interchange, parking, taxi parking/ operation, and delivery and servicing;
- Changes to bus routes and stop locations; and
- Changed journey times and distances, and changes in amenity and ambience, for vulnerable road users and waterway users.

15.2 Establishment of baseline and definition of survey

15.2.1 Traffic data, traffic surveys and modelling will be undertaken to inform the transport models along the route of the Proposed Scheme. These transport models will also be used to provide information to determine the baseline for the traffic and transport assessment within the ES.

15.2.2 The future baseline will include consideration of the growth in travel demand, including the changes arising from other developments and proposed transport network improvements.

15.3 Consultation

Consultation on the AoS

15.3.1 The main traffic and transport themes raised during consultation on the 2011 scheme as part of the AoS include:

- Whether the highway and public transport networks around the stations and interchanges could cope with the additional demands that would be placed upon them;
- The need to minimise potential disruption and disturbance during the construction of the Proposed Scheme, including tunnels and viaducts;
- Concern that footpaths and rights of way would become inaccessible or be closed, and that some waterways would be negatively affected; and
- General disruption to roads from increasing traffic levels and reduced access to local areas during construction of the Proposed Scheme. These concerns were raised in relation to both the local road network and parts of the strategic road network.

Consultation as part of the EIA process

15.3.2 The following organisations will be amongst those to be consulted on traffic and transport issues:

- DfT;
- Highways Agency;
- Network Rail;
- Transport for London;
- Centro;
- Metropolitan, county, district and parish councils;
- London boroughs;
- Local enterprise partnerships;
- Rail Passengers Council;
- Disabled Persons Transport Advisory Committee;
- Office of Rail Regulator; and
- Emergency Services.

15.4 Key aspects of the Proposed Scheme for the topic

15.4.1 Construction and operation of the following elements of the Proposed Scheme are relevant to the topic of traffic and transport:

- The railway itself;
- The new stations/interchanges at Birmingham Curzon street, Birmingham International interchange, Old Oak Common and Euston stations;
- Stabling, infrastructure maintenance and rolling stock depots;
- Interfaces with other public transport and highway networks including changes to existing, new and improved infrastructure and services;
- Rights of way and users (pedestrians, cyclists etc.); and

- All construction including tunnelling, tunnel portals and vent shafts, lorry routes and points of access, haul routes and construction sites.

15.5 Scope of assessment

Spatial Scope

15.5.1 The spatial scope of the traffic and transport assessment will be different for the construction and operational impacts being assessed.

Spatial scope – construction

15.5.2 The assessment will focus on traffic and transport issues resulting from land taken for worksites, the presence of construction heavy goods vehicles (HGV) traffic on the local road network, and effects on routes crossing the construction areas (footpath and highways). The extent of the assessment will include:

- The highway network (including parking, loading and access arrangements) effected by construction worksites and on routes used by construction traffic, focusing on routes between worksites and the strategic road network surrounding the Proposed Scheme;
- Public transport networks directly effected by construction works including heavy rail, light rail, the London Underground and bus and coach services, including lines, routes and stations that may be indirectly affected by the Proposed Scheme;
- Transport interchange arrangements such as bus to rail in the vicinity of stations, interchanges and worksites;
- Pedestrian, cyclist and equestrian routes in the vicinity of the Proposed Scheme;
- Railways used to transport materials and excavated materials; and
- Navigable waterways.

Spatial scope – operation

15.5.3 The spatial scope will include the transport routes where there is a significant change in the usage either through people accessing the Proposed Scheme, or from the effects of modal shift. It will also include roads and other rights of way that are permanently diverted or stopped up.

15.5.4 The assessment will therefore include:

- The highway network where changes are likely to occur as a result of the Proposed Scheme;
- The public transport system where it is effected by the increased usage or changed journey patterns arising from the Proposed Scheme, including heavy and light rail, underground and bus and coach services;
- Pedestrian, cyclist and equestrian routes in the vicinity of the Proposed Scheme; and
- Navigable waterways potentially effected by the Proposed Scheme.

Temporal Scope

15.5.5 Potential effects of the Proposed Scheme will be considered for the following:

- Construction Period (2017-2026): impacts arising from construction;
- Year 1 operation (2026): impacts associated with operation;
- Year 15 operation (2041): assumed to reflect the full technical capacity and operation of HS2 as a whole (i.e. 18 trains per hour per direction in the peaks); and
- In addition, a qualitative assessment will be undertaken with Phase 1 operating at its capacity prior to opening of Phase 2.

15.6 Assessment methodology

15.6.1 The traffic and transport assessment developed for the Proposed Scheme will be used as the basis for the forecasts of passenger and vehicle movements and transport network characteristics that will be used in the EIA. The traffic and transport effects arising from the construction strategy and engineering design for the Proposed Scheme will also be assessed within this process.

15.6.2 Having established the likely changes on the road and public transport networks during construction and operation, impacts will be assessed using a set of criteria developed for the Proposed Scheme.

15.6.3 The detailed criteria used for the identification and assessment of potentially significant impacts are provided below. The magnitude of each impact and its significance will be predicted by a variety of mechanisms, including computer modelling and professional judgement.

Guidance

15.6.4 Whilst there is no legislation on how traffic and transport assessments should be undertaken the following guidance documents are relevant:

- DfT's Guidance on Transport Assessment¹⁴⁷; and
- TfL's Guidance Document: Transport Assessments Best Practice¹⁴⁸.

¹⁴⁷ Department for Transport (DfT), 2007, *Guidance on Transport Assessment*, DfT

¹⁴⁸ Transport for London (TfL), 2010, *Transport Assessment Best Practice: Guidance Document*, TfL

Significance criteria for construction assessment

15.6.5 The criteria outlined below will be used to assess the significance of temporary traffic and transport impacts during the construction of the Proposed Scheme at stations, interchanges, depots and work sites along the route. Some of the significance criteria may be further refined in the development of the traffic and transport assessment.

15.6.6 The criteria have been based on information included in the guidance documents referred to in paragraph 15.6.4, in the following documents, and using professional judgement:

- DMRB Volume 11: Environmental Assessment (1993 and updates);
- DfT's WebTAG;
- Guidelines for the Environmental Assessment of Road Traffic¹⁴⁹; and
- Guidelines for Traffic Impact Assessment¹⁵⁰.

Public transport delay

15.6.7 A significant impact on journeys by bus, heavy and light rail, and the London Underground effected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results; and is defined as any of the following where this lasts for more than four consecutive weeks in any 12 month period:

- Changes of more than 10% in a majority of journey times by rail or the Underground;
- Changes in journey distance by bus of more than 400m in urban areas and 1km in rural areas;
- A relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area; and
- A relevant change to service frequency, capacity, loss of through connections or reduction in hours of operation.

Disruption at stations/interchanges

15.6.8 A significant impact on stations/interchanges is defined as a change in the vicinity that lasts for more than four consecutive weeks in any 12 month period including:

- Loss of physical linkage for the next stage of the journey;
- Loss of or relocation of more than 100m of bus facilities and operations (e.g. of bus stops, passenger waiting facilities, bus stands or operator facilities);
- Loss of or relocation of more than 100m of taxi facilities and operations (e.g. taxi stands, passenger waiting facilities or operator facilities); and
- Loss of or relocation of more than 100m of 'park-and-ride' facilities or operations (e.g. dropping off areas).

¹⁴⁹ Institute of Environmental Assessment (IEA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEA

¹⁵⁰ Institution of Highways and Transportation, 1994, *Guidelines for Traffic Impact Assessment*, Institution of Highways and Transportation

Traffic flows and delays to vehicle occupants

15.6.9 A significant increase in traffic levels and driver/vehicle passenger delay (including delays to bus and coach passengers) is defined as any one of the following:

- A 30% increase in traffic flows (i.e. HGVs or all vehicles)¹⁵¹, where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas;
- A diversion for more than four consecutive weeks in any 12 month period that leads to an increase in journey length of more than 1km on a route carrying more than 100 vehicles per day, or 5km on a route carrying more than 40 vehicles per day, or 10km on any other route; and
- Where a significant change in delay relating to junction congestion resulting from the construction of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local Highways Authority, based on the increase in the level of congestion at the relevant location. This will be measured either as the forecast ratio of flow to capacity or degree of saturation.

Parking and loading

15.6.10 A significant impact arising from the Proposed Scheme on parking and loading, where facilities are identified to be heavily used, is defined as a change for more than four consecutive weeks in any 12 month period of:

- A predicted increase of 10 or more, or 10%, whichever is the greater, in on-street parking demand in the vicinity of a station/interchange;
- A loss of any designated on-street or off-street spaces, including spaces for disabled persons, buses, taxis, doctors, ambulances, police vehicles and car club bays;
- A loss of ten or more, or 10%, whichever is the greater, private off-street car parking spaces;
- A loss of ten or more, or 10%, whichever is the greater, off-street station car parking spaces;
- A loss of ten or more, or 10%, whichever is the greater, pedal or motorcycle parking spaces; and
- A loss of 10% or more designated loading bay spaces or facilities.

Vulnerable road user delay, amenity and ambience

15.6.11 Impacts of delays on pedestrians, cyclists, equestrians and others will be assessed based on changes in the 'person-minutes' of the journey times of pedestrians and other non-motorised travellers.¹⁵² The following information will be addressed:

- Numbers of pedestrians, cyclists equestrians and others; and

¹⁵¹ Based on Institute of Environmental Assessment (IEA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEA

¹⁵² Based on Department for Transport (DfT), 2003, *Transport Analysis Guidance (TAG), Impacts on Pedestrians, Cyclists and Others: WebTAG Unit 3.5.5*, DfT

- Changes in journey time in minutes.

15.6.12 The changes in journey times will be defined in proportion to the scale of the impacts being assessed, for example as minor (less than one minute), moderate (between one and two minutes) and major (greater than three minutes); and the numbers of travellers affected as: minor (less than 200 in total), moderate (between 200 and 1,000) and major (greater than 1,000). The significance of the impacts are based on the matrix shown in Table 35, where beneficial impacts occur if journey times are reduced or adverse impacts if journey times are increased. A combined assessment resulting in a 'major' impact (as defined in Table 35) will be reported as significant.

Table 35 - Significance levels for travellers affected by delay during construction¹⁵³

Journey Time Changes	Number of Travellers Effected		
	Minor	Moderate	Major
Minor	Neutral	Neutral	Minor
Moderate	Neutral	Minor	Moderate
Major	Minor	Moderate	Major - significant

15.6.13 WebTAG Unit 3.3.13's The Journey Ambience Sub-Objective document¹⁵⁴, describes the assessment of ambience, which includes traveller's amenity. Traveller's journey ambience can be affected by:

- Traveller care;
- Travellers' views; and
- Traveller stress.

15.6.14 Traveller care for pedestrians, cyclists, equestrians and others will be assessed through the provision and design of dedicated facilities (e.g. footpaths, cycle lanes and crossings, information), as well as their cleanliness and environment.

15.6.15 The extent to which travellers can see the landscape or townscape view will vary with the relative height of the Proposed Scheme and the surrounding ground, vegetation, buildings and structures. Views can be categorised as providing:

- No view - where the route is in a deep cutting, a tunnel or surrounded by environmental barriers;
- Restricted view - where there are frequent cuttings, tunnels or barriers;
- Intermittent view - where there are shallow cuttings or barriers; and
- Open view - where the view extends over many miles.

¹⁵³ Source: Department for Transport (DfT), 2003, Transport Analysis Guidance (TAG), *Impacts on Pedestrians, Cyclists and Others: WebTAG Unit 3.5.5*, DfT

¹⁵⁴ Department for Transport (DfT), 2003, Transport Analysis Guidance (TAG), *The Journey Ambience Sub-Objective: WebTAG Unit 3.3.13*, DfT

15.6.16 Traveller stress is the adverse mental and physiological effects experienced by travellers. Three main factors influence traveller stress:

- Frustration;
- Fear of potential accidents; and
- Route uncertainty.

15.6.17 Taken together, these can lead to feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the quality and safety of a journey.

15.6.18 Assessments will be made of the traveller care, travellers' views and traveller stress ambience factors using the pro-forma in Table 36. These assessments will consider the impact of the Proposed Scheme on each of these sub-factors using a simple three point scale (i.e. better, neutral or worse than existing ambience).

Table 36 - Environment: journey ambience

Factor	Sub-factor	Better	Neutral	Worse
Traveller Care	Cleanliness			
	Facilities			
	Information			
	Environment			
Travellers' Views	-			
Traveller Stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

15.6.19 An overall impact score for the quality of a journey will be determined using the following guidelines:

- The overall assessment is likely to be neutral if the assessment is neutral for all or most of the sub-factors, or improvements on some sub-factors are generally balanced by deterioration on others;

- If the change in impact across the sub-factors is, on balance, for the better, the assessment is likely to be beneficial, and, conversely, it is likely to be adverse if there is an overall change for the worse;
- The overall assessment is likely to be minor (beneficial or adverse) where the numbers of travellers affected is low (less than 200 a day);
- The overall assessment is likely to be major (beneficial or adverse) where the numbers of travellers affected is high (more than 1,000); and
- The overall assessment is likely to be moderate (beneficial or adverse) in all other cases.

15.6.20 The methodology, set out above will be applied to the Proposed Scheme on a locational basis where ambience issues for pedestrian, cyclists, equestrians and others are considered likely to be of concern. In addition, it is likely that more general conclusions in relation to more aggregated areas will also be reached.

Accidents and safety

15.6.21 Significant impacts on accidents and safety risks will be defined for links and junctions as follows:

- Links and junctions for which data is available that have experienced on average more than nine personal injury accidents in a three-year period ending in 2011-12 and which would be subject to an increase of 30% or more in total traffic flow during construction for a period of more than four consecutive weeks in any 12 month period.

Severance

15.6.22 Severance can affect travellers using non-motorised modes, especially pedestrians. Where reasonable, practically and economically, public footpaths and routes will be reinstated or alternatives provided. Cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although there may still be significant impacts on these groups. Severance¹⁵⁵ will be classified according to the following four broad levels: no impact, minor, moderate and major.

15.6.23 To ensure a consistent approach, the classification and assessment will be based only on pedestrian movements. The proposed categories of effect are discussed below.

15.6.24 *Minor*: In general the current journey pattern is likely to be maintained, but there may be some hindrance to movement for example:

- Pedestrians at-grade crossing of a new road carrying less than 8,000 vehicles per day (annual average daily traffic - AADT); or

¹⁵⁵ Based on Department for Transport (DfT), 2011, Transport Analysis Guidance (TAG), *The Severance Sub-Objective: WebTAG Unit 3.6.2*, DfT; and the Highways Agency, 1993, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 8 Pedestrians, Cyclists, Equestrians and Community Effects*, The Stationery Office

- A new bridge which will need to be climbed or a sub-way traversed; and/or
- Journey lengths being increased by up to 100-250m (less than 100m increase in journey length is considered to be of no impact).

15.6.25 *Moderate*: Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive, for example:

- Two or more of the hindrances set out under 'minor' applying to an individual journey; or
- Pedestrians at-grade crossing of a new road accommodating between 8,000-16,000 vehicles per day (AADT) in the opening year; and/or
- Journeys lengths being increased by 250 - 500m.

15.6.26 *Major*: People are likely to be deterred from making trips to an extent sufficient to induce a change in their habits. This could lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be caused to people making their existing journeys. Such impacts can result from:

- Pedestrians at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT) in the opening year;
- Journey lengths being increased by over 500m; and/or
- Three or more of the hindrances set out under 'minor' or two or more set out under 'moderate'.

15.6.27 An overall assessment for the option will then be based on the following guidelines (in each case, the assessment is beneficial if severance is reduced and adverse if severance is increased):

- The overall assessment is likely to be of no impact if increases in severance are broadly balanced by relief of severance;
- The overall assessment is likely to be minor where change in severance is slight or the total numbers of people effected across all levels of severance is minor (less than 200 per day);
- The overall assessment is likely to be major where change in severance is major, and effects a moderate or high number of people or the total numbers of people effected across all levels of severance is major (greater than 1,000); and
- The overall assessment is likely to be moderate where greater than 200 and less than 1,000 people are affected.

15.6.28 Table 37 provides guidance on how the categories are combined to estimate the numbers of people likely to be affected by changes in severance. A combined assessment resulting in a 'major' impact as defined in Table 37 will be reported as significant.

Table 37 - Assessment of Change in Severance Scoring¹⁵⁶

	Severance scoring 'with the Proposed Scheme'			
Severance scoring 'without the Proposed Scheme'	No Impact	Minor	Moderate	Major
No Impact	No Impact	Minor Negative	Moderate Negative	Major Negative - Significant
Minor	Minor Positive	No impact	Minor Negative	Moderate Negative
Moderate	Moderate Positive	Minor Positive	No Impact	Minor Negative
Major	Major Positive - Significant	Moderate Positive	Minor Positive	No Impact

Waterways

15.6.29 British Waterways' document Third Party Works' Procedures, Section 2, Code of Practice¹⁵⁷ (Sections 4.1 - 4.3) identifies their requirements that need to be followed in relation to works affecting the navigation or amenity of canals. In summary, these are that generally no stoppages of the canal or navigation or towpath will be allowable, except for technical reasons. Stoppages must be discussed and agreed in advance with British Waterways and all stoppages must be of minimised duration. For the purpose of the EIA, a significant stoppage is defined as occurring when an unbroken stoppage exceeding six weeks in duration is required, as this is when specific arrangements regarding the transfer of boats around the works by road may be required.

15.6.30 British Waterways also require that towing paths must remain open wherever possible. If a diversion is unavoidable, these should be localised. They may be used by the British Waterways maintenance plant and be of a standard to allow continued use by existing visitors – walkers, anglers, people with disabilities, cyclists etc. Only as an unusual event would towing paths be permitted to be used for access to the temporary and permanent works for the Proposed Scheme because of conflict with visitors and the

¹⁵⁶ Source: Department for Transport (DfT), 2011, Transport Analysis Guidance (TAG), *The Severance Sub-Objective: WebTAG Unit 3.6.2*, DfT

¹⁵⁷ British Waterways, 2012, *Third Party Work's Procedures Section 2 Code of Practice*, British Waterways

unsuitability of the towing path for vehicular use. Impacts on pedestrians, cyclists, mobility impaired persons and equestrians using the towing paths will be assessed in relation to the vulnerable road user and ambience heading and associated criteria.

Significance criteria for operational assessment

15.6.31 The criteria outlined below will be used to assess the significance of traffic and transport impacts during the operational phase of the Proposed Scheme.

Public transport delay

15.6.32 Significant permanent impacts on journeys by bus, heavy and light rail, and the Underground effected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results; and are defined as any of the following:

- A 10% change in a majority of journey times by any public transport mode; and
- A change in journey distances by bus of more than 400m in urban areas and 1km in rural areas.

Station/interchange impacts

15.6.33 Impacts that may be caused by additional passengers of the Proposed Scheme arriving and departing at the stations/interchanges will be assessed using modelling information, taking account of:

- Forecast numbers of additional passengers using the Proposed Scheme;
- Local transport conditions at each location;
- Resulting increases in congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme ; and
- Any loss of physical linkage for the next stage of the journey.

15.6.34 The results from the traffic and transport assessment and modelling will be used to identify if there are any significant journey time, interchange and accessibility changes for travellers.

Traffic flows and delays to vehicle occupants

15.6.35 A significant impact in traffic levels (i.e. HGVs and all vehicles) and driver and vehicle passenger delay will be defined as any of the following:

- A 10% increase in peak hour two-way traffic flows¹⁵⁸;
- Increases in traffic flows that cause the design capacity to become exceeded, on links that would not otherwise be congested;
- A 30% increase in the average off-peak hour two-way traffic flows;
- A permanent diversion that results in an increase in journey length of more 1km; and

¹⁵⁸ Based on Institute of Environmental Assessment (IEA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEA

- Where a significant change in delay relating to junction congestion resulting from the operation of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local Highways Authority, based on the increase in the level of congestion at the location. This will be measured either as the forecast ratio of flow to capacity or degree of saturation.

Vulnerable road user delay, amenity and ambience

15.6.36 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Parking and loading

15.6.37 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Severance

15.6.38 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Waterways

15.6.39 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Accidents and safety

15.6.40 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

15.7 Assumptions

15.7.1 The following assumptions are relevant to the traffic and transport assessment:

- Operational patterns and capacities of the Proposed Scheme and Phase 2;
- Number of train services associated with the Proposed Scheme and Phase 2;
- Change in operational patterns and stations serviced by other operators; and
- Construction impacts of the Proposed Scheme.

15.7.2 The modelling for the traffic and transport assessment and future year assessments will require a number of assumptions to be made, including:

- Committed developments and transport schemes;
- Socio-economic forecasts (e.g. population, employment and economic conditions);
- Demand forecasts; and
- Travel characteristics including:
 - Modal share of trips;

- Traffic flows;
- Public transport passenger flows;
- Traffic speeds and congestion; and
- Journey times.

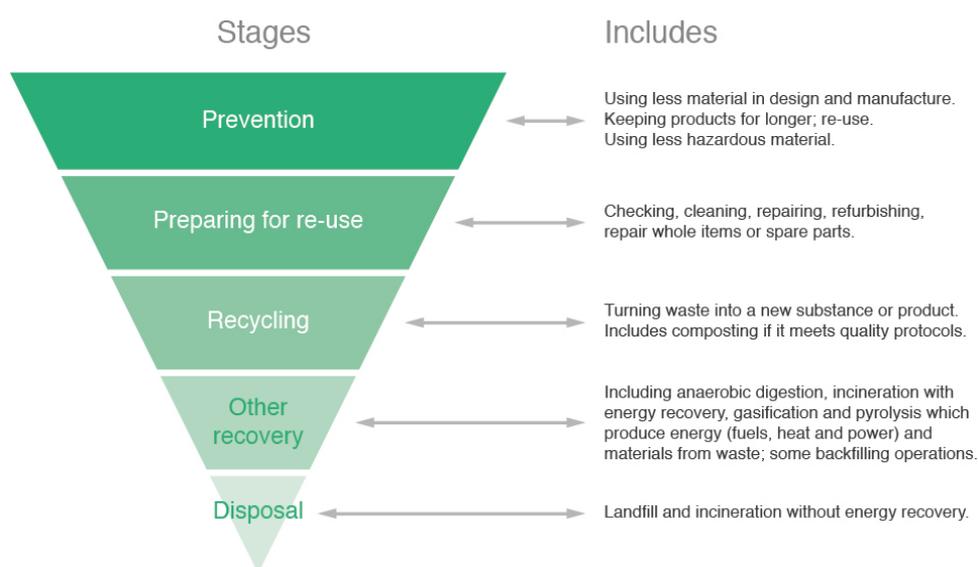
16 Waste and material resources

16.1 Introduction

- 16.1.1 This section of the Report describes the scope and methodology that will be used to assess the likely significant environmental impacts and effects associated with the generation of solid waste during the construction and operational phases of the Proposed Scheme.
- 16.1.2 Liquid waste such as wastewater from dewatering operations and sewage from buildings and operation of the rolling stock is covered in Section 17 (Water Resources and Flood Risk Assessment) of this Report.
- 16.1.3 The consideration of material resources in the context of this Report comprises maximising the beneficial re-use of materials arising from the construction of the Proposed Scheme (e.g. excavated materials). Only if materials are not required or are unsuitable for the construction of the Proposed Scheme will they become waste.
- 16.1.4 The likely significant environmental impacts and effects from the use of materials (e.g. aggregate, concrete, brick and steel) for the construction of the Proposed Scheme will not be addressed in the EIA.
- 16.1.5 Safeguarding and extraction of mineral resources located along the route of the Proposed Scheme will be considered as part of the route engineering design, construction logistics as well as within Section 11 (Land Quality) of this Report.
- 16.1.6 The principal objective of sustainable waste and material resource management is to use material resources more efficiently, thereby preventing and reducing the amount of waste generated as well as minimising the quantity of waste that requires final disposal to landfill.
- 16.1.7 Where waste is generated, HS2 Ltd proposes that it will be dealt with in line with the Government's waste hierarchy (see Figure 6), which is a guide to sustainable waste and material resource management, and implements the revised EU Waste Framework Directive.¹⁵⁹

¹⁵⁹ The revised EU Waste Framework Directive (revised WFD) was adopted on 20 October 2008, signed on behalf of the European Parliament and the Council on 19 November 2008, and published in the Official Journal of the European Union on 22 November (L312/3) as Directive 2008/98/EC. The revised WFD entered in to force on 12 December 2008; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:EN:PDF>

Figure 6 - The Government's Waste Hierarchy¹⁶⁰



16.1.8 The waste hierarchy generally describes a priority order of what constitutes the best overall environmental option for the management of waste. It advocates the use of disposal only as a last resort, due to the range of potential adverse environmental effects associated with its use, such as loss of valuable land resources, GHG emissions, and nuisance effects (e.g. dust and odour emissions).

16.1.9 Types and quantities of waste for each phase of the Proposed Scheme, from initial design through to construction, operation and eventual decommissioning will be considered in the assessment.

16.2 Establishment of baseline and definition of survey

16.2.1 A description of the baseline environment for the 2011 consultation scheme is contained within the AoS [Section 7 (Sustainability baseline) in Volume 1]. Section 7.6 (Sustainable consumption and production) of the AoS describes the baseline environment in relation to materials and waste.

16.2.2 A baseline will be developed for waste and material resources as part of the EIA. Baseline conditions shall be identified with respect to:

- Types, quantities and management of construction, demolition and excavation waste generated along the route corridor of the Proposed Scheme and sites identified for the railway stations/interchanges, stabling and maintenance depots, and other works sites within the local and regional area;
- Types, quantities and management of commercial and industrial waste generated by users and workers of existing railway stations/interchanges and buildings, and within the local and regional area; and

¹⁶⁰ Department for Environment, Food and Rural Affairs (Defra), 2011, *Government Review of Waste Policy in England 2011*, Defra

- Availability (types and capacity) of existing and planned waste infrastructure for managing construction, demolition and excavation waste and commercial and industrial waste in the local and regional areas.

16.2.3 The local area will be defined as the relevant district or county councils of the regional areas, which include Greater London, South East, Eastern, East Midlands and West Midlands.¹⁶¹ Waste planning authorities are usually constituted at a county or unitary authority (e.g. most cities and larger towns) level.

Local and regional baseline - waste arisings

16.2.4 Data on construction, demolition and excavation waste arisings for the route of the Proposed Scheme will be identified as part of baseline data gathering where this information exists using information from, for example, the Environment Agency and other public sources.

16.2.5 Data on commercial and industrial waste generated for the route of the Proposed Scheme will be identified as part of the baseline data gathering where this information exists. Sources of information will include:

- Operational waste data from Eurostar and Southeastern trains for HS1, where available; and
- Operational waste data for existing railway stations along the route of the Proposed Scheme (e.g. Euston station and Birmingham International) and rail stabling and maintenance depots operated by Network Rail, where available.

Local and regional baseline - waste management infrastructure capacity

16.2.6 Information on the availability of waste management infrastructure will be identified as part of the baseline data gathering from published sources of information and in consultation with the relevant waste disposal authorities. Sources of information that will be used to provide this information include, but will not be limited to:

- Defra Waste and Recycling Statistics¹⁶²;
- Department of Energy and Climate Change Renewable Energy Statistics (RESTATS) online database¹⁶³;
- Environment Agency Waste Data and Information¹⁶⁴;
- Various waste disposal authority Waste and Minerals Development Plan Documents (e.g. West London Waste Plan, North London Waste Plan, Buckinghamshire Waste and Minerals Development Plan Documents);
- London Capital Waste Facts information¹⁶⁵; and

¹⁶¹ See Local Government Boundary Commission for England; www.lgbce.org.uk

¹⁶² Department for Environment, Food and Rural Affairs (Defra); Statistics; Environment and wildlife statistics; Waste and recycling; www.defra.gov.uk/statistics/environment/waste/

¹⁶³ Department of Energy and Climate Change; Planning Database; Renewables Map; <http://restats.decc.gov.uk/app/pub/map/map/>

¹⁶⁴ Environment Agency; Planning & research; Our library; Data & statistics; Waste data and information; www.environment-agency.gov.uk/research/library/data/34169.aspx

¹⁶⁵ Capital Waste Facts; www.capitalwastefacts.com

- London Waste and Recycling Board, London Waste Map.¹⁶⁶

16.2.7 The waste and minerals plan, together with any relevant evidence which supports it and up to date waste capacity information held by the Environment Agency, will be used to indicate where and how much landfill void space is likely to be available during the construction phase of the Proposed Scheme. If surplus materials from the Proposed Scheme arises, this information will be used to assess whether or not there is likely to be a shortfall of suitable landfill void space for the management of these materials.

16.2.8 Site visits to the existing railway stations/interchanges, infrastructure maintenance depots and landfill sites located along the route of the Proposed Scheme will also be undertaken.

16.3 Consultation

Consultation on the AoS

16.3.1 In relation to waste and material resources management, very few comments were made during the consultation on the 2011 consultation scheme. However, a number of comments were made regarding the generation of 'spoil' from the construction of the scheme, the impacts of transporting the spoil on local communities and road congestion and safety. The Environment Agency recommended that the management of construction waste is considered as early as possible.

16.3.2 It was proposed to reduce the amount of waste generated as a result of the 2011 consultation scheme through the use of the waste hierarchy and include waste minimisation as a design aim, which was supported by the Environment Agency.

Consultation as part of the EIA process

16.3.3 Consultation will be undertaken primarily with the Environment Agency to agree the approach for re-use of excavation materials and other materials resulting from the construction of the Proposed Scheme in, for example, scheme-wide landscaping works such as construction of noise and landscape bunds.

16.3.4 Consultation will also be undertaken with county and district councils (including Waste Planning Authorities) to identify and confirm the following:

- Local and regional waste arisings used to inform the baseline and assessment of the likely significant environmental effects of waste;
- Availability of local and regional waste infrastructure to be used to inform the baseline and assessment of the likely significant environmental effects of waste; and

¹⁶⁶ London Waste and Recycling Board; London Waste Map; www.londonwastemap.org

- Planning, development management and waste management policies to be considered during the assessment process; and particularly with respect to defining any mitigation measures required.

16.3.5 This information will be used to establish the baseline waste quantities, understand the future regional disposal capacity and to identify opportunities for re-use and recovery of excavation and demolition materials from the Proposed Scheme.

16.4 Key aspects of the Proposed Scheme for the topic

16.4.1 The construction of the Proposed Scheme will generate large quantities of soils and other aggregate materials mainly associated with the excavation of cuttings, cut and cover tunnels, bored tunnels, foundations and drainage. In addition, the demolition of existing commercial and residential buildings within the line of the route of the Proposed Development will generate large quantities of demolition materials such as steel, broken concrete, timber and brick. The rebuilding of railway stations/interchanges, highways and bridges and the construction of stabling and maintenance depots will also generate construction waste.

16.4.2 Waste may also arise from the interaction with operational and closed landfill sites, removal of fly-tipped waste, and management of contaminated land where present along the route [Section 11 (Land Quality)].

16.4.3 Waste will be generated during the operation of the Proposed Scheme by passengers, railway staff and maintenance activities of the rolling stock. Environmental effects associated with the management of this waste are likely to be relatively small compared with the management of arisings from tunnelling and earthworks surplus to the Proposed Scheme's requirements.

16.5 Scope of assessment

16.5.1 The likely significant environmental impact and effects of solid waste generation associated with the Proposed Scheme will be assessed with respect to both the construction and operational phases. These effects may be positive or negative dependent on the measures employed to prevent and/or manage the waste generated.

Construction

16.5.2 Construction effects will address the temporary, indirect effects of solid waste that would be generated during demolition, excavation and construction activities. Demolition materials would be generated as a result of site clearance works and from the demolition of buildings and other structures currently in existence along the route of the Proposed Scheme. Natural, uncontaminated and contaminated materials are likely to be excavated or generated as a result of construction of the Proposed Scheme.

It is likely that the majority of the excavated materials will comprise natural and inert soils.

- 16.5.3 The assessment of contaminated soils and materials will be addressed in Section 11 (Land Quality) of this Report. The quantity and type of waste likely to be generated from contaminated land after remedial measures have been applied will be determined and the impacts and effects assessed in the EIA.
- 16.5.4 Solid waste is likely to be generated during the construction and fit-out of above ground structures such as new and redeveloped stations/interchanges, stabling and infrastructure maintenance depots. Waste would also be generated by the construction and installation of rail infrastructure components, including tunnelling sections, the laying of new tracks and installation of line-side equipment, including new power supply connections and sub-stations.
- 16.5.5 Excavated materials that can be used, in their natural state, for site engineering and restoration purposes will be excluded from the assessment of likely significant environmental effects of construction. This is in accordance with the scope of the revised EU Waste Framework Directive and should reflect the measures taken during the design phase to prevent waste.¹⁶⁷ This is in accordance with Article 2 of the revised EU Waste Framework Directive and will reflect incorporated mitigation measures that have been considered during the design phase to prevent waste. It is also assumed that such materials will meet the requirements of The Definition of Waste: Development Industry Code of Practice.¹⁶⁸ This industry Code of Practice has been developed to enable the transfer or re-use of clean naturally derived soil materials, and provides a framework for proactively managing contaminated materials on the sites of production. As stated in Section 16.3 (Consultation), consultation will be undertaken with the Environment Agency regarding the approach for the re-use of materials resulting from the construction of the Proposed Scheme.

Operation

- 16.5.6 Operational effects shall address the permanent, indirect impacts of solid waste that would be generated during the first full year operation of the Proposed Scheme. This includes solid waste that would be generated by passengers and staff at new and redeveloped stations, and at staff depots and rail maintenance facilities. Waste would also be generated by passengers and staff on trains whilst these are in use along the route of the Proposed Scheme and from track maintenance works.

¹⁶⁷ The scope of Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives excludes 'uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated'

¹⁶⁸ Contaminated Land: Applications in Real Environments (CL:AIRE), 2011, *The Definition of Waste: Development Industry Code of Practice*, CL:AIRE.

16.6 Assessment methodology

- 16.6.1 There is no recognised methodology or waste significance criteria to assess the likely significant environmental impacts and effects of solid waste generation from either construction or operation. The proposed assessment methodology is, therefore, based on EIA practitioners' professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects.
- 16.6.2 The assessment will consider the types and quantities of solid waste that would be generated during construction and operation, and the severity of the likely significant environmental impacts and effects that may arise from the quantity of waste requiring off-site disposal to landfill (this being a finite and least preferred waste management option). The assessment will consider waste arisings and waste infrastructure capacity at local and regional levels, alongside the route of the Proposed Scheme.

Legislation and guidance

- 16.6.3 The assessment will consider relevant waste management legislation, policies and guidance applicable to all buildings and infrastructure components along the route of the Proposed Scheme. This will include, but will not be limited to the legislation, policy and guidance set out within this section.

Legislation

- 16.6.4 The Waste Management (England and Wales) Regulations 2011¹⁶⁹ transpose the revised EU Waste Framework Directive into English law.
- 16.6.5 Site Waste Management Plans Regulations 2008 (as amended)¹⁷⁰ require the preparation of a site waste management plan (SWMP) for any construction project with an estimated capital cost of over £300,000. The purpose of the SWMP is to identify opportunities to design out waste; as well as identifying the types and quantities of waste likely to be produced during construction; the opportunities for sustainable management of the waste identified; and to monitor and report on the actual management of these wastes throughout the construction period. It is acknowledged that these regulations are likely to be repealed through the Defra Red Tape Challenge¹⁷¹. However, HS2 Ltd will apply an integrated approach to the design of the Proposed Scheme aiming to maximise the beneficial re-use of materials where possible, and minimise the generation of waste, which will be facilitated through the implementation of the Environmental Design Aims and Code of Construction Practice for the Proposed Scheme.

¹⁶⁹ HM Government, 2011, *Waste (England and Wales) Regulations 2011*, The Stationery Office

¹⁷⁰ HM Government, 2008, *Site Waste Management Plans Regulations*, The Stationery Office

¹⁷¹ Department for Environment, Food and Rural Affairs (Defra); Publications; About Defra; Red Tape Challenge – Environment Theme proposals; <http://www.defra.gov.uk/publications/2012/03/19/pb13728-red-tape-environment/>

Policy

- 16.6.6 The Government Review of Waste Policy in England 2011 sets out the Government's long-term strategy for the prevention and management of waste in England. It follows the waste hierarchy approach set out in the EU Waste Framework Directive.
- 16.6.7 Planning Policy Statement 10: Planning for Sustainable Waste Management¹⁷², as exempted within the NPPF, sets out Government policy on waste planning which is of relevance to the management strategy for solid waste generated during the construction and operation of the Proposed Scheme.
- 16.6.8 Regional and local planning policy, such as the London Plan¹⁷³, which sets out strategic planning policies for the management of waste generated in Greater London and elsewhere along the route of the Proposed Scheme. Specifically, these policies seek to minimise the amount of waste generated, increase the re-use and recycling of waste and reduce waste to landfill.

Guidance

- 16.6.9 Relevant guidance includes The Definition of Waste: Development Industry Code of Practice and the Waste & Resources Action Programme (WRAP) guidance and tools developed to achieve better resource efficiency in construction projects, such as designing out waste tools (e.g. The Designing out Waste Tool for Civil Engineering Projects and Net Waste Tool).¹⁷⁴

Significance criteria

- 16.6.10 There are no recognised significance criteria against which direct and indirect waste impacts and effects for both the construction and operational phases of the Proposed Scheme can be assessed. As such, the criteria for the assessment have been derived from professional experience previously applied to large-scale infrastructure projects, and takes into account:
- The net change in solid waste arisings overall as a result of the Proposed Scheme;
 - The magnitude of the quantity of waste requiring landfill disposal;
 - The availability of landfill disposal capacity in the local and regional area; and
 - Significance criteria to be used for the assessment of the likely significant environmental impact and effects of solid waste generation are shown in Table 38 for inert waste and Table 39 for non-hazardous waste.

¹⁷² Communities and Local Government (CLG), 2011, *Planning Policy Statement 10: Planning for Sustainable Waste Management*, The Stationery Office

¹⁷³ Greater London Authority (GLA), 2011, *The London Plan: Spatial Development Strategy for Greater London*, GLA

¹⁷⁴ WRAP; <http://www.wrap.org.uk/content/designing-out-waste-tool-civil-engineering>; and <http://www.wrap.org.uk/content/net-waste-tool-0>

Table 38 - Waste significance criteria for inert waste

Degree of Significance	Waste Criteria
Major adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to a severe, national-scale reduction in landfill void space capacity for inert waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 10,000,000 tonnes. Effect may be judged to be of importance in the national planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making
Moderate adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to regional-scale reduction in landfill void space capacity for inert waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 2,000,000 to 10,000,000 tonnes. Effect may be judged to be important in the regional planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required
Minor adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to local-scale reduction in landfill void space capacity for inert waste. Need for additional small scale waste treatment and/or disposal capacity of up to 2,000,000 tonnes. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project
Negligible	No significant increase in waste arisings relative to the future baseline without the Proposed Scheme or reduction in landfill void space capacity for inert waste. No appreciable adverse or beneficial effects
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure

Table 39 - Waste significance criteria for non-hazardous waste

Degree of Significance	Waste Criteria
Major adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to a severe, regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 100,000 tonnes per annum. ¹⁷⁵ Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in decision-making
Moderate adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 50,000 ¹⁷⁶ to 100,000 tonnes per annum. Effect may be judged to be important in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required
Minor adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to local-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional small scale waste treatment and/or disposal capacity of up to 50,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project
Negligible	No significant increase in waste arisings relative to the future baseline without the Proposed Scheme or reduction in landfill void space capacity for non-hazardous waste. No appreciable adverse or beneficial effects
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure

¹⁷⁵ Waste throughput capacity based on large-scale waste infrastructure project experience

¹⁷⁶ The waste throughput capacity of greater than 50,000 tonnes per annum has been selected with reference to the Department for Communities and Local Government (DCLG), 1999, *Circular 02/99: Environmental Impact Assessment*, DCLG; which states in Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA, under 'Installation for the disposal of non-hazardous waste' at A36: "...EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year..."

Construction effects

- 16.6.11 The assessment will identify the types and quantities of solid waste forecast to be generated during each of the demolition, excavation and construction stages of the Proposed Scheme. Quantification will be on the basis of survey information, using published waste generation rates or forecasting tools such as the WRAP Net Waste Tool.
- 16.6.12 Assumptions regarding the type and quantity of waste to be diverted from landfill via re-use, recycling and recovery will be applied. Following this, the type and quantity of demolition materials, excavated materials and construction materials requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity in the designated local and regional areas throughout the proposed construction period.

Operation effects

- 16.6.13 The assessment will identify the types and quantities of solid waste forecast to be generated during the first full year of operation of the Proposed Scheme. This forecast will be based on an assumption of maximum capacity of the Proposed Scheme as described in Section 2.2 (Scope of the assessment) and any impacts will be assumed to be annual. Quantification may be on the basis of existing operational waste management performance data (e.g. for stations/interchanges) or using published operational waste generation rates for the relevant land-use activities.
- 16.6.14 Assumptions regarding the quantity of waste to be diverted from landfill via re-use, recycling and recovery will be applied. Following this, the quantity of operational waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity during the first full year of operation of the Proposed Scheme.

Cumulative effects

- 16.6.15 The construction of the Proposed Scheme will generate economic stimulus for development along the route, and particularly at the proposed railway stations/interchanges. In combination with developments that are already taking place or anticipated along the route of the Proposed Scheme, will result in increased pressure on material resources and waste generation.
- 16.6.16 Cumulative effects will be assessed qualitatively (based on professional judgment) taking into account other major development proposals along the route of the Proposed Scheme.

Mitigation, enhancement and off-setting

- 16.6.17 Mitigation and enhancement for waste and resources management during construction and operation will be considered in line with the waste hierarchy and residual environmental effects identified.

16.7 Assumptions

- 16.7.1 It has been assumed that all existing land uses along the route of the Proposed Scheme would remain unchanged should the Proposed Scheme not proceed.
- 16.7.2 The assessment of likely significant environmental effects resulting from waste generated due to the interaction with operational and closed landfill sites, fly-tipped waste and contaminated land present along the route will be covered in Section 11 (Land Quality) of this Report. This will also include hazardous materials.
- 16.7.3 There is currently no information available to inform the quantities of solid waste likely to arise from the demolition and construction stages of the Proposed Scheme. Whilst these activities are likely to generate smaller quantities of waste than that generated during excavation, they will contain a wider range of materials such as asbestos, green waste from site clearance, concrete, brick, metals, timber, plasterboard, insulation and plastics. Following best practice for large infrastructure projects, all such activities are within the scope of the assessment of construction effects. This also applies to the generation of solid waste during operation of the Proposed Scheme.
- 16.7.4 Assumptions will be required as to the proportion of solid construction and operational waste that would be diverted from landfill via re-use, recycling and recovery. This will be informed by information gathered at the time of the assessment as to any waste management measures proposed to divert waste from landfill. Alternatively, landfill diversion performance for other similar rail-related projects, such as Crossrail, will be considered.
- 16.7.5 Waste transferred off-site would be handled by a registered waste carrier authorised by the Environment Agency and taken to a permitted or exempt facility authorised to receive and handle that waste under Duty of Care arrangements (i.e. this assessment does not consider the likely significant environmental effects of any illegal waste management and disposal). It has been assumed that all construction and operational activities will be in accordance with the relevant environmental regulatory requirements.
- 16.7.6 The assessment of likely significant environmental effects associated with waste-related transport, including the interactive effects of air quality, climate, sound and noise will be addressed in Section 5 (Air Quality), Section 6 (Climate), Section 14 (Sound, Noise and Vibration) and Section 15 (Traffic and Transport) of this Report.

17 Water resources and flood risk assessment

17.1 Introduction

17.1.1 This section of the Report sets out the scope and methodology for assessing the likely significant impacts and effects of the Proposed Scheme on the water environment. This includes effects on water resources (both surface water features and groundwater), hydrology, flooding and drainage. Surface water features include natural water bodies such as rivers, streams and lakes, and artificial ones such as canals and reservoirs. Drainage includes both surface water drainage and foul water drainage, where it is combined with surface water drainage. Flooding includes the risk from rivers, surface water, groundwater, drainage, canals and reservoirs.

17.2 Establishment of baseline and definition of survey

17.2.1 The baseline conditions will be those at the time of assessment (i.e. documented during the baseline data collection phase). Given the variable nature of the water environment through time, it is not usually feasible to set a baseline for the future (i.e. the time of construction or operation of the Proposed Scheme). However, where projected climate change effects predict a future trend, a future baseline condition will be identified.

17.2.2 The Proposed Scheme crosses 24 major rivers (having an upstream catchment greater than 50km²) 88 minor rivers, 12 navigable canals and 11 lakes or reservoirs. Many of these rivers have adjacent flood plains. There is a total of 16.2km in Flood Zone 3 and 19.1km in Flood Zone 2. The Proposed Scheme also crosses lengths of aquifer, including 4.9km of Source Protection Zone (SPZ) 1 and 15.7km of SPZ2.¹⁷⁷

17.2.3 Baseline conditions will be set, where appropriate, for:

- Floodplain extent (1 in 20, 100, 100 + climate change and 1,000 year return periods);
- Floodplain depth/velocity/hazard (1 in 20, 100, 100 + climate change and 1,000 year return periods);
- Surface water flood depth (1 in 30 and 1 in 200 year);
- Surface water quantity and quality and Water Framework Directive¹⁷⁸ (WFD) Status (both physico-chemical and hydromorphology quality elements);

¹⁷⁷ Environment Agency; At Home & Leisure; What's in your backyard?; <http://www.environment-agency.gov.uk/homeandleisure/37793.aspx>

¹⁷⁸ European Commission (EC), 2000, *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*, EC

- Surface water designations, licences/consents;
- Surface water / groundwater interaction;
- Groundwater quality and quantity (including WFD Status);
- Hydrogeology, including geology, aquifer hydraulic parameters, groundwater level and flow directions;
- Groundwater yield, licences/consents; and
- Hydro-meteorological conditions and variability arising from climate change.

Baseline Data and Sources

17.2.4 Table 40 sets out the baseline data to be collected, along with the likely source.

Table 40 - Baseline data and sources

Baseline data	Source
Flood plain extent, depth, velocity, hazard Surface water flood depths Groundwater level and flow directions Groundwater yield Aquifer extent (vertical and horizontal) and hydraulic parameters	Targeted hydraulic modelling, Information held by the Environment Agency, British Geological Survey, Internal Drainage Boards (IDBs), British Waterways, Water Companies, and Lead Local Flood Authorities. Information contained within local planning authorities' Strategic Flood Risk Assessments and Surface Water Management Plans
Surface water quality Groundwater quality	Targeted water sampling and testing at accredited laboratory. Information held by the Environment Agency, River Basin Management Plans, Local Authorities, Water companies
Surface water designations	Information held by the Environment Agency and Natural England
Surface water licences/consents Groundwater licences/permits Unlicensed abstractions	Information held by the Environment Agency Information held by the Environment Agency Information held by local authorities
Hydro-meteorological data, as needed	Met Office, Environment Agency

17.3 Consultation

Consultation on the AoS

17.3.1 The following key organisations responded to the consultation on the AoS:

- Environment Agency;
- British Waterways Board;
- The Inland Waterways Association;
- Water and sewerage companies; and
- Water supply companies.

17.3.2 The Environment Agency noted that developments in Flood Zone 3, if not properly mitigated, can put people and property at increased risk of downstream flooding. It advised that the detailed design of viaducts and raised embankments in floodplains consider these possible effects.

17.3.3 British Waterways requested to see details of any effects of the 2011 consultation scheme on the hydrology of any watercourses feeding their canals or reservoirs and to see details of proposed storm water runoff.

17.3.4 The concerns of both these organisations will be addressed by ensuring that appropriate designs and mitigation are considered to manage the flood risks. Any floodplain lost to viaducts or embankments would be fully compensated, wherever practicable, by creating new floodplain nearby and by considering the risks on a catchment basis. The rate of discharge of storm runoff and water supply to canals would be controlled to match existing conditions.

17.3.5 The route of the tunnel line under the Chilterns was re-aligned in part to be further away from three public water supply groundwater sources.

Consultation as part of the EIA process

17.3.6 As part of the EIA process, the following organisations as a minimum will be consulted:

- Environment Agency;
- British Waterways Board (likely to become the Canal and River Trust in 2012);
- Natural England;
- Water and sewerage companies;
- Water supply companies;
- Internal Drainage Boards;
- Lead Local Flood Authorities;
- District Councils; and
- Land owners.

17.4 Key aspects of the Proposed Scheme for the topic

17.4.1 The following aspects of the Proposed Scheme are of particular relevance to this topic:

- Sections of the Proposed Scheme located in Flood Zones 2 or 3. The route crosses about 16km of land in Flood Zone 3 (land having a greater than 1% probability of flooding in any one year) and a further 19km in Flood Zone 2 (land having an annual flooding probability of between 1% and 0.1% in any one year). These lengths include 24 major crossings of rivers, of which five may require river diversions of at least 200m;
- The Proposed Scheme also crosses 88 smaller rivers, of which eight may require a diversion, 12 navigable canals and 11 lakes or reservoirs. The assessment will consider whether there is any likely increase in the flood risk in these areas and, if so, will consider appropriate mitigation measures. For those lengths of river to be diverted, the assessment will consider likely effects on the river hydrology and riparian habitats. The assessment of habitats is included in Section 9 (Ecology) of this Report;
- Sections of the Proposed Scheme located above aquifers and planned to be in cutting or in tunnel may require dewatering. The Proposed Scheme has a length of 230km with approximately 36km of tunnels and 90km of cuttings. The Proposed Scheme requires cut or tunnel through principal and secondary aquifers and in areas close to licensed abstractors with protected rights (particularly the Chilterns). The assessment will consider the likely effects on the quality and yield of the aquifers protected rights and how these can be mitigated;
- Redevelopment of Euston station, development of the Birmingham interchange, Curzon Street station and Old Oak Common interchange, the depots at Calvert and Washwood Heath. In these areas, the assessment will consider the likely effects of surface water flooding from the increase in impermeable area and the possible effects of pollution from their operation, including road transport use; and
- The risk of pollution of water bodies from the construction and operation of the Proposed Scheme.

17.4.2 Possible environmental benefits that may result from the Proposed Scheme include more natural river channels after diversion, and a reduction of flood risk to some adjacent properties.

17.5 Scope of assessment

Spatial scope

- 17.5.1 The spatial scope of the assessment will be based upon the identification of surface water features within 1km of the route of the Proposed Scheme, except where there is clearly no hydraulic connectivity and in urban areas where the extent will be 500m as outside of these distances, it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme.
- 17.5.2 All groundwater bodies will be considered that are within 1km horizontally of the route of the Proposed Scheme and where there is an aquifer within 10m of the lowest possible construction or dewatering depth.
- 17.5.3 Exceptions to the above will be required in some locations where:
- Major groundworks are required (e.g. green tunnels);
 - Infrastructure is to be placed within floodplains;
 - The route intersects groundwater SPZ or Principal Aquifers where the abstraction may lie over 1km away;
 - Pathways are identified to the wider environment (e.g. canal or stream routing to distant river or highly transmissive aquifer);
 - The route intersects the inundation area of a reservoir; and
 - Other scenarios, as deemed appropriate when the route is reviewed in line with data received.
- 17.5.4 When considering the possible effects of the Proposed Scheme on a watercourse or aquifer, the assessment will consider the possible effects throughout the catchment of the impacted watercourse or the wider aquifer extent.
- 17.5.5 It is not considered that the Proposed Scheme will be affected by coastal or tidal impacts; hence this aspect of the topic has been excluded.

Temporal scope

17.5.6 The effect of construction impacts will be assessed (up to 2026 when the Proposed Scheme is due to open). Most mitigation measures are expected to take effect immediately, but for those associated with river diversions or interference with groundwater flow, an assessment will be made at Year 1 (2027) and another assessment in the period up to Year 15 (2041), by when all measures will be fully effective or conditions will have stabilised.

17.6 Assessment methodology

Legislation and guidance

17.6.1 The following legislation, policy and guidance will be taken into account in the assessment of water resources and flood risk. Assessment of the Proposed Scheme and its impacts in relation to the provisions of this legislation and policy, will form an essential step in the assessment of the significance of effects associated with the Proposed Scheme.

- EU WFD; EU Groundwater Directive¹⁷⁹; EU Floods Directive¹⁸⁰ and associated UK Flood Risk Regulations 2009¹⁸¹; EU Habitats Directive;
- Flood and Water Management Act¹⁸²; Water Act¹⁸³ and any new provisions brought in through the current Water White Paper¹⁸⁴; the Environmental Protection Act 1990; the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009¹⁸⁵; Land Drainage Act¹⁸⁶;
- Water and flood risk local planning policy for local authorities along the route of the Proposed Scheme (saved local plan policies and adopted Local Development Framework policy); and
- Environment Agency Groundwater Protection: Policy and Practice (GP3).¹⁸⁷

¹⁷⁹ Official Journal of the European Union, 2006, *Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration*, European Commission

¹⁸⁰ Official Journal of the European Union, 2007, *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*, European Commission

¹⁸¹ HM Government, 2009, *The Flood Risk Regulations*, The Stationery Office

¹⁸² HM Government, 2010, *Flood and Water Management Act 2010*, The Stationery Office

¹⁸³ HM Government, 2003, *The Water Act 2003 (Commencement No. 11) Order 2012*, The Stationery Office

¹⁸⁴ HM Government, 2011, *Water for Life*, The Stationery Office

¹⁸⁵ HM Government, 2009, *Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009*, The Stationery Office

¹⁸⁶ HM Government, 1994, *Land Drainage Act 1994*, The Stationery Office

¹⁸⁷ Environment Agency; Planning & research; Our library; Publications and reports; Water reports; Groundwater; Management and protection; GP3 (Groundwater Protection Policy and Practice); <http://www.environment-agency.gov.uk/research/library/publications/40741.aspx>

17.6.2 The WFD is the most relevant in terms of likely impacts and effects on water resources and flood risk from the Proposed Scheme, and as a result, tests against the provisions of this legislation has been built into the assessment methodology for this topic.

17.6.3 The assessment will also need to have due regard to the NPPF and its Technical Guidance, and also to Environmental Permitting Regulations and amendments.¹⁸⁸

Significance criteria

17.6.4 The significance of an effect is defined by the magnitude of the impact and the overall value of the receiving water body or receptor (the 'attribute') (see Table 41A and Table 41B). Table 41A, Table 41B, Table 42 and Table 43 have been adapted from the tables in the DMRB.¹⁸⁹

Table 41A - Significance of effects (excluding flood risk)

Value of Receptor	Magnitude of Impact			
	Negligible	Minor	Moderate	Major
Very high	Neutral	Moderate / Large	Large / Very Large	Very Large -
High	Neutral	Slight / Moderate	Moderate / Large	Large / Very Large -
Moderate	Neutral	Slight	Moderate	Large
Low	Neutral	Neutral	Slight	Slight / Moderate

Table 41B - Significance of effects (flood risk)

	Magnitude of Impact			
	Negligible	Minor	Moderate	Major
Significance (flood risk)	Neutral	Slight	Moderate	Large / Very Large

17.6.5 Table 42 provides an indication of possible impacts and their magnitude. These may be reported as either beneficial or adverse. The list is not exhaustive and is intended as a guide.

¹⁸⁸ HM Government, 2012, *The Environmental Permitting (England and Wales) (Amendment) Regulations 2012*, The Stationery Office

¹⁸⁹ Highways Agency, 2009, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 10: Road Drainage and the Water Environment*, The Stationery Office

Table 42 - Magnitude of possible impacts

Magnitude	Criteria	Examples
Major	<p><u>Adverse:</u> Loss of an attribute and / or quality and integrity of an attribute</p> <p><u>Beneficial:</u> Creation of new attribute or major improvement in quality of an attribute</p>	<p>Adverse: Increased flood risk to essential infrastructure, highly or more vulnerable developments; loss of a fishery; decrease in surface water ecological or chemical WFD status or groundwater qualitative or quantitative WFD status</p> <p>Beneficial: Creation of flood plain and decrease in flood risk; increase in productivity or size of fishery; increase in surface water ecological or chemical WFD status; increase in groundwater qualitative or quantitative WFD status.</p>
Moderate	<p><u>Adverse:</u> Loss of part of an attribute or decrease in integrity of an attribute</p> <p><u>Beneficial:</u> Moderate improvement in quality of an attribute</p>	<p>Adverse: Increased flood risk to less vulnerable developments; Partial loss of fishery; measurable decrease in surface water ecological or chemical quality or reversible change in the yield or quality of an aquifer, affecting existing users, but not changing any WFD status</p> <p>Beneficial: Measurable increase in surface water quality or in the yield or quality of aquifer benefiting existing users but not changing any WFD status</p>
Minor	<p><u>Adverse:</u> Some measurable change to the integrity of an attribute</p> <p><u>Beneficial:</u> Measurable increase, or reduced risk of negative effect to an attribute</p>	<p>Adverse: Increased flood risk to water-compatible development or impact which does not affect existing or any possible future developments; measurable decrease in surface water ecological or chemical quality; decrease in yield or quality of aquifer not affecting existing users or changing any WFD status</p> <p>Beneficial: Measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD status</p>
Negligible	<p>No change to integrity of attribute</p>	<p>Negligible change to flood risk; discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity</p>

17.6.6 Table 43 provides an indication of the value of receiving water body or receptor. The list is not exhaustive and is intended as a guide.

Table 43 - Examples of the value of possible water bodies or receptors

Value	Criteria	Examples ¹⁹⁰
Very high	Nationally significant attribute of high value	SPZ 1, Flood Zone 3 with highly vulnerable development, good quality or Principal aquifer; watercourse having a WFD classification and $Q_{95} \geq 1.0 \text{ m}^3/\text{s}$
High	Locally significant attribute of high value	Poor quality or Principal aquifer; watercourse having a WFD classification and $Q_{95} < 1.0 \text{ m}^3/\text{s}$. Flood Zone 3 without highly vulnerable development
Moderate	Of moderate quality and rarity	Watercourses not having a WFD classification, Secondary aquifer, Flood Zone 2

Construction effects

17.6.7 The following possible effects arising from the construction of the Proposed Scheme will be considered:

- Effects on the water quality of receiving water bodies due to the deposition or spillage of soils, sediment, fuels or other construction materials, or through mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff;
- Effects on river or stream flows during temporary disruption, discharges or diversion of surface water or groundwater flows, during adjacent works;
- Effects on water bodies that support habitats and ecosystems;
- Effects on aquifers from groundworks, temporary abstractions, from discharges to ground, where permitted and from obstructions to groundwater flow by tunnelling, cuttings, cut offs etc.;
- Effects on 'areas with critical drainage problems' (as notified by the Environment Agency to local planning authorities);
- Effects of liquid wastes on the environment;
- Effects on flood defence schemes;
- Effects on water abstractors; and

¹⁹⁰ Q_{95} is the flow equalled or exceeded in a water course for 95% of a recording period - typically over several years

- Effects on local flood risk due to uncontrolled site runoff, deposition of silt, sediment in drains or ditches, temporary diversion of rivers, sewers or ditches, temporary earthworks affecting natural drainage paths.

17.6.8 Assessment of the effects arising from construction of the Proposed Scheme will take into account the requirements of the Code of Construction Practice.

Operational effects

17.6.9 The following examples of possible operational effects will be assessed:

- Effects on water quality due to the contamination of groundwater or surface waters from both routine discharges from the railway or associated infrastructure and from accidental spillages;
- Effects on river or stream quality and flows caused by the permanent discharge to or diversion of watercourses, and consequent effects on groundwaters;
- Effects on aquifers, such as changes to groundwater flows, recharge rates and quality, resulting from the permanent works: typically tunnels and cuttings, including dewatering of these structures, and consequent effects on surface waters;
- Effects on water bodies that support habitats and ecosystems;
- Effects on other flood defence schemes;
- Effects on 'areas with critical drainage problems' (as notified by the Environment Agency to local planning authorities);
- Effects on water abstractors; and
- Effects on flood risk due to loss of flood plain storage, uncontrolled runoff, accumulation of silt, sediment in drains or ditches, the diversion of rivers, drains, sewers or ditches, and new infrastructure affecting natural drainage paths.

17.6.10 When assessing the effects on the quality of surface watercourses, details of the receiving watercourse and an estimate, based on a combination of expert judgement and analysis, for the quantity of pollution that could be released during routine operations, will be used. Estimates will be conservative and assume little or no dispersion. An assessment will be made of the risk of accidental spillages and the possible effects on water quality.

17.6.11 The effects on groundwater, both in quantitative and qualitative terms, will be assessed using a suitable combination of professional judgement, analytical calculation and computational modelling. This will include the impacts of any contaminated land causing an effect on groundwater quality.

17.6.12 The assessment of flood risk will be made using the guidance in BS8533¹⁹¹ and national policy.

17.6.13 Where significant adverse effects are identified on groundwater, the design will be amended where possible to mitigate the effects, for example by reducing the effect of dewatering by the use of cut off walls or by recharging water to aquifers. In some cases, groundwater sources may need to be augmented with alternative supplies or boreholes deepened, with agreement from owners. Effects on surface waters would be mitigated by the use of sustainable drainage systems. Pollution risk would be mitigated through pollution prevention measures and environmental permitting.

Cumulative effects

17.6.14 Cumulative effects may occur due to the combination of one or more separate impacts. These may be due to the coincidence of impacts or the cumulative impact of separate events occurring at different times. The following are examples of possible cumulative effects that may be assessed:

- Impacts from the Proposed Scheme will be assessed together with impacts from adjacent development, such as a flood defence scheme, to derive an assessment of the cumulative effects from all the schemes;
- Accumulation of minor or major impacts on a river or aquifer that when considered together, constitute a major impact leading to a significant or more significant effect; and
- A minor impact on river hydrology which, together with a minor impact on the riparian habitat (an ecological impact), when considered together, constitute a major impact leading to a significant effect.

¹⁹¹ British Standards Institute (BSi), 2011, BS8533 *Assessing and managing flood risk in development. Code of practice*, BSi

17.7 Assumptions

- 17.7.1 The assessment will assume that track drainage will wherever possible be kept separate from existing land drainage that crosses the route.
- 17.7.2 Discharge from the new infrastructure will go directly to a receiving water body or sewer, in accordance with the principles of the draft National Standards for sustainable drainage, published for consultation by Defra in December 2011.¹⁹²
- 17.7.3 The effects on watercourses will be affected by third party abstractions and discharges, and the assessment will take consideration of all that are recorded.
- 17.7.4 The assessment of the ecological effects on riparian and other habitats, that are dependent on surface or groundwater flows, will be included in Section 9 (Ecology) of this Report.

¹⁹² Department for Environment, Food and Rural Affairs (Defra), 2011, *National Standards for sustainable drainage systems: Designing, constructing, operating, and maintaining drainage for surface run-off*, Defra

Part C

18 Structure of the Environmental Statement

18.1.1 Although the requirements for the contents of an ES are set out in Schedule 4 of the EIA Regulations, there is no prescribed form or structure provided. The structure of the ES is currently under consideration with the intention that it provides an assessment of the environmental impacts of the Proposed Scheme in accordance with the requirements of the EIA Regulations. The ES will be structured in a logical and comprehensible manner, taking account of the need for the information to be accessible, understandable and readable to a broad audience. It is intended that it will contain appropriate signposting and web-links (in the case of the electronic version) to make navigation through the document easier for those seeking information relevant to their needs.

18.1.2 It is anticipated that the ES will comprise several volumes dealing with the following matters:

- Description of the HS2 project, the need for the project and the main alternatives studied;
- The EIA processes and the consultation that has been carried out;
- Description of the environmental baseline, environmental effects and mitigation, set out in a number of sections (anticipated to comprise 26 Community Forum Areas) along the route;
- Project-wide and cumulative effects assessment;
- Non-Technical Summary; and
- Environmental mapping, Proposed Scheme drawings, and other illustrations.

18.1.3 Further documents will be produced to meet hybrid bill requirements and to support the ES including:

- Scope and Methodology Report (this document);
- Environmental Minimum Requirements;
- Environmental Design Aims;
- Code of Construction Practice; and
- Transport Assessment.

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and <http://www.wrap.org.uk/content/net-waste-tool-0>

20 Annex A – List of Consultees

Comment has been sought from the following list of formal consultees on the content of this Scope and Methodology Report. Consultees were not limited to this list and responses received from others, were taken into account where relevant to the Scope and Methodology consultation.

Amersham Parish Council
Armitage with Handsacre Parish Council
Ashow and Stoneleigh Joint Parish Council
Aston le Walls Parish Council
Aylesbury Parish Council
Aylesbury Vale District Council
Balsall Parish Council
Barton Hartshorn Parish Council
Berkswell Parish Council
Bickenhill Parish Council
Birmingham City Council
Boddington Parish Council
Brackley Parish Council
Buckinghamshire County Council
Burton Green Parish Council
Calvert Green Parish Council
Castle Bromwich Parish Council
Centro
Chalfont St Giles Parish Council
Chalfont St Peter Parish Council
Charndon Parish Council
Chelmsley Wood Parish Council
Cherwell District Council
Chetwode Parish Council
Chiltern District Council
Chipping Warden & Edgcote Parish Council
City of Westminster
Claydon with Clattercot Parish Council
Coal Authority
Coldharbour Parish Council
Coleshill Parish Council
Cubbington Parish Council
Culworth Parish Council
Curdworth Parish Council
Denham Parish Council
Drayton Bassett Parish Council
Edgcott Parish Council
Ellesborough Parish Council

English Heritage
Finmere Parish Council
Fleet Marston Parish Council
Fordbridge Parish Council
Fradley & Streethay Parish Council
Godington Parish Council
Great Missenden Parish Council
Greater London Authority
Greatworth Parish Council
Grendon Underwood Parish Council
Hampton in Arden Parish Council
Harbury Parish Council
Hertfordshire County Council
Highways Agency
Hints Parish Council
Kenilworth Parish Council
King's Bromley Parish Council
Kingsbury Parish Council
Kingshurst Parish Council
Ladbroke Parish Council
Lea Marston Parish Council
Lichfield Parish Council
Lichfield District Council
Little Missenden Parish Council
Little Packington Parish Council
London Borough of Brent
London Borough of Camden
London Borough of Ealing
London Borough of Hammersmith and Fulham
London Borough of Hillingdon
London Borough of Islington
Long Itchington Parish Council
Marston St Lawrence Parish Council
Middleton Parish Council
Mixbury Parish Council
Natural England
Network Rail
Newton Purcell with Sherswell Parish Council
North Warwickshire District Council
Northamptonshire County Council
Offchurch Parish Council
Oxfordshire County Council
Preston Bissett Parish Council
Priors Hardwick Parish Council
Quainton Parish Council

Radbourn Parish Council
Radstone Parish Council
Royal Borough of Kensington and Chelsea
Smiths Wood Parish Council
Solihull Metropolitan Borough Council
South Buckinghamshire District Council
South Northamptonshire District Council
Southam Parish Council
Sports England
Staffordshire County Council
Steeple Claydon Parish Council
Stoke Mandeville Parish Council
Stone with Bishopstone and Hartwell Parish Council
Stoneton Parish Council
Stratford on Avon District Council
Swinfen & Packington Parish Council
The Association of National Parks Authorities
The British Waterways Board
The Environment Agency
The Lee Parish Council
Thorpe Mandeville Parish Council
Three Rivers District Council
Transport for London
Turweston Parish Council
Twyford Parish Council
Ufton Parish Council
Waddesdon Parish Council
Warwick District Council
Warwickshire County Council
Water Orton Parish Council
Weeford Parish Council
Wendover Parish Council
Westbury Parish Council
Weston under Wetherley Parish Council
Whitfield Parish Council
Whittington Parish Council
Wishaw Parish Council
Wormleighton Parish Council

21 Annex B – Route Maps

Legend

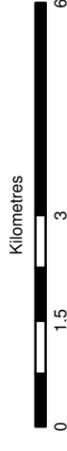
Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

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1	30/03/12	DMc	PJ	CB
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Issue	Date	By	Chkd	Appd
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Client



Job Title

High Speed 2

Key Plan



Drawing Title

**HS2 Scope and Methodology Report -
Proposed Scheme Route (1of6)**

Scale at A3

1:100,000

Discipline

GIS

Drawing Status

For Information

Drawing No

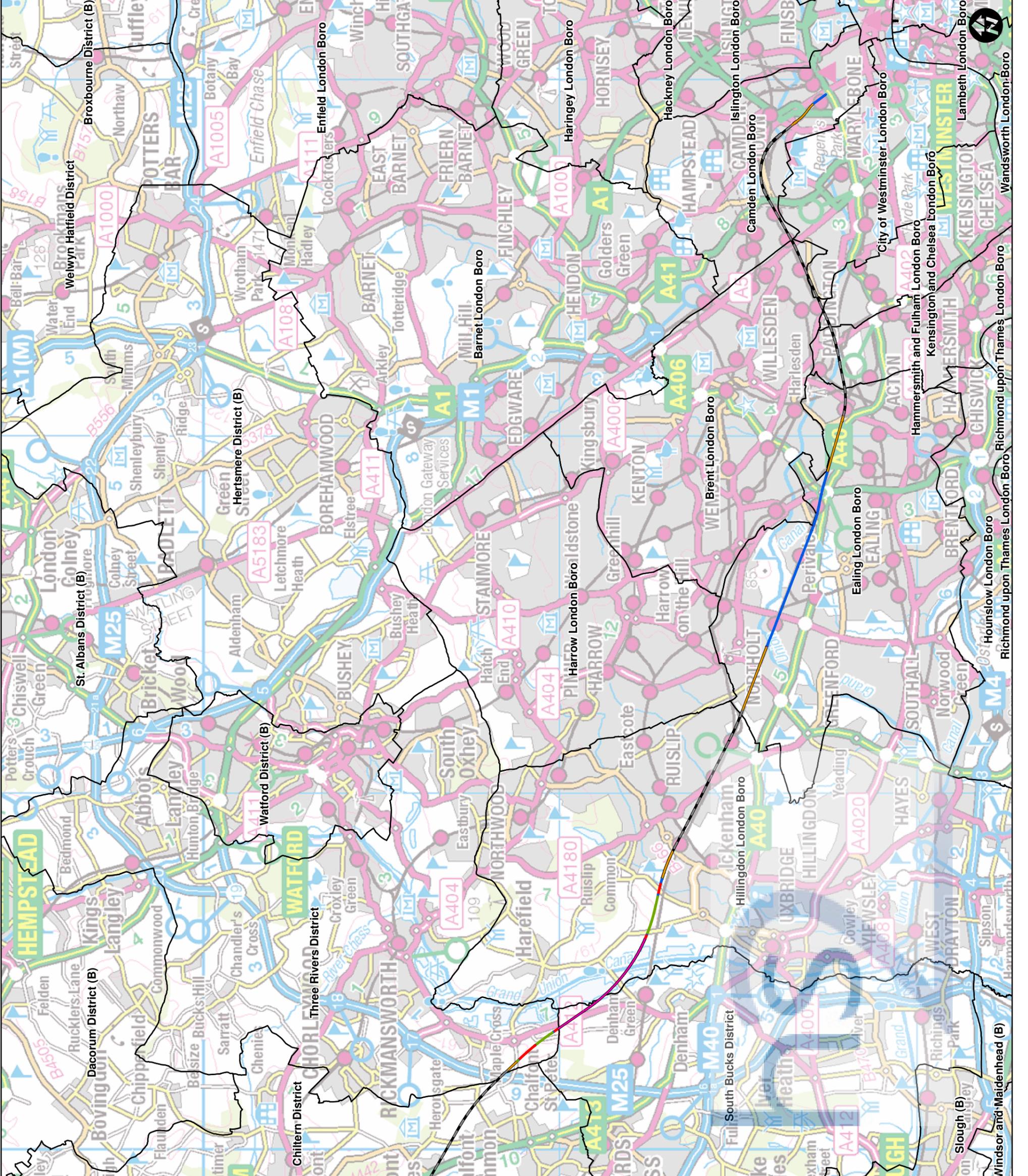
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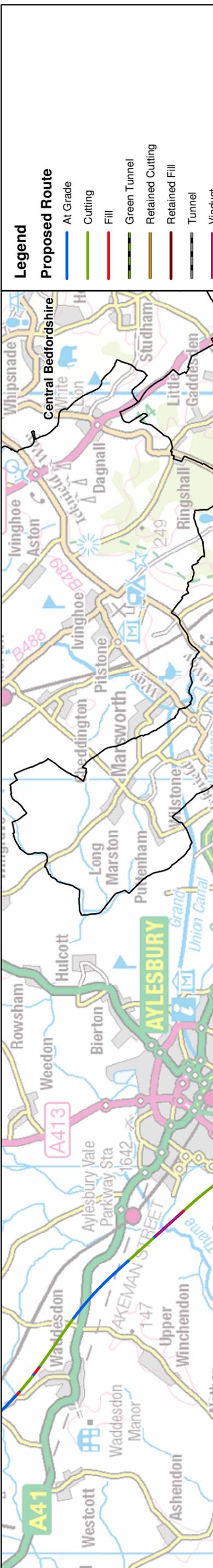
Job No

209742-00

Issue

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Legend

Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

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Key Plan



Drawing Title
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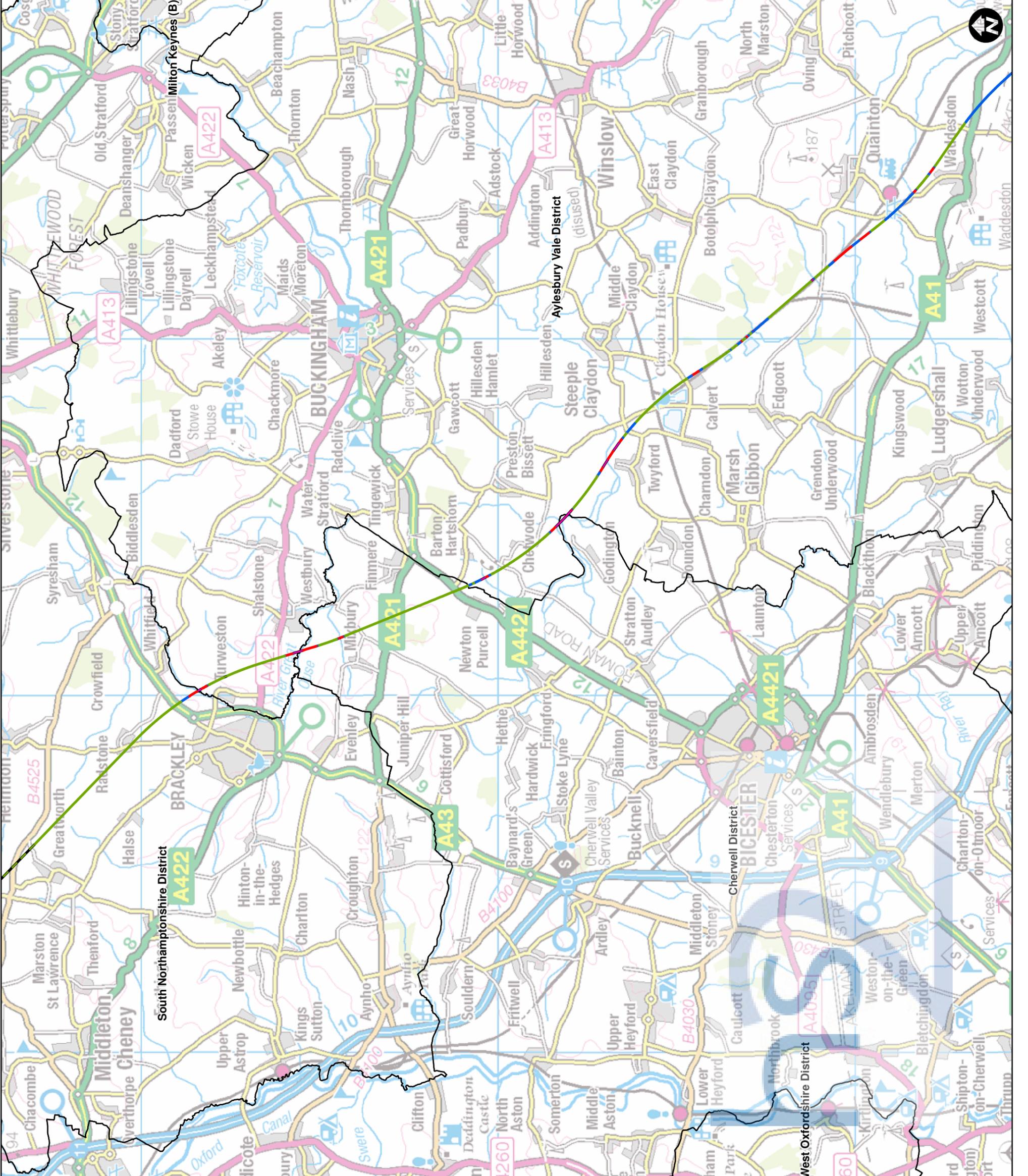
Discipline
GIS

Drawing Status
For Information

Drawing No
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Job No
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Issue
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Legend

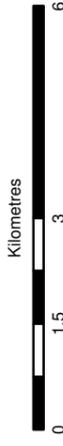
Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

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Issue	Date	By	Chkd	Appd



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Key Plan



Drawing Title

**HS2 Scope and Methodology Report -
Proposed Scheme Route (3of6)**

Scale at A3

1:100,000

Discipline

GIS

Drawing Status

Job No
209742-00

For Information

Drawing No

C222-HS2-EV-MAP-000-000002

Issue

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Legend	
Proposed Route	At Grade
	Cutting
	Fill
	Green Tunnel
	Retained Cutting
	Retained Fill
	Tunnel
	Viaduct

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Key Plan

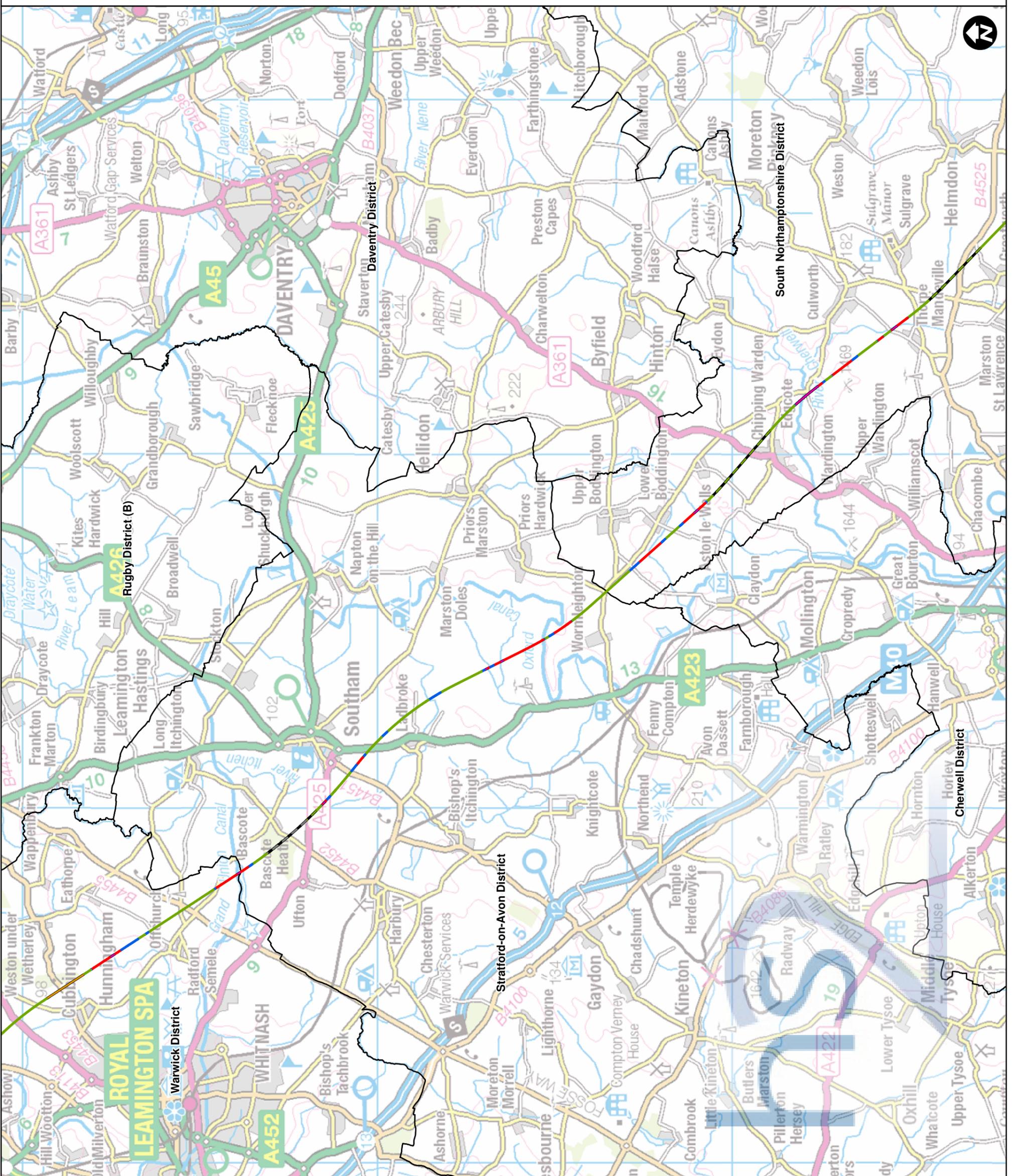


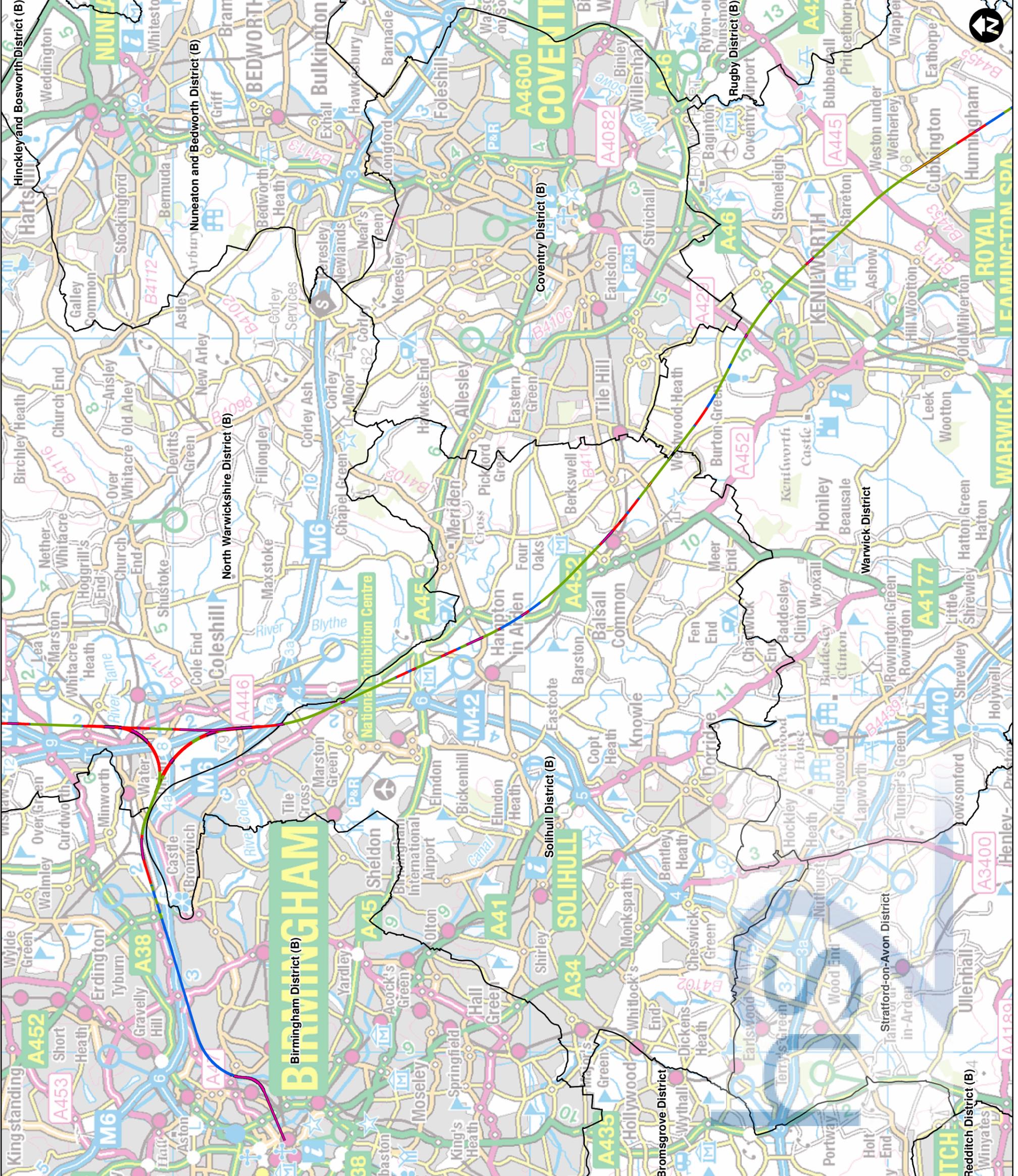
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Proposed Scheme Route (4of6)**

Scale at A3
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Discipline
GIS

Drawing Status	Job No
For Information	209742-00
Drawing No	Issue
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Legend

- Proposed Route**
- At Grade
 - Cutting
 - Fill
 - Green Tunnel
 - Retained Cutting
 - Retained Fill
 - Tunnel
 - Viaduct

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Key Plan



Drawing Title
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Proposed Scheme Route (50f6)**

Scale at A3

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Discipline
GIS

Drawing Status
For Information

Drawing No
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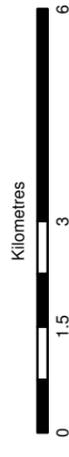
Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

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Job Title
High Speed 2

Key Plan



Drawing Title

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Proposed Scheme Route (60f6)**

Scale at A3
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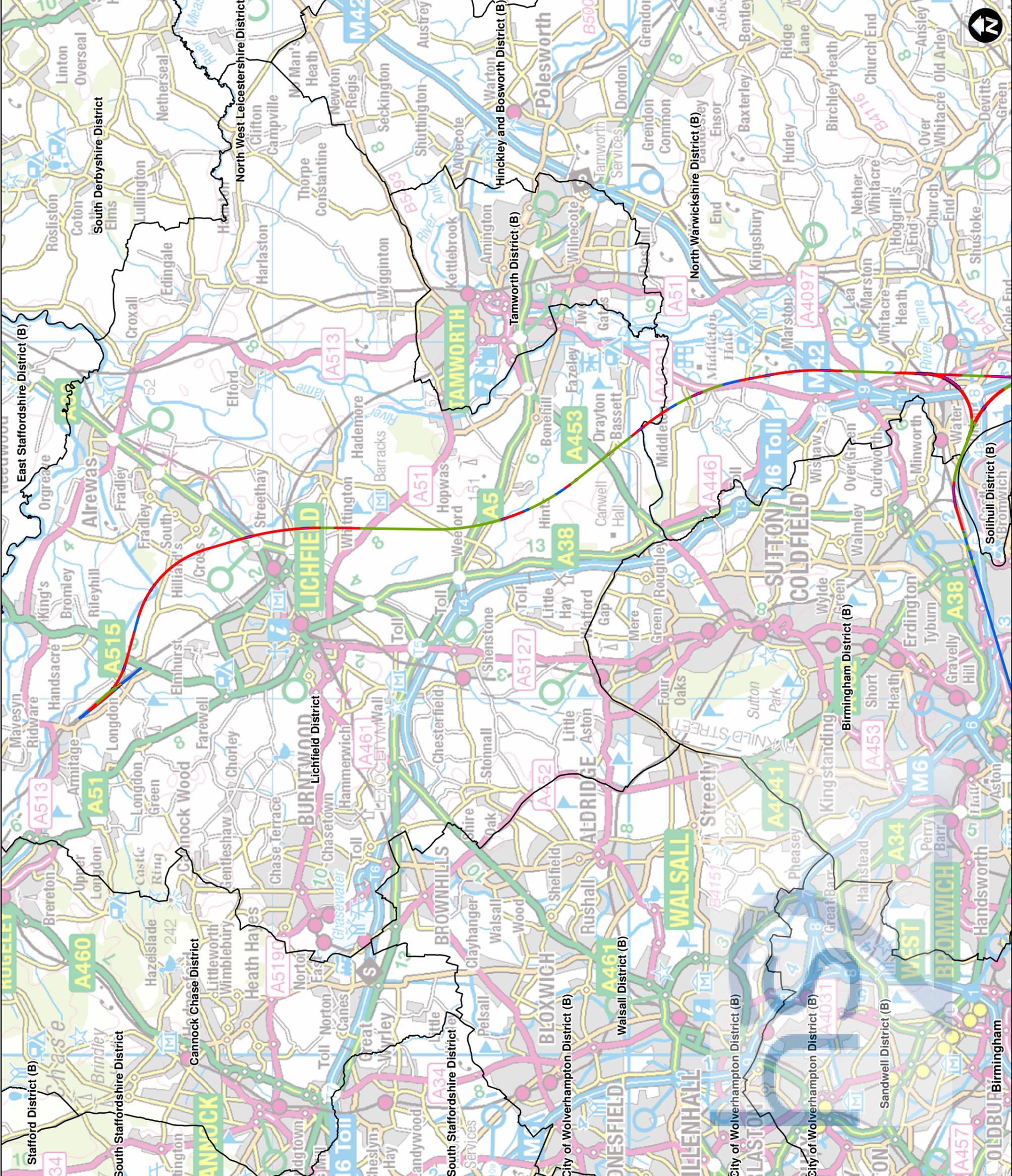
Discipline
GIS

Drawing Status
For Information

Drawing No
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Issue
1

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22 Annex C – List of acronyms

Abbreviations

$\mu\text{g}/\text{m}^3$	Microgram per cubic metre.
AA	Appropriate Assessment
AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
AIR	Air Information Resource
ALARP	As Low As Reasonably Practicable
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
AoS	Appraisal of Sustainability
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
ATO	Automatic Train Operation
ATOC	Association of Train Operating Companies
AURN	Automatic Urban and Rural Network
BAP	Biodiversity Action Plan
BCR	Benefit Cost Ratio
BHS	British Horse Society
BS	British Standards
CAAV	Central Association of Agricultural Land Valuers
CCA	Climate Change Act
CCC	Committee on Climate Change
CDEW	Construction Demolition and Excavation Waste
CHP	Combined Heat and Power
CLA	Country Land and Business Association
CLEA	Contaminated Land Exposure Assessment
CLR	Contaminated Land Report
cm	Centimetre
CO ₂	Carbon Dioxide
CoCP	Code of Construction Practice
COP	Code of Practice
CPRE	Campaign to Protect Rural England
CRN	Calculation of Railway Noise
CRoW	Countryside and Rights of Way
DART Underground	Dublin Area Rapid Transport Underground

dB	Decibel
DCLG	Department of Communities and Local Government
DDA	Disability Discrimination Act
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DoS	Degree of Saturation
EA	Environment Agency
EC	European Commission
ECML	East Coast Main Line
EH	English Heritage
EIA	Environmental Impact Assessment
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPUK	Environmental Protection UK
EqIA	Equality Impact Assessment
ERTMS	European Rail Traffic Management System
ES	Environmental Statement
ETCS	European Train Control System
EU	European Union
EU ETS	European Union Emissions Trading System
FRA	Flood Risk Assessment
GHG	Green House Gases
GIS	Geographical Information System
GLA	Greater London Authority
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GPLC	Guiding Principles on Land Contamination
GVA	Gross Value Added
GWML	Great Western Main Line
HCA	Home and Communities Agency
HDV	Heavy Duty Vehicle
HEPPG	Historic Environment Planning Practice Guide
HER	Historic Environment Record
HGV	Heavy Goods Vehicle
HIA	Health Impact Assessment

HRA	Habitat Regulations Assessment
HS1	High Speed One (formerly Channel Tunnel Rail Link – CTRL)
HS2	High Speed Two
HSI	Habitat Suitability Index
IAQM	Institute of Air Quality Management
IAQM.TG	Institute of Air Quality Management Technical Guidance
ICOMOS	International Council on Monuments and Sites
IDB	Internal Drainage Board
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Assessment and Management
IMD	Indices of Multiple Deprivation
IPC	Infrastructure Planning Commission
IPCC	Intergovernmental Panel on Climate Change
JT	Journey time
km	Kilometre
kph	Kilometres per hour
LAeq	Equivalent continuous sound level (noise)
LAQM	Local Air Quality Management
LAQN	London Air Quality Network
LDD	Local Development Document
LDF	Local Development Framework
LEP	Local Enterprise Partnership
LGBCE	Local Government Boundary Commission for England
LiDAR	Light Detection and Ranging
LLAU	Limits of Land to be Acquired or Used
LNR	Local Nature Reserve
LPA	Local Planning Authority
LWM	London to West Midlands
m	Metre
MAFF	Ministry of Agriculture, Fisheries and Food
MML	Midland Main Line
Mt	Million tonnes
NBR	National Buildings Record
NE	Natural England
NEC	National Exhibition Centre

NFU	National Farmers Union
NGO	Non-governmental Organisation
NHS	National Health Service
NIRR	Noise Insulation (Railway) Regulations
NMR	National Monuments Record
NNR	National Nature Reserve
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NPV	Net Present Value
NR	Network Rail
NVC	National Vegetation Classification
OLE	Overhead line equipment
ONS	Office for National Statistics
ORR	Office for Rail Regulation
OS	Ordnance Survey
PDFH	Passenger Demand Forecasting Handbook
PM ₁₀	Particulate matter with aerodynamic diameter of less than 10 micrometre
PM _{2.5}	Particulate matter with aerodynamic diameter of less than 2.5 micrometres
PPS	Planning Policy Statement
PV	Present Value
PVB	Present Value of Benefits
PVC	Present Value of Costs
QRA	Quantitative Risk Assessment
Ramsar	Site designated under Ramsar Convention
RESTATS	Department of Energy and Climate Change Renewable Energy Statistics
RIGS	Regionally Important Geological and Geomorphological Sites
RPG	Regional Planning Guidance
RSPB	Royal Society for the Protection of Birds
RSSB	Rail Safety and Standards Board
SA	Sustainability Appraisal
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monument

SEA	Strategic Environmental Assessment
SINC	Sites of Importance for Nature Conservation
SPA	Special Protection Area
SPP	Statement of Public Participation
SPZ	Source Protection Zone
SSSI	Sites of Special Scientific Interest
SUDs	Sustainable Drainage System
SWMP	Site Waste Management Plan
TBM	Tunnel Boring Machine
TfL	Transport for London
TIA	Transport Impact Assessment
TIN	Technical Information Note
tph	trains per hour
TSI	Technical Specification for Interoperability
UK	United Kingdom
UK APIS	UK Air Pollution Information System
UKCCRA	UK Climate Change Risk Assessment
UKCP09	UK Climate Projections
VCS	Voluntary and Community Sector
VDV	Vibration Dose Value
VfM	Value for Money
WCML	West Coast Main Line
WebTAG	Web Transport Analysis Guidance
WEI	Wider Economic Impact
WFD	Water Framework Directive
WHO	World Health Organisation
WRAP	Waste and Resources Action Programme
ZTV	Zone of Theoretical Visibility

23 Glossary of terms

Glossary

Air quality exceedence	A period of time (defined for each standard) where the concentration is higher than that set out in the Standard
Air quality limit values	Legally binding EU parameters that must not be exceeded. They are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedences allowed per year, if any, and a date by which it must be achieved
Air Quality Management Area (AQMA)	Air Quality Management Area. Designated under the Local Air Quality Management regime for areas currently, or forecast, to exceed National Air Quality Strategy objectives
Air quality objective	The target date on which exceedences of a Standard must not exceed a specified number
Air quality standard	Concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment
Air quality target values	Values used in some EU Directives and are set out in the same way as limit values. They are to be attained where possible by taking all necessary measures not entailing disproportionate costs
ALARP Rule	As low as reasonably practicable – A rule which involves weighing a risk against the time and money needed to control it
Ambient	Totally encompassing sound at a given location and time, usually composed of sound from many sources both near and far
Ancient Woodland	Land that has been continually wooded since at least 1,600
Appraisal of Sustainability (AoS)	Appraisal of impact of plans or policies from environmental, economic and social perspective and against objectives of sustainable development

Appropriate Assessment (AA)	An assessment of the effect of a plan or project on the Natura 2000 network of European sites of nature conservation significance, as required under the Habitats Directive
Aquifer	A below ground, water bearing layer of soil or rock
Area of Outstanding Natural Beauty (AONB)	Area designated under section 82 of the Countryside and Rights of Way Act 2000 for the purpose of conserving and enhancing its natural beauty
Auger	An auger is a drilling device, or drill bit, that usually includes a rotating helical screw blade called a 'flighting' to act as a screw conveyor to remove the drilled out material. The rotation of the blade causes the material to move out of the hole being drilled
Baseline	Existing environmental conditions present on, or near a site, against which future changes can be measured or predicted
Biodiversity Action Plan	A Biodiversity Action Plan (BAP) is an internationally recognised programme addressing threatened species and habitats and is designed to protect and restore biological systems. The original impetus for these plans derives from the 1992 Convention on Biological Diversity
Birmingham Interchange Station	Interchange station on the proposed route which would allow access to Birmingham International railway station, the National Exhibition Centre and Birmingham Airport
Borehole	A deep hole bored into the ground as part of intrusive investigations typically to test depth and quality of groundwater
Built Heritage	A heritage asset that is a structure or building visible above the land surface
Buried Heritage	A heritage asset that remains buried beneath the land surface and which may include earthworks
Captive	High speed trains designed to European legislation on interoperability, which may only operate on new HS2 infrastructure

Classic compatible	High speed trains designed to European legislation on interoperability and also to be capable of operating services to destinations north of HS2 through connections with the existing GB rail network
Classic Rail	The existing GB inter-city rail network
Code of Construction Practice	The code of Construction Practice sets out the standards and procedures to which a Developer or Contractor must adhere to when undertaking construction of major projects thus managing the environmental impacts. It also identifies the main responsibilities and requirements of Developers and Contractors in constructing their projects
Committee on Climate Change	Established under the CCA, the Committee on Climate Change is an independent advisory body tasked with helping the UK Government set and meet carbon budgets and adapt to climate change
Conservation	The preservation or enhancement of a species or building/structure
Conservation Area	An area designated under section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990 as being of special architectural or historic interest the character or appearance of which it is desirable to preserve or enhance
Conurbation	A region comprising a number of cities, large towns and other urban areas that, through population growth and physical expansion, have merged to form one continuous urban and industrially developed area
Crossrail	A new east-west railway linking Maidenhead and Heathrow Airport in the West via tunnels under Central London to Shenfield and Abbey Wood in the East
Crossrail interchange	Proposed interchange station in Old Oak Common, in outer London providing access to Crossrail and other rail services including the Great Western Main Line
Department for Transport (DfT)	Government department responsible for transport policy in the UK (where not devolved)

Directive	European Commission Directives impose legal obligations on European Member States. They are binding as to the results to be achieved, but allow individual states the right to decide the form and methods used to achieve the results. An example of this is the EC Air Quality Framework Directive 96/62 that is brought into legal effect in the UK by the Air Quality (England) Regulations (2000)
Displacement	The extent to which the benefits of a project are offset by reductions of output or employment elsewhere
Dust	Defined as all particulate matter up to 75 micrometre in diameter (according to BS6069) and comprising both suspended and deposited dust
EMC Zones	A bounded area in which specific levels of EM energy exist. It follows that some EMC zones contain higher levels of EM energy than others. In the railway environment the zone containing most energy in these EMC zones exists on the trackside of the railway (where traction power is returned to the running rails) and close to traction or non-traction power distribution equipment
English Heritage	The Government's statutory advisor on the historic environment. Officially known as Historic Buildings and Monuments Commission for England, English Heritage is an executive Non-Departmental Public Body sponsored by the Department for Culture, Media and Sport, with principal powers and responsibilities are set out in the National Heritage Act (1983)
Environmental Impact Assessment (EIA)	Assessment of environmental effects of certain public and private projects under Directive 2011/92/EU
Environmental Statement (ES)	The formal document or suite of documents reporting the requisite environmental information in respect of a project in accordance with EC Directive 2011/92/EU. Includes all such information that is reasonably required to assess the environmental effects of a development

European Union Emissions Trading System	The European Union Emissions Trading System or European Union Emissions Trading Proposed Scheme is a cap-and-trade greenhouse gas emissions framework, designed to result in emissions reductions across multiple countries
Floodplain	Land adjacent to a watercourse over which water flows, or would flow but for defences in place, in times of flood
Grade I building	A listed building of exceptional interest, sometimes considered to be internationally important
Grade II* building	A listed building of particular importance, of more than special interest
Grade II building	Nationally important buildings that are of special interest
Green Tunnel	Where earth is built up around and over a section of the rail line to reduce its environmental impacts
Greenhouse Gases	Gases that trap thermal radiation in the atmosphere; examples include: carbon dioxide, water vapour, methane and nitrous oxide
Groundwater	Water associated with soil or rocks below the ground surface but is usually taken to mean water in the saturated zone
Groundwater Source Protection Zone	A defined area within which groundwater is extracted for potable water supply. The area is defined by the Environment Agency on the basis of the length of time taken for groundwater to migrate from the potable source
Habitat	The living place of an organism characterised by its physical or biotic properties
Habitat Suitability Index (HSI)	An HSI is a numerical index evaluating habitat quality and quantity for a particular species, where a value of 1 represents optimum habitat and 0, habitat of no value. The HSI for great crested newt incorporates 10 suitability indices, all of which are factors known to affect this species

Heritage Asset	A building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions. Heritage assets are the valued components of the historic environment. They include designated heritage assets and assets identified by the local planning authority during the process of decision-making or through the plan-making process (including local listing)
High Speed One (HS1)	The Channel Tunnel Rail Link from St Pancras International station to the Channel Tunnel
HS2 Ltd	The company set up by the Government to develop proposals for a new high speed railway line between London and the West Midlands and to consider the case for new high speed rail services linking London, northern England and Scotland
Hybrid bill	Public bill which affects a particular private interest in a manner different from the private interest of other persons or bodies of the same category or class
Hydrogeology	The study of geological factors relating to the Earth's water
Inert waste	<p>The EU Landfill Directive in Article 2(e) defines 'inert waste' as follows:</p> <p>Waste is considered inert if:</p> <ol style="list-style-type: none"> 1) It does not undergo any significant physical, chemical or biological transformations; 2) It does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health; and 3) Its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water and/or groundwater
Infrastructure maintenance depot	Base for maintenance of infrastructure associated with the proposed high speed rail line, including track, signalling equipment, cuttings and embankments

In-situ preservation	Preserving archaeological remains in the natural, original or appropriate position.
Institute of Environmental Management and Assessment	Professional membership organisation for environmental practitioners
Intergovernmental Panel on Climate Change	A scientific intergovernmental body, tasked with the production of assessments of our overall understanding of the scientific, environmental, technical and socio-economic risks from and likely responses required to climate change
Intrusive Investigation	An in-depth investigation involving further sampling and analysis, such as the gathering of samples from the ground, walls, ceilings for the detection of contamination, asbestos and or archaeological remains
Listed Buildings	Buildings of special architectural or historic interest listed by the Secretary of State for Culture, Media and Sport on the advice of English Heritage. Buildings are graded to indicate their relative importance
Mitigation	The measures put forward to prevent, reduce and where possible, offset any adverse effects on the environment
National Farmers Union	Member organisation/industry association for Welsh and English farmers
National Trust	A UK conservation charity protecting historic places and green spaces and opening up for everyone
National Vegetation Classification	The National Vegetation Classification (NVC) is a comprehensive classification and description of the plant communities of Britain

Natural Area	Natural Areas are sub-divisions of England, defined by Natural England, each with a characteristic association of wildlife and natural features. They provide a way of interpreting the ecological variations of the country in terms of natural features, illustrating the distinctions between one area and another. Each Natural Area has a unique identity resulting from the interaction of wildlife, landforms, geology, land use and human impact. Natural Areas have been formally defined as 'biogeographic zones which reflect the geological foundation, the natural systems and processes and the wildlife in different parts of England, and provide a framework for setting objectives for nature conservation' (Biodiversity: The UK Steering Group Report, HMSO, 1995)
Natural England	The Government's advisor on the natural environment who provides practical advice, grounded in science, on how best to safeguard England's natural wealth for the benefit of everyone
Net NO ₂	After all deductions have been made Nitrogen Dioxide. Road transport and the burning of fossil fuels for power are the main sources of Nitrogen dioxide. In addition to being a green house gas it also contributes to photochemical smog formation. It is an irritant to the respiratory system
Non-governmental Organisation	Legally constituted organisation, which is independent of government. It is ordinarily non-profit and may be organised at a local, national or international level

Non-hazardous waste	<p>The EU Landfill Directive in Article 2, paragraph (d) defines 'non-hazardous waste' in reference to Article 2, paragraph (c) as follows:</p> <p>"(d) 'non-hazardous waste' means waste which is not covered by paragraph (c);"</p> <p>Article 2 paragraph (c) states the following:</p> <p>"(c) 'hazardous' waste means any waste which is covered by Article 1(4) of Council Directive 91/689/EEC of 12 December 1991 on hazardous waste."</p>
NOx	<p>Nitrogen Oxides. NOX is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. NOX is typically comprised largely of nitric oxide (NO) and nitrogen dioxide (NO₂). Many of the nitrogen oxides are colourless and odourless, although NO₂ can often be seen as a reddish-brown layer over many urban areas when present alongside particulates</p> <p>NOX form when fuel is burned at high temperatures, as in a combustion process. Consequently, these emissions occur almost exclusively from the combustion of fossil fuels for industry and transport, and from the burning of biomass</p>
Particulate matter	<p>Discrete particles in ambient air, sizes ranging between nanometres (nm, billionths of a metre) to tens of micrometres (µm, millionths of a metre)</p>
Pathways	<p>The routes by which impacts are transmitted through air, water, soils or plants and organisms to their receptors</p>
Phase 1	<p>Phase 1 of the proposed Y network - a high speed railway between London and the West Midlands with a connection via the West Coast Main Line at conventional speeds to the North West and Scotland and to the Channel Tunnel via HS1. Phase 1 includes four high speed rail stations at London Euston, Old Oak Common (West London), Birmingham Airport (Birmingham Interchange) and Birmingham (Curzon Street)</p>

Phase 1 habitat survey	The Phase 1 habitat classification and associated field survey technique provides a relatively rapid system to record semi-natural vegetation and other wildlife habitats. Each habitat type/feature is defined by way of a brief description and is allocated a specific name, an alpha-numeric code, and unique mapping colour. The system has been widely used and continues to act as the standard 'phase 1' technique for habitat survey across the UK
Phase 2	Phase 2 of the proposed Y network - extending the high speed railway beyond the West Midlands to Manchester and Leeds with connections at conventional speeds via the West Coast and East Coast Main Lines and a direct link at high speed to Heathrow Airport
Priority habitats and species	The UK Biodiversity Action Plan published in 1994 sets out a programme for conserving biodiversity in the UK. The UK BAP has published lists of species and habitats that are conservation priorities because of their rarity and rate of decline. A review of the UK BAP priority list in 2007 led to the identification of 1,150 species and 65 habitats that meet the BAP criteria at UK level. Priorities for England have been published under Section 41 of the NERC Act 2006
Proposed Scheme	Proposals for a high speed railway between London and the West Midlands announced by Government in <i>High Speed Rail: Investing in Britain's Future – Decisions and Next Steps</i> (January 2012)
Public Realm	The space between and within buildings that are publicly accessible, including streets, squares, forecourts, parks and open space
Receptor	A component of the natural, created or built environment such as human being, water, air, a building, or a plant that is affected by an impact
Registered Historic Parks and Gardens	A national record of the historic parks and gardens, which make a rich and varied contribution to the landscape and should be treated with care

Residual Impacts	Those impacts of the development that cannot be mitigated following implementation of mitigation proposals
Riparian Area	The interface between land and a river or stream
Risk Assessment	An assessment of the likelihood and severity of an occurrence
River Corridor Survey	Field mapping vegetation and physical features along the watercourse corridor using standard symbols, with cross-sections of channel form
River Habitat Survey	A method designed to characterise and assess, in broad terms, the physical structure of watercourses
Rolling Stock Depot	Depot used to service and maintain trains operating on the proposed route
Scheduled Monument	Important sites and monuments are given legal protection by being placed on a schedule by English Heritage
Scoping	An initial stage in determining the nature and potential scale of environmental impacts arising as a result of a development, and an assessment of what further studies are required to establish their significance
Setting (Heritage Asset)	The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral
Site of Special Scientific Interest (SSSI)	Area of land notified by Natural England under section 28 of the Wildlife and Countryside Act 1981 as being of special interest by reason of its flora, fauna or geological or physiological features
Strategic Environmental Assessment	Environmental assessment of certain plans or programmes under Directive 2001/42/EC
Threshold	A level of effect above which an assessment will be taken of whether any changes to procedures need to be made
Topography	The natural or artificial features, level and surface form of the ground surface

Transport for London (TfL)	TfL was created in 2000 and is the integrated body responsible for London's transport system.
Tunnel boring machine	A machine that excavates tunnels – commonly called a 'mole'
UK Climate Change Risk Assessment	Research into the anticipated impacts of climate change on the UK and its economy
UK Climate Projections	Information on the projected evolution of climate change in the UK explored through three possible scenarios: High, Medium and Low greenhouse gas emissions levels
West Coast Main Line (WCML)	Intercity railway route in the UK connecting London, Birmingham, Manchester, Liverpool and Glasgow



HS2 London-West Midlands

**Addendum to the EIA Scope
and Methodology Report**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 Purpose of this Addendum

- 1.1.1 The HS2 Scope and Methodology Report (SMR)(Volume 5: Appendix CT-001-000/1) was published in Autumn 2012 and set out the proposed scope and methodology for the Environmental Impact Assessment (EIA) for Phase 1 (London-West Midlands) of HS2.
- 1.1.2 This SMR Addendum outlines where the methodology presented within the SMR has been amended or advanced as a result of:
- legislation or industry best practice guidance having changed;
 - the methodology having undergone refinement as a result of its application within the EIA; and
 - further feedback on the outlined methodology having been received from stakeholders including statutory bodies following the ongoing application of that methodology.
- 1.1.3 This addendum generally focuses on updates and refinement to:
- the establishment of the baseline and definition of the survey;
 - the scope of the assessment; and
 - the assessment methodology.
- 1.1.4 There has been no material change to Part A of the SMR, including the report's Introduction, the high level methodology presented within the 'EIA Methodology' section, and the reporting of scheme alternatives considered. The scope and methodology contained within this addendum is generally presented in the future tense to emulate the SMR (which, being a consultation document in advance of the EIA was provided in the future tense).
- 1.1.5 The detailed assessment methodology is collated and presented in one or more Technical Notes for some of the topic areas under assessment. These are appended to this addendum. Not all topics have required the preparation of technical notes.
- 1.1.6 The addendum is arranged by topic area in the same order as they are presented within the SMR. It should be noted that for ease of cross reference, the section numbering of the remainder of this addendum document reflects the numbering utilised within the SMR document. Thus Sections 2 and 3 of this document are unused. Each section commences with a list of amendments to the SMR for the particular topic.

2 (not used)

3 (not used)

4 Agriculture, forestry and soils

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
4.5.1	Supplementary text provided within SMR Addendum.
4.6.6	Paragraph deleted and replacement text provided within SMR Addendum.
4.6	Supplementary text provided as new paragraphs and tables after 4.6.15 within SMR Addendum
4.6.15	Paragraph deleted
4.6.16	Paragraph deleted
4.6.17	Paragraph deleted
4.6.18	Paragraph deleted
4.6.19	Paragraph deleted

4.1 Scope of Assessment

Spatial scope

- 4.1.1 *[paragraph 4.5.1 supplemented with:]* Baseline agricultural land quality and farm holding data will initially be collected for a 200m-wide corridor centred on the Proposed Scheme alignment, as the full extent of the study area (which equates to all agricultural land required for the construction of the Proposed Scheme) will be uncertain at the time of baseline work, although there will be a need for flexibility in the study area where off-site works are anticipated to extend beyond this limit.

4.2 Assessment methodology

Planning policy

- 4.2.1 *[paragraph 4.6.6 amended to:]* There is no guidance in policy with regard to the effects of development proposals on farm holdings. Although Natural England's Technical Information Note (TIN) 049 indicates that land quality is not the sole consideration in how development proposals affect agricultural land in the planning system, it no longer refers to other relevant factors such as the impact on farm size and structure, the use of buildings and other fixed equipment, or any stimulus a development might give to rural economic activity. Instead, the updated TIN 049 indicates that planning authorities are guided by the National Planning Policy Framework to protect and enhance soils more widely, including for example conserving soil resources during construction and preventing soil from being adversely affected by pollution.

Significance criteria

- 4.2.2 *[Supplementary text provided as new subheadings, paragraphs and tables after 4.6.15:]*

Agricultural receptors (farms and other rural land-based businesses)

4.2.3 The nature of impacts will comprise primarily the loss of land to the farm holding (permanent and temporary), the severance of land (permanent and temporary), the loss of key farm infrastructure (dwellings, buildings and other structures such as irrigation reservoirs and slurry pits) and the imposition of disruptive effects (such as noise and dust) on land uses and the holding's operations.

4.2.4 Guideline criteria are presented in Table A. Where a farm holding experiences different levels of impact according to the nature of impact, the higher level will be assigned. Thus, for example, a farm holding that will lose 15% of its land (medium impact) but will retain access to severed land via a private means of access (low impact) will be assessed as incurring a medium impact.

Table A: Impact magnitude criteria for farm holdings

Impact magnitude	Definitions			
	Land required	Severance	Infrastructure	Disruptive effects
High	>20% of all land farmed	No access available to severed land	Direct loss of farm dwelling, building or structure	Disruption discontinues land use or enterprise
Medium	>10% - 20% of all land farmed	Access available to severed land via the public highway	Loss of or damage to infrastructure affecting land use	Disruption necessitates change to scale or nature of land use or enterprise
Low	> 5% - 10% of all land farmed	Access available to severed land via private way	Infrastructure loss/damage does not affect land use	Disruption does not affect land use or enterprise
Negligible	5% or less of all land farmed	No new severance	No impact on farm infrastructure	No disruption on land use or enterprise

4.2.5 The sensitivity of receptors will be determined by the extent to which they have the capacity to absorb or adapt to impacts, which will be determined primarily by their nature and scale.

4.2.6 In general terms, larger farm holdings will have a greater capacity to absorb impacts and will be less sensitive. However, the scale of the land holding is reflected in the magnitude of impact and the percentage land take from the farm. For example, the loss of 100 hectares from a 400-hectare (1,000 acre) farm would be a high impact (25%) whereas the same land take from a 1,000-hectare farm would be low (10%). The sensitivity criteria therefore concentrate on the nature of the receptor in order to avoid giving undue weight to the scale of operations. They are presented in Table B.

Table B: Agriculture receptor sensitivity criteria

Receptor sensitivity	Definition
High	<p>Farm types in which the operation of the enterprise is dependent on the spatial relationship of land to key infrastructure, and where there is a requirement for frequent and regular access between the two, or dependent on the existence of the infrastructure itself, e.g.:</p> <ul style="list-style-type: none"> • Dairying, in which milking cows must travel between fields and the parlour at least twice a day; • Irrigated arable cropping and field-scale horticulture, which are dependent on irrigation water supplies; • Intensive livestock or horticultural production which is undertaken primarily within buildings, often in controlled environments.
Medium	<p>Farm types in which there is a degree of flexibility in the normal course of operations, e.g.:</p> <ul style="list-style-type: none"> • Combinable arable farms; • Grazing livestock farms (other than dairying).
Low	Farm types and land uses undertaken on a non-commercial basis.

4.2.7 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table C.

Table C: Significance of effect criteria

Significance		Impact magnitude			
		High	Medium	Low	Negligible
Sensitivity of receptor	High	Major – significant	Major/ Moderate – significant	Moderate – significant	Minor – not significant
	Medium	Major/ Moderate – significant	Moderate – significant	Minor – not significant	Negligible – not significant
	Low	Moderate – significant	Minor – not significant	Negligible – not significant	Negligible – not significant

Agricultural land

4.2.8 The areas of different grades of agricultural land that will be affected by the Proposed Scheme will be measured within each CFA, and summarised in the categories shown in Table D which reflect the Defra database and maps, 'Likelihood of Best and Most Versatile Agricultural Land'. The maps show:

- areas of High Likelihood, where more than 60% of the land is likely to be Best and Most Versatile;
- areas of Moderate Likelihood, where 20% to 60% of the land is likely to be Best and Most Versatile;
- areas of Low Likelihood, where less than 20% of the land is likely to be Best and Most Versatile; and
- other non-agricultural use, such as woodland.

Table D: Impact magnitude criteria for agricultural land

Impact magnitude	Definitions
High	More than 60% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land
Medium	20% - 60% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land
Low	Less than 20% or less than 10ha of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land
Negligible	Less than 2% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile agricultural land

4.2.9 The sensitivity of resources affected will be determined by their inherent value, as reflected in their ALC grade, within the context of the abundance of agricultural land in the locality, defined as a 4-km corridor centred on the Proposed Scheme, as demonstrated in Table E.

Table E: Agriculture resources sensitivity criteria

Resources sensitivity	Definition
High	Best and most versatile agricultural land where 'Low Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps
Medium	Best and most versatile agricultural land where 'Moderate Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps
Low	Best and most versatile agricultural land where 'High Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps

4.2.10 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table C.

Forestry land

4.2.11 Woodlands are an important natural resource as they offer soil protection, water regulation and carbon storage, and provide wood products and support forest industries.

4.2.12 This assessment will consider the impact on forestry land and woodland in a quantitative fashion, as a land use feature. It will not assess the qualitative impacts on woodland or forestry, for which reference needs to be made principally to the Ecology and Landscape and visual assessments.

4.2.13 The nature of the impact will comprise the direct requirement for forestry land. The areas of forestry land that will be affected by the Proposed Scheme will be measured and also expressed as a percentage of the total land requirements within the CFA, as shown in Table F.

Table F: Impact magnitude criteria for forestry land

Impact magnitude	Definitions
High	More than 10% of land required for the construction or operation of the Proposed Scheme is forestry land
Medium	6% - 10% of land required for the construction or operation of the Proposed Scheme is forestry land
Low	Less than 6% of land required for the construction or operation of the Proposed Scheme is forestry land
Negligible	Less than 1% of land required for the construction or operation of the Proposed Scheme is forestry land

4.2.14 The sensitivity of forestry, as a land use, will be determined within the context of the abundance of forestry land in the locality, as measured within a 4km-wide corridor, following the approach taken with agricultural land. The abundance will be related to the average woodland coverage in England of 10%, as demonstrated in Table G.

Table G: Forestry land sensitivity criteria

Resources sensitivity	Definition
High	Forestry land where there is less than the national average forestry cover (<6%)
Medium	Forestry land where there is the national average forestry cover (6-10%)
Low	Forestry land where there is above the national average forestry cover (>10%)

4.2.15 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table C.

Soil resources

4.2.16 The impact on the soil resource will reflect the degree to which soil resources are reused on and off the Proposed Scheme in a manner that enables the resource to continue to fulfil one or more of the primary soil functions of:

- the production of food and biomass, and the provision of raw materials;
- the storage, filtration and cycling of water, carbon and nitrogen in the biosphere;
- the support of ecological habitats and biodiversity;
- the support for the landscape;
- the protection of cultural heritage; and
- the provision of a platform for human activities, particularly construction and recreation.

4.2.17 High impacts will occur where the soil displaced from the Proposed Scheme is unable to fulfil one or more of these functions; Medium impacts will occur where these functions are fulfilled primarily off-site due to the displacement of the soil; Low impacts will occur where these functions are fulfilled primarily on-site; and Negligible impacts will occur where the soil retains its pre-existing functions on-site.

4.2.18 The sensitivity of displaced soil will reflect its textural characteristics and its susceptibility to the effects of handling during construction and the re-instatement of

land. Following the soil wetness class assessments set out in the Agricultural Land Classification guidelines:

- high sensitivity soils are those with a high clay and silt fraction (clays, silty clays, sandy clays, heavy silty clay loams and heavy clay loams);
- medium sensitivity soils are silty loams, medium silty clay loams, medium clay loams and sandy clay loams; and
- low sensitivity soils are those with a high sand fraction (sands, loamy sands, sandy loams and sandy silt loams).

4.2.19 The significance of effect will be a product of the magnitude of impact and the sensitivity of the soil resource, following the matrix in Table C.

Construction effects

4.2.20 Construction effects on agricultural and forestry land and farm and farm-based enterprises will include land requirements; severance of agricultural and forestry land and farm holdings; the loss of, or disruption to, buildings and operational infrastructure such as drainage; and the use of the soil resource displaced by the construction of the Proposed Scheme.

4.2.21 Other construction effects will include the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; unintentional pollution of soil and water courses or bodies (used for crop irrigation or livestock drinking water supplies); spread of injurious weeds to adjacent agricultural land from soil and material stockpiles; and construction noise on farm and farm-based enterprises.

4.2.22 Construction effects will be distinguished between temporary and permanent effects. Temporary construction effects will comprise the land required to construct the Proposed Scheme which will include the land returned to agricultural or forestry use after construction; the temporary severance of land during the construction period; and the effects of disruption, principally from construction noise and dust, on land uses and enterprises.

4.2.23 Permanent construction effects will comprise the net area of agricultural and forestry land required to operate the Proposed Scheme, following the construction period and the restoration of land required temporarily to agricultural and forestry uses; the permanent severance of land; and the permanent loss of or effect on farm infrastructure such as property, buildings and structures, and the consequential effects on land uses and enterprises.

Operational effects

4.2.24 Operational effects on agricultural and forestry land and farm and farm-based enterprises may include sound emanating from moving trains and warning signals and the propensity of operational land to harbour noxious weeds.

4.2.25 The approach to the assessment of effects of operational sound of the Proposed Scheme on agricultural livestock receptors will be made in liaison with sound, noise and vibration specialists, and will concentrate on sound from operational trains

('passby' sound) rather than construction sound where effects are likely to be temporary and reversible.

- 4.2.26 In a review of existing research, Hanson (2007)¹ identifies reported effects of noise upon different animals, including interference with communication, masking predation, startle and fright, along with other physiological effects. Hearing acuity differs significantly between species and consequently no uniform frequency weighting has been established to best evaluate response. Consequently, the A-weighted sound pressure continues to be used and Hanson cites a number of studies using various noise sources which suggest that levels of around 100dB are associated with an observable effect for disturbance in domestic and wild birds (effects such as accelerated hatching, nest abandonment and panic responses), domestic animals (reduction in cattle milk production, changes of hormonal composition in swine) and startle or panic effects in terrestrial mammals.
- 4.2.27 Studies specifically investigating the effects of sound from high speed rail and other rail transport are few but it is important to note that high speed train passbys have a different signature to sound from heavily used highways where the sound levels are more continuous and more likely to result in masking and communication interference effects than startle or panic effects. There are however some similarities between the characteristics of noise arising from high speed rail and sub-sonic low flying aircraft, including rapid onset rates, high maximum sound pressure levels and spectra dominated by low frequencies. It is however acknowledged that high speed train passbys are more regular, fixed in terms of route and more consistent in terms of signature, so that habituation may be more likely to occur than for irregular and less predictable over-flights by aircraft. Hanson (2007)² suggests that the sound exposure level (SEL), which accounts for both sound pressure level and duration of the event, is the most useful predictor of responses in both wildlife and domestic animals. SEL can be described as the sum of the sound energy over the duration of an event normalised to a 1 second reference period.
- 4.2.28 Some of the research studies indicate that some animals habituate to noise after several repetitions of exposure. Previous exposure to noise levels below 100dB served to eliminate panic among turkeys, and swine showed initial alarm followed by indifference to aircraft noise greater than 100dB.
- 4.2.29 With regard to the effects of noise on horses, the International League for Protection of Horses issued advice in relation to the Airdrie-Bathgate Railway Improvements Bill which indicated that horses usually became habituated to repeated noise including that from passing trains, although it is acknowledged that there may be a short period of adjustment.
- 4.2.30 Based on the preliminary indications identified in these studies regarding the most appropriate descriptor, threshold levels for disturbance and habituation characteristics of a small number of species, the US Department of Transportation, Federal Railroad Administration (FRA) has identified interim criteria for identifying the potential impact of high speed rail noise on animals in wilderness and farming areas.

¹ C.E. Hanson (2007), High Speed Train Noise Effects on Wildlife and Domestic Livestock, Notes on Numerical Fluid Mechanics and Multidisciplinary Design Vol 99, 2008, pp26-32.

² C.E. Hanson (2007), High Speed Train Noise Effects on Wildlife and Domestic Livestock, Notes on Numerical Fluid Mechanics and Multidisciplinary Design Vol 99, 2008, pp26-32.

- 4.2.31 The FRA interim criteria (FRA, 2005)³ have been defined as follows:
- noise metric – A-weighted sound pressure level (dBA);
 - noise descriptor – sound exposure level (SEL);
 - threshold for impact – 100 dBA; and
 - habituation – no general criterion (insufficient information on species specific responses).
- 4.2.32 It should be noted that these criteria are based on responses observed in birds and mammals only. Criteria are not yet fully developed to the point where dose-response relationships can be fully described for different animal species.
- 4.2.33 The data from the sound, noise and vibration assessment indicate that the SEL of a train pass-by is unlikely to exceed 100 dB(A) beyond approximately 25m from the track. Consideration of the FRA interim criteria would therefore suggest that adverse effects on relevant wildlife species or agricultural livestock are less likely to occur beyond this distance.
- 4.2.34 The FRA interim criterion of SEL 100dB(A) will be used to identify potential significant adverse effects upon agricultural livestock. In the absence of natural or man-made wayside barriers, this would include receptors within a distance of up to 25m from the nearside track for trains travelling at a maximum speed of 360km/h; at lower speeds this distance may be reduced.
- 4.2.35 However, as it is assumed that grazing livestock will be able to move freely away from the sound source, the assessment will concentrate on identifying fixed livestock buildings or other enclosures close to the track. It is proposed to identify potential receptors within 40m rather than 25m of the track, as livestock buildings within 25m of the nearside track could be demolished as part of the construction works. Once identified, the sound, noise and vibration specialists will advise on the operational sound level at the identified receptor locations given the likely train speeds and known scheme design (including cuttings and other features that would attenuate sound). The significance of effect will be determined in liaison with the sound, noise and vibration specialists.

³ U.S. Department of Transportation, Federal Railroad Administration (2005), High-Speed Ground Transportation Noise and Vibration Impact Assessment, Office of Railroad Development, (<http://www.fra.dot.gov/us/content/253>).

5 Air quality

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
5.2.5	Supplementary text provided within SMR Addendum and text within paragraph clarified.
5.5.6	Paragraph deleted and replacement text provided within SMR Addendum.
5.6.4	Supplementary text provided within SMR Addendum.
Table 1	Table updated within SMR Addendum.
5.6.16	Paragraph amended
5.6.20	Paragraph deleted and replacement text provided within SMR Addendum.
Technical Notes – appended to this document	
Air quality assessment for construction issues	
Guidance on assessment methodology	

5.1 Establishment of baseline and definition of survey

- 5.1.1 *[Paragraph 5.2.5 amended to:]* Further background air pollutant concentration data is available on Defra’s Air Information Resource (AIR) website⁴. This data comprise estimated background air pollution data for 2010 and projections for future years for a 1km² grid for every local authority in the UK.
- 5.1.2 *[paragraph 5.2.5 supplemented with:]* It is acknowledged that there is considerable uncertainty regarding future pollutant concentrations in the UK. It is expected that pollutant concentrations will reduce as a result of continuing emission controls, although the rate of future decreases is uncertain. In this assessment, the current Government guidance will be followed to predict future pollutant concentrations. The assessment of the significance of air quality impacts will be based on an established method taking into account the predicted changes in concentrations as a result of the Proposed Scheme.

5.2 Scope of assessment

Technical scope

- 5.2.1 *[paragraph 5.5.6 amended to:]* The assessment will not include the transboundary effects of the Proposed Scheme on air quality, as the likely changes in atmospheric emissions would be negligible in this context.

5.3 Assessment methodology

Significance criteria

- 5.3.1 *[Paragraph 5.6.4 - the following sentence now added at the end of paragraph:]* Within the CFA reports, the term ‘air quality standards’ refers to both the English Air Quality Objectives and the Air Quality Limit Values introduced in the UK based on EU Directives.
- 5.3.2 *[Table 1 of the SMR amended to:]*

⁴ Defra; UK-Air; <http://uk-air.defra.gov.uk>

Table 1: UK and EU air quality standards

Pollutant	Averaging period	Limit value / objective	Date for compliance	Basis
Nitrogen dioxide (NO ₂)	1 hour mean	200µg/m ³	11 June 2010	UK ^(a)
		not to be exceeded more than 18 times a year (99.8 th percentile)	1 Jan 2010	EU ^(b)
	Annual mean	40µg/m ³	11 June 2010	UK ^(a)
			1 Jan 2015 ⁽¹⁾	EU ^(b)
Particulates (PM ₁₀) Measurement technique: Gravimetric	Daily mean	50µg/m ³	11 June 2010	UK ^(a)
		not to be exceeded more than 35 times a year (90.4 th percentile)	11 June 2011 ⁽²⁾	EU ^(b)
	Annual mean	40µg/m ³	11 June 2010	UK ^(a)
			1 Jan 2005 ⁽³⁾	EU ^(b)
Particulates (PM _{2.5}) Measurement technique: Gravimetric	Annual mean	25µg/m ³	1 Jan 2015	UK ^(a)
				EU ^(b)
		20µg/m ³	1 Jan 2020	EU*

^(a) The Air Quality Standards Regulations 2010, SI 2010/1001.

^(b) Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

⁽¹⁾ Extension to the compliance with the annual mean NO₂ limit value granted by the European Commission. Sources: C(2011)6208 and C(2012)4155.

⁽²⁾ Extension to the compliance with the daily mean PM₁₀ limit value granted by the European Commission. Source: C(2011)1592.

⁽³⁾ Extension to the compliance with the annual mean PM₁₀ limit value not granted by the European Commission. Source: C(2009)9588.

http://ec.europa.eu/environment/air/quality/legislation/time_extensions.htm

* Indicative until the European Commission's review of air policies.

Operational Effects

5.3.3 *[Paragraph 5.6.16 amended to:]* With regard to assessment of the effects of emissions arising from changes in traffic flows during construction, traffic data will be screened using the DMRB criteria described in paragraph 5.5.1. Following this screening exercise, roads meeting any of these criteria would be subject to further assessment, including using the air quality screening tool specified in DMRB, as required. This tool can then be used to forecast concentrations of traffic-related pollutants (NO₂ and PM₁₀) at receptors. If this predicts significant change in pollutant concentrations, an appropriate atmospheric dispersion model (e.g. ADMS-Roads or ADMSUrban) would be used to further investigate the effects of changes in traffic flow at those receptors. Dispersion modelling would use the latest available vehicle emission data from Defra and take into account information in the National Atmospheric Emission Inventory and the London Atmospheric Emissions Inventory as appropriate. Comparison of results with and without the construction traffic and local diversions in the future years would allow the effect to be determined.

5.3.4 *[Paragraph 5.6.20 amended to:]* Defra has published technical guidance for local authorities on when and how emissions from moving and stationary diesel trains should be considered in relation to Local Air Quality Management duties^{5,6}. In the absence of any other specific guidance, this will be used to inform the assessment of potential local air quality impacts from construction related train operations. Defra's guidance addresses locations with relevant public exposure where there is risk of

⁵ UK Government; International, European and national standards for air quality; <http://www.defra.gov.uk/environment/quality/air/air-quality/laqm/guidance/>

⁶ Defra; Guidance on Assessing Emissions from Railway Locomotives; <http://laqm.defra.gov.uk/laqm-faqs/faq37.html>

exceedance of the annual mean air quality standard for NO₂. Such locations are within 30m of railway tracks but only where the background annual mean NO₂ concentration is above 25µg/m³. In the context of the Proposed Scheme these locations may occur in the vicinity of temporary railheads where diesel locomotives are routinely idling or used for shunting.

6 Climate - greenhouse gas emissions

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
6.1.3	Supplementary text provided within SMR Addendum
6.2.2	Supplementary text provided within SMR Addendum
6.6.5	Paragraph deleted and replacement text provided within SMR Addendum
6.6.6	Paragraph deleted
6.6.7	Paragraph deleted and replacement text provided within SMR Addendum
6.6.8	Paragraph deleted
6.6.9	Text within paragraph clarified within SMR Addendum

6.1 Introduction

6.1.1 *[paragraph 6.1.3 amended to:]* Assessments will be carried out for the following time periods:

- 2017 – start of construction;
- 2026 - Proposed Scheme opening;
- 2036- once maximum timetable is in operation; and
- 2086 – 60 years of operation after opening.

6.2 Establishment of baseline and definition of survey

6.2.1 *[paragraph 6.2.2 amended to:]* Scenarios of current and future baselines will be built on the work of the Appraisal of Sustainability (AoS)⁷. The baseline greenhouse gas (GHG) assessment will cover the following aspects:

- changing travel patterns and modal shift;
- surface access to existing stations;
- projected UK grid power emissions (for example nuclear versus coal based projection); and
- planned associated developments (such as roads and depots).

6.3 Assessment methodology

6.3.1 *[Paragraph 6.6.5 amended to:]* Construction related emissions will be based on the engineering team's Construction and Logistics reports for the Proposed Scheme. These reports include information relating to specific design element (such as viaducts or bridges) across the entire route in terms of:

- volume (m³) of construction materials;
- type of construction material (e.g. concrete, imported fill, steel, gravel etc.);

⁷ Booz and Co. Ltd/Temple Group Ltd (2011), HS2 London to the West Midlands Appraisal of Sustainability.

- transport distances (km) of construction material; and
- volume (m³) of waste generated (both construction and demolition).

6.3.2 *[Paragraph 6.6.7 amended to:]* Construction site emissions relating to fuel and energy use by plant equipment will be calculated using Arup's CO₂ST tool. The tool considers carbon associated with machinery and plant used as well as travel from construction workers. The background library of information which the CO₂ST tool is based on includes The Reference Manual for Construction Plant⁸ and Defra's carbon coefficients.

6.3.3 *[paragraph 6.6.9 amended to:]* Transport related emissions will be based on the PLANET Framework Model (PFM⁹) outputs. Outputs from the transport modelling requested for the GHG assessment include:

- Surface access: travel to and from each station by modal split, number of trips and average trip distance;
- Classic rail network: change in train movements on the classic network as a result of uptake of services on the Proposed Scheme. If modelling outputs permit, an analysis of the released capacity on the classic network for passenger or freight transport (outputs to be confirmed with transport modellers) will be undertaken;
- Modal shift: transfers from air to rail for domestic trips between London and Manchester/ Birmingham/ Glasgow and Leeds. Although there are no flights between London and Birmingham (the route of the Proposed Scheme), there are flights to Manchester, Leeds and other destinations further north. Phase 2 will indirectly impact the modal shift (road and rail) on the Proposed Scheme through, for example, planned increase in services on the London to Birmingham section). This impact of Phase 2 on the Proposed Scheme will be considered in the assessment;
- Modal shift: transfer from road onto the Proposed Scheme (i.e. between London and Birmingham); and
- Construction transport: transport movements associated with construction activities such as movement of spoil and access to site; and
- Personal transport: any additional transport on existing routes caused by disruption associated with the Proposed Scheme in terms of construction activities and operation.

⁸ Institution of Civil Engineering Surveyors (2003), The Reference Manual for Construction Plant.

⁹ PLANET is a multimodal transport model which estimates the numbers of passengers that will use the Proposed Scheme.

6(A). Climate change adaptation

Note – Section 6 of the SMR largely discussed the effects of the Proposed Scheme on climate with reference to greenhouse gases (GHG), with climate change adaptation (CCA) discussed within individual topic areas, where relevant. For ease of reference the scope and methodology for CCA will now be grouped together, and is presented below as a new addition to the SMR.

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
N/A – new section not previously within SMR	Supplementary text provided within SMR Addendum.

6.1 Establishment of baseline and definition of survey

6.1.1 A climate change impacts assessment, which will include consideration of the combined impacts of the Proposed Scheme and potential climate change on the receiving environment and community, will be undertaken.

Climate change projections

6.1.2 At present, no legislation exists that specifies which climate change projections and scenarios are to be used as part of a climate change impacts assessment within the UK Environmental Impact Assessment (EIA) process. Given this, the methodology for the consideration of potential climate change impacts within the EIA draws upon the following sources:

- trends derived from UKCPog projection data¹⁰, which reflect scientists' best understanding of how the climate system operates and how it might change in the future;
- European Union guidance¹¹ on integrating climate change and biodiversity into Environmental Impact Assessment (EIA);
- Institute of Environmental Management and Assessment (IEMA)¹²;
- European Bank of Reconstruction and Development (EBRD)¹³; and
- relevant reports from Reporting Authorities submitted under the UK Adaptation Reporting Power¹⁴ (for example Network Rail, National Grid, Highways Agency and Transport for London).

6.1.3 The consideration of the potential additional impacts of climate change on the effects associated with the Proposed Scheme will be based upon the most recent, publically available research and evidence. However, climate change science is an evolving field of enquiry, and the integration of potential climate change impacts into the EIA process is a relatively new approach. For some topics the evidence base is not definitive, or there is insufficiently detailed evidence available at the local level, which

¹⁰ UKCPog (2009) Climate Change Projections Report. [online] <http://ukclimateprojections.defra.gov.uk/22566>. Accessed July 2013.

¹¹ <http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf>.

¹² IEMA; EIA & Climate Change; <http://www.iema.net/eia-climate-change>.

¹³ European Bank for Reconstruction and Development; Sustainability Report 2011; <http://www.ebrd.com/pages/digital-publications/flagships/sr11/climate-change-and-energy/integrating-climate-change-adaptation-into-projects.html>.

¹⁴ Defra; <http://www.defra.gov.uk/environment/climate/sectors/reporting-authorities/reporting-authorities-reports/>.

means it may be difficult to draw conclusions about the potential impacts of climate change in line with the established EIA methodologies for each topic.

- 6.1.4 Therefore, following consideration of potential climate change impacts, informed professional judgement will be used by topic experts to produce high level, qualitative statements about potential topic specific impacts resulting from projected changes and trends for climate averages and extreme weather events, along with consideration of any potential additional topic specific mitigation measures required.
- 6.1.5 A notable exception is the assessment of flood risk, which will be undertaken using climate change projections as specified in the National Planning Policy Framework (NPPF)¹⁵. The flood risk assessment will use the recommended precautionary sensitivity ranges of key parameters as given in Table 5 in the Technical Guidance to the NPPF. Sensitivity testing to be undertaken will allow for variations in climate change factors included in other national guidance.
- 6.1.6 The consideration of potential climate change impacts on the effects associated with the Proposed Scheme will be undertaken in accordance with timeframes outlined in the methodologies for each topic. Table H provides a comparison of these timeframes and the corresponding timeframes for UK climate change projections.

Table H: Temporal scope for consideration of climate change impacts

	Construction	Operation (start)	Operation (peak)
Topic assessment timeframe	2017-2026	2026 onwards	2041
Corresponding UKCP09 timeframe	'the 2020s' (2010-2039)	'the 2020s' (2010-2039)	'the 2050s' (2040-2069)

6.1.7 During the construction phase of the Proposed Scheme (2017 – 2026), the trends within the UKCP09¹⁶ climate change projections suggest the following changes to long-term, seasonal averages:

- warmer, drier summers, particularly in parts of southern England¹⁷;
- milder, wetter winters, particularly in the western side of the UK¹⁸;
- an increase in annual average temperature¹⁹; and
- fewer days with snow and frost²⁰.

6.1.8 Extreme weather during the construction phase will:

- very likely include more very hot days²¹;
- likely include more intense downpours of rain²² (particularly in summer); and
- very likely include an increase in dry spells²³.

¹⁵ Communities and Local Government; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf.

¹⁶ UK Climate Impacts Programme (UKCIP) (2009), *Climate Change Projections*.

¹⁷ UKCIP (2009), *Climate Change Projections*, Table 4.1, 4.2, 4.4 and 4.5.

¹⁸ Table 4.1, 4.2, 4.4 and 4.5, *Climate Change Projections*, UKCIP (2009).

¹⁹ UKCIP (2009), *Climate Change Projections*, Section 4.3.5.

²⁰ UKCIP (2009), *Climate Change Projections*, Table 3. UKCIP (2009), *Climate Change Briefing Report*, Figure 4.31.

²¹ UKCIP (2009), *Climate Change Briefing Report*, Table 3.

²² UKCIP (2009), *Climate Change Projections*, Table 4.2.

²³ UKCIP (2009), *Climate Change Briefing Report*, Table 4.

- 6.1.9 In addition, it is likely, although with a higher level of uncertainty, that the probability of the following extreme weather events will be increased as a consequence of climate change²⁴:
- short periods of intense cold weather (still expected as a result of natural variability²⁵); and
 - an increase in the frequency of storms and high winds (widely accepted as difficult to predict with any certainty²⁶).
- 6.1.10 During the operation of the Proposed Scheme (2026 onwards), these changes in climatic averages and extreme weather events are projected to become more pronounced.

6.2 Scope of assessment

Spatial scope

- 6.2.1 Potential climate change impacts will be considered at a spatial scope appropriate to each topic as described in their respective scope and methodology sections. In terms of reporting the results of the assessment, Water Resources and Flood Risk will report at the local level (in Volume 2) to determine if there are any receptors that are particularly sensitive to potential climate change impacts. Other topics will report their findings in Volume 1, as appropriate.

Temporal scope

- 6.2.2 Most topics will consider potential climate change impacts during construction (which includes the reinstatement of landforms and soils, and the commencement of a five-year aftercare period), which is estimated to commence in 2017. Those topics considering potential climate change impacts associated with operation will include 2026 (to reflect the first year of operation) in addition to 2041 (considered to represent peak operation).
- 6.2.3 Table I contains a summary of each topic’s respective choice of temporal scope for their overall impact assessment. The relevant sections of the SMR and SMR Addendum for each topic contain further information regarding their respective temporal scopes, which will be used to inform the consideration of potential climate change impacts within the future baseline.

Table I: Topic specific temporal scope

EIA topics	Temporal scope
Agriculture, forestry and soils	2017, 2026 and 2041
Air quality	2017, 2026
Community	2017 and 2026
Cultural heritage	2017 and 2026
Ecology	2017 to 2025, 2026 and 2041
Electromagnetic interference	-

²⁴ Scaife, A (2012), Climate Jigsaw Puzzle, Met Office, Available at: <http://www.metoffice.gov.uk/barometer/science/2012-04/climate-jigsaw-puzzle>

²⁵ UKCIP (2009), Climate Change Briefing Report, Table 3.

²⁶ UKCIP (2009), Climate Change Projections, Section 1.4.

EIA topics	Temporal scope
Land quality	2017 and 2026
Landscape and visual assessment	2017, 2026, 2041 and 2086
Socio-economic	2017 and 2026
Sound, noise and vibration	2017, 2026 and 2041
Traffic and transport	2012, 2021 2026 and 2041
Waste and material resources	2017 to 2025 and 2026
Water resources and flood risk	2017, 2026, 2041 and 2115 (for flood risk only)

6.2.4 Some topics will not extend their overall assessments of effects associated with the Proposed Scheme through to 2041. Therefore, consideration of potential climate change impacts will relate to the construction phase only. These topics are:

- Air quality;
- Community;
- Cultural heritage;
- Electromagnetic interference;
- Socio-economic; and
- Waste.

6.2.5 This means that potential climate change impacts for these topics will only be considered for the 2020s and not the 2050s.

Technical scope

6.2.6 The potential significance of climate change impacts is greater for some topics than others due to the varying sensitivity of topic specific receptors and resources to projected changes and trends for climate variables.

6.2.7 The potential significance of climate change impacts for each of the EIA topics is contained in Table J.

Table J: EIA topics and potential significance of climate change impacts

Agriculture, forestry and soils**		Land quality*
Air quality*		Landscape and visual assessment**
Community**		Sound, noise and vibration*
Cultural heritage*		Socio-economic*
Ecology**		Traffic and transport*
Electromagnetic interference		Waste and material resources*
Water resources and flood risk**		

Key:

** Topics for which climate change impacts were considered to have the greatest potential direct significance

* Topics for which climate change impacts were considered to have less direct potential significance.

No asterisk Topics for which there was not considered to be any significant direct potential climate change impact.

6.3 Assessment methodology

Overview

- 6.3.1 All EIA Topics will undertake a preliminary consideration of potential climate change impacts to determine the requirement for, or feasibility of, undertaking a further, more detailed assessment.
- 6.3.2 This will involve the following steps and will be based upon the professional judgement of the EIA topic specialists working with the climate change adaptation topic specialists:
1. consideration of all impacts associated with the Proposed Scheme already assessed in the Draft Environmental Statement²⁷ for each topic and the associated mitigation measures for significant impacts;
 2. consideration of those assessed impacts which could potentially be affected by climate change; and
 3. consideration of whether the potential change in any of these assessed impacts as a result of climate change is likely to be significant and, as a consequence, identification of mitigation measures which enhance climate change resilience.
- 6.3.3 The results of this preliminary consideration for all topics are included in Volume 5: Appendix CT-009-000.

Legislation and guidance

- 6.3.4 Relevant European, national and local policies and guidance on climate change impacts, risks and adaptation (where they exist) are to be identified and referenced for each topic, where relevant.

Significance criteria

- 6.3.5 The significance of potential climate change impacts will be assessed qualitatively, based upon the professional judgement of topic specialists working with the climate change adaptation topic specialists.

Construction effects

- 6.3.6 The effects of the Proposed Scheme will be assessed for the construction phase, including consideration of the potential additional impacts of climate change if required and/or feasible.

Operational effects

- 6.3.7 The effects of the Proposed Scheme will be assessed for the operational phase, including consideration of the potential additional impacts of climate change if required and/or feasible.

²⁷ HS2 (2013), Draft Environmental Statement, London – West Midlands.

Mitigation measures

- 6.3.8 If any of the impacts associated with the Proposed Scheme are considered to be significantly affected by potential climate change impacts, then enhanced or additional mitigation measures (i.e. management measures that reduce the impact of the Proposed Scheme on the environment/and or community - rather than those to reduce greenhouse gas emissions) will be developed by topic specialists.
- 6.3.9 Recommended additional mitigation measures will be designed so that the measures themselves are resilient to potential additional climate change impacts.

7 Community

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
7.1.9	Paragraph deleted and replacement text provided within the SMR Addendum.
7.4.1	Paragraph deleted and replacement text provided within the SMR Addendum.
7.5.2	2 nd row in Table 7 deleted.
7.5.2	4 th row in Table 7 text amended from 'severance' to 'isolation'.
7.5.2	6 th row in Table 7 deleted
7.5.2	9 th row in Table 7 text amended from 'severance' to 'isolation'.
7.5.2	Rows ten – thirteen in Table 7 deleted.
Technical Notes – appended to this document	
Community and Socio-economics Technical Note - Further Assessment Guidance	

7.1 Introduction

Community infrastructure/organisations

- 7.1.1 *[Paragraph 7.1.9 amended to:]* The community assessment recognises the inter-relationship of community and economic effects. As well as covering direct community effects, it takes into account how economic and development impacts and effects identified by the socio-economic assessment will indirectly effect communities (the socio-economic assessment being focused on economic rather than social impacts and effects).

7.2 Scope of assessment

Spatial scope

- 7.2.1 *[Paragraph 7.4.1 amended to:]* The assessment of community effects will consider impacts and effects during both construction and operation of the Proposed Scheme. Impacts can generate the following broadly defined effects on receptors and resources:

- Loss or gain: A loss or gain to a resource or receptor. For example, a decrease in housing stock as a result of demolitions;
- Displacement: The re-location of receptors and resources from one location to another within the study area. For example, people moved from their homes to replacement homes permanently or temporarily;
- Change in amenity: The benefits of enjoyment and wellbeing that receptors gain from a resource in line with its intended function is referred to as an amenity value. The amenity value that receptors give to resources may be effected by a combination of factors such as: noise and vibration; air pollution/odours; traffic/congestion; air and water quality; and visual impacts. As such, the amenity assessment will draw on the conclusions from other assessment topics which could lead to impacts on communities; and

- Isolation: In the context of this assessment isolation is to be measured by the barriers local communities face in making their usual journeys. This includes physical, psychological and social barriers (i.e. non-economic) and the effects of this on local communities. Isolation of commercial and industrial buildings and land, and agricultural property and land, are addressed within the scope of assessments presented in Section 13 (Socio-economics) and Section 4 (Agriculture, Forestry and Soils).

8 Cultural heritage

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
Throughout	Erratum replace undesignated asset with non-designated asset - undesignated is not the correct term, the NPPF uses the phrase non-designated.
8.2.10	Revision to paragraph, Text within paragraph clarified within SMR Addendum
8.2.15	Text deleted 'ZTV' and replaced with 'study area'
8.2.16	Paragraph deleted
8.2.20	Text deleted 'ZTV' and replaced with 'study area'
8.2.21	Paragraph deleted
8.5.7	Text deleted 'as defined by the ZTV'
Technical Notes – appended to this document	
Risk based approach to archaeological assessment	
Fieldwalking	
Geophysical survey	

8.1 Establishment of baseline and definition of survey

8.1.1 *[paragraph 8.2.10 amended to:]* The definition of the study area for heritage assets will vary between the metropolitan urban and country sections of the Proposed Scheme. The study area in urban London and Birmingham will comprise the entire loss of land required for construction (including permanent and temporary works), plus 250m either side of the full extent of the required land. In rural sections, the study area will encompass the entire land required for the construction of the Proposed Scheme plus 500m either side of the full extent of the land required. In addition for the appraisal of the setting of designated heritage assets, including historic landscapes, the study area will be defined by an area of up 2km from the centre line of the Proposed Scheme for both rural and urban sections of the route. In urban sections of the route a degree of professional judgement will be required in order to determine an appropriate extent for the study area within which designated assets are to be assessed so as to ensure that the assessment remains proportionate. The setting of designated assets within the study area will be cross-referenced to the zone of theoretical visibility (ZTV) as this becomes available. The extent of the ZTV will be identified by the Landscape, and Visual Assessment within the ES.

9 Ecology

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
9.2	Supplementary text provided within SMR Addendum
9.5	Supplementary text provided within SMR Addendum after 9.5.4
9.5	Supplementary text provided within SMR Addendum after 9.5.7
9.6.1	Paragraph deleted and replacement text provided within SMR Addendum
9.6.2	Supplementary text provided within SMR Addendum
9.6.5 - 9.6.8	Paragraphs deleted within SMR Addendum and replacement text provided within SMR Addendum, with further detail in the Ecological Assessment Method Technical Note
9.6.9	Paragraph deleted and replacement text provided within SMR Addendum
9.7.1	Paragraph deleted
Technical Notes – appended to this document	
Field survey methods and standards	
Ecological assessment method	
Methodology for demonstrating no net loss in biodiversity	
Ecological principles of mitigation	

9.1 Establishment of baseline and definition of survey

- 9.1.1 *[Section 9.2 supplemented with:]* As a general rule desk study records dated prior to 1 October 1997 will be considered as historic and unlikely to provide relevant information to inform the baseline for the assessment. Different cut-off dates will be applied for the following receptors:
- habitats and higher/lower plant records - all records prior to 1 October 1986 considered as historic (a longer period than the standard due to their less mobile nature); and
 - white-clawed crayfish - all records prior to 1 October 2002 considered as historic (a shorter period than the standard due to the on-going rapid decline in numbers resulting from the spread of non-native crayfish).
- 9.1.2 Data from prior to the above dates will only be included in the ES where no more recent survey data are available, or where the data are of contextual value in relation to considering evidence of longer term species declines/advances and/or to identifying potential targets for habitat creation or species re-introductions.
- 9.1.3 Survey methodologies and basic extents for common ecological surveys required on a widespread basis across the route are provided in the Ecological surveys: field survey methods and standards (FSMS) technical not within Annex D of this SMR Addendum. The methods incorporate feedback from engagement with Natural England and the Environment Agency.
- 9.1.4 The FSMS Technical Note is not intended to cover all survey methodologies utilised. Where specific locations will require the use of additional survey methods or deviations from the methodologies identified in the FSMS these are to be reported within the relevant Community Forum Area (CFA) reports within the ES.

9.2 Scope of assessment

Geographic scope

9.2.1 *[Additional Text inserted after 9.5.4:]* Due to the large scale of the scheme and the large volumes of information to be collected in support of the assessment, The ES will report on only those resources/receptors identified as potentially relevant to the assessment. This has been defined as follows:

- all statutory designated sites located within a 500m radius of the land required for the construction of the Proposed Scheme, and any others considered potentially subject to significant effects; and
- non-statutory designated sites, protected and/or notable habitats and species within or adjacent to land required for the construction of the Proposed Scheme, and any others considered potentially subject to significant effects.

Technical scope

9.2.2 *[Additional text inserted after 9.5.7:]* In order to ensure that all likely significant effects of the Proposed Scheme will be identified, where baseline information is incomplete a precautionary approach of assuming a 'reasonable worst-case' valuation is to be adopted. This approach will be utilised to assign precautionary values to both known receptors and potential receptors based on the best available information. Further details are provided in the Ecological assessment method technical note, see Annex D of the SMR Addendum.

9.2.3 In line with Government policy, HS2 Ltd is seeking to ensure that the Proposed Scheme results in no net loss in biodiversity. A modified version of the Defra offsetting pilot methodology²⁸ will be utilised to compare the habitats present pre- and post-construction, and inform the level of compensation provision required to achieve this goal. Biodiversity offsetting will not form part of the EIA to be reported in the ES and the commitment to no net loss does not form part of the requirements under the EIA Regulations.

9.2.4 Consideration of the Proposed Scheme's compliance with Water Framework Directive objectives will be presented in a stand-alone document within the ES.

9.2.5 The potential impacts and effects of climate change on ecological receptors, alongside the effects of HS2 on the ability of habitats and species in the wider landscape to respond to climate change will be considered, primarily as part of the route-wide assessment in Volume 3 of the ES.

9.3 Assessment methodology

9.3.1 *[Paragraph 9.6.1 amended to]* The assessment is to be guided by the methodology advocated by the Institute of Ecology and Environmental Management (IEEM). Full details of the assessment methodology are provided in the Ecological assessment method technical note in Annex D of the SMR Addendum.

²⁸ Defra (2012), *Biodiversity Offsetting Pilots – The metric for the biodiversity offsetting pilot in England*, Defra.

Legislation

- 9.3.2 *[Paragraph 9.6.2 supplemented with:]*
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003²⁹; and
 - Salmon and Freshwater Fisheries Act, 1975 (as amended).³⁰

Significance criteria

- 9.3.3 *[Paragraphs 9.6.5 to 9.6.8 deleted and replaced by:]* Further details of the significance criteria used for the assessment are provided within the Ecological assessment method technical note in Annex D of the SMR Addendum.
- 9.3.4 *[Paragraph 9.6.9 amended to:]* Each potential ecological receptor will be evaluated against the following geographical frames of reference: international; national; regional; county/metropolitan; district/borough; local/parish; and negligible. The standard geographical frames of reference of 'site' and 'within zone of influence' will not be utilised as they are not considered appropriate for a linear scheme of this scale.

Determining the significance of effects

- 9.3.5 *[Section 9.6 supplemented with:]* Details of the process for determining significance of effects is provided within ecological assessment method technical note.

²⁹ HM Government (2003), *Statutory Instrument 2003 No. 3242 The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003*, The Stationery Office.

³⁰ HM Government (1975) *Salmon and Freshwater Fisheries Act, 1975*, Chapter 51. Her Majesty's Stationery Office.

10 Electromagnetic interference

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
10.1.1	Paragraph deleted and replacement text provided within SMR Addendum
10.1.4	Paragraph deleted and replacement text provided within SMR Addendum
10.1.6	Paragraph deleted and replacement text provided within SMR Addendum
10.1.7 Footnote	Text deleted and replacement text provided within SMR Addendum
10.2.4	Text deleted and replacement text provided within SMR Addendum
10.2.6	Text deleted and replacement text provided within SMR Addendum
'consultation as part of the EIA process'	Heading deleted (above paragraph 10.3.2)
10.3.2	Paragraph deleted
10.4.2	Text deleted and replacement text provided within SMR Addendum
10.5.1	Text deleted and replacement text provided within SMR Addendum
10.5.2	Text deleted and replacement text provided within SMR Addendum
10.5.4	Text deleted and replacement text provided within SMR Addendum
10.5.5	Text deleted and replacement text provided within SMR Addendum
10.6.1	Text deleted and replacement text provided within SMR Addendum
'EMC Zones'	Heading deleted (above paragraph 10.6.2)
10.6.2	Text deleted and replacement text provided within SMR Addendum
10.6.3	Text deleted and replacement text provided within SMR Addendum
10.6.4	Text deleted and replacement text provided within SMR Addendum
10.6.5	Paragraph deleted
10.6.6	Paragraph deleted
10.6.7	Paragraph deleted
10.6.8	Text deleted and replacement text provided within SMR Addendum
10.6.9	Paragraph deleted
10.6.10	Text deleted and replacement text provided within SMR Addendum
10.6.11	Text deleted and replacement text provided within SMR Addendum
10.6.12	Text deleted and replacement text provided within SMR Addendum
10.6.13	Text deleted and replacement text provided within SMR Addendum

Technical Notes – appended to this document

Electromagnetic interference

10.1.1 The majority of the amendments to the SMR for Electromagnetic Interference (EMI) reflect the change in emphasis from Electromagnetic Compatibility (EMC), which is the method of mitigating against electrical interference, to the assessment of the effects of electromagnetic fields (EMF) (which cause EMI and potential human health problems).

10.2 Introduction

10.2.1 *[Paragraph 10.1.1 amended to:]* This section of the Report covers the impacts and effects of the Proposed Scheme on Electromagnetic Fields (EMF), and

Electromagnetic Interference (EMI), including Electro Magnetic Compatibility (EMC). EMF is produced whenever electricity is present.

- 10.2.2 *[Paragraph 10.1.4 amended to:]* The principal source of EMF from the Proposed Scheme that may have an effect on third parties will be the traction power supply system. Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system. In addition, equipment located within the infrastructure maintenance depot and the stations/interchanges such as lifts and escalators and other large items of plant, do not produce levels of EMF that will have an effect outside of the operational railway.
- 10.2.3 *[Paragraph 10.1.6 amended to:]* EMI is an issue that can normally be mitigated through the application of EMC industry accepted practice during design and installation.
- 10.2.4 *[10.1.7 Footnote amended to:]*⁸⁹ ICNIRP (2010) 'Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (1Hz to 100kHz)', Health Physics, 99 (6): pp. 818-836

10.3 Establishment of baseline and definition of survey

- 10.3.1 *[Paragraph 10.2.4 amended to:]* British and European Standards exist to mitigate the effects of EMI on neighbouring railways, which will be adopted through design, installation, operation and maintenance best practice. HS2 Ltd will consult with other infrastructure owners during the design period.
- 10.3.2 *[Paragraph 10.2.6 amended to:]* EMI from the Proposed Scheme's rolling stock will only affect the operational railway.
- 10.3.3 *[Supplementary text provided after 10.2.6:]* A desk top assessment will be undertaken to identify potential receptors at risk. Examples of potential sensitive sites that may be at risk and are to be considered are:
- universities;
 - schools;
 - hospitals;
 - military establishments;
 - airports;
 - emergency and commercial radio stations;
 - residential properties; and
 - industrial properties.

10.4 Key aspects of the Proposed Scheme for the topic

- 10.4.1 *[Paragraph 10.4.2 amended to:]* The main source of EMF will be the traction power system, as electromagnetic emissions are caused by the current flowing in an electrical system.

10.4.2 The higher currents found in high voltage power lines have the potential to create larger EMF, the strength of which diminish rapidly with distance from the source.

10.5 Scope of assessment

10.5.1 *[Paragraph 10.5.1 amended to:]* A desk study will be undertaken to identify potential sources of EMF and EMI that may be produced during both the construction and operational phases of the Proposed Scheme. This will identify the potential risk and the potential impact and effect. The desk-based study will also identify establishments where people are potentially at risk from the electromagnetic fields produced by the Proposed Scheme's 25 kilovolts (kV) electrification traction power.

10.5.2 *[Paragraph 10.5.2 amended to:]* The study will identify potentially sensitive receptor sites within a 50m corridor either side of the centreline of the nearest track within the Proposed Scheme, or from proposed power equipment (e.g. overhead lines and traction substations)

10.5.3 *[Paragraph 10.5.4 amended to:]* A risk assessment will be undertaken to assess the impact of EMF effects on nearby equipment, installations and people.

10.5.4 *[Paragraph 10.5.5 amended to:]* The assessment will use data from the preliminary traction power modelling completed by HS2, in undertaking the evaluation.

10.6 Assessment methodology

10.6.1 *[Paragraph 10.6.1 amended to:]* The following standards are relevant:

- ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (1Hz to 100kHz 2010);
- The Electromagnetic Compatibility Directive 2004/108/EC;
- BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments;
- BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments;
- BS EN 50499:2008. Procedure for the assessment of the exposure of workers to electromagnetic fields;
- EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz);
- EU Directive 2006/42/EC on machinery;
- BS EN 50121 series of standards, Railway Applications, Electromagnetic Compatibility, which contains the following parts;
 - BS EN 50121-1:2006 Part 1: General;
 - BS EN 50121-2:2006 Part 2: Emissions of the whole railway system to the outside world;

- BS EN 50121-3-1:2006 Part 3-1: Rolling stock - train and complete vehicle;
- BS EN 50121-3-2:2006 Part 3-2: Rolling stock – apparatus;
- BS EN 50121-4:2006 Part 4: Emissions and immunity of the signalling and telecommunications apparatus;
- BS EN 50121-5:2006 Part 5: Emissions and immunity of fixed power supply installations and apparatus.
- BS EN 50122 series of standards, Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit, which consists of;
 - BS EN 50122-1:2011 Part 1: Protective provisions against electric shock;
 - BS EN 50122-2:2010 Part 2: Provisions against the effects of stray currents caused by d.c. traction systems;
 - BS EN 50122-3:2010 Part 3: Mutual Interaction of a.c. and d.c. traction systems.

10.6.2 *[Paragraph 10.6.2 amended to:]* Using the estimated levels of generated EMF from the preliminary traction power modelling results, the levels of predicted EMF will be assessed against the maximum levels mandated by British and European Standards and ICNIRP.

10.6.3 *[Paragraph 10.6.3 amended to:]* For the effects of EMF on human health, any level above 200 microTesla (μT) stated within ICNIRP will be considered as significant.

10.6.4 *[Paragraph 10.6.4 amended to:]* For the effects of EMI on susceptible electrical or electronic equipment, where the level exceeds 3 Amperes per metre (A/m) for residential and 30A/m for industrial equipment, this will be regarded as significant. These levels are the current limits identified in BS EN 61000-6-1 and BS EN 61000-6-2 respectively.

10.6.5 *[Paragraph 10.6.8 amended to:]* Where risk is identified, proposals for mitigation will be recommended.

10.6.6 *[Paragraph 10.6.10 amended to:]* The effects of construction will be evaluated and mitigation measures implemented if required. Ongoing measurements and monitoring will be considered during construction, where significant risks are identified.

10.6.7 *[Paragraph 10.6.11 amended to:]* The effects of operation will be evaluated and mitigation measures implemented if required.

10.6.8 *[Paragraph 10.6.12 amended to:]* Any cumulative effect due to the Proposed Scheme running close to an existing electrified railway, for example, will be included in the assessment

10.6.9 *[Paragraph 10.6.13 amended to:]* The traction power modelling, the results from which the assessment will be made, will be developed using the worst case traction loads for the proposed timetable. Any effects of EMF and EMI will therefore be considered using the worst case loads.

11 Land quality

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
11.2	Supplementary text provided within SMR Addendum
11.2.3	Text deleted and replacement text provided within SMR Addendum
11.4.5	Text 'Mining issues.....areas in the Midlands' deleted.
11.6.8	Text within paragraph clarified within SMR Addendum
Table 15	Text within table clarified within SMR Addendum
11.6.13	Text within paragraph clarified within SMR Addendum
Table 16	Text within table clarified within SMR Addendum
Technical Notes – appended to this document	
Introduction to land quality assessments	
Detailed methodology for land contamination assessments	
Methodology and significance criteria for geological issues (excluding land contamination)	
Operational issues	
Potential mitigation measures	

11.1 Establishment of baseline and definition of survey

- 11.1.1 *[Section 11.2 supplemented with:]* The technical note 'Introduction to land quality assessments' gives more details of the sources and types of information to be collected – refer to Annex F of the SMR Addendum.
- 11.1.2 *[Section 11.2 supplemented with:]* The issue of the effects of underground mining on the construction of the Proposed Scheme will not be assessed during the environmental assessment. It is however being considered as part of the engineering design of the route.
- 11.1.3 *[Paragraph 11.2.3 amended to:]* Documentary data are available from a number of Governmental and non-governmental organisations including:
- Environment Agency;
 - British Geological Survey; and
 - county councils and district councils.

11.2 Assessment methodology

Significance criteria

- 11.2.1 *[Paragraph 11.6.8 and Table 15 clarified with:]* Impact magnitude criteria are presented separately for contaminated land, mining/mineral issues and for geo-conservation resources. These are provided in the technical notes - 'Detailed methodology for land contamination assessments' and 'Methodology and significance criteria for geological issues (excluding land contamination)' in Annex F of this SMR Addendum.
- 11.2.2 *[Paragraph 11.6.13 and Table 16 clarified with:]* Significance of effects criteria are presented separately for contaminated land, mining/mineral issues and for geo-

conservation resources. These are provided in - 'Detailed methodology for land contamination assessments' and 'Methodology and significance criteria for geological issues (excluding land contamination)' in Annex F of the SMR Addendum.

- 11.2.3 *[Section 11.6 supplemented with:]* A screening system will be utilised to identify sites which may pose a contaminative risk for the Proposed Scheme, and a revised methodology developed to determine the significance of such sites in the context of the construction of the Proposed Scheme. Further details on the developed methodology are contained within 'Detailed methodology for land contamination assessments' in Annex F of the SMR Addendum.

12 Landscape and visual assessment

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
12.1.1	Supplementary text provided within SMR Addendum.
12.1.3	Paragraph deleted and replacement text provided within SMR Addendum.
12.2.4	Paragraph deleted and replacement text provided within SMR Addendum.
12.2.7	Supplementary text provided within SMR Addendum
12.2.12	Supplementary text provided within SMR Addendum.
Table 19	Table deleted and replacement provided within SMR Addendum.
12.5.3	Supplementary text provided within SMR Addendum.
12.5.5	Supplementary text provided within SMR Addendum.
12.6.12	Supplementary text provided within SMR Addendum.
12.7.2	Paragraph deleted and replacement text provided within SMR Addendum.
Table 20	Table deleted and replacement provided within SMR Addendum
Table 22	Table deleted and replacement provided within SMR Addendum.
Technical Notes – appended to this document	
Approach to tranquillity assessment	
Zone of theoretical visibility production methodology	
Approach to verifiable photomontages	

12.1 Introduction

12.1.1 *[Paragraph 12.1.1 supplemented with:]* The definition of landscape is 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (European Landscape Convention – Council of Europe³¹, 2000).

12.1.2 *[Paragraph 12.1.3 replaced with:]* For this assessment, the term 'landscape' encompasses all types and forms of open space and development in the countryside, villages, towns and cities. This is to avoid the use of interchangeable terms (such as townscape) which may cause confusion, therefore the term 'landscape' has been consistently used throughout.

12.2 Establishment of baseline and definition of survey

12.2.1 *[Paragraph 12.2.4 amended to:]* The landscape and visual surveys will be carried out by Chartered Landscape Architects experienced in EIA. Assessments made will be verified by at least two other Chartered Landscaped Architects experienced in EIA. Survey work will be carried out in both the summer and winter, in order for seasonal change to be considered in the assessment. The survey work will be undertaken in a methodical order as follows:

- verification of the zone of theoretical visibility (ZTV) i.e. the study area [see Section 12.5 (Scope of assessment - Spatial Scope)];

³¹ Council of Europe, 20/10/2000 Florence, European Landscape Convention CETS No.: 176.

- definition of the landscape character areas (see paragraphs 12.2.7 and 12.2.8);
- assessment of the condition, tranquillity and value of each of the character areas (see paragraphs 12.2.9 to 12.2.12);
- establishment of the sensitivity of each of the character areas (see paragraph 12.2.14);
- definition of viewpoints representative of groups of visual receptors within the ZTV (see paragraph 12.2.15);
- definition of the type and nature of the view from each viewpoint (see paragraph 12.2.17); and
- determination of the magnitude of change for each character area (see paragraph 12.6.2) and visual receptor (see paragraph 12.6.9).

12.2.2 *[Paragraph 12.2.7 supplemented with:]* The character area boundaries will follow natural changes in the landscape rather than political or administrative boundaries.

12.2.3 *[Paragraph 12.2.12 supplemented with:]* Further detail on how the level of tranquillity is determined for individual landscape character areas in urban and rural areas is provided in the Approach to tranquillity assessment technical note (see Annex G of the SMR Addendum).

12.2.4 *[Table 19 amended to:]*

Table 19: Visual sensitivity

Sensitivity	Level of interaction with the landscape
High	Occupiers of residential properties Recreational users or tourists whose attention may be focussed on the landscape Designated or protected views
Medium	People travelling along scenic roads through the landscape People staying in hotels and healthcare institutions People walking along residential streets
Low	People at work and in educational institutions People engaged in formal sports activities People walking through urban areas (for example commuters) People travelling on main roads through the landscape

12.3 Scope of assessment

Spatial scope

12.3.1 *[Paragraph 12.5.3 supplemented with:]*

- Operation year 15 – defined as the area over which the components of the Proposed Scheme (including trains) will be visible taking into account the screening effect new planting established as part of the Proposed Scheme may have in summer after 15 years of growth.

12.3.2 *[Paragraph 12.5.5 supplemented with:]* The detailed methodology for producing the ZTV is described in the Zone of theoretical visibility production methodology technical note (see Annex G of the SMR Addendum).

12.4 Assessment methodology

Visual assessment methodology

12.4.1 *[Table 20 amended to:]*

Table 20: Landscape magnitude of change

Impact magnitude	Definition
High	Total loss or substantial alteration to key characteristics of the character and/or setting of the character area Addition of new features or components that substantially alter the character and/or setting of the character area Introduction of elements that markedly alter the tranquillity of the character area
Medium	Noticeable change or alteration to one or more key characteristics of the character and/or setting of the character area Addition of new features or components that form prominent elements of the character and/or setting of the character area, but are largely characteristic of the existing setting Introduction of elements that noticeably alter the tranquillity of the character area
Low	Slight loss or alteration to one or more characteristics of the character and/or setting of the character area Addition of new features or components that form largely inconspicuous elements of the existing character and/or setting Introduction of elements that discernibly alter the tranquillity of the character area
Negligible	No change to, or barely perceptible loss or alteration of inconspicuous characteristics of the character and/or setting of the character area Addition of new features or components that do not influence the overall character and/or setting of the character area, or are entirely characteristic of the existing setting Introduction of elements that make no perceptible change to the tranquillity of the character area

12.4.2 *[Table 22 amended to:]*

Table 22: Visual magnitude of change

Impact magnitude	Definition
High	Total loss or substantial alteration to key characteristics of the view from a receptor Addition of new features or components that are continuously highly visible and incongruous with the existing view from a receptor Substantial changes in close proximity to the visual receptor, within the direct frame of view
Medium	Noticeable change or alteration to one or more key characteristics of the view from a receptor Addition of new features or components that may be continuously highly visible, but are largely characteristic of the existing view from a receptor Changes a relatively short distance from the receptor, but viewed as one of a series of components in the middle ground of the view Substantial change partially filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor
Low	Slight loss or alteration to one or more characteristics of the view from a receptor Addition of new features or landscape components that may be continuously or intermittently visible, but are largely characteristic of the existing view from a receptor Changes within the background of the view, viewed as one of a series of components in the wider panoramic view from a receptor Change largely filtered by intervening vegetation and/or built form, or viewed obliquely from the visual

Impact magnitude	Definition
	receptor
Negligible	<p>No change to, or barely perceptible loss or alteration of inconspicuous characteristics of the view from a receptor.</p> <p>Addition of new features or landscape components that are largely inconspicuous and characteristic of the existing site when viewed from a receptor</p> <p>Changes within the background of the view, viewed as an inconspicuous element within the wider panoramic view from a receptor</p> <p>Change from a visual receptor almost entirely obscured by intervening vegetation and/or built form</p>

Verifiable photomontage methodology

- 12.4.3 *[Paragraph 12.6.12 supplemented with:]* The detailed methodology for producing the verifiable photomontages is described in the 'Approach to verifiable photomontages' technical note (see Annex G of the SMR Addendum).

13 Socio-economics

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
13.1.2	Paragraph deleted
13.1.3	Paragraph deleted and replacement text provided within SMR Addendum.
13.4.1	Paragraph deleted and replacement text provided within SMR Addendum.
13.5.1(Table 24)	Third row in Table 24 deleted
13.5.2	Paragraph deleted and replacement text provided within SMR Addendum.
13.6.13	Paragraph deleted and replacement text provided within SMR Addendum.

Technical Notes – appended to this document

It is to be noted that for the purpose of the Technical notes, the topic areas of community and socio-economics have been combined, and are contained within Annex B.

13.1 Introduction

13.1.1 *(Paragraph 13.1.3 amended to:)* The assessment will also complement the wider business case for HS2, focusing on the identifiable implications for jobs, skills and development, particularly along the route of the Proposed Scheme and elsewhere (e.g. relevant locations on the WCML). The assessment is distinguished from the wider business case in that it will identify direct and significant impacts on local economies. The wider business case is related to, but differs from, the socio-economic assessment in that it predicts overall benefits to the output of the national economy. Benefits to the national economy arise through the circulation of monies over a wide area, which may not have directly observable or significant consequences in the context of EIA.

13.2 Key aspects of the Proposed Scheme for the topic

13.2.1 *(Paragraph 13.4.1 amended to:)* Relevant aspects of the Proposed Scheme include:

- direct and indirect effects of construction and operation;
- Demand for labour, particularly during construction, including labour skills and sources;
- Relocation of businesses during construction, e.g. for development of new stations/interchanges;
- Indirect effects on businesses and labour markets served by the existing WCML and any other lines affected by the Proposed Scheme;
- The economic and land use effects of changes in accessibility; and
- Wider catalytic effects and city regeneration.

13.3 Scope of assessment

Temporal scope

- 13.3.1 *(Paragraph 13.5.2 amended to:)* The temporal scope is outlined in Section 2.2 (Scope of assessment). Socio-economic impacts will generally be assessed for the construction period (2018-26) and first year of operation.

13.4 Assessment methodology

Cumulative effects

- 13.4.1 *(Paragraph 13.6.13 amended to:)* Cumulative effects will be identified on the basis of a high level assessment of other developments individually or cumulatively in the planning pipeline that have the potential to interact significantly with the Proposed Scheme. Other developments will include major infrastructure projects and large scale urban development (e.g. extensions to urban areas). The known characteristics of such developments will be converted into an employment effect using productivity assumptions and identified in relation to the Proposed Scheme's own timeline.

14 Sound, noise and vibration

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
14.2.2	Paragraph deleted and replacement text provided within SMR Addendum
14.2	Supplementary text provided as new paragraph after 14.2.2 within SMR Addendum
14.2.7	Paragraph deleted and replacement text provided within SMR Addendum
14.2.13	Paragraph deleted and replacement text provided within SMR Addendum
Table 29	Table deleted and replacement provided within SMR Addendum
14.2	Supplementary text provided as new paragraph after 14.2.22 within SMR Addendum
14.2	Supplementary text provided as new paragraph after 14.2.18 within SMR Addendum.
14.2	New heading 'Impact criteria' inserted after 14.2.20
14.2	Supplementary text provided as new paragraph after 14.2.20 within SMR Addendum
14.2.23	Paragraph deleted and replacement text provided within SMR Addendum
14.2.24	Paragraph deleted and replacement text provided within SMR Addendum
14.2	New heading 'Impact criteria – indirect effects' inserted after 14.2.27
14.2	Supplementary text provided as new paragraph after 14.2.27 within SMR Addendum
14.2.32	Paragraph deleted and replacement text provided within SMR Addendum
14.3.6	Paragraph deleted and replacement text provided within SMR Addendum
14.3.14	Paragraph deleted and replacement text provided within SMR Addendum
14.3.15	Paragraph deleted and replacement text provided within SMR Addendum
14.3	Supplementary text provided as new paragraph after 14.3.17 within SMR Addendum
14.3.19	Paragraph deleted and replacement text provided within SMR Addendum
14.3	New heading 'Impact Criteria- Direct Impacts' inserted after 14.3.23
14.3	Supplementary text provided as new paragraph after 14.3.23 within SMR Addendum
14.3.25	Paragraph deleted and replacement text provided within SMR Addendum
14.3.26	Paragraph deleted and replacement text provided within SMR Addendum
14.3	New heading 'Impact criteria- indirect impacts' inserted after Table 34
14.3	Supplementary text provided as new paragraph after Table 34 within SMR Addendum
14.3	Supplementary text provided as new paragraph after 14.3.26 within SMR Addendum
14.3	Additional sub-sub-section heading inserted after 14.3.30: Significance Criteria
14.3.34	Paragraph deleted and replacement text provided within SMR Addendum
14.3.35	Paragraph deleted and replacement text provided within SMR Addendum

14.1 Ground-borne Sound and Vibration

Introduction

- 14.1.1 *[Paragraph 14.2.2 amended to:]* Without mitigation, ground-borne vibration created by either construction activities or train services can propagate through the ground to surrounding buildings where it may result in the vibration of floors, walls and ceilings; and which could also be heard as a low frequency 'rumbling' sound (called ground-borne sound).

Ground-borne vibration

- 14.1.2 *[Paragraph 14.2.7 amended to:]* The exceptions are receptors close to existing rail sources. Baseline vibration will be calculated, as required, in these locations and verified by focused surveys.

Key aspects of the Proposed Scheme for the topic

- 14.1.3 *[Paragraph 14.2.13 amended to:]* 'Best practicable means' will be used to control and mitigate temporary construction noise and vibration effects consistent with legislation and best practice. 'Best practicable means' will include consideration of working methods, working hours, selection of plant, logistical planning and proactive community engagement. The framework for determining such mitigation on a site-by-site basis will be set out in the Code of Construction Practice.
- 14.1.4 *[Supplementary text provided as a new paragraph after 14.2.18:]* Relevant policy includes the NPPF, the Noise Policy Statement for England 2010 and the Government's emerging planning guidance³² on noise (NPPG).

Assessment methodology

- 14.1.5 *[Table 29 amended to:]*

Table 29: Ground-borne sound impact criteria for non-residential receptors

Category of Building	Impact criterion dB L _{pAS,max} (Measured inside the noise sensitive part of the receptor)
Theatres / large auditoria and concert halls	25
Sound recording / broadcast studios	30
Places of meeting for religious worship / courts / cinemas lecture theatres / museums / small auditoria or halls	35
Offices / schools / colleges / hospitals / hotels / libraries	40

Impact Criteria – Direct Impacts

- 14.1.6 *[Supplementary text provided as a new paragraph after 14.2.20]* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor

Ground-borne vibration: buildings - construction and operation

- 14.1.7 *[Supplementary text provided as a new paragraph after 14.2.22:]* Vibration from the operation of the permanent railway and all construction will be assessed in terms of the potential impact on buildings using the criteria presented in Table 30.
- 14.1.8 *[Paragraph 14.2.23 amended to:]* Guidance on the impact and effect of vibration on people in buildings is presented in BS6472: 2008.³³ Part 1 of the standard assesses the impact of vibration using the Vibration Dose Value (VDV). This is an indicator taking

³² Emerging National Planning Practice Guidance – Noise: <http://planningguidance.planningportal.gov.uk>

³³ British Standards Institute (BSI), 2008, 6472 *Guide to evaluation of human exposure to vibration in buildings Parts 1 and 2*, BSi.

into account how people respond to vibration in terms of frequency content, vibration magnitude and the number of vibration events during an assessment period.

Ground-borne vibration: disturbance of occupants and users of buildings - construction and operation

- 14.1.9 *[Paragraph 14.2.24 amended to:]* Vibration from the operation of the permanent railway and all construction will be assessed in terms of the potential impacts and adverse effects due to disturbance of occupants and users of buildings using the criteria presented in Table 31.

Impact Criteria – Indirect Impacts

- 14.1.10 *(Supplementary text provided as a new paragraph after 14.2.27:)* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor

Cumulative effects

- 14.1.11 *[Paragraph 14.2.32 amended to:]* Community, ecological or heritage adverse effects arising from impacts and effects identified for ground-borne noise and vibration will be considered and reported in the relevant sections of the ES.

14.2 Airborne sound

Establishment of baseline and definition of survey

- 14.2.1 *[Paragraph 14.3.6 amended to:]* Initially, existing data will be gathered to form the 'desk top' baseline (Baseline 1). Baseline 1 data will be used early in the programme to support initial dialogue, assessment work and design development. Initial field surveys will be undertaken during the summer of 2012 to fill gaps in Baseline 1 data and provide more detailed information at locations where significant effects are likely. Combined with Baseline 1, these data will form Baseline 2, to be used for the draft ES. Further, more targeted surveys will be undertaken in early 2013, responding to the findings of the draft ES assessments and ongoing stakeholder dialogue. Combined with Baseline 2, these data will provide Baseline 3 and 4 for the ES.

Scope of assessment

- 14.2.2 *[Paragraph 14.3.14 amended to:]* Temporal scope - the Proposed Scheme will be assessed, as necessary, in the short term at the year of opening; and in the long-term with the highest rail traffic patterns forecast for the first 15 years of operation. These will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

Assessment methodology

Legislation and Guidance

- 14.2.3 *[Paragraph 14.3.17 amended to:]* Relevant legislation includes the Control of Pollution Act 1974, the Environmental Protection Act 1990, the Noise and Statutory Nuisance

Act 1993, the Land Compensation Act 1973 (including the Noise Insulation Regulations) and the European Communities Act 1972 (including the Environmental Noise (England) Regulations 2006) (all as amended).

14.2.4 [Supplementary text provided as a new paragraph after 14.3.17:] Relevant policy includes the NPPF, the Noise Policy Statement for England 2010 and the Government's emerging NPPG.

14.2.5 [Paragraph 14.3.19 amended to:] The airborne sound generated by construction activities will be calculated in line with the method set out in BS5228-1.

Impact criteria - direct impacts

14.2.6 [Supplementary text provided as a new paragraph after 14.3.23] The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor.

Airborne sound – (road or rail)

14.2.7 [Paragraph 14.3.25 amended to:] During the day (0700-2300), an operational noise adverse or beneficial effect on a receptor will be identified where the impact of the Proposed Scheme is:

- An absolute free-field sound level at or above 50 dB $L_{pAeq,16hr}$ and
- Where the magnitude of the impact and its effect on a receptor is indicated by the change in the equivalent continuous sound level as defined in Table 33.

14.2.8 During the day (0700-2300), an operational noise significant adverse effect on residential receptors will be identified where the impact of the Proposed Scheme is:

An absolute free-field sound level at or above 65 dB $L_{pAeq,16hr}$.

14.2.9 [Paragraph 14.3.26 amended to:] During the night (2300-0700), an operational noise adverse or beneficial effect on a receptor will be identified where the impact of the Proposed Scheme is:

- An absolute free-field sound level at or above 40 dB $L_{pAeq,8hr}$ and
- Where the magnitude of the impact and its effect on a receptor is indicated by the change in the equivalent continuous sound level as defined in Table 33.

14.2.10 During the night (2300-0700), an operational noise significant adverse effect will be identified on residential receptors where the impact of the Proposed Scheme is:

An absolute free-field sound level at or above 55 dB $L_{pAeq,8hr}$ or

- An absolute sound level above 85 dB L_{pAFmax} at the façade (outside) of a residential receptor (where the number of events exceeding this value is less than or equal to 20); or

- An absolute sound level above 80 dB L_{pAFmax} at the façade (outside) of a residential receptor (where the number of events exceeding this value is greater than 20).

14.2.11 *[Supplementary text provided as a new paragraph after 14.3.26:]* By exception, impacts and resulting adverse or beneficial effects may also be identified following consideration of any unique features of the sound impact from the Proposed Scheme and/or the character of the existing soundscape.

Impact criteria - indirect impacts

14.2.12 *[Supplementary text provided as a new paragraph after Table 34:]* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor.

14.2.13 *[Additional sub-sub-section heading inserted after 14.3.30:]* **Significance Criteria**

Cumulative and Combined Effects

14.2.14 *[Paragraph 14.3.34 amended to:]* Community, ecological, landscape/visual (including tranquillity) or heritage effects arising from impacts and effects identified for airborne sound will be considered and reported in the relevant section of the ES.

14.2.15 *[Paragraph 14.3.35 amended to:]* Secondary effects (e.g. on landscape) associated with mitigation (e.g. noise barriers) proposed to reduce or remove significant airborne sound effects will be considered under the relevant section of the ES.

15 Traffic and transport

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
Paragraph 15.6.9	Supplementary text provided within SMR Addendum.
Paragraph 15.6.11	Supplementary text provided within SMR Addendum.
Paragraph 15.6.12 and Table 35	Text deleted and replacement text provided within SMR Addendum
Paragraph 15.6.22	Supplementary text provided within SMR Addendum.
Paragraph 15.6.28 and Table 37	Table deleted and replacement text provided within SMR Addendum
Technical Notes – appended to this document	
Guidance on further development of significance criteria	

15.1 Assessment methodology

Significance criteria

- 15.1.1 *[Paragraph 15.6.9 supplemented with:]* Effects that are of duration less than four consecutive weeks in any 12 month period will be assessed as being not significant.
- 15.1.2 *[Paragraph 15.6.11 supplemented with:]* Effects that are of duration less than four consecutive weeks in any 12 month period will be assessed as being not significant.
- 15.1.3 *[Paragraph 15.6.12 amended to:]* The changes in journey times will be defined in proportion to the scale of the impacts being assessed, for example: as not significant (less than one minute); minor (between one and two minutes); moderate (between two and three minutes) and major (greater than three minutes); and the numbers of travellers affected as: minor (less than 200 in total per day); moderate (between 200 and 1,000 per day) and major (greater than 1,000 per day). The significance of the impacts are based on the matrix shown in Table 35, where beneficial impacts occur if journey times are reduced or adverse impacts if journey times are increased.
- 15.1.4 *[Table 35 amended to:]*

Table 35: Significance levels for travellers affected by delay during construction

Number of travellers affected	Journey time changes		
	Minor	Moderate	Major
Minor	Neutral	Neutral	Minor
Moderate	Neutral	Minor	Moderate
Major	Minor	Moderate	Major

- 15.1.5 *[Paragraph 15.6.22 supplemented with:]* Effects that are of duration less than four consecutive weeks in any 12 month period will be assessed as being not significant.
- 15.1.6 *[Paragraph 15.6.28 amended to:]* Table 37 provides guidance on how the categories are combined to estimate the numbers of people likely to be affected by changes in severance.
- 15.1.7 *[Table 37 amended to:]*

Table 37: Assessment of Change in Severance Scoring

Numbers of travellers affected	Change in severance scoring with the Proposed Scheme			
	Not significant	Minor	Moderate	Major
negligible numbers	Not significant	Minor	Moderate	Major
Minor numbers	Not significant	Minor	Minor	Minor*/Moderate**
Moderate numbers	Not significant	Minor	Moderate	Major
Major numbers	Not significant	Minor	Major	Major

Notes: * duration between four weeks and four months; and

** duration four months or more

15.1.8 Further information is provided within the technical note - Guidance on further development of significance criteria (see Annex I of the SMR Addendum) which discusses:

- determining the magnitude of impacts;
- determining receptor sensitivity; and,
- the classification of construction and operational effects as being of minor, moderate or major significance.

16 Waste and material resources

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
16.1.1	Paragraph deleted and replacement text provided within SMR Addendum
16.1.4	Paragraph deleted and replacement text provided within SMR Addendum
16.1.9	Paragraph deleted and replacement text provided within SMR Addendum.
16.1	Supplementary text provided as new paragraph after 16.1.9 within SMR Addendum to clarify scope of assessment.
16.2.2	Paragraph deleted and replacement text provided within SMR Addendum.
16.2.7	Paragraph deleted and replacement text provided within SMR Addendum
16.2.8	Paragraph deleted as no longer relevant to scope and methodology
16.5.1	Paragraph deleted and replacement text provided within SMR Addendum
16.5	Supplementary text provided as new paragraph after 16.5.1 within SMR Addendum to clarify spatial scope.
16.5	Supplementary text provided as new paragraph after 16.5.1 within SMR Addendum to clarify temporal scope.
16.5.2	Paragraph deleted and replacement text provided within SMR Addendum
16.5.6	Paragraph deleted and replacement text provided within SMR Addendum
16.6.1	Paragraph deleted and replacement text provided within SMR Addendum
16.6.2	Paragraph deleted and replacement text provided within SMR Addendum
16.6.4	Paragraph deleted and replacement text provided within SMR Addendum
16.6.4 to 16.6.5	Details of relevant legislation added as supplementary paragraphs between 16.6.4 and 16.6.5.
16.6.5	Paragraph deleted and replacement text provided within SMR Addendum
16.6.8	Paragraph deleted and replacement text provided within SMR Addendum
16.6.10	Paragraph deleted and replacement text provided within SMR Addendum
16.6	Supplementary text provided as new paragraph after 16.6.10 within SMR Addendum to provide reference to Technical Note.
Table 38	Table deleted
Table 39	Table deleted
16.6.11	Paragraph deleted and replacement text provided within SMR Addendum
16.6.12	Paragraph deleted and replacement text provided within SMR Addendum.
16.6	Supplementary text provided as new paragraph after 16.6.12 within SMR Addendum to provide reference to Technical Notes.
16.6.13	Paragraph deleted and replacement text provided within SMR Addendum
16.6	Supplementary text provided as new paragraph after 16.6.13 within SMR Addendum to provide reference to Technical Note.
16.7.3	Paragraph deleted.
Technical Notes – appended to this document	
Rationale for landfill significance criteria	
Waste forecast and assessment methodology	

16.1 Introduction

- 16.1.1 *[Paragraph 16.1.1 amended to:]* This section of the report describes the scope and methodology that will be used to assess the likely significant environmental effects associated with the generation and management of solid waste during the construction and operational phases of the Proposed Scheme.
- 16.1.2 *[Paragraph 16.1.4 amended to:]* The likely significant environmental effects from the use of materials (e.g. aggregate, concrete, brick and steel) for the construction of the Proposed Scheme will not be addressed in the EIA.
- 16.1.3 *[Paragraph 16.1.9 deleted and replacement text provided:]* The following types of waste to be generated by construction of the Proposed Scheme will be considered in the assessment:
- excavation wastes;
 - demolition wastes;
 - construction wastes; and
 - worker accommodation site waste.
- 16.1.4 *[Section 16.1 – additional text inserted as new paragraph after 16.1.9:]* The following types of waste to be generated by operation of the Proposed Scheme will be considered in the assessment:
- railway station and train waste;
 - rolling stock maintenance waste;
 - track maintenance waste; and
 - ancillary infrastructure waste.

16.2 Establishment of baseline and definition of survey

- 16.2.1 *[Paragraph 16.2.2 amended to:]* A baseline will be developed for waste and material resources as part of the EIA. Baseline conditions will be identified with respect to:
- types, quantities and management of construction, demolition and excavation waste arisings generated in England and within each of the county and former regional planning jurisdictions through which the route of the Proposed Scheme will pass;
 - types, quantities and management of commercial and industrial waste generated in England and within each of the county and former regional planning jurisdictions through which the route of the Proposed Scheme will pass; and
 - availability (types and capacity) of waste infrastructure within each of the county and former regional planning jurisdictions through which the route of the Proposed Scheme will pass.
- 16.2.2 *[Paragraph 16.2.7 amended to:]* The waste and minerals plan, together with any relevant evidence which supports it and up to date waste capacity information held by

the Environment Agency, will be used to indicate where and how much landfill void space is likely to be available during construction (2017 to 2025) and operation (2026) of the Proposed Scheme. This information will be used to assess whether or not there is likely to be a shortfall of suitable landfill void space for the management of waste requiring off-site disposal to landfill.

16.3 Scope of assessment

16.3.1 *[Paragraph 16.5.1 amended to:]* The likely significant environmental effects of solid waste generation associated with the Proposed Scheme will be assessed with respect to both the construction and operational phases. These effects may be beneficial or adverse dependent on the measures employed to prevent and/or manage the waste generated.

Spatial Scope

16.3.2 *[Section 16.5 supplemented with:]* Waste and material resources shall be assessed on a route-wide basis having regard to the local (i.e. counties or London boroughs) and regional (i.e. former regional planning jurisdictions) areas along the route. The latter is significant with respect to historical methods of waste infrastructure planning and capacity reporting.

Temporal scope

16.3.3 *[Section 16.5 supplemented with:]* The temporal scope of the assessment shall be 2017 to 2025 for construction (i.e. the proposed construction period) and 2026 for operation (i.e. the first full year of operation of the Proposed Scheme).

Construction

16.3.4 *[Paragraph 16.5.2 amended to:]* Construction effects will address the temporary, indirect effects of solid waste that will be generated by earthworks, demolition and construction activities and that will require off-site disposal during the proposed construction period. The scope of the assessment of construction effects will also include waste generation and its off-site disposal to landfill associated with the worker accommodation sites during the same time period. Demolition materials will be generated as a result of site clearance works and from the demolition of buildings and other structures currently in existence along the route of the Proposed Scheme. Natural, uncontaminated and contaminated excavated material is likely to be generated as a result of construction of the Proposed Scheme. It is likely that the majority of the excavated material will comprise natural and inert soils.

Operation

16.3.5 *[Paragraph 16.5.6 amended to:]* Operational effects will address the permanent, indirect impacts of solid waste that will be generated and require off-site disposal to landfill during the first full year operation of the Proposed Scheme. This includes solid waste that will be generated by passengers and staff at new and redeveloped stations, and at staff depots and rail maintenance facilities. Waste will also be generated by passengers and staff on trains whilst these are in use along the route of the Proposed Scheme and from track maintenance works.

16.4 Assessment methodology

- 16.4.1 *[Paragraph 16.6.1 amended to:]* There is no recognised methodology or waste significance criteria to assess the likely significant environmental effects of solid waste generation from either construction or operation. The proposed assessment methodology is, therefore, based on EIA practitioners' professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects.
- 16.4.2 *[Paragraph 16.6.2 amended to:]* The assessment will consider the types and quantities of solid waste that will be generated during construction and operation, and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring disposal to landfill (this being a finite and least preferred waste management option). The assessment will consider waste arisings and waste infrastructure capacity in local and regional areas through which the route of the Proposed Scheme will pass.

Legislation and guidance

- 16.4.3 *[Paragraph 16.6.4 amended to:]* The Waste (England and Wales) Regulations 2011 SI No. 988³⁴ (as amended), which transpose the provisions of the 'EU Waste Framework Directive' (2008/98/EC)³⁵ into England and Wales.
- 16.4.4 *[additional text added after 16.6.4 as follows:]* The Controlled Waste (England and Wales) Regulations 2012 SI No. 811³⁶ (as amended), which sets out the definition of controlled waste to which regulatory waste management controls apply.
- 16.4.5 The Environmental Permitting (England and Wales) Regulations 2010 SI No. 675³⁷ (as amended), which provide a consolidated system for permitting of waste operations.
- 16.4.6 The Hazardous Waste (England and Wales) Regulations 2005 SI No. 894³⁸ (as amended), which sets out the regime for the control and tracking of the movement of hazardous waste.
- 16.4.7 The List of Wastes (England) Regulations 2005 SI No. 895³⁹ (as amended), which provides for the classification of wastes and determination of hazardous wastes.
- 16.4.8 *[Paragraph 16.6.5 amended to:]* The Site Waste Management Plans Regulations 2008 SI No. 314⁴⁰ require the preparation of a site waste management plan (SWMP) for any construction project with an estimated capital cost of over £300,000. The purpose of the SWMP is to identify opportunities to design out waste; as well as identifying the types and quantities of waste likely to be produced during construction; the opportunities for sustainable management of the waste identified; and to monitor and report on the actual management of these wastes throughout the construction period. It is acknowledged that these regulations are likely to be repealed as a result of

³⁴ *The Waste (England and Wales) Regulations 2011 (SI 2011 No. 988)*. London, Her Majesty's Stationery Office.

³⁵ *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives*.

³⁶ *The Controlled Waste (England and Wales) Regulations 2012 (SI 2012 No. 811)*. London, Her Majesty's Stationery Office.

³⁷ *The Environmental Permitting (England and Wales) Regulations 2010 (SI 2010 No. 675)*. London, Her Majesty's Stationery Office.

³⁸ *The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005 No. 894)*. London, Her Majesty's Stationery Office.

³⁹ *The List of Wastes (England) Regulations 2005 (SI 2005 No. 895)*. London, Her Majesty's Stationery Office.

⁴⁰ *The Site Waste Management Plans Regulations 2008 (SI 2008 No. 314)*. London, Her Majesty's Stationery Office.

consultation proposed by the Defra Red Tape Challenge⁴¹. However, HS2 Ltd will apply an integrated approach to the design of the Proposed Scheme aiming to maximise the beneficial re-use of materials where possible, and minimise the generation of waste, which will be facilitated through the implementation of the Code of Construction Practice for the Proposed Scheme.

- 16.4.9 *[Paragraph 16.6.8 amended to:]* Regional and local planning policy, such as The London Plan: Spatial Development Strategy for London⁴², which sets out strategic planning policies for the management of waste generated in Greater London and elsewhere along the route of the Proposed Scheme. Specifically, these policies seek to minimise the amount of waste generated, increase the reuse and recycling of waste and reduce waste to landfill.

Significance criteria

- 16.4.10 *[Paragraph 16.6.10 amended to:]* There are no recognised significance criteria against which direct and indirect waste effects for both the construction and operational phases of the Proposed Scheme can be assessed. As such, the criteria for the assessment have been derived from professional experience previously gained from the application of EIA to large-scale infrastructure projects, which take into account:
- the net change in solid waste arisings overall as a result of the Proposed Scheme;
 - the magnitude of the quantity of waste requiring landfill disposal; and
 - the availability of landfill disposal capacity in the local and regional area.

Significance criteria to be used for the assessment of the likely significant environmental effects of solid waste generation are provided in the Rationale for landfill significance criteria technical note (see Annex J of the SMR Addendum).

Construction effects

- 16.4.11 *[Paragraph 16.6.11 amended to:]* The assessment will identify the types and quantities of solid waste forecast to be generated during each of the demolition, excavation and construction stages of the Proposed Scheme. It will also identify types and quantities of waste forecast to be generated by occupants of the worker accommodation sites during the overall construction programme. Quantification will be on the basis of survey information, using published waste generation rates or forecasting tools such as the WRAP Net Waste Tool.
- 16.4.12 *[Paragraph 16.6.12 amended to:]* Assumptions regarding the type and quantity of waste to be diverted from landfill via reuse, recycling and recovery will be applied. Following this, the type and quantity of demolition materials, excavated materials, construction materials and worker accommodation site waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity in the designated local and regional areas throughout the proposed construction period.

⁴¹ Department for Environment, Food and Rural Affairs; *Red Tape Challenge – Environment Theme Proposals March 2012*; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69584/pb13728-red-tape-environment.pdf; Accessed 24 September 2013.

⁴² Greater London Authority (2011), *The London Plan: Spatial Development Strategy for Greater London*.

- 16.4.13 *[Section 16.6 – additional text inserted as new paragraph after 16.6.12:]* Further information regarding the waste forecasting and assessment methodology for construction effects is provided in the Waste forecast and assessment methodology technical note (see Annex J of the SMR Addendum)..

Operational Effects

- 16.4.14 *[Paragraph 16.6.13 amended to:]* The assessment will identify the types and quantities of solid waste forecast to be generated during the first full year of operation of the Proposed Scheme. This forecast will be based on an assumption of maximum capacity of the Proposed Scheme and any effects will be assumed to be annual. Quantification may be on the basis of existing operational waste management performance data (e.g. for stations/interchanges) or using published operational waste generation rates for the relevant land use activities.
- 16.4.15 *[Section 16.6 – additional text inserted as new paragraph after 16.6.13:]* Further information regarding the waste forecasting and assessment methodology for operational effects is provided in the Waste forecast and assessment methodology technical note (see Annex J of the SMR Addendum).

17 Water resources and flood risk assessment

List of amendments to the SMR for this topic

SMR Paragraph Reference/Table Number	Note
17.2.3	Text within paragraph clarified within SMR Addendum
Table 40	Table deleted and replacement provided within the SMR Addendum
17.5.1	Paragraph deleted and replacement text provided within SMR Addendum
17.5.2	Paragraph deleted and replacement text provided within SMR Addendum
17.6.4	Paragraph deleted and replacement text provided within SMR Addendum
Table 41A and 41B	Table deleted and replacement Table41 provided within the SMR Addendum
Table 42	Table deleted and replacement provided within the SMR Addendum
17.6.6	Paragraph deleted and replacement text provided within SMR Addendum
Technical Notes – appended to this document	
Surface water quality assessment	
Ground water assessment method	
Spillage risk assessment	

17.1 Establishment of baseline and definition of survey

17.1.1 *[Paragraph 17.2.3 clarified with]* Baseline conditions will be set, where appropriate, for:

- surface water quantity and quality and Water Framework Directive (WFD) chemical and ecological status; and
- groundwater quality and quantity (including WFD chemical and quantitative status);

17.1.2 *[Table 40 amended to]*

Table 40: Baseline Data and sources

Flood plain extent, depth, velocity, hazard	Targeted hydraulic modelling, Information held by the Environment Agency, British Geological Survey, Internal Drainage Boards (IDBs), British Waterways, Water Companies, and Lead Local Flood Authorities. Information contained within local planning authorities'
Surface water flood depths	
Groundwater level and flow directions	
Groundwater yield	
Aquifer extent (vertical and horizontal) and hydraulic parameters	Strategic Flood Risk Assessments and Surface Water Management Plans
Surface water quality Groundwater quality	Targeted water sampling and testing at accredited laboratory. Information held by the Environment Agency, River Basin Management Plans, Local Authorities, Water companies
Surface water designations	Information held by the Environment Agency and Natural England
Surface water licences/consents	Information held by the EA and/or LLFAs
Groundwater licences/permits	Information held by the EA and/or LLFAs
Unlicensed abstractions	Information held by local authorities
Hydro-meteorological data, as needed	Met Office, Environment Agency

17.2 Scope of assessment

Spatial scope

- 17.2.1 *[paragraph 17.5.1 amended to]* The spatial scope of the assessment will be based upon the identification of surface water and groundwater features within 1km of the centreline of the Proposed Scheme, except where there is clearly no hydraulic connectivity and in urban areas where the extent will be 500m, as outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme.
- 17.2.2 *[paragraph 17.5.2 amended to]* Where works extend more than 200m from the centreline, for example at stations and depots, professional judgement will be made in selecting the appropriate limit to the extension in spatial scope required.

17.3 Assessment methodology

Significance criteria

- 17.3.1 *[paragraph 17.6.4 amended to]* The significance of an effect is defined by the magnitude of the impact and the overall value of the receiving water body or receptor (the 'attribute') (see Table 41). Table 41, Table 42 and Table 43 have been adapted from the tables in the DMRB (Volume 11.3.10: Road Drainage and the Water Environment). Significant effects on the water environment are those that have a moderate significance of effect or greater.
- 17.3.2 *[Table 41A and 41B replaced by]*

Table 41: Significance of effects

Value of Receptor	Magnitude of Impact			
	Negligible	Minor	Moderate	Major
Very high	Neutral	Moderate / Large	Large / Very Large	Very Large -
High	Neutral	Moderate	Moderate / Large	Large / Very Large -
Moderate	Neutral	Slight	Moderate	Large
Low	Neutral	Neutral	Slight	Slight

- 17.3.3 *[Table 42 amended to:]*

Table 42: Magnitude of possible impacts

Magnitude	Criteria	Examples
Major	<p><u>Adverse</u>: Loss of an attribute and / or quality and integrity of an attribute</p> <p><u>Beneficial</u>: Creation of new attribute or major improvement in quality of an attribute</p>	<p>Adverse: Increase in peak flood level* (> 100mm); loss of a fishery; decrease in surface water ecological or chemical WFD status or groundwater qualitative or quantitative WFD status.</p> <p>Beneficial: Creation of flood storage and decrease in peak flood level* (> 100mm); increase in productivity or size of fishery; increase in surface water ecological or chemical WFD status; increase in groundwater qualitative or quantitative WFD status.</p>
Moderate	<p><u>Adverse</u>: Loss of part of an attribute or decrease in integrity of an attribute</p> <p><u>Beneficial</u>: Moderate improvement in quality of an attribute</p>	<p>Adverse: Increase in peak flood level* (> 50mm); Partial loss of fishery; measurable decrease in surface water ecological or chemical quality, or flow; reversible change in the yield or quality of an aquifer; such that existing users are affected, but not changing any WFD status.</p> <p>Beneficial: Creation of flood storage and decrease in peak flood level* (> 50mm); Measurable increase in surface water quality or in the yield or quality of aquifer benefiting existing users but not</p>

Magnitude	Criteria	Examples
		changing any WFD status.
Minor	<p>Adverse: Some measurable change to the integrity of an attribute</p> <p>Beneficial: Measurable increase, or reduced risk of negative effect to an attribute,</p>	<p>Adverse: Increase in peak flood level*(> 10mm); measurable decrease in surface water ecological or chemical quality, or flow; decrease in yield or quality of aquifer; not affecting existing users or changing any WFD status.</p> <p>Beneficial: Creation of flood storage and decrease in peak flood level* (> 10mm); Measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD status.</p>
Negligible	No change to integrity of attribute	Negligible change to peak flood level* (< +/- 10mm); Discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity.

* Peak flood level for a 1% annual probability event, including climate change. Where access or egress routes are affected, the magnitude of the impact will be defined by the change in the Flood Hazard Rating as defined in Defra/EA report FD2320

17.3.4 [Table 43 amended to:]

Table 43: Examples of the value of possible water bodies or receptors

Value	Criteria	Examples ⁴³
Very high	Nationally significant attribute of high value	Watercourse having a WFD classification shown in a RBMP and $Q_{95} \geq 1.0 \text{ m}^3/\text{s}$, SPZ 1 within a Principal Aquifer, essential infrastructure or highly vulnerable development*
High	Locally significant attribute of high value	Watercourse having a WFD classification shown in a RBMP and $Q_{95} < 1.0 \text{ m}^3/\text{s}$, Principal Aquifer, more vulnerable development*
Moderate	Of moderate quality and rarity	Watercourses not having a WFD classification shown in a RBMP, Secondary Aquifer, less vulnerable development*
Low	Lower quality	Surface water sewer, non aquifer, water compatible development *

* as defined in Table 2 of the Flood Risk section of the Technical Guidance to the NPPF.

⁴³ Q95 is the flow equalled or exceeded in a watercourse for 95% of a recording period - typically over several years.

Annex A: Air quality – technical notes

1.1.1 The following technical notes are appended to this document:

- Air quality assessment for construction issues
- Guidance on assessment methodology



HS2 London-West Midlands

Air quality

**Technical note – Air quality
assessment for construction
issues**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 Purpose of the note

1.1.1 This technical note provides further information on the assessment of air quality during construction of the Proposed Scheme. The Scoping and Methodology Report (SMR) (see Volume 5: Appendix CT-001-000/1) provided guidance that the assessment of construction impacts would follow the recommendations of the Institute of Air Quality Management (IAQM) guidance¹. This note provides an interpretation of the IAQM guidance for application to the assessment of the Proposed Scheme.

1.2 Relevant issues

1.2.1 The IAQM guidance considers the potential air quality impacts during construction to be:

- dust deposition;
- visible dust plumes;
- elevated PM₁₀ concentrations; and
- an increase in concentrations of particulate matter and nitrogen dioxide from exhaust emissions from vehicles and equipment used on site.

1.2.2 The assessment of air quality impacts during construction will also consider the impact of exhaust emissions from vehicles travelling to and from the construction site, particularly the Heavy Duty Vehicles (HDVs). The assessment of impacts from these vehicles is considered to be well covered by existing guidance in the Design Manual for Roads and Bridges (DMRB)² and Defra's Local Air Quality Management Technical Guidance TG(09)³ and is not considered further in this note.

2 Methodology

2.1 Relevant receptors

2.1.1 The IAQM guidance details two types of relevant receptors that will be taken into account in the assessment – human and ecological receptors.

2.1.2 A human receptor is defined as any location where a person may experience the annoyance effects of airborne dust or dust soiling, or exposure to PM₁₀ over a time period relevant to the air quality standards. For the purposes of the assessment of the Proposed Scheme this is mainly residential dwellings. The IAQM guidance also directs that some commercial premises may have a particular sensitivity to dust, however, the assessment must take into account the actual situation at premises of this type as they may already have protected their operations against increased dust levels. Some horticultural operations are also considered to be dust sensitive.

¹ IAQM, 2012, *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance*.

² Highways Agency (2007), *Design Manual for Roads and Bridges, Volume 11, Section 3 Part 1 HA207/07 Air Quality*.

³ Defra (2009), *Local Air Quality Management: Technical Guidance LAQM.TG(09)*.

- 2.1.3 An ecological receptor is any habitat that may be sensitive to dust soiling from direct impacts (e.g. excessive dust deposition) or indirect impacts on fauna (foraging habitats).
- 2.1.4 The IAQM guidance suggests that an assessment is required where there are sensitive receptors within 350m of the boundary of the site, within 100m of the route used by construction vehicles on the public highway and up to 500m from the site entrance. It is acknowledged in the guidance that these values are conservative and hence there is scope for specific criteria to be applied for this assessment.
- 2.1.5 The guidance also states that the assessment should assume that no mitigation measures are applied except those required by legislation, however, the HS2 project intends to apply mitigation at all its major construction sites (where a high or medium level of risk is identified according to the IAQM guidance) to reduce the potential impacts of the development. These mitigation measures are detailed in Table 1 and are based on the requirements for low risks sites in the Greater London Authority (GLA) guidance⁴. With these measures in place and by examining the intensity of construction activities in some instance, the distances described in paragraph 2.1.4 can be reduced without risk of underestimating the air quality impacts.
- 2.1.6 Detailed assessment of construction impacts will be undertaken in accordance with the following principles:
- where the construction activities fall into a high risk category for either demolition, earthworks, construction or trackout (defined in Sections 8.3-8.7 of the IAQM guidance) then the distances in Section 7 of the IAQM guidance will apply;
 - in other situations only sensitive receptors within 200m of the site boundary will be considered; however, it is not possible to draw up an exhaustive list of criteria and professional judgement will be applied in certain cases; and
 - reference will be made to the Code of Construction Practice (CoCP) and the Local Environment Management Plan (LEMP) proposed for each community forum area .

⁴ Greater London Authority and London Councils (2006), *The control of dust and emissions from construction and demolition: Best Practice Guidance*, London: Greater London Authority.

Table 1: Mitigation measures assumed to be applied at all construction sites

Activity	Mitigation
Site planning	<p>Machinery, fuel and chemical storage and dust generating activities should not be located close to boundaries and sensitive receptors if at all possible.</p> <p>Erect effective barriers around dusty activities or the site boundary.</p>
Haul roads	<p>Use consolidated surfaces on haul roads near to residential areas.</p> <p>Use agreed wet cleaning methods or mechanical road sweepers on all roads during periods of dry weather.</p> <p>Clean road edges and pavements using agreed wet cleaning methods.</p>
Vehicles	<p>All vehicles should switch off engines - no idling.</p> <p>Clean or wash all vehicles effectively before they leave a site if there is a risk of affecting nearby sensitive receptors.</p> <p>All loads entering and leaving site to be covered.</p>
Site entrances/exits	<p>Wash or clean all vehicles effectively before leaving the site if it is close to sensitive receptors.</p> <p>Ideally there should be a paved area between the wheel wash and before the public road.</p>
Excavation and earthworks	<p>All dusty activities should be damped down, especially during dry weather.</p> <p>Temporarily cover earthworks if possible.</p> <p>Minimise drop heights to control the fall of materials.</p>
Stockpiles	<p>Make sure that stockpiles exist for the shortest possible time.</p>
Grinding, cutting, sawing	<p>All equipment should use water suppressant or suitable local exhaust ventilation systems.</p>
Chutes and skips	<p>Securely cover skips.</p> <p>Minimise drop heights to control the fall of materials.</p> <p>Regularly damp down surfaces with water.</p>
Off road vehicles and plant	<p>All non-road mobile machinery should use fuel equivalent to ultra low sulphur diesel (ULSD), especially where a bunkered fuel supply is available.</p> <p>No vehicles or plant will be left idling unnecessarily.</p> <p>NRMM (vehicles and plant) should be well maintained. Should any emissions of dark smoke occur (except during start up) then the relevant machinery should be stopped immediately and any problem rectified before being used.</p> <p>Engines and exhaust systems should be regularly serviced according to manufacturer's recommendations and maintained to meet statutory limits/opacity tests.</p> <p>All vehicles should hold current MOT certificates where required.</p> <p>Vehicle exhausts should be directed away from the ground and positioned so they are not directed at site entrances.</p> <p>Locate plant away from the boundaries close to residential areas</p>

2.2 Temporal considerations

- 2.2.1 The assessment of impacts will consider the construction activities throughout the construction period. However, a separate assessment will not be undertaken for every year throughout construction at every site. Nonetheless, the assessment will capture the periods where the risk of adverse impacts are at their highest.
- 2.2.2 The assessment at each major construction activity will therefore draw upon the construction programme to identify the duration and location of activities that would give rise to air quality impacts. As the IAQM guidance provides a three scale level of risk for various activities that depends on their scale and distances to sensitive

receptors, it is likely that the overall risk will change at different times during the construction period.

- 2.2.3 The assessment will therefore identify the changes in risk of adverse effects throughout the construction period and set out an appropriate level of mitigation to reduce these. The level of mitigation proposed will be consistent with that proposed in the IAQM guidance document and has been detailed within the draft CoCP (see Volume 5: Appendix CT-003-000). This assessment will identify the periods when there are major changes in the construction activities and assess periods when construction effects may change as a result.
- 2.2.4 Assessment of construction traffic impacts will follow a similar principle although relatively few sites require detailed modelling of the air quality impacts. Assessment is not required for every year of the construction period although it may be necessary to consider the impacts for more than one year if the levels of routing of traffic change throughout the construction period. A worst case year will be selected based on the year of assessment (which will change the emission and background concentration data) and the volume of traffic generated. Given the reducing emissions and background concentrations, it is very likely that the worst case impacts will be found in the early years of the construction period.



HS2 London-West Midlands

Air quality

Technical note – Guidance on assessment methodology

A report to HS2 Ltd by Arup/URS

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1 General considerations

1.1 Scenario nomenclature

- 1.1.1 2012 Current Baseline (for model verification if required).
- 1.1.2 2017 Construction without the Proposed Scheme – The baseline scenario for construction assessment without the Proposed Scheme in place.
- 1.1.3 2017 Construction with the Proposed Scheme - The scenario for assessment of the effects of construction of the Proposed Scheme.
- 1.1.4 2026 Operation without the Proposed Scheme – The scenario without the Proposed Scheme in place (baseline) against which the assessment of the operation of the Proposed Scheme will be made.
- 1.1.5 2026 Operation with the Proposed Scheme – The scenario for assessment of the operational effects of the Proposed Scheme.

1.2 Baseline data

- 1.2.1 Baseline monitoring data should be reported from the nearest available sites that represent the location under assessment. Where data capture is less than 90% in a year, commentary will be given on how these data may or may not reflect annual mean data.

1.3 Selection and types of receptors

- 1.3.1 For the assessment of the impacts from roads, receptors will be chosen so the worst affected relevant sensitive exposure (residential properties, schools, hospitals, nursing homes) on each road and at each junction on the assessed road network is represented. If several receptors are present at a junction and it is unclear which of them would be the worst affected receptor, all of the potential worst affected receptors will be modelled. Where there is no sensitive exposure at junctions, receptors will be chosen alongside roads which meet the Design Manual for Roads and Bridges¹ criteria so that all possible worst case effect locations are represented.
- 1.3.2 For assessment of car parks receptors will be chosen near the perimeter of the car park where worst case effects are likely, considering contributions from other modelled sources (car parks and roads). Additionally, receptors included in any combustion plant assessment or in an independent road traffic assessment nearby the modelled road network will be included in the model runs to account for cumulative effects.
- 1.3.3 Receptors will be selected based on either their proximity to the combustion source (such as boilers and CHP systems) or as the likely most affected receptors; receptors will include all locations where people might reasonably be (including residential, hotels, nurseries, hospitals, schools, nursing home buildings) and/or ecological receptors if considered sensitive to the pollutant being considered and present on a nationally designated site.

¹ Highways Agency (2007), *The Design Manual for Roads and Bridges (Volume 11, Section 3, Part 1 Air Quality HA207/07)*.

- 1.3.4 If receptors are present in several directions from the stack, the closest receptor in each direction will be selected. The height above ground of the receptors will be set to the height of opening windows and/or air intakes most similar in height to the stack height. Nearby receptors included in any quantitative road and car park assessment will be included in the model runs to account for cumulative effects.
- 1.3.5 In addition to modelling at selected discrete receptors, a grid of equally spaced receptors will be modelled of at least 50 x 50 points with a maximum spacing of not more than 1.5 times the minimum stack/flue height being modelled. The grid will be centred on the stack(s) and ensure that the maximum off-site concentration is included (this may require several iterations of the model to ensure the optimal spacing is selected). Several grids may also be used. All discrete receptors do not need to be within the area covered by the receptor grid. Maximum concentrations will be reported as well as those at discrete receptors.
- 1.3.6 Receptors (gridded and/or discrete) will all be at ground level (zero metres above local ground level) and also at various heights above ground if relevant. Consideration will be given in urban areas where there are many receptors at heights more than two metres above ground to modelling a series of grids at various heights (in order to ensure that exposure of receptors at height are considered. Discrete receptors at height may also be used if an elevated grid is not justified.

1.4 Interfaces

- 1.4.1 Any results that relate to receptors within an adjacent Community Forum Area (CFA) will be included as part of that CFA report.

1.5 ADMS model parameters

- 1.5.1 ADMS-Roads² meteorological setting will remain as default, except for the surface roughness and minimum Monin-Obukhov length – advice on the relevant values to be used will be taken from the ADMS-Roads Manual based on the characteristics of the study area as follows:
- Large urban areas : 1.5m;
 - Cities/Woodlands : 1.0m;
 - Parkland, Open Suburbia : 0.5m;
 - Agricultural Areas (max) : 0.3m;
 - Agricultural Areas (min) : 0.2m;
 - Root crops : 0.1m;
 - Open Grassland : 0.02m; and
 - Short grass : 0.005m
- 1.5.2 Terrain will not be included in dispersion modelling unless justified using professional judgement.

² Cambridge Environmental Research Consultants, ADMS Roads User Guide, September 2011.

1.6 Model verification

1.6.1 When undertaking an ADMS-Roads assessment, the model will be verified at selected suitable continuous NO₂ and NO₂ diffusion tube monitoring sites in accordance with LAQM.TG(09)³. Kerbside sites will not be included in the model verification exercise. Adjustment to the model using the procedure detailed in LAQM.TG(09) will be made if the average difference between modelled and monitored NO₂ concentrations exceeds 25% of monitored concentrations. DMRB screening method results will not be subject to verification as this method will not be used in areas where a significant air quality impact is likely.

1.7 Meteorological data

1.7.1 When dispersion modelling is undertaken, a sensitivity analysis will be performed using five years of hourly sequential meteorological data from a station as indicated below (depending on location). The results for the full assessment will then be presented based on 2011 meteorological data unless the sensitivity analysis justifies another year as likely to lead to results that would materially affect the conclusions of the assessment. Choice of any year other than 2011 will be justified.

1.7.2 The following meteorological stations (Table 1) will be used in the assessment, unless there are particular local features to suggest another site is more appropriate.

Table 1: Meteorological Data

No.	Met Station	OS X	OS Y	Description of Data
1	Heathrow	507733	176810	London Heathrow
2	Elmdon	418242	283593	Elmdon/Birmingham Airport with missing cloud from Coventry

³ Defra, Local Air Quality Management, Technical Guidance LAQM.TG(09), February 2009.

2 Combustion plant assessment

2.1 Type of assessment required

- 2.1.1 Emissions from buildings will be included in the assessment. Professional judgement will be used to determine the most appropriate method for assessment which will be qualitative or quantitative, including dispersion modelling.
- 2.1.2 The assessment of stationary combustion plant shall comply with the provisions of the Clean Air Act (1993). In summary:
- plant burning less than 45.4kg/hr of solid fuel or thermal input of liquid or gaseous fuel of less than 366.4 kW (or combined plant sharing flues) will be screened out of the assessment; and
 - plant falling within the provisions of the Clean Air Act will have their stack/flue height sited at a location and height acceptable under the terms of the Act. This will initially be estimated using the D1 method⁴.
- 2.1.3 Where relevant, professional judgement and/or dispersion modelling will be used to suggest design modifications including height and location of flues/stacks, particularly in relation to any adjacent or neighbouring buildings or structures.
- 2.1.4 Professional judgement will be exercised to ensure that the criteria given above are appropriate e.g. if there are many small boilers that may each fall under the criteria set out above but cumulatively their effect on air quality may be non-negligible, modelling may be deemed appropriate.
- 2.1.5 Professional judgement will be used as to whether modelling of plant that is not used throughout the year is appropriate (e.g. back-up generators run only for testing other than in the event of power failure).
- 2.1.6 Dispersion modelling will be undertaken with the atmospheric dispersion model ADMS and/or ADMS-Roads, using the most up to date version as of the date of receipt of the model input data.
- 2.1.7 Dispersion modelling of point source emissions will be undertaken if one or more of the following conditions are met:
- the height of stack from the D1 determination is not acceptable for some reason, (e.g. it is unacceptable to the designers, physical limitations relating to use/access); or
 - the combustion plant has the potential to affect air quality where the existing or estimated future annual mean baseline NO₂ concentrations are over 36 µg/m³ or PM₁₀ concentrations are over 30 µg/m³ (if the source is non-gas fired) and where impacts are likely to be significant.
- 2.1.8 For natural gas fired equipment modelling will only be for NO₂. For other fuel types (e.g. biomass) consideration will be given to the inclusion of PM₁₀, PM_{2.5} and/or SO₂.

⁴ Her Majesty's Inspectorate of Pollution (1993), *Technical Guidance Note (Dispersion) D1: Guidelines on Discharge Stack Heights for Polluting Emissions*. London, Her Majesty's Stationery Office.

- 2.1.9 Where existing or future air quality is likely to exceed the relevant assessment criteria consideration will be given to the modelling of sources that would be excluded using the above criteria.

2.2 Pollutant emissions and model inputs

- 2.2.1 The D1 and modelling assessments will consider annual mean NO_x emissions for gas fired plant and both NO_x and PM₁₀ emissions for other fired plant. If a specific combustion plant has not been selected by the energy consultant/mechanical engineer, standard emissions data will be used. Background concentrations for use with the D1 method will be taken from Table 2 of the D1 Technical Guidance using the 'type of district' at the location of the assessed boiler. This information is repeated in Table 2, however, this data will be checked for consistency with available local background concentration information and where good quality local information is available this will be used in preference. To convert locally measured annual mean NO₂ concentrations to the 98th percentile values used in D1, a factor of 2.5 will be used.

Table 2: D1 – Typical background levels of common pollutants

Type of district	Background concentrations, mg/m ³	
	NO ₂ *	PM ₁₀
Major city centre/heavy industrial area	0.17	0.15
Highly developed large urban area	0.12	0.10
Urban area of limited size with parkland or largely rural surroundings	0.09	0.07
Partially developed area	0.07	0.05
Rural area with little development	0.05	0.03

* 98th percentile of hourly means

- 2.2.2 Emission characteristics from Table 3 will be used in any boiler dispersion modelling. Boilers of intermediate size will have their characteristics linearly interpolated using a most similar smaller and most similar larger boiler from the table.

Table 3: Combustion plant model inputs for natural gas CHPs (MW thermal input)

Property	0.5 MW	1 MW	2 MW	5 MW	10 MW
Stack height (m)	As per D1 or building ht +1m				
Total flow (actual m ³ /s)	0.22	0.44	0.87	2.98	5.69
Stack/Flue diameter (m)	0.17	0.24	0.33	0.62	0.85
Exit velocity (m/s)	10				
Discharge temperature (°C)	72	69	69	179	162
NO ₂ emissions rate g/s (a)	0.011	0.022	0.044	0.111	0.222
Based on the Hoval Ultragas (0.5, 1 and 2 MW) and Royalist range of boilers (5 and 10 MW)	Assumed density of flue gas is the same as nitrogen (1.25 g/l at normal conditions)		NB this is based on an emission factor of 80 mg/kWh, there may be other local authority advice for the particular study area.		

- 2.2.3 For boilers of intermediate size, emissions will be interpolated and sizes rounded to the nearest 100 kW before interpolation takes place

2.2.4 Assumptions on NO_x:NO₂ conversion ratios for point source plant NO_x emissions will be based on the likely oxidation rates to the point of maximum impact. Where no other data exist, Table 4 will be used to determine the NO_x to NO₂ oxidation rate for specific distances. It is assumed that the minimum conversion is 10% based on the likely NO₂ percentage in the emissions. Linear interpolation will be undertaken between the distances provided to the nearest 10 metres.

Table 4: Oxidation rates (derived from Janssen)⁵

Distance from source (m)	Estimated annual mean ozone concentration (ppb)			
	< 20	20-40	40-60	> 60
10	10%	10%	10%	10%
25	10%	10%	10%	10%
50	10%	10%	10%	10%
75	10%	10%	10%	10%
100	10%	10%	10%	10%
200	10%	10%	10%	10%
300	10%	10%	10%	10%
500	10%	10%	10%	14%
750	10%	10%	14%	20%
1000	10%	10%	18%	26%
1500	10%	15%	25%	36%
2000	10%	19%	32%	44%
3000	14%	27%	43%	57%

Note: Assuming that wind speed is in the range 5-15m/s, and conversion rates are the highest they would be for the range of ozone given. In reality conversion rates to NO₂ would be lower than stated.

2.2.5 All combustion plant sharing a common flue or stack will be combined in a manner that preserves an exit velocity of 15 m/s (the minimum recommended stack emission velocity).

2.2.6 Only annual mean concentrations will require modelling. The handling of short term statistics is explained in Section 3.3.

⁵ Janssen et al. (1987) *A Classification of NO Oxidation Rates in Power Plant Plumes Based on Atmospheric Conditions*.

3 Assessment of vehicle emissions

3.1 Type of assessment required

3.1.1 All affected roads will be assessed. This includes screening out of roads on which traffic changes are likely to lead to negligible effects on air quality.

3.1.2 A DMRB scoping assessment of traffic effects will be undertaken where any of the DMRB criteria, as follows, are met and detailed modelling is not required (see paragraph 3.1.4):

- road alignment will change by 5m or more; or
- daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- daily average speed will change by 10km/hr or more; or
- peak hour speed will change by 20km/hr or more.

3.1.3 Consideration will be given as to whether roads that would be screened out using the above criteria are to be included in the assessment. Examples of this are heavily trafficked roads in areas where air quality criteria may or may not be exceeded, but where traffic changes caused by the construction or operation of the Proposed Scheme are small.

3.1.4 Consideration will be given as to whether dispersion modelling using ADMS-Roads will be carried out, taking into account the following criteria.

- roads screened within the assessment are within the hotspots located within an AQMA (not necessarily if the roads are within an AQMA that has been designated over a wider area than where air quality criteria are exceeded);
- where existing or future estimated annual mean concentrations of NO₂ concentrations are over 36 µg/m³; and
- where existing or future estimated annual mean PM₁₀ concentrations are over 30 µg/m³.

3.2 Spatial scope of assessment

3.2.1 Any quantitative air quality assessment will cover the roads which meet the DMRB criteria and roads which adjoin them to enable the effects at junctions to be assessed.

3.3 Modelled Pollutants, Model Version and Emissions Factors

3.3.1 Only annual mean NO_x and PM₁₀ concentrations are required to be modelled. The treatment of short-term statistics is explained in the following paragraphs.

3.3.2 NO_x output from either the DMRB Spreadsheet or ADMS-Roads models for both on road sources and car parks will be combined with the background NO_x and NO₂ concentrations in the Defra NO_x to NO₂ conversion spreadsheet, available on the

Defra website⁶, to obtain total roadside and background annual mean NO₂ concentrations. Modelled combustion plant NO₂ contributions will be added to these values to yield a total annual mean NO₂ concentration.

3.3.3 The number of exceedances of the 1-hour NO₂ objective will not be reported since it is only likely to be breached if the annual mean NO₂ concentrations are over 60 µg/m³, (LAQM.TG(09)). Therefore, this less onerous statistic will not be reported unless there is a very short term activity being examined where high peaks in NO₂ concentrations are expected.

3.3.4 To calculate the annual mean PM₁₀ concentrations, the background PM₁₀ concentrations will be added to the road-side concentration output (and any modelled combustion plant output) from the DMRB or ADMS-Roads model. The number of exceedances of the 24-hour PM₁₀ objective should be calculated using the formula in LAQM.TG(09), that is:

$$\text{No. 24-hour mean exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206/\text{annual mean})$$

3.3.5 The DMRB Spreadsheet version 1.03c (July 2007)⁷ available on the Defra website will be used for any DMRB spreadsheet assessments.

3.3.6 The most recent versions of ADMS-Roads and ADMS will be used for any dispersion modelling assessment. Emissions suitable for use in the ADMS-Roads model will be generated using the most recent Emission Factors Toolkit (EFT) emission factors (COPERT not TRL) (v5.2).

3.4 Car Parks, Stationary Idling Vehicles

3.4.1 New car parks will be assessed using ADMS-Roads where they meet the Environmental Protection UK criteria for assessment; that is they have more than 100 spaces outside Air Quality Management Areas (AQMAs) or more than 50 spaces inside AQMAs.

3.4.2 Emissions from movements within the car park will be estimated using EFT as indicated above. The travel speed will be set at 5 kph and the travel distance within the car park set to the car park perimeter for surface car parks with half the perimeter distance added for each floor above ground level for multi-storey car parks.

3.4.3 Consideration will be given to the inclusion of places where vehicles may stand with engines idling e.g. taxi stands (use design length of taxi ranks, number of vehicles, duration of stay etc.) and a separate calculation made for these emissions with EFT.

3.4.4 The EXEMPT model, available on the Defra website⁸, will be used to estimate cold start emissions from car parks. Cold start emissions should be applied to vehicles which stay over two hours. If this information is not available, all vehicles should be assigned cold start emissions (using a length of stay of 600 minutes and an assumed ambient temperature of 10°C) as a worst case assessment. The "excess emissions" from the model will be calculated using half the driving distance within the car park (as estimated using the method in the previous paragraph) since cold start emissions will only be applicable to vehicles exiting the car park.

⁶ <http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html>

⁷ <http://dft.gov.uk/ha/standards/guidance/air-quality.htm>

⁸ <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#exempt>

- 3.4.5 Car parks will be modelled as area sources at ground level for surface cars parks, as volume sources the height of the car park for multi-storey car parks, or as point sources at ventilation points for mechanically ventilated underground car parks (or at the entrance or openings of the car park if not mechanically ventilated) using emissions calculated for cold start and internal movement emissions uniformly distributed throughout the sources.

3.5 Background concentrations

- 3.5.1 Data for background concentrations will be taken from the maps available on the Defra website⁹ or the Greater London Authority (GLA) pollution mapping¹⁰ where more appropriate and from local monitoring information available in the area. Professional judgment will be used to determine which data is most appropriate to be used for the assessment of each area.
- 3.5.2 If local monitoring data is not available for the base year of 2012, it will be adjusted using the same factors for the area as those used in the Defra background maps. Local background monitoring data will also be adjusted, if used, for the two future assessment years of 2017 for construction and 2026 for operation of the Proposed Scheme.

3.6 Speeds

- 3.6.1 Where data exist on actual speeds these will be used. In the absence of actual or modelling traffic speed data, the following speeds will be used (unless justified otherwise):
- 50% of the speed limit on central urban and or congested roads;
 - 75% for urban but not congested roads;
 - Roads within 50m and on junctions (including roundabouts) should have their speeds adjusted as advised by LAQM.TG(09).;
 - Signalled junctions = 15kph;
 - Small roundabouts (total roundabout length <150m) = 20kph;
 - Large roundabouts (total roundabout length >150m) = 30kph; and
 - Roads within 50m of roundabouts with traffic lights = 15kph.

3.7 Baseline verification traffic

- 3.7.1 An existing baseline year of traffic data will be utilised for the study area. A full assessment of the entire study area will not be required, however, this information will be used to test model performance and undertake model verification in line with guidance in the LAQM.TG(09).

⁹ Defra; 2010 based background maps for NO_x, NO₂, PM₁₀ and PM_{2.5}; <http://laqm.defra.gov.uk/maps/maps2010.html>; Accessed: July 2013

¹⁰ Greater London Authority; London Atmospheric Emissions Inventory 2008 Concentration Maps; <http://data.london.gov.uk/laei-2008-concentration-maps>; Accessed: May 2013.

3.8 Construction traffic

- 3.8.1 Traffic data will be utilised for a hybrid year during construction – essentially this will be the worst case traffic data for each location. The construction impact assessment will be carried out with a year of assessment of 2017.

3.9 Operational traffic

- 3.9.1 Only opening year operational traffic (2026) will be assessed for local air quality. A 'without the Proposed Scheme' scenario and a 'with the Proposed Scheme' scenario will be assessed and compared. A Baseline scenario will be assessed for information purposes.

4 Construction assessment

- 4.1.1 In addition to a construction traffic assessment, the construction assessment will follow the IAQM Dust Guidance 2012 methodology¹¹.

- 4.1.2 The scale of non-road mobile and non-road machinery emissions will be considered in the assessment. It is expected that these emissions are likely to be very low in relation to other sources in the area and will not require a quantitative assessment but this will be confirmed..

4.2 Mitigation measures

- 4.2.1 When undertaking the construction impact assessment the mitigation measures detailed within the draft Code of Construction Practice (see Volume 5: Appendix CT-003-000) will be applied.

4.3 Limitations

- 4.3.1 Non-scheme car park emissions will not be assessed unless professional judgement indicates that they may contribute significantly to the outcome and have not been included in the baseline.
- 4.3.2 On-road cold start emissions associated with car parks and the developments have not been assessed although these will have a very small effect on the emissions from the local road network.
- 4.3.3 Emissions from rail brake and track wear during operation are assumed to be negligible and should not be included in the assessment.
- 4.3.4 Trains and much of the Proposed Scheme infrastructure will be electrically operated however emissions from power plants used to power the trains and infrastructure have not been assessed as this is outside the scope of a local air quality assessment.

¹¹ IAQM (2011), *Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance*.

Annex B: Community – technical note

1.1.1 The following technical note is appended to this document:

- Further assessment guidance

1.1.2 It should be noted that for the purpose of the technical notes, the topic areas of community and socio-economics have been combined.



HS2 London-West Midlands

Community and socio- economics

Technical note – Further assessment guidance

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 Introduction

1.1.1 This technical note provides further guidance on the assessment methodology for assessing potential community and socio-economic impacts and effects considered likely to arise from the construction and operation of the HS2 project.

1.1.2 The technical note builds upon and should be read alongside the HS2 Scope and Methodology Report (SMR see Volume 5: Appendix CT-001-000/1), Section 7: Community and Section 13: Socio-economics.

1.2 Community

1.2.1 Community effects are defined as non-economic effects upon people and organisations operating community facilities and will be considered against four principal types of infrastructure:

- residential property;
- community infrastructure;
- recreation infrastructure; and
- open and play space.

1.3 Socio-economics

1.3.1 The socio-economic assessment will identify impacts on businesses and organisations and effects on employment levels. It will consider the potential for the project to generate impacts and effects on:

- existing businesses and organisations;
- local economies, including employment; and
- planned growth and development.

1.3.2 The socio-economic assessment will provide inputs into the community assessment and draw upon other assessments where relevant, such as agriculture and soils.

1.4 Other environmental impacts

1.4.1 There are a number of other environmental topics, such as air quality, noise and vibration, visual, transport and climate that inform both the community and socio-economic assessments. An understanding of these methodologies and topics will be required to give context for potential in combination effects arising from impacts related to these topics.

1.5 Structure of guide

1.5.1 This technical note is structured as follows:

- Section 2 provides core definitions for the receptors and resources which are relevant in assessing potential community and socio-economic effects;

- Section 3 sets out further details of the community and socio-economic assessment criteria and guidance on how this will be applied.
- Section 4 provides a list of assumptions which have been applied to the community and socio-economic assessments.

2 Receptor and resource definitions

2.1 Introduction

2.1.1 Community resources and receptors are set out below against the infrastructure themes of residential property, recreational infrastructure; community infrastructure; open and play space.

2.2 Community resources and receptors

Residential property

2.2.1 **Resources:** Residential property included:

- private, rented and shared ownership residential dwellings and their surrounding grounds/gardens;
- student accommodation;
- extra care/retirement housing;
- mobile homes where there is an established and recognised location for them to use, (e.g. barge moorings, caravan sites, traveller sites); and
- homes used in conjunction with a business or other function, for example, bed and breakfasts, farm houses and church rectories.

2.2.2 **Receptors:** includes the residents or tenants of properties. It also includes employees who permanently reside in a residential property, for example, care givers and janitors.

2.2.3 **Exclusions:** Residential health/social care facilities are covered under community infrastructure. Other community property will be considered under community infrastructure or recreation infrastructure. Travel accommodation such as hotels, bed and breakfasts and serviced apartment hotels will be included as businesses under the socio-economic assessment, except where the accommodation in question provides permanent residential dwelling for the owner/manager and/or staff when they are considered under community as well as socio-economic. Landlords or owners who do not reside in the property are also excluded.

2.2.4 Effects on the property market as a whole are considered under the socio-economic assessment.

Community infrastructure

2.2.5 **Resources:** Community infrastructure includes:

- health and social care facilities including GP practices and health centres, hospitals, hospices, residential care facilities, sure start centres, social work centres, health-related emergency services, dentists;
- educational facilities including day nurseries, primary schools, secondary schools, colleges, universities, other organised learning environments and education resource centres;

- community centres, youth centres, and other relevant facilities used for local community meetings and activities;
- institutional uses defined as government local authority and emergency services open to the public;
- local high streets and local centres which provide local services including convenience retail and services such as post offices and hairdressers; and
- places of worship (with some potential overlap with open space, e.g. burial grounds, cemeteries).

2.2.6 **Receptors:** users and beneficiaries of resources which include local residents, organised (community) groups, pupils, patients, congregations and employees who used community infrastructure. Receptors also include owners and organisations running the resources.

2.2.7 **Exclusions:** employment impacts will be covered under the socio-economic assessment.

Open space and play space

2.2.8 **Resources:** open space including areas of land and water (such as rivers, canals, lakes and reservoirs) which offer opportunities for sport and recreation and could also act as a visual amenity.

2.2.9 Open spaces include publicly accessible spaces and open space that is visible from places where people have regular access.

2.2.10 The following typology illustrates the broad range of open space resources that may be of public value, including play spaces:

- parks and gardens – includes urban parks, country parks and formal gardens;
- accessible countryside in urban fringe areas;
- wider countryside;
- natural and semi-natural urban green spaces – includes woodlands, urban forestry, scrub, grasslands (e.g. downlands, commons and meadows), wetlands, open and running water, wastelands and derelict open land and rock areas (e.g. cliffs, quarries and pits);
- green corridors – includes river and canal banks, recreational (off road) cycle routes, bridleway, and promoted recreational walking routes;
- outdoor sports facilities (with natural or artificial surfaces and either publicly or privately owned) – includes tennis courts, bowling greens, sports pitches, golf courses, athletics tracks, school and other institutional playing fields;
- amenity green space (most commonly, but not exclusively in housing areas) – includes informal recreation spaces, green spaces in and around housing, and village greens;
- allotments, community gardens, and city (urban) farms;

- cemeteries and churchyards;
- civic spaces, included civic and market squares, and other hard surfaced areas designed for pedestrians; and
- outdoor play spaces included provision for children and teenagers – including play areas, skateboard parks, outdoor basketball hoops, and other more informal areas.

2.2.11 **Receptors:** users and beneficiaries of resources which include local residents, organised (community) groups, pupils, patients, congregations and employees who use community infrastructure. Receptors also include owners and organisations running the resources.

2.2.12 **Exclusions:** employment impacts will be covered under the socio-economic assessment.

Recreational infrastructure

2.2.13 **Resources:** recreation infrastructure related to public and commercial recreational facilities where not covered under open space and play space. Recreation infrastructure includes:

- sports centres and facilities, leisure centres and fitness clubs. (Some recreation facilities may include both indoor and outdoor recreation facilities, e.g. golf clubs, paintballing);
- stadia, arena and professional sports clubs which host games and events open to the public;
- indoor (publicly owned and commercial) children’s play areas;
- museums, art galleries, theatres, cinemas, historic buildings and stately homes open to the public, other cultural venues and facilities;
- food venues, cafes, restaurants;
- music venues, bars, pubs, night clubs, social clubs (e.g. Irish clubs, Conservative clubs, Labour clubs, Working Men’s clubs); and
- other recreational facilities, for example, theme parks, animal sanctuaries, zoos, aquariums, visitor centres, camp sites, equestrian facilities.

2.2.14 **Receptors:** users and beneficiaries of resources which include local residents, organised (community) groups, pupils, patients and employees who used recreation infrastructure. Receptors also include owners and organisations that ran the resources.

2.2.15 **Exclusions:** outdoor and open spaces used for recreation which are already covered under open space, e.g. a public bridleway used for horse riding. Employment impacts will be covered under the socio-economic assessment.

2.3 Socio-economic resources and receptors

2.3.1 Socio-economic resources and receptors are set out below covering the themes of construction, operation and wider development effects.

Resources: property units

2.3.2 All property units considered to be physically affected by project proposals supporting the employment of persons.

2.3.3 Property units include identifiable land and property including:

- commercial offices;
- warehousing;
- retail;
- open land storage;
- partial covered land storage;
- surface plant and machinery;
- land used for the production of agricultural produce (crops and/or livestock);
- land used for minerals extraction;
- Institutional uses (e.g. public administration, armed forces, police, regulatory bodies);
- community infrastructure, open space and play space and recreational infrastructure where they have employment and/or economic characteristics; and
- communal residential establishments (residential and nursing homes, dormitories).

Resources: businesses

2.3.4 Businesses are considered to be all legal entities with definable establishments and employing persons within the impact area. A legal entity is considered to be:

- sole traders;
- partnerships;
- limited companies;
- public limited companies;
- social enterprises (including companies limited by guarantee, co-operatives, charitable trusts, community interest organisations);
- membership and representative bodies (political parties, professional associations, trade unions, unincorporated societies); and
- public services.

2.3.5 Businesses are considered to carry out a recognisable activity including any of the following from their establishment:

- agriculture, forestry and fishing;
- manufacturing;
- wholesale and retail trade;
- repair of motor vehicles and motorcycles;
- accommodation and food service activities;
- electricity, gas, steam and air conditioning supply;
- water supply, sewerage, waste management and remediation activities;
- construction;
- transportation and storage;
- information and communication;
- public administration and defence;
- compulsory social security;
- other service activities (excluding those covered under Community);
- financial and insurance activities;
- real estate activities;
- professional, scientific and technical activities;
- administrative and support service activities; and
- arts, entertainment and recreation.

2.3.6 The effect on agricultural businesses will be covered under the agriculture assessment and the results summarised in the socio-economic assessment together with other economic impacts.

Receptors

2.3.7 Receptors include resident workers in employment associated with a resource including:

- employees in employment;
- sole traders; and
- partners.

Exclusions

2.3.8 Businesses concerned with health and social care and education and other service delivery activity play a dual role in the assessment in so far as they provide services to people as individuals as well as performing a role as an employing business. Impacts

on the delivery of services to people and amenity impacts on employees and organisations are considered under the community assessment whilst impacts on employment will fall under the remit of the socio-economic assessment.

- 2.3.9 Property units that support embedded infrastructure such as pipe line networks, digital communications or utility network connections infrastructure are not considered to support employment in a direct sense rather this was a matter for consideration in relation to service diversions/relocations.
- 2.3.10 For the purposes of assessing the impacts on home based businesses, all such businesses are considered to be ancillary to the main use as a residence (unless separately rated). The loss of residences will be captured under the requirements dealt with under the community assessment. Businesses operated as an ancillary activity will be considered to follow the relocation of any affected household.
- 2.3.11 Businesses without employment include companies registered to an address or companies remotely operating physical assets e.g. sub-let premises. The latter include owners of tenanted properties e.g. buy to let landlords or institutional owners. In these instances, the impacts affecting occupiers as individuals will be assessed under community impacts.
- 2.3.12 Businesses operating in the informal economy may be encountered. Businesses who have no formal title to land/property used in pursuit of a business activity are presumed to lie outside scope e.g. car repairs operated from a residential garage.

3 Community and socio-economic assessment criteria

3.1 Introduction

3.1.1 The ES uses both the terms 'impact' and 'effect' in all environmental topics. Whilst the nature of the difference of the topics means that the terms are likely to be used slightly differently in each, conformity of approach should be sought. An impact will be generally considered to be a physical change caused by the scheme (and in this context changes in air quality, noise levels or the quality of a view for example will be 'impacts'). The consequences of impacts on the receptors will be generally termed effects.

3.1.2 For the community and socio-economic assessments, resources will be the assets and facilities which are affected. Receptors are the operators, users or beneficiaries of those resources. Resources and receptors will vary for each type of impact and effect. So for example, the impact of 'increased construction traffic' may have a range of impacts, such as congestion on the roads. The effects of this congestion could be disturbance and annoyance to local residents and disruption for local businesses.

3.2 Impacts and effects

3.2.1 Impacts relevant to the community and socio-economic assessments fall broadly within the following categories:

- demolition and direct land possession;
- damage to property as a result of construction;
- intrusion/disturbance to communities, businesses and community facilities caused by other environmental impacts; and
- the economic consequences for local economies and their communities, for example via multiplier mechanisms¹.

3.2.2 Impacts will generate the following broadly defined effects on receptors and resources:

- **loss or gain:** a loss or gain to a resource or receptor. For example a decrease in housing stock as a result of demolitions, an increase in employment opportunities as a result of construction;
- **displacement:** displacement means the re-location of receptors from one location to another location within the study area, for example people moving from their homes to replacement homes, or businesses moving from their premises. The assessment recognises that in some cases businesses may expire if they are forced to relocate, and some businesses/residents may relocate outside of the study area (referred to as leakage);

¹ Multiplier mechanisms could include indirect employment opportunities generated as a result of construction and operation of the Proposed Scheme.

- **change in amenity:** The benefits of enjoyment and wellbeing that receptors gain from a resource in line with its intended function. This is referred to as an amenity value. The amenity value that receptors give to resources could be affected by a combination of factors such as: noise and vibration; heavy goods vehicle (HGV) construction traffic; air quality; and visual impacts. The socio-economic assessment will consider when a change in receptor amenity could potentially result in a loss of trade for affected businesses; and
- **isolation:** In the context of this assessment, isolation will be measured by potential isolation and islanding of communities and businesses. This includes physical and social barriers (i.e. non-economic) and the effects of this on local communities and businesses. The socio-economic assessment will consider when isolation of a business or group of businesses could potentially result in a loss of trade for those affected businesses.

3.3 Assessment criteria

- 3.3.1 Significance should be determined by assessing both the magnitude of the impact and the sensitivity of resources and receptors for each effect. Taken together magnitude and sensitivity will determine whether effects were considered to be 'significant' or 'not significant'. All effects are to be assessed, including adverse and beneficial.
- 3.3.2 There are several factors which determine magnitude of impact and sensitivity of resources and receptors. These factors and thresholds of significance vary for each theme of the community and socio-economic assessments.
- 3.3.3 The assessment criteria described in Table 1² highlight the types of impacts and effects on resources and relevant receptors. This includes guidance on the factors to consider and thresholds to ensure a consistent approach to assessing significance.
- 3.3.4 This table has been established using professional judgement and existing precedents and should be used as the starting point for assessment. In some instances it may be considered appropriate to adjust sensitivity and magnitude in the light of specific circumstances.
- 3.3.5 Table 1 will be used to determine both construction phase effects and operational phase effects. Whether a particular resource and receptor needs separate assessment for the construction and operational phases will depend upon the specifics of the scheme. Some receptors need different assessments for both construction and operational phases while other receptors will only require an assessment for one of the phases. There will also be instances in which it will be appropriate to take into account the construction phase effects when carrying out the assessment of the operational phase, for example if a facility will be closed down during the construction phase and would only be partly reopened during the operational phase.

² Table 1 builds upon the assessment guidance set out in the HS2 Scope and Methodology Report Chapters 7: Community and Chapter 14: Socio-economics.

Table 1: Guidance on assessing sensitivity and magnitude
(boxes in yellow are community impacts/effects, boxes in orange are socio-economic impacts/effects)

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
1. Residential Property	1.1 Residential property (including gardens) lost in part or whole to land required for construction or operation of the Proposed Scheme	Reduction in housing stock available for people	Displacement of home owners/ tenants, inconvenience and loss of their assets	<ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – Permanent loss (> 3 months) of 25 residential units or more – Temporary displacement (< 3 months) of 50 residential units or more • MEDIUM: <ul style="list-style-type: none"> – Permanent loss (> 3 months) of 10 residential units or more – Temporary displacement (< 3 months) of 20 residential units or more • LOW³: <ul style="list-style-type: none"> – Permanent loss (> 3 months) of 5 residential units or more – Temporary loss (< 3 months) of 10 residential units or more • NEGLIGIBLE: <ul style="list-style-type: none"> – Permanent loss (> 3 months) of 4 residential units or less – Temporary displacement (< 3 months) of 9 residential units or less – Possible variations: Where the number of dwellings affected is a high proportion of the size of a local community it may be appropriate to adjust the magnitude of impact 	<ul style="list-style-type: none"> • HIGH <p>Possible variations:</p> <ul style="list-style-type: none"> – Residents who only live for short periods of time in the properties (e.g. student accommodation) will experience less/limited disruption and so it may be appropriate to reduce sensitivity.
	1.2 Amenity value of residential property is changed	Character or quality of residential properties changes	Receptors' of resource is changed	At least five properties need to experience an effect for a resource to potentially experience a community impact. The primary test of magnitude will be the nature of the effects on the function of the resource. Also of relevance is the duration of the impact.	<ul style="list-style-type: none"> • HIGH <p>Given the likely fairly small range in the number of units making up an individual receptor it is not anticipated to be relevant to vary the</p>

³ The low impact quantities will be the same as used for the Crossrail threshold of significance. When combined with the usual high sensitivity of the residential receptor this also will give a significant impact for HS2 receptors.

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>Effect on function of resource and implications for receptors:</p> <ul style="list-style-type: none"> • HIGH: Three or more residual significant other effects • MEDIUM: Two significant residual other environmental effects <p>The amenity assessment will only consider the in-combination significant residual effects from other topics so the LOW and NEGLIGIBLE categories are not considered to be applicable with regards to magnitude of impact.</p> <p>Potentially other topic effects⁴ could include relevant elements of: air quality; landscape and visual; sound, noise and vibration; and traffic and transport (in terms of impacts of HGV (construction traffic) movements⁵).</p> <p>Duration: The duration of the impact should be taken into account. Generally speaking where duration is less than six months it may be appropriate to reduce the magnitude of the impact below the initial effect thresholds.</p>	magnitude by the number of units.
	1.3 Isolation of residential properties from other properties and infrastructure ⁶	Physical e.g. islanding or isolation of resource	Social and/or community functioning is damaged	<p>At least five properties need to experience an effect for a resource to potentially experience a community impact.</p> <ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – Permanent isolation (>12 months) of residences from their communities and services covering many of the other properties and/or much of the infrastructure that they typically connect with/access on an at least weekly basis. Occurs as a result of either road closure and/or lengthy delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings. – Temporary isolation (6 to 12 months) of residences from their communities and services covering many of the other properties and/or much of the infrastructure that they typically connect with/access on an at least daily basis. Occurs as a result of either road closure 	<ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – No comparable and accessible alternatives exist within the relevant catchment area – Resources/receptors have no or very little ability to absorb the change – With a high proportion of more vulnerable user groups, e.g., children, elderly, disabled. • MEDIUM: <ul style="list-style-type: none"> – Limited comparable and accessible alternatives exist within the relevant catchment area – Resources/receptors have limited ability to

⁴ Some of the other Topics will not assess all community resources potentially susceptible to amenity impacts. For the community resources which fall into this category, the community assessor should liaise with the relevant Topic Lead who can provide expert judgement on whether there is likely to be a residual significant effect.

⁵ The HGV (construction traffic) movements' assessment assesses routes to be used by HGV construction traffic which will be significantly affected by the Proposed Scheme. Assessors should identify and map community resources whose sensitivity is considered susceptible to HGV construction traffic flows.

⁶ This type of impact is different from the severance impacts assessed in Traffic and Transport, which are focused solely on impacts on journeys.

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>and/or lengthy delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings.</p> <ul style="list-style-type: none"> • MEDIUM: <ul style="list-style-type: none"> – Permanent isolation (> 12 months) of residences from their communities and services leaving them partially isolated from some of the other properties and/or infrastructure that they typically connect with/access on an at least a weekly basis. Occurs as a result of either road closure and/or moderate delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings. – Temporary isolation (6-12 months) of residences from their communities and services leaving them mostly isolated from some of the other properties/infrastructure that they typically connect with/access on a weekly basis. Occurs as a result of road closure or moderate delay/disruption to journeys on a weekly basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings. – Temporary isolation (1 to 6 months) of residences from their communities and services leaving them mostly isolated from some of the other properties and/or infrastructure that they typically access on a daily basis. Occurs as a result of road closure or moderate delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings. • LOW: <ul style="list-style-type: none"> – Permanent isolation (> 12 months) of residences from their communities and services from a small number of the other properties and/or amount of infrastructure that they typically connect with/access on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. – Temporary isolation (1-12 months) of residences from their communities and services leaving them partially isolated from a small number of the other properties 	<p>absorb the change</p> <ul style="list-style-type: none"> – With a mix of user groups • LOW: <ul style="list-style-type: none"> – Many comparable and accessible alternatives exist within the relevant catchment area – Resources/receptors has sufficient means and capacity to absorb the change – A narrow population of users with no specific vulnerable groups where access is a key issue; or a general mix of users

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>and/or amount of infrastructure that they typically connect with/access on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding residential dwellings.</p> <ul style="list-style-type: none"> - Temporary isolation (< 1 month) of residences from their communities and services partially isolated from a small number of the other properties and/or infrastructure that they typically access on a weekly (or less frequent) basis. Occurs as a result of road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding residential dwellings. <p>• NEGLIGIBLE:</p> <ul style="list-style-type: none"> - No permanent isolation (> 12 months) of any residences from their communities and services from the other properties and/or infrastructure that they typically connect with or access on an infrequent basis. There may be short delay/disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding residential dwellings. - Temporary isolation (1-12months) of any residential properties/communities from a small number of the other properties and/or infrastructure that they typically access on an infrequent basis. There may be short delay/disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding residential dwellings. - Temporary isolation (< 1 month) of any residential properties/communities from a small number of the other properties and/or infrastructure that they typically access on an infrequent basis. There may be short delay/disruption to access services. Can also occur as a visual barrier due to construction works surrounding residential dwellings. <p>Possible variations: Where the number of dwellings affected is a high proportion of the size of a local community it may be appropriate to adjust the</p>	

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>magnitude of impact.</p> <p>Assessors should review Traffic and Transport assessments of severance and journey delays to check for consistency with findings. These assessments are anticipated to be helpful for context and issues.</p>	
2. Community infrastructure, recreation infrastructure and open/play space	2.1 Infrastructure lost due to land required for construction or operation of the Proposed Scheme in part or in whole	Decline in facilities available for community use or temporary impairment of use	Loss of facilities and benefits for users, workers owners, and groups/ organisations, including any differential equality and health effects	<p>Below are details of characteristics (function and duration) typically associated with each magnitude of impact. Depending on the nature of the impact the weight given by the assessor to each characteristic will vary so that it is not necessary that the assessed degree of impact includes all of the characteristic thresholds given under each magnitude.</p> <ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – Function/ability to absorb: Resource is completely closed/compromised and unusable for its intended purpose(s)Duration: Long term (>1 year)/permanent • MEDIUM: <ul style="list-style-type: none"> – Function/ability to absorb: Resource is partially closed/compromised and unusable for a proportion of its intended purposes – Duration: Medium term (6 months to 12 months) • LOW: <ul style="list-style-type: none"> – Function/ability to absorb: Resource is compromised and its functionality is partly impaired or compromised Duration: Short term (1 month to 6 months) and reversible • NEGLIGIBLE: <ul style="list-style-type: none"> – Function/ability to absorb: Resource is not closed and can continue to be used for its intended purpose without any significant inconvenience or detriment to the users – Duration: Short term (<1 month and fully reversible) 	<p>Below are details of characteristics typically associated with each sensitivity of impact.</p> <ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – No comparable and accessible alternatives exist within the relevant catchment area – Highly or regularly used and valued resource • MEDIUM: <ul style="list-style-type: none"> – Limited comparable and accessible alternatives exist within the relevant catchment area – Moderately or semi-regularly used and valued resource • LOW: <ul style="list-style-type: none"> – Many comparable and accessible alternatives exist within the relevant catchment area – Sparingly or infrequently used and valued resource <p>Possible variations: It may be appropriate to vary sensitivity if receptors have limited ability to absorb change</p>
	2.2 Amenity value of infrastructure is changed	Character or quality of cities/towns/ neighbourhoods/ paths changes.	Receptors' enjoyment of resource is changed, including any differential equality and health	<p>The primary test of magnitude will be the nature of the effects on the function of the resource. Also of relevance is the duration of the impact.</p> <p>Effect on function of resource and implications for</p>	<p>Below are details of characteristics typically associated with each sensitivity of impact.</p> <ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – There are limited/no comparable and

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
			effects	<p>receptors:</p> <ul style="list-style-type: none"> • HIGH: Three or more residual significant other effects • MEDIUM: Two significant residual other environmental effects <p>The amenity assessment will only consider the in-combination significant residual effects from other Topics so the LOW and NEGLIGIBLE categories are not considered to be applicable with regards to magnitude of impact.</p> <p>Potentially other topic effects could include relevant elements of: air quality; landscape and visual; sound, noise and vibration; and traffic and transport (in terms of impacts of HGV (construction traffic) movements.</p> <p>Duration: The duration of the impact should be taken in to account. Generally speaking where duration is less than 6 months it may be appropriate to reduce the magnitude of the impact below the initial effect thresholds.</p>	<p>accessible alternatives that exist within the relevant catchment area</p> <ul style="list-style-type: none"> – Resource/receptor has limited ability to absorb the change (e.g. this may be applicable for quiet gardens, quiet/solitary natural beauty spots, etc.) – Highly or regularly used and valued resource <ul style="list-style-type: none"> • MEDIUM: <ul style="list-style-type: none"> – There are limited comparable and accessible alternatives within the relevant catchment area – Resources/receptors have limited ability to absorb the change. – Moderately or semi-regularly used and valued resource • LOW: <ul style="list-style-type: none"> – Resource/receptor are able to relatively easily absorb the change (e.g. this may be applicable for active recreational sports fields and grounds and open spaces) – There are many comparable and accessible alternatives exist within the relevant catchment area. – Sparingly or infrequently used and valued resource
	2.3 Isolation of community infrastructure from other properties and infrastructure ⁷ Isolation of community infrastructure	Physical e.g. Islanding or isolation of resource	Social and/or community functioning is damaged	<ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – Permanent isolation (>12 months) of services from its community covering much of the relevant local community that it typically serves on at least a weekly basis. Occurs as a result of either road closure and/or lengthy delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding community 	<ul style="list-style-type: none"> • HIGH: <ul style="list-style-type: none"> – No comparable and accessible alternatives exist within the relevant catchment area – Resources/receptors have limited ability to absorb the change – With a high proportion of more vulnerable user groups, e.g., children, elderly, disabled

⁷ This type of impact is different to the severance impacts assessed in Traffic and Transport, which are focused solely on impacts on journeys.

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>infrastructure.</p> <ul style="list-style-type: none"> – Temporary isolation (6 to 12 months) of services from its community covering much of the relevant local community that it typically serves on at least a daily basis. Occurs as a result of either road closure and/or lengthy delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure. <ul style="list-style-type: none"> • MEDIUM: <ul style="list-style-type: none"> – Permanent isolation (> 12 months) of services from its community leaving it partially isolated from some of the relevant local community that it typically serves on at least a weekly basis. Occurs as a result of either road closure and/or moderate delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure. – Temporary isolation (6-12 months) of services from its community leaving it mostly isolated from some of the relevant local community that it typically serves on at least a weekly basis. Occurs as a result of road closure or moderate delay/disruption to journeys on an at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure. – Temporary isolation (1 to 6 months) of services from its community leaving it mostly isolated from some of the relevant local community that it typically serves on at least a daily basis. Occurs as a result of road closure or moderate delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure. • LOW: <ul style="list-style-type: none"> – Permanent isolation (> 12 months) of services from its community leaving it partially isolated from a small part of the relevant local community that it typically serves on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption 	<ul style="list-style-type: none"> • MEDIUM: <ul style="list-style-type: none"> – Limited comparable and accessible alternatives exist within the relevant catchment area – Resources/receptors have limited ability to absorb the change – With a mix of user groups • LOW: <ul style="list-style-type: none"> – Many comparable and accessible alternatives exist within the relevant catchment area – Resource/receptor are able to relatively easily absorb the change – A narrow population of users with no specific vulnerable groups where access is a key issue; or a general mix of users

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>to journeys. Can also occur as a visual barrier due to construction works surrounding community infrastructure.</p> <ul style="list-style-type: none"> – Temporary isolation (1-12 months) of services from its community leaving it partially isolated from some of the relevant local community that it typically serves on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding community infrastructure. – Temporary isolation (< 1 month) of services from its community leaving it partially isolated from some of the relevant local community that it typically serves on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding community infrastructure. <ul style="list-style-type: none"> • NEGLIGIBLE: <ul style="list-style-type: none"> – No permanent isolation (> 12 months) of services from its community that it typically serves on an infrequent basis. There may be short delay/ disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding community infrastructure. – Temporary isolation (1-12months) of services from its community that it typically serves on an infrequent basis. There may be short delay/ disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding community infrastructure. – Temporary isolation (< 1 month) of services from its community that it typically serves on an infrequent basis. There may be short delay/disruption to access services. Can also occur as a visual barrier due to construction works surrounding community infrastructure. <p>Possible variations: Where the number of users is a high proportion of the size of a local community it may be</p>	

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>appropriate to adjust the magnitude of impact</p> <p>Assessors should review Traffic and Transport assessments of severance and journey delays to check for consistency with findings. These assessments are anticipated to be helpful for context and issues.</p>	
4. Existing businesses and organisations – due to land required for construction or operation of the Proposed Scheme and amenity impacts	4.1 Businesses (including community) lost due to land required for construction or operation of the Proposed Scheme	Loss or impairment of business activities	Change in employment and skills mix	<p>Individual receptors:</p> <ul style="list-style-type: none"> • HIGH: Estimated loss/relocation of more than 50 jobs • MEDIUM: Estimated loss/relocation of between 10 and 50 jobs • LOW: Estimated loss/relocation of between 2 and 9 jobs • NEGLIGIBLE: Loss/relocation of 1 or less jobs. <p>Possible variations:</p> <ul style="list-style-type: none"> • Where the number of employees is a high/low proportion of the size of a local community/business cluster it may be appropriate to increase/reduce the magnitude assessment. <p>Route wide:</p> <ul style="list-style-type: none"> • HIGH: Estimated loss/relocation of more than 5000 jobs • MEDIUM: Estimated loss/relocation of between 1000 and 5000 jobs • LOW: Estimated loss/relocation of between 100 and 999 jobs • NEGLIGIBLE: Estimated loss/relocation of less than 100 jobs 	<p>Sensitivity will vary significantly and depend upon a range of factors:</p> <ul style="list-style-type: none"> • Availability of alternative, suitable premises • Site specific issues • Size of local labour market • Skill levels and qualifications of local people; and • Levels of unemployment <p>Assessors should use the question prompts in List B (refer to Section 3.4) when weighing up sensitivity.</p>
	4.2 Businesses (including community): Amenity value of infrastructure is changed resulting in an impact on businesses and organisations' operations	Character or quality of businesses and organisations' environment changes.	Change in employment and skills mix	<p>The primary test of magnitude will be the nature of the effects on the function of the resource. Also of relevance is the duration of the impact.</p> <p>Magnitude of impact is anticipated to vary significantly depending upon the characteristics of each situation. Generally though the magnitude of socio-economic impacts will depend upon the magnitude of other environmental impacts. The following guide is consequently suggested at the receptor level:</p> <p>Effect on function of resource and implications for</p>	<p>Sensitivity will vary significantly depending upon a wide range of characteristics of each business/organisation. Generally more sensitive receptors are likely to fall in sectors including:</p> <ul style="list-style-type: none"> • Hospitality • Recreation and culture • Retail • Education and training. <p>Assessors should use the question prompts in</p>

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
				<p>receptors:</p> <ul style="list-style-type: none"> • HIGH: Three or more residual significant other effects • MEDIUM: Two significant residual other environmental effects <p>The amenity assessment will only consider the in-combination significant residual effects from other Topics so the LOW and NEGLIGIBLE categories are not considered to be applicable with regards to magnitude of impact.</p> <p>Potentially other effects include relevant elements of: air quality; landscape and visual; sound, noise and vibration; and traffic and transport (in terms of impacts of HGV (construction traffic) movements.</p> <p>Duration: The duration of the impact should be taken in to account. Generally speaking where duration is less than 6 months it may be appropriate to reduce the magnitude of the impact below the initial effect thresholds.</p> <p>Given the uncertainties of estimating such employment losses/relocations at an individual receptor level the individual assessments will be used as an input to estimate an aggregated route-wide level impact⁸:</p> <ul style="list-style-type: none"> • HIGH: Estimated loss/relocation of more than 500 jobs • MEDIUM: Estimated loss/relocation of between 100 and 500 jobs • LOW: Estimated loss/relocation of between 10 and 99 jobs. • NEGLIGIBLE: Estimated loss/relocation of less than 10 jobs. 	List B (refer to Section 3.4) when weighing up sensitivity.
	4.3 Isolation of infrastructure from receptors resulting in an impact on businesses and organisations'	Physical e.g. Islanding or isolation of resource results in change to business and organisations'	Change in employment and skills mix	<p>Magnitude of Impact will vary depending upon a number of factors including:</p> <ul style="list-style-type: none"> • Closures of roads/PRoW and duration of closures • Extent of diversions • Potential delay/disruption 	<p>Sensitivity will vary significantly depending upon a wide range of characteristics of each business/organisation. Generally more sensitive receptors are likely to fall in sectors including:</p> <ul style="list-style-type: none"> • Hospitality • Recreation and culture

⁸ Establishments which will be significantly affected by amenity and/or isolation should be converted to an employment total using available information (e.g. business type and estimated employment within business establishment). This information will be presented in the Route Wide Assessment (Volume 3).

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
	operations	environment		<p>Assessors should use the question prompts in List A (refer to Section 3.4) when weighing up magnitude.</p> <p>Given the uncertainties of estimating such employment losses/relocations at an individual receptor level the individual assessments will be used as an input to estimate an aggregated route-wide level impact:</p> <p>Route wide:</p> <ul style="list-style-type: none"> • HIGH: Estimated loss/relocation of more than 500 jobs • MEDIUM: Estimated loss/relocation of between 100 and 500 jobs • LOW: Estimated loss/relocation of between 10 and 99 jobs • NEGLIGIBLE: Estimated loss/relocation of less than 10 jobs 	<ul style="list-style-type: none"> • Retail • Education and training. <p>Assessors should use the question prompts in List B (refer to Section 3.4) when weighing up sensitivity.</p>
5. Employment associated with construction	5.1 Direct employment opportunities associated with the construction phase	Demand for construction phase services	Demand for construction phase associated jobs and change in opportunities for local employment	<p>Route wide:</p> <ul style="list-style-type: none"> • HIGH: Estimated creation of more than 10,000 person years⁹ of construction employment • MEDIUM: Estimated creation of between 5,000 and 10,000 person years of construction employment • LOW: Estimated creation of between 100 and 4,999 person years of construction employment • NEGLIGIBLE: Estimated creation of less than 100 person years of construction employment 	<p>Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be:</p> <ul style="list-style-type: none"> • HIGH
	5.2 Indirect impacts on the economy of the construction phase	Indirect impacts on other construction sector projects, multiplier impacts on the wider economy	Demand for construction sector jobs and change in opportunities for local employment	<p>Route wide:</p> <ul style="list-style-type: none"> • HIGH: Estimated creation of more than 10,000 person years of construction employment • MEDIUM: Estimated creation of between 5,000 and 10,000 person years of construction employment • LOW: Estimated creation of between 100 and 4,999 person years of construction employment • NEGLIGIBLE: Estimated creation of less than 100 person years of construction employment 	<p>Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be:</p> <ul style="list-style-type: none"> • HIGH

⁹ 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.

Theme	Impacts	Effects:		Magnitude of impact	Sensitivity of receptors/resources
		On resources	On receptors		
6. Employment associated with operations	6.1 Direct employment opportunities associated with the operations phase	Demand for operational phase services	Change in employment and skills and change in opportunities for local employment	Route wide: <ul style="list-style-type: none"> • HIGH: Estimated net creation of more than 5,000 jobs over baseline • MEDIUM: Estimated net creation of between 1,000 and 5,000 jobs over baseline • LOW: Estimated net creation of between 100 and 999 jobs over baseline • NEGLIGIBLE: Estimated net creation of less than 100 jobs over baseline 	Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be: <ul style="list-style-type: none"> • HIGH
	6.2 Indirect impacts on the economy of the operations phase	Indirect impacts on sectors of the economy, multiplier impacts on the wider economy	Change in employment and skills and change in opportunities for local employment	Route wide: <ul style="list-style-type: none"> • HIGH: Estimated net creation of more than 5,000 jobs over baseline • MEDIUM: Estimated net creation of between 1,000 and 5,000 jobs over baseline • LOW: Estimated net creation of between 100 and 999 jobs over baseline • NEGLIGIBLE: Estimated net creation of less than 100 jobs over baseline 	Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be: HIGH

3.4 Assessment criteria checklist

Magnitude of impact

- 3.4.1 In considering the magnitude of an impact on a resource and its receptors, assessors should consider each impact against the checklist of magnitude questions presented in List A. The questions are designed to assist in deciding on magnitude and judging whether there could be any specific circumstances in which the magnitude ranking should differ from the thresholds. Not every question will be relevant to the circumstances.
- 3.4.2 Some situations/outcomes may not be known for certain. Assessors should base their work on an assessed mostly likely situation/outcome.

List A: Questions relevant to the assessment of magnitude of impact

Effect on function of resource and implications for receptors:

- How will the impact affect the functioning of the resource? To what degree can it absorb the change?
- What is the severity/intensity of the impact on people's lives and activities?
 - Do other EIA topics conclude a significant effect?

Duration – temporal scope of effect on receptor:

- What is the temporal scope of the impact?
 - Does the impact occur at specific times of the day?
 - For how long does the impact occur?
 - How regularly does the impact occur?
 - Is the impact temporary or permanent?

Sensitivity of receptors

- 3.4.3 In considering the sensitivity of receptors to an impact, assessors should consider each impact against the checklist of sensitivity questions given in List B. Not every question will be relevant to the circumstances of each receptor. The questions are designed to assist in deciding on sensitivity and judging whether there could be any specific circumstances in which the sensitivity ranking should differ from the thresholds.
- 3.4.4 Some situations/outcomes may not be known for certain. Assessors should base their work on assessed mostly likely situations/outcomes.
- 3.4.5 For the assessment of amenity impacts, sensitivity should be considered as a separate step in the community and socio-economic assessment process. Where there is an overlap with other disciplines and this is considered by assessors to be important they should ensure that the overall significance rating is consistent with the other relevant assessments.

List B: Questions relevant to the assessment of sensitivity

Scarcity/alternatives for receptors

What is the scarcity of the affected resource and what is the availability of alternatives? Factors to consider include:

- What is the catchment area of the affected resource?
- Are there comparable alternative resources available within the relevant catchment area?
- How easy is it to replace the resource? E.g. does it have special site requirements that are difficult to replicate or are its locational requirements generic and relatively easily met elsewhere?
- What is the spare capacity of the alternative resources and is this potentially available to the users of the affected resource?
- What is the likelihood that alternative resources/sites/options will become available?

Capacity to respond to loss/gain for receptors

- What is the receptor's capacity to experience a loss or gain of the affected resource?
- Nature of users – are they concentrated in the local area? Are they a specialised interest group? Are they local/ regional/ national/ international? Does this nature then influence their capacity to experience a loss or gain in the affected resource?
- Are users concentrated in potentially more sensitive groups, such as people on low incomes, unemployed, older people, children, ethnic minorities, people in poor health etc.
- How mobile are the receptors? E.g. are they likely to have access to a car? Do they have any physical constraints on their movement such as walking slowly etc?

Number of people affected/extent of use/value of resource

What is the spatial scope of the effect (i.e. to help inform judgement on the number of people affected)?

- How many people/what proportion of people, are likely to experience the impact?
 - Generally the greater the number of people which experience an impact the greater the magnitude.
 - But also consider people experiencing an impact as a proportion of the total people in a relevant community and/or group, i.e. if the number of people experiencing an impact is low but the proportion is high, then it may be appropriate to consider the magnitude as higher.

3.5 Community wide effects

Defining community-wide effects

- 3.5.1 There may be instances where a combination of effects on individual community resources has a wider impact on a community. Community assessors should consider whether the Proposed Scheme is likely to change the way in which a significant proportion of the people in a specific local community experience and performed their local functions (live, work, leisure, travel) on a day-to-day basis. Community-wide effects will be reported as 'cumulative effects' in the Formal Environmental Statement.

Outline guidance

- 3.5.2 Using the individual assessments conducted at CFA level, community assessors should undertake a qualitative assessment of community-wide effects. This will require assessors to use professional judgement to consider whether the assessment findings on community resources and receptors in the CFA have identified matters that could be applicable/relevant at a community-wide level (i.e. having an appreciable effect across the majority of the community) as opposed to only affecting individually identified resources and receptors.

Defining community geography

- 3.5.3 Assessment will either be undertaken at sub-CFA or CFA level. At sub-CFA level this will involve carrying out assessments at the level of smaller community areas. These smaller community areas would be typically aligned with obvious or clear spatial boundaries that separate or join-up geographic areas into distinct communities.

4 Community and Socio-economic Assumptions

4.1 Introduction

4.1.1 The key assumptions underlying the community and socio-economic assessments are set out below.

4.2 Community Assumptions

- 4.2.1 The assessment draws on other assessment topics where necessary to identify the primary sources of community impacts. Although the level and intensity of proposed construction will vary during the construction period, the assessment focusses on the construction activities and durations which could lead to the greatest potential impact.
- 4.2.2 The spatial scope of the assessment varies, depending on the nature of the receptors and the impacts being considered. Whilst effects associated with construction or the land used for construction/operation will be confined to the immediate vicinity of the route, effects resulting from a combination of impacts or relating to the overall functionality of a community will typically apply to wider areas such as neighbourhoods or parishes.
- 4.2.3 The community assessment considers the function of land rather than its ownership as the key parameter for assessing impacts associated with the Proposed Scheme.
- 4.2.4 The hybrid Bill identifies various categories of land required to facilitate the construction and operation of the Proposed Scheme. Some of these categories of land will have no impact on the ability of existing and future baseline uses of that land to continue both during construction and operation. For example, one category to which this applies is land above the line of tunnels.
- 4.2.5 Where practicable, land required solely during the construction period will be returned to its previous use after construction unless that use cannot continue or resume within a reduced area. Where the use cannot resume, the effect is treated as permanent.
- 4.2.6 The assessment considers the construction phase (2017-26) and the first year of operation (2026), with one exception. For the assessment of amenity effects, the operational noise assessment is based upon the service frequency associated with Phase two of the Proposed Scheme, which will not commence until some years later. For other assessment topics, it is generally assumed that effects are unlikely to persist for a long time into the future as communities adjust to the presence of the Proposed Scheme and as new or replacement community facilities will have been developed where necessary.
- 4.2.7 Community resources are mentioned expressly in the environmental baseline only where they contribute to the local context or where they may be affected by the Proposed Scheme. Consequently not all community resources within the study area are mentioned.
- 4.2.8 Effects relating to the severance of public rights of way (PRoWs) (public footpaths and bridleways) and highway and pedestrian diversions, are assessed under Traffic and

Transport. However, where PRoWs are a "promoted" destination in their own right as a recreational resource, they have been considered within the community assessment. Where impacts on open space and PRoWs are considered, these have been informed by open space and PRoW usage surveys.

- 4.2.9 Open space surveys were undertaken by community assessors in order to collect primary survey data on use of such spaces. Assessors surveyed each site on one week day during the autumn term and one summer weekend day. Surveying aimed to avoid adverse weather conditions and weather conditions were recorded for each survey. Any variations from the above and the reasons for this have been reported on in the individual open space survey write-ups in Volume 5 Community Appendices.
- 4.2.10 Where open space is privately owned and not available for use by the general public, it has been excluded from the assessment (e.g. woodlands on farmland). However, where land is privately owned but open for public use (e.g. parks or gardens surrounding country houses) it has been included in the assessment.
- 4.2.11 The community assessment reports on all significant community effects as well as those effects which are not significant but are considered of importance to reference given their relevance to the study area which represents each CFA.
- 4.2.12 The different assessments within the Community section (residential property and community infrastructure affected by land required for construction and operation of the Proposed Scheme, isolation and changes in amenity) are not directly comparable when considering significance of effect. Assessments have been considered in aggregate as part of the Community Wide analysis which is presented in the Community section (cumulatives section) in the CFA reports (ES Volume Two).
- 4.2.13 Isolation effects are included within the scope of this assessment and the analysis considers physical separation, major increases in delay/disruption (as identified in the Transport Assessment), and the psychological barrier effects (including those which may be caused by visual barriers, such as residential properties located amongst construction works) that might impair links between residents and their facilities. Isolation is assumed to be a phenomenon that will occur as a result of the construction of the Proposed Scheme and can be either a temporary or permanent effect.
- 4.2.14 The community amenity assessment draws on the residual significant effect findings from other topics (i.e. after mitigation has been taken into account by those topics) and combines these findings to determine whether there is a significant amenity effect on the community. Findings from other topic assessments are not directly comparable in terms of the specific scale of effect.
- 4.2.15 Increases in HGV construction traffic flows as a result of construction of the Proposed Scheme will affect the amenity of local communities. Community assessors obtained this information from the Transport Assessment. This aspect of the assessment is about the presence of HGV on routes and their proximity to community resources.
- 4.2.16 Information on duration of significant residual effects was provided by other topics where available. Where the relevant information was available, community assessors used this to identify when significant residual effects from other topics occurred simultaneously.

- 4.2.17 Professional judgement was provided by other topics (i.e. sound, noise and vibration (SNV), Landscape and Visual and Air Quality) to inform the community amenity assessment. Any significant effects findings established through professional judgement have been used in the same way as assessment findings derived through quantitative assessment.
- 4.2.18 The SNV Topic assumes all PRow (with the exception of those that exist in tranquil areas) to be, by their nature, transitory routes with users not staying in any one location for a long period of time and hence have not included these PRow within their assessment scope. Consequently, there are not considered to be any significant noise effects on PRow (unless the assessment identifies significant SNV on areas prized for their tranquillity and hence the PRow therein) as a result of construction and operation of the Proposed Scheme.
- 4.2.19 Commentary on noise impacting on recreational PRow as a result of the Proposed Scheme was provided for those recreational PRow which run adjacent to the Proposed Scheme for at least 800m (this includes where the Proposed Scheme crosses the PRow).
- 4.2.20 The assessment methodology excludes, for the purposes of reporting amenity and isolation effects, residential properties where the total number of dwellings is fewer than five. There are a number of individual properties scattered along the route where impacts may be experienced from other Topics. These impacts are assessed, where relevant, in other Topic chapters.
- 4.2.21 Residential properties which are impacted by the Proposed Scheme have been grouped together either by street, hamlet or village. In some circumstances along the route other Topics, such as SNV, may have grouped residential properties slightly differently. In these situations, community assessors liaise with the relevant Topic to determine professional judgement with regards to the residential grouping.
- 4.2.22 The community assessment considers three different types of cumulative effects. These are inter-project, in-combination (amenity) and community-wide (synergistic).
- 4.2.23 Community resources identified as part of inter-project (cumulative) schemes may interact with the Proposed Scheme during their construction and as a result of their occupation by new receptors during the time when the Proposed Scheme is being constructed and beyond. During their construction, cumulative projects have the potential to create their own environmental impacts. Additional SNV, visual, air quality, dust and HGV traffic movement impacts risk compounding those effects generated by the Proposed Scheme. However, given these projects are far into the future, a lack of information prevented any assessment of effect being undertaken.

4.3 Socio-economic Assumptions

- 4.3.1 The impacts of the Proposed Scheme on socio-economic resources (property units supporting employment) and the consequential effects on receptors (users of the resource or it's service/goods) was considered in terms of full time equivalent (FTE) jobs gained, lost or relocated.
- 4.3.2 Loss of trade within a business can be considered as a loss of turnover and represented as a change in employment at the affected business (assuming a positive

relationship between growth/contraction in a business' turnover and growth/contraction in employment at that business).

- 4.3.3 Since the level and intensity of proposed construction will vary during the construction period, the level of significant effects on socio-economic resources could vary. The assessment reported is focused on the construction activities and durations which could lead to the greatest potential impact.
- 4.3.4 Where practicable, land required solely during the construction period will be returned to its previous use after construction unless that use cannot continue or resume within a reduced area. Where the use cannot resume, the effect is treated as permanent.
- 4.3.5 The assessment considers the construction phase (2017-26) and the first year of operation (2026). The first year of operation, 2026, was assessed as it was considered to offer a worse-case forecast of effects.
- 4.3.6 The future baseline of the construction phase was taken to be the existing employment position of those socio-economic resources identified as being directly affected or indirectly affected by the Proposed Scheme. It can be expected, due to changes in socio-economic conditions, that there would be changes in the number and type of business activities of those resources affected from that which is currently observed, for instance businesses may open or close, and sites or premises that are currently occupied may become unoccupied. However in absence of information about the specific economic circumstances of the businesses, their financial plans, owner intentions, or whether the capacity of the commercial site or building is likely to change in the long term, it is not possible to forecast how employment could change with any certainty before commencement of the Proposed Scheme.
- 4.3.7 The different assessments within the Socio-economic chapter (socio-economic resources affected by land required for the Proposed Scheme, isolation and changes in amenity) are not directly comparable when considering the significance of effect. For resources affected by land required for the Proposed Scheme the implication is that the employment within these resources will either relocate or be lost and the significance of this has been assessed. For resources affected by isolation and/or changes in amenity the situation is less clear in terms of employment implications. With this in mind impacts are assessed and reported at an individual resource level although any employment implications are assessed at route wide level.
- 4.3.8 The assessment considers the potential reduction in economic output arising as a consequence of direct effects – the relocation or closure of businesses located on land required for the construction and operation of the Proposed Scheme. For the purposes of this assessment the indicative rate of successful business relocations is judged to be 88% and no employment at these businesses will be lost. The rate of closure of directly affected businesses is therefore 12% and all employment within these businesses is assumed to be lost.
- 4.3.9 The socio-economic business amenity assessment draws on the residual significant effect findings from other Topics. These findings are combined to determine whether there is a significant amenity effect. Findings from other Topic assessments are not directly comparable in terms of their scale of effects.
- 4.3.10 The socio-economic business amenity assessment and community amenity assessment are not directly comparable. The business amenity assessment considers

whether a business may lose trade as a result of its users/customers amenity being affected by the Proposed Scheme and the potential employment consequences. The community amenity assessment considers whether the amenity that a community places on a community resource is affected by the Proposed Scheme.

- 4.3.11 Employment implications on individual socio-economic resources which result from single Topic significant residual effects are outside the scope of this assessment. At route wide level, any employment implications of this nature are considered to be limited and not significant.
- 4.3.12 The socio-economic assessment does not assess localised impacts on tourism/visitors to venues along the route. There is no robust evidence (or method of assessment) to determine whether or not there is a significant displacement of employment at these venues as a result of the Proposed Scheme.
- 4.3.13 With regards to the amenity and isolation assessments the sensitivity of receptors will vary from business to business but will be dependent on whether the Proposed Scheme will be likely to have an adverse effect on trade. Businesses located in the hospitality, recreation and culture and retail sectors are most likely to have receptors with high levels of sensitivity given the risk of trade diversion as a result of the Proposed Scheme. In determining sensitivity, consideration is given to catchment of the affected socio-economic resource, alternative unaffected competitor business, attraction of the facility to customers and type and make-up of facility.
- 4.3.14 With regards to the amenity and isolation assessments, it is assumed a business establishment experiencing an adverse effect on trade can adopt a number of strategies before reducing employment (e.g. cancel/postpone investment in premises/stock/machinery, reduce staff working hours, family members working longer hours, cancel/postpone plans to expand business, temporary laying-off staff, renegotiate loans or mortgage, increase marketing or advertising activity etc.). Any reduction in employment has been calculated by estimating the total employment of the business(es) affected; then, based on the business activity/sector type, by applying a percentage to represent the likely proportion of employment which could be significantly affected by changes in amenity or isolation.
- 4.3.15 Increases in HGV construction traffic flows as a result of construction of the Proposed Scheme will affect the amenity of local businesses and organisations. Socio-economic assessors obtained this information from the Transport Assessment. This aspect of the assessment is about the presence of HGV on routes and their proximity to socio-economic resources.
- 4.3.16 Information on duration of significant residual effects was provided by other Topics where available. Where the relevant information was available, socio-economic assessors used this to identify when significant residual effects from other topics occurred simultaneously.
- 4.3.17 Other Topics, such as SNV and Landscape and Visual, have not explicitly identified in their chapters all socio-economic resources which are significantly affected by the Proposed Scheme. In such cases, socio-economic assessors consulted with relevant Topics in order that they provided professional judgement on whether there were significant effects associated with those socio-economics resources which were not specifically identified in their chapters. For the purposes of business amenity

assessment, any significant effects findings which have been established through professional judgement were used in the same way as findings which had been derived by technical assessment and provided directly by the other Topics.

- 4.3.18 Magnitude of impact within the business amenity assessment is anticipated to vary significantly depending upon the characteristics of each situation. Generally the magnitude of impact will depend upon the magnitude of other environmental effects. However, in certain circumstances it was appropriate to acknowledge that some significant residual effects from other Topics (for example visual) may not be appropriate to apply to particular socio-economic resources in terms of contributing to a possible amenity loss.
- 4.3.19 Socio-economic resources identified as part of cumulative schemes may interact with the Proposed Scheme during their construction and as a result of their occupation by new receptors during the time when the Proposed Scheme is being constructed and beyond. During their construction, cumulative projects have the potential to create their own environmental impacts. Additional SNV, visual, air quality, dust and HGV traffic movement impacts risk compounding those effects generated by the Proposed Scheme. However, given these projects are far into the future, a lack of information prevented any assessment of effect being undertaken.
- 4.3.20 Employment within socio-economic resources was estimated through a combination of sources, for example, business consultation, Experian employment dataset, employment floor space (obtained from either the Valuation Office Agency or an estimate made via site visits and GIS mapping) and the Homes and Communities Agency (HCA) Employment Density Guide (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas and may vary from actual employment at the sites.
- 4.3.21 Employment loss within agricultural organisations has been estimated by the Agriculture, forestry and soils topic and is reported in aggregate at route wide level in Volume Three.
- 4.3.22 Construction labour was reported in construction person years, where one construction person year represented the work done by one worker in a year composed of a standard number of working days.
- 4.3.23 It is assumed that the demand for and supply of construction labour will remain largely the same as at present up to the commencement of the Proposed Scheme. Employment effects associated with the construction phase of the Proposed Scheme are presented in gross and net terms, whereas operational employment of the Proposed Scheme is reported as gross; employment on the classic network is assumed to remain the same as present as released capacity is utilised by new services.
- 4.3.24 Additionality of the Proposed Scheme is defined as the impact that arises as a result of an intervention (in this case the Proposed Scheme) that would have not have occurred in the absence of that intervention.

4.3.25 The route wide additionality assumptions for the intervention case are set out in Table 2 and are based on rates set out in the English Partnerships Additionality guidance¹⁰:

Table 2: Proposed Scheme: Route wide additionality assumptions

	Effect Rate	Effect Level
Leakage	0%	None
Displacement	25%	Low
Substitution	0%	None
Multiplier	1.5	Medium

4.3.26 Leakage: Impacts are considered at the UK level. Leakage for all types of impact is therefore assumed to be zero.

- Displacement refers to the potential change in economic output from businesses as a consequence of the Proposed Scheme. Displacement is estimated in relation to:
 - Construction employment created by the Proposed Scheme: A low displacement is applied to reflect the uniqueness of the project and high demand for specialist, skilled workers, which will have a lower likelihood of displacing other construction projects or construction jobs over the relevant time period.
 - The contraction in economic output as a consequence of employment losses at businesses directly affected (business relocations or closure) or indirectly affected (changes in amenity and isolation effects) during the construction phase is reflected by the resultant displacement effects on other parts of the economy: A low level of displacement was applied to employment identified as being potentially lost in these businesses to reflect the likelihood that these businesses operate in an established and competitive economy .
 - The operational phase: During the operational phase it was not anticipated that operational jobs will supplant other economic activities from taking place, and therefore a low degree of displacement was assumed.
- Substitution: For all types of impact, zero substitution effects were assumed as employment created by the Proposed Scheme (during construction and operation) is not thought to be directly supported by initiatives which generate public sector assistance.
- Composite multiplier: The medium level composite multiplier is identified as being typical of the majority of public sector interventions.

¹⁰ English Partnerships Additionality guidance.

Annex C: Cultural heritage– technical notes

1.1.1 The following technical notes are appended to this document:

- Risk based approach to archaeological assessment
- Fieldwalking
- Geophysical survey



HS2 London-West Midlands

Cultural heritage

**Technical note – Risk based
approach to archaeological
assessment**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1.1 This technical note outlines the cultural heritage environmental impact assessment (EIA) methodology which been developed for the Proposed Scheme.

1.1.2 A zone-based methodology for the assessment of archaeological risk for the EIA has been developed in conjunction with English Heritage (EH) and the Local Planning Authority (LPA) archaeological officers. This approach seeks to move beyond known 'point data' to look at the archaeological potential of the landscape as a whole, and recognises the possibility that there may be land access issues that limit the areas available for field evaluation survey work (either non-intrusive or intrusive).

1.1.3 The methodology identified in this technical note explicitly recognises that this zone-based approach relates solely to the EIA. However, this approach to risk assessment will provide a starting point for the future programme of archaeological investigation, and will help to ensure that this programme meets the National Planning Policy Framework (NPPF)¹ aim of increasing understanding of the historic environment.

1.1.4 Risk is defined, for the purposes of this methodology, as:

Those areas of the project (within the land required for the construction or for the operation of the Proposed Scheme) where knowledge regarding the potential presence and/or characteristics of archaeological assets is insufficient to form a professional judgement as to their extent or significance (as defined in NPPF Annex 2: Glossary), or to understand the level of harm to that significance which might be anticipated.

1.2 Objectives

1.2.1 The objectives of this methodology are to:

- provide a framework for the consistent consideration of archaeological risk within the context of the EIA process across the Proposed Scheme;
- enable reasoned professional judgements as to the likely presence/absence, nature and significance of buried archaeological assets, and to understand the level of impact to that asset which might be anticipated; and
- provide a mechanism that will focus the assessment on areas of the Proposed Scheme where there is considered to be archaeological risk.

1.3 Background

1.3.1 The traditional approach to assessment and decisions about where to undertake field evaluation tends to focus on known archaeological assets, thereby increasing our understanding of what we already know about. This can lead to overlooking locations and tracts of land where there is little information, either because there has been little development and therefore little need for planning-led investigation or where the landscape is not conducive to survey. This approach can lead to a 'data bias', resulting in an only partial understanding of the characteristics of the buried archaeological assets that may be present. However, there are increasing examples across the country where areas previously thought to be devoid of archaeological activity are

¹ Department for Communities and Local Government, 2012, *National Planning Policy Framework*.

being revealed as landscapes used by our ancestors for a range of purposes. The traditional approach, particularly on linear projects that traverse areas of differing landscape characteristics, can result in missed opportunities to extend understanding of the character and extent of buried archaeological assets across the landscape as a whole.

- 1.3.2 Paragraph 169 of the NPPF highlights the need for up to date evidence to predict the likelihood that currently unidentified heritage assets, particularly sites of historic and archaeological interest, will be discovered in the future. This approach is reflected in the Scope and Methodology Report (SMR see Volume 5; Appendix CT-001-000/1); a risk-based approach to survey is adopted, taking consideration of a series of archaeological 'zones' or 'character areas', as opposed to point specific assets.
- 1.3.3 A 'zone' or 'character area' based approach to the cultural heritage enables the disparate information sources collected during the EIA process to be ordered and characterised, in a way which allows consideration to be given to all parts of the landscape. Such an approach has been advocated by EH. Phase One of HS2 traverses contrasting regions crossing wide tracts of land. Although it is unlikely that these zones will correspond with community forum areas (which form the basis of public consultation and the structure), they can be used to order the data into meaningful areas/zones, providing a context in which predictions can be made about the likely locations, nature and significance of archaeological assets.
- 1.3.4 It is also necessary to understand the potential impacts on specific assets, in particular where those assets are, or might be, designated (NPPF para 139). The approach here will be to concentrate on those assets where there is insufficient evidence to understand that impact.

2 Risk Based Predictive Methodology

2.1 The EIA Process

- 2.1.1 It is not proposed here to reiterate the cultural heritage EIA methodology as presented in the SMR, but rather to guide the use of that methodology in defining archaeological risk in relation to the selection of sites for field survey.
- 2.1.2 During the desk-based element of the EIA, archaeological character zones and the level of archaeological risk they hold will be defined.
- 2.1.3 The work undertaken as part of the cultural heritage EIA comprises the collection, synthesis and interpretation of available baseline data. The first phase of research focuses on a range of existing data sources, e.g. designated asset records, Historic Environment Records, historic maps and academic publications. Techniques such as LiDAR and hyperspectral surveys will be used to provide further information about the historic landscape. The zones will be refined a number of times during the EIA process to reflect increased understanding (e.g. following the completion of an element of survey). The descriptions of the zones will be proportionate to the nature of the archaeology and will focus on describing known archaeological character and potential for remains. The factors that may have affected survival and recovery will also be considered, for example agricultural practices and levels of recent development. The geology, topography, hydrology and historic character of the landscape will also be considered.

2.2 Examples of Prediction

- 2.2.1 During the preparation of the EIA for the M₄ road scheme, trial trenching was not possible in the majority of locations due in particular to the sensitive habitats of the Sites of Special Scientific Interest. LiDAR was used to locate and map previously unknown Medieval farming enclosures and the route of old watercourses where, for example, there were likely to be survivals of Romano-British activity. This enabled the likelihood of impacts and their significance to be assessed by using comparative fieldwork data².
- 2.2.2 The M₁ widening junctions 21-30 project also used LiDAR to good effect to reveal the hidden archaeological landscape and to guide assessment and subsequent field evaluation. The use of LiDAR in combination with available borehole data provided key insights into buried archaeological deposits in relation to the soil and geological deposits, thus allowing more effective prediction for the design of field work undertaken for the EIA as well as to guide the scheme development process³.

2.3 Input from English Heritage and Local Planning Authority archaeologists

- 2.3.1 This assessment of archaeological risk in relation to, in particular, the issue of the unavailability of land for field evaluation has been discussed with consultees. EH and LPA archaeological officers have reviewed their respective counties and regional areas and have provided their interpretation of character zones based on their curatorial knowledge. This will be presented as a gazetteer describing the nature and elements of the zones and is supported by GIS mapping delineating the zone (Volume 5, Appendix 1 and Map Book series CH-03).
- 2.3.2 This information will feed into the research to aid in the assessment and consideration of perceived blank areas and/or those areas where further characterisation is considered necessary to assess the potential impact of the scheme. Proposals will be prepared for field evaluation (see Appendix A). As part of the process the known assets will be identified where field evaluation will inform an understanding of the potential for impacts. It is recognised that as part of the development of the zones, assets may extend outside of the area of, or be situated beyond, the boundary of land required for the construction and operation of the Proposed Scheme but will continue to have an influence on the definition of risk.

3 Field evaluation selection

- 3.1.1 Following on from the desk-based stage, field evaluation will be proposed, following standard industry practice, where appropriate and possible. The purpose of the field evaluation programme is primarily to:
- provide definition of the assets to aid the decision making process;
 - clarify the presence/absence of heritage assets;
 - establish the significance of heritage assets;

² Wessex Archaeology (2011), *New M₄ Project, Baseline conditions Report*, Unpublished client report number 76880.02.

³ University of Birmingham (2007), *M₁ Junction 21-30 Widening Airborne Laser Scanning (Lidar) Analysis*, Unpublished client report.

- inform the understanding of the potential harm to the significance of heritage assets;
- contribute to the reduction of the risk of unexpected discoveries as far as is practicable within the compilation of the EIA; and
- inform the design and mitigation strategies.

3.2 Factors determining selection

3.2.1 A number of factors will guide the selection of the locations for field evaluation. These factors will focus on the level of previous work and the state of our understanding and will include:

- locations where there is a lack of archaeological knowledge due to, for example a lack of research, or developer led investigations;
- investigations in the surrounding locality where the presence of a specific monument and/or type of evidence is suggested – known patterns of discovery;
- the context of these investigations i.e. have the investigated locations themselves been biased by misconceptions regarding potential landscape models?;
- geology, soils, topography, hydrology indicators, noting for example, deep deposits, potential areas for palaeo-environmental and/or waterlogged survival, as well as, for example, hilltop defensive locations, routeways; and
- influence of past landuse, e.g. quarrying, urban expansion, agricultural regime – influence of heritage asset survival.

3.2.2 Tying the above together will be the use of professional judgement and experience, knowledge and experience employed to develop an understanding based on the assessment of the above points.

3.2.3 No field evaluation surveys will be required in support of the EIA if there is sufficient known information on the likely extent, value and vulnerability of buried remains from previous field surveys; and/or where desk-based sources (e.g. LiDAR, aerial photographs) provide enough evidence on the site type with an appropriate degree of confidence. No field evaluation surveys will be required where existing information currently allows a sufficient assessment of the impacts.

3.3 Site Selection Table

3.3.1 To capture the processes, the template for 'Site Selection' will be completed setting out a robust commentary on the site selection for surveys. An illustrative example is provided in Appendix A. This table will take each location within the Study Area and use the known information and predicted archaeology from the character zones to assess 'the need, appropriateness and feasibility' of field surveys. This will allow for a robust understanding of the decision making process during the EIA process as well as providing an audit trail.

3.3.2 Appendix B details the overall process, illustrating the stages presented in this technical note, from the collection of baseline data to the incorporation of the results of field evaluation survey into the EIA.

3.4 Categorisation of Risk

3.4.1 In order to take forward the categorisation of risk for those areas where selective field evaluation has been identified the following ranking has been developed. It is recognised that in the development of the model and the assignment of ranking, as defined in Table 1, the application of professional judgement is a key element in the definition of the levels of risk. However the definitions have been formulated to provide as far as possible a quantitative assessment of the risk for each zone identified.

Table 1: Categorisation of Risk

Ranking	Risk rating	Criteria to define rank/risk rating
1	Very high	Area where there is no site specific data available to characterise archaeological assets, but data from other sources, for example boreholes and historic landscape analysis, indicates that significant remains may be present.
2	High	Area where archaeological character is poorly understood and where data collected indicates that the area is likely to contain archaeological remains of significance.
3	Medium	Area where archaeological character is partially understood and further detail would help clarify the nature of deposits to inform the assessment, where significant remains are suspected.
4	Low	Area where archaeological character is very well understood and sufficient data is available to characterise these to inform the assessment.
5	None	Area where archaeological remains are known to have been removed by past activity and the chances of encountering assets are reduced to essentially nil.

3.4.2 Areas that meet a risk rating of 1 and 2 will be taken forward for field work as a priority to inform the EIA.

3.4.3 Where access for field evaluation is not possible, the assessment will set out the reasonable worst case scenario, based on professional judgement and the information available.

4 Evaluation Techniques

4.1.1 For each location, the evaluation technique will be specified. In some instances a suite of techniques may be envisaged and where possible these should be stated. Although not an exhaustive list, the following comprises the likely suite of evaluation techniques for which access may be requested:

Non-intrusive

- walkover (site reconnaissance);
- field walking/surface artefact collection;
- geophysical survey;
- metal detecting (for distribution only); and
- other (specify).

Intrusive

- metal detecting;
- borehole/augering;
- test-pitting;
- trial trenching; and
- other (specify).

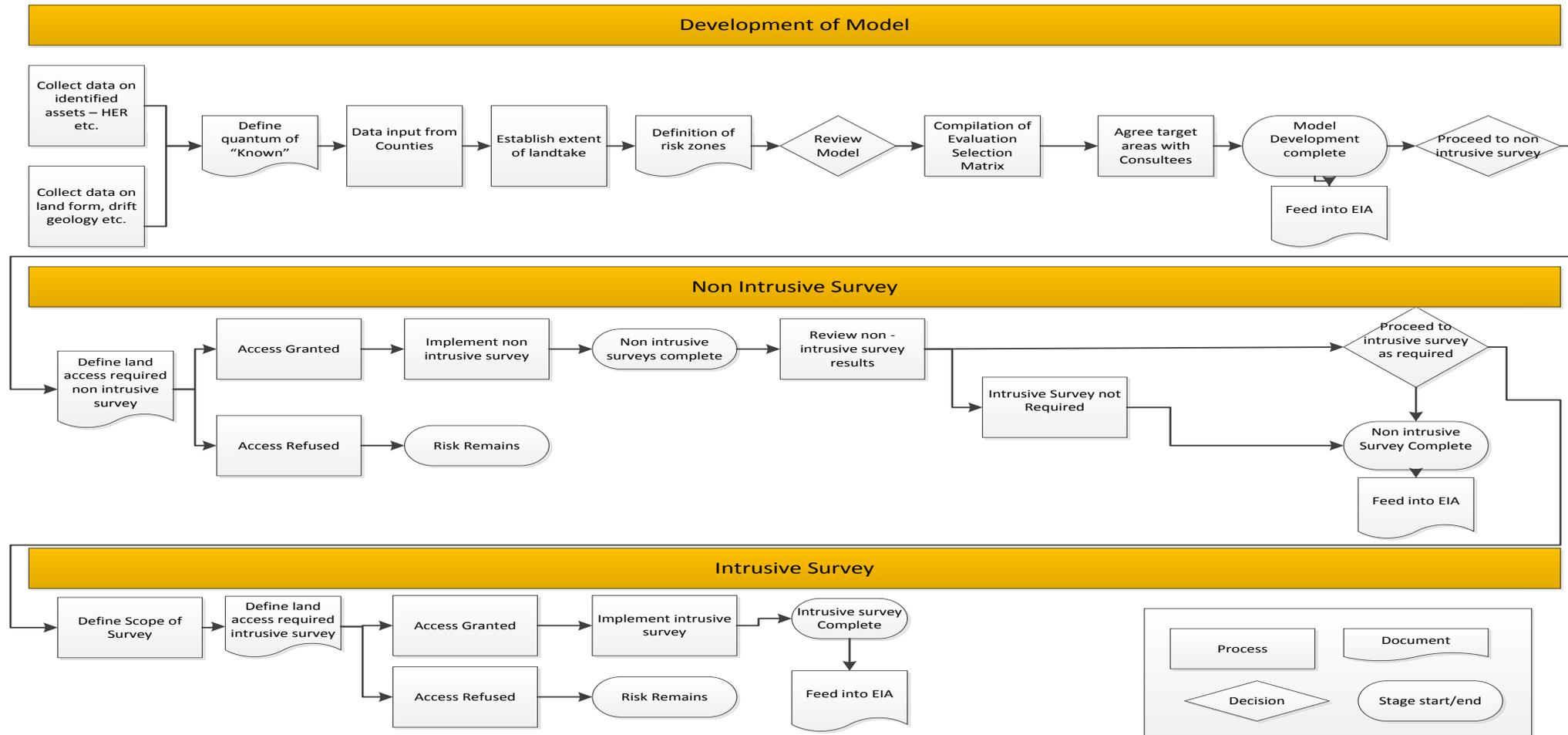
Appendix A: Tables

Table A 1 Example site selection table (Provided for illustration only)

Item no.	Community forum area	Archaeological character zone	Sub-zone	Site name / location	Chainage	Indicators of potential (e.g. find spots, cropmarks, earthworks, proximity of known sites nearby, topography/geology)	Can a robust commentary be provided on the extent/value of archaeological assets based on existing sources?	Risk rating	What info is needed to provide a robust commentary? What are the questions requiring answers?	What field survey techniques are available to answer outstanding questions?	Access to land?
1	Offchurch & Cubbington	Dunsmore and Avon Valley	A209/210	Route of the former Bytham river	X to Y	Projected route of the Pre-Anglian Bytham river (A2026). Palaeolithic finds of National, possibly international, importance have been recovered from deposits within this former river c. 1.8km to the north east of the Study Area. Further such finds may survive in the section that crosses the site. Ridge and furrow systems located immediately to the north west and south east of the site. Baseline study suggests a National significance for remains of High value	Given the proximity of the site to the known route of an ancient river known to contain Palaeolithic material it is important to establish whether similar deposits are located within the temporary and permanent land take. The depth of the palaeo-channel below current ground level also has also to be established.	2:High	Does the route of the Bytham actually pass through the Site? At what depths below current ground level do these deposits survive? Are the depths at which they survive likely to be impacted by the proposed scheme?	The following staged works proposed. Borehole/auger survey To test whether deposits associated with the Bytham palaeo-channel survive within the site. Trial Trenching Targeted trial trenches over areas of potential identified from borehole results in order to further investigate palaeo-channel deposits and recover datable finds.	TBC
2	Greatworth to Lower Boddington	Edgcote	(TBC)	Likely Roman Villa	X to Y	Pasture, south facing slope with plateau; extensive curvi-linear & linear cropmarks nearby on arable land	No	1: Very High	Do buried archaeological remains survive on site? Are they of schedulable quality? Most likely site type - enclosed (& unenclosed) late	Geophysics should reveal cut/filled & burnt features of settlement remains. If no evidence from	

Item no.	Community forum area	Archaeological character zone	Sub-zone	Site name / location	Chainage	Indicators of potential (e.g. find spots, cropmarks, earthworks, proximity of known sites nearby, topography/geology)	Can a robust commentary be provided on the extent/value of archaeological assets based on existing sources?	Risk rating	What info is needed to provide a robust commentary? What are the questions requiring answers?	What field survey techniques are available to answer outstanding questions?	Access to land?
						but none within footprint; no find spots or earthworks; nothing on LiDAR but cropmarks nearby also don't show up on LiDAR; scheduled villa site overlying prehistoric settlement located 3km down the valley (similar topographical site characteristics)			prehistoric / early Roman settlement; how can we find these?	geophysics no further field surveys	
3	Dunsmore, Wendover & Halton	Misbourne Valley	(TBC)	Grim's Ditch	X to Y	Scheduled linear earthwork of probable Iron Age date, running for 25km+ in sections; no known associated remains other than in-filled ditch and bank;	Yes	4: Low	Excavated sections elsewhere provide sufficient information to extrapolate likely extent of survival.	n/a	

Table A 2: Risk process





HS2 London-West Midlands

Cultural heritage

Technical note -Fieldwalking

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This document describes the minimum requirements and standards for fieldwalking surveys to inform the cultural heritage assessment of HS2 Phase One or the 'Proposed Scheme'.

2 Scope of works

2.1 Overview

- 2.1.1 The objectives are to gather information on the character, location and extent of any surface indications, in the form of artefact scatters or concentrations, of potential sub-surface archaeological features and material that only exists within the plough soil, such as flint scatters. The specific locations for the surveys to support the formal Environmental Statement (ES) have been defined in accordance with the Cultural heritage Risk based approach to archaeological assessment Technical Note (see Annex C of the SMR addendum). The content of this technical note is also to be used for survey work that may be undertaken following the deposition of the ES and in advance of construction.

2.2 Pre-fieldwork activities

- 2.2.1 Prior to the implementation of the fieldwork the following activities shall be undertaken and documented:
- a Written Scheme of Investigation (WSI) shall be compiled detailing the methodologies to be used for all stages of the works including a site plan/s and the site recording pro forma (see section 9.1.3) identifying the limits of each fieldwalking event, for issue to Local Planning Authority (LPA) Archaeologists. The WSI shall be issued in accordance with standard document control processes;
 - a site code for each fieldwalking event shall be obtained in liaison with the LPA Archaeologist (county or unitary authority) or other appropriate representative. The museum archive accession code shall also be obtained, as appropriate to each county for each event;
 - liaison with other disciplines, in particular ecology, to identify and implement any restrictions on the works resulting from interdisciplinary considerations, such as the presence of protected species;
 - appropriate arrangements shall be made to ensure the protection and safe storage of all artefacts recovered during the works, including requirements for conservation of artefacts. This shall encompass fieldwork, post excavation activities and the storage of material in advance of archive deposition; and
 - site visits to determine if the ground conditions (e.g. crop cover, weathering, ploughing regime) are suitable for the fieldwalking survey and to identify any factors that may influence the survey.

3 Reference standards

3.1.1 All stages of the works shall be managed and implemented in accordance with industry best practise and guidance in relation to the management of archaeological projects. This shall include, but not be limited to:

- Institute for Archaeologists, 2008, Standard and Guidance for Archaeological Field Evaluation; Institute for Archaeologists, Revised 2008, Standard and Guidance for the collection, documentation, conservation and research of archaeological materials;
- RESCUE/United Kingdom Institute for Conservation, Archaeology Section and Museum of London, 1998, First Aid for Finds. (3rd edition); and
- English Heritage, 2006, Management of Research Projects in the Historic Environment (MORPHE): Project Manager's Guide.

4 Project management documents

4.1.1 A programme risk log shall be prepared and shall consist of a tabulated schedule by event, in spread sheet format detailing the proposed start and completion dates for the fieldwork and off-site activities including the milestone for the delivery of the draft report. An example format is provided in Appendix A. It is recognised that access arrangements shall be a key factor in determining the availability of survey areas and the development and implementation of the fieldwork programme.

5 Access

5.1.1 All access arrangements to undertake the surveys shall be made by HS2 Ltd in liaison with the teams carrying out the surveys. It is the responsibility of the survey teams to ensure that they comply with HS2 Ltd access procedures and any specific requirements imposed by land owners and/or their tenants.

6 Health and safety

6.1.1 Health and safety shall take priority over archaeological matters. All operatives undertaking fieldwork must comply with all relevant health and safety legislation and HS2 Ltd project procedures. Prior to the commencement of any fieldwork activities it shall be necessary to ensure that all health and safety documentation required by HS2 Ltd has been completed and signed off.

7 Personnel

7.1.1 The teams undertaking the survey works shall have the relevant experience and competency to undertake the works required.

8 Monitoring

8.1.1 The fieldwork and reporting outputs shall be monitored and reviewed to ensure compliance with this document and industry standards.

Setting out and location of grid.

- 8.1.2 Data shall be collected along regularly spaced transects within a regularly spaced survey grid. All recorded survey data shall be collected with reference to the survey grid. Where the survey area approaches boundaries or obstructions, partial grids shall be set out and surveyed using sightlines. The survey transects shall generally be aligned with the long axis of each survey area.
- 8.1.3 The survey grid shall be established using Real Time Kinematic (RTK) differential GPS equipment. However, on rare occasions where this is not practicable (i.e. no phone cell network; trees or buildings present, not lack of equipment), other methods such as Total Station, optical square, ranging rods and tape measures may be used.
- 8.1.4 The survey grid shall be marked out by appropriate means and grid nodes shall be set out with a positional accuracy of at least 100mm (0.1m). A sample of the grid markers shall be re-checked at the start of each working day to ensure consistencies in surveying and to ensure that grid markers have not been tampered with. In this event, HS2 Ltd shall be provided with the details of the method/s used and the areas where the survey technique was deployed.
- 8.1.5 GPS measurements shall be taken to allow the accurate relocation of the survey grid by a third party and for the production of maps and diagrams in the report. On request, written evidence of the calibration of all equipment to be used in the surveys in accordance with the manufacturer's specification is to be provided. Calibration or reference measurements shall be made using GPS to clearly defined features (such as buildings) which appear on the mapping: poorly defined field boundaries or corners shall not be used. In the event that no clearly defined features are within reasonable distance of the grid, sturdy marker stakes shall be left in situ at boundaries and the coordinates recorded by GPS for calibration when re-establishing the grid.
- 8.1.6 On completion of the survey all pegs/canes and any other temporary markers shall be removed from the survey area, with the exception of any calibration markers (see paragraph 9.1.4).
- 8.1.7 A survey record of the grid location in the form of a Grid Relocation Plot / Figure, at a suitable scale showing the survey area and grid subdivisions, key GPS co-ordinates and calibration points; all sufficient to enable the accurate location of the grid on mapping and re-establishment in the field shall be provided. All recorded GPS measurements shall be OSTNo2/OSGB36 coordinate format.

9 Fieldwork

- 9.1.1 In undertaking the fieldwork, as a minimum the following shall be implemented:
- fieldwalking shall take place over each suitable field using transects with a survey grid established at regular intervals. The spacing of the survey grid intervals for the collection of material shall be determined on a site by site basis depending on the specific survey objectives and circumstances of the anticipated assets or specific objectives for each fieldwork event. Finds shall be bagged at the same interval along each transect to form the grid, usually 20m;

- the bags used for the collection of artefacts from each search area shall be marked with the following as a minimum:
 - site code;
 - field number; and
 - twelve digit National Grid Reference (NGR) number with the NGR being the southern end of each survey grid walked; and
 - interval number.

9.1.2 All artefacts, including bone, shall be recovered, except those of clearly modern origin. In these circumstances the location of such artefacts/spreads of material shall be clearly identified in relation to the survey grid. For bulk ceramic building material and industrial waste sufficient sample should be collected to characterise the material present.

9.1.3 A site recording pro forma shall be completed on a daily basis during the course of the fieldwork. This as a minimum is to identify the following:

- date of survey;
- NGR;
- weather conditions;
- land use/field conditions;
- ground visibility;
- any other factors influencing the survey results; and
- personnel deployed.

9.1.4 On completion of the survey all materials, grid pegs and other equipment used in the fieldwork shall be removed and the survey and associated working areas shall be left in a clean and tidy condition.

10 Post fieldwork

10.1.1 On completion of fieldwork, or earlier depending on the programme, all artefacts recovered shall be washed, marked and bagged, assessed, conserved (where appropriate) and packaged in accordance with professional best practice and standards.

10.1.2 An ordered, indexed, and internally consistent site archive shall be compiled in accordance with the requirements of Archaeological Archives Forum, 2007¹, and any particular requirements of the Local Authority within which the works are being undertaken.

10.1.3 All digital data shall be produced in a format that is compliant with HS2 Ltd data standards and is capable of being deposited with the Archaeology Data Service (ADS).

¹ Archaeological Archives: A Guide to Best Practice in Creation, Compilation, Transfer and Curation.

Further details of HS2 Ltd proposals for the deposition of a digital archive with ADS are provided in section 12.

10.1.4 All artefacts recovered during the fieldwork shall be examined by appropriately qualified specialists utilising national and local type series for pottery.

10.1.5 Where appropriate, conservation of artefacts recovered may be required that shall necessitate the deployment of staff with the necessary experience to undertake the appropriate works on the classes and types of material recovered.

11 Reporting

11.1 General

11.1.1 A report shall be compiled detailing the findings of the fieldwork for each event. This shall contain a textual narrative supported by drawings illustrating the results of the fieldwork.

11.1.2 The report shall be produced in the HS2 Ltd standard report document template format. All documents shall be issued in accordance with the appropriate document control processes.

11.1.3 The unique land parcel identification number that has been allocated by the HS2 Ltd land access team to enable ready identification of the survey area within HS2 Ltd systems shall be identified.

11.1.4 An online access to the index of archaeological investigations (OASIS) form shall be completed and this shall be included with the final report for each event. Electronic copies of the form shall not be uploaded until instructed and all paper copies shall contain all metadata necessary to complete online data requirements.

11.1.5 Draft copies of the site and artefact distribution plans shall be provided in PDF format for review and comment. Each event (discrete area of survey) shall be issued as a separate report.

11.1.6 The final issue of reports shall consist of:

- One CD containing:
 - a PDF copy of the report;
 - the text of the report in the format in which they were produced;
 - figures in the format in which they were produced;
 - all artefact catalogues and other supporting information in the format in which they were produced; and
- One CD containing CAD and GIS data in an Esri format

11.1.7 All electronic data received shall be transferred for long term storage and retrieval within the projects data management system.

11.1.8 The HS2 Ltd data standards shall be adhered to for all reports and data sets that are issued.

- 11.1.9 The format of the plans shall be compliant with HS2 Ltd data standards and in particular the production of plans in GIS format. Plans and figures may be produced in CAD but shall also be required in GIS format.
- 11.1.10 Copies of the final report shall be issued to HS2 Ltd for submission to the relevant LPA Archaeologists and English Heritage and shall be issued in accordance with HS2 Ltd data standards.

11.2 Report content

11.2.1 The headings and contents of each report shall conform to the following structure, and as a minimum contain:

- a summary of the results written for a non-specialist audience;
- contents page;
- introduction;
 - event location;
 - site description; and
 - survey objectives - the rationale and circumstances of the work including previous works and other planned or completed HS2 works.
- methodology;
 - survey methods used and any limitations;
 - date(s) of fieldwork;
 - grid location and transect intervals;
 - method(s) of data capture including any biases or other factors that may have influenced the survey results;
 - method(s) of data processing including any biases or other factors that may have influenced the survey results; and
 - methods of data presentation including any biases or other factors that may have influenced the survey results.
- results;
 - description of results;
 - interpretation of results; and
 - data tables providing a quantification of the material recovered.
- conclusions; and
 - to include justified recommendations for further work.
- plans;

- a location plan showing the position of the survey area within the landscape by reference to existing features such as roads and other tangible features. The plan shall be produced at a scale of 1:10,000 or alternative scales, for example 1:2500, agreed with HS2 Ltd in advance of the production of the plan; and
- plans showing the distribution of transects walked and the densities of and spatial distribution of materials recovered by type. Plans shall be produced at a scale of 1:5,000 or alternative scales, for example 1:2500, agreed with HS2 Ltd in advance of the production of the plans.

11.2.2 All reports shall contain the following sections:

- report text;
- list of figures;
- report figures; and
- appendix detailing technical information.

11.2.3 The report text shall:

- describe the site and situation of the survey area and the prevailing local topography, land use, soils and geology;
- provide a brief description of any known archaeological remains in the vicinity including the archaeological character zones formulated as part of the compilation of the Risk Model, and their relevance to the survey results;
- state the aims and objectives of the survey including reference to the Archaeological Character Zones;
- describe any general factors or complications which must be considered when viewing the data. These shall include any local factors which may hinder the collection or interpretation of the results;
- assess the results in accordance with the aims of the survey, including period represented incorporating absence of data representation; and

11.2.4 A database of all artefacts recovered shall be compiled for deposition.

11.2.5 The report text shall be supported by and cross referenced to site plans and drawings. The contents of the figures shall be dependent on the nature of the material recovered and may require the production of multiple figures depending on the quantity and diversity of material that is recovered during the fieldwork. Site plans shall be produced at a clearly legible scale to enable the full detail of the fieldwork results to be clearly discernible. This may require the use of multiple sets of plans to illustrate the data.

12 Archive

12.1.1 Normal industry practice shall be followed for the preparation of all archives generated during the course of the survey work. HS2 Ltd requires compliance with

industry archive standards for digital data as well as those of HS2 Ltd (which are more stringent).

Appendix A: Example of Programme/Progress Report

Event Name	Fieldwork				Reporting						
	Start		Finish		Start		Issue Draft report		Final Report		Summary of findings
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	



HS2 London-West Midlands

Topic – Cultural heritage

**Technical note – Geophysical
survey**

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This document describes the minimum requirements and standards for geophysical surveys to be undertaken as part of the compilation of the Environmental Statement (ES) for Phase One of HS2.

2 Scope of works

2.1 Overview

- 2.1.1 The objectives are to gather information on the character, location and extent of any archaeological deposits, and to gain an understanding of the subsurface environment as a whole, as far as the data shall allow. The specific locations for the survey have been defined in accordance with the Cultural heritage Risk based approach to archaeological assessment Technical Note (see annex C of the SMR addendum). This technical note is also to be used during survey work that may be undertaken following the deposition of the ES and in advance of construction.

2.2 Pre-fieldwork activities

- 2.2.1 Prior to the implementation of the fieldwork the following activities shall have been undertaken and documented:

- a Written Scheme of Investigation (WSI) shall be compiled detailing the methodologies to be used for all stages of the works including a site plan/s and shall be agreed for issue to Local Planning Authority (LPA) (County or Unitary Authority) Archaeologists. The WSI shall be issued in accordance with standard document control processes;
- prior to the issue of the draft report in liaison with the LPA (County or Unitary Authority) Archaeologist, or other appropriate representative, the requirements for obtaining a site code for each survey event shall be obtained. A museum archive accession code, as appropriate to each County shall be obtained for each event;
- liaison with other disciplines, in particular ecology, shall be undertaken to identify and implement any specific requirements resulting from the presence of restrictions on the manner of working for example protected species; and
- the location of the work shall be visited to determine if the ground conditions (e.g. crop cover, weathering, ploughing regime) are suitable for geophysical survey and if there are any factors that shall influence the survey.

3 Reference standards

- 3.1.1 All stages of the works shall be managed and implemented in accordance with industry practice and guidance in relation to the management of archaeological projects. This shall include, but not be limited to:

- English Heritage, 2008, Geophysical Survey in Archaeological Field Evaluation;

- Institute for Archaeologists, 2002, Paper 6, The use of geophysical techniques in archaeological evaluations;
- Institute for Archaeologists, 2011, Standard and Guidance for archaeological geophysical survey;
- English Heritage, 2006, Management of Research Projects in the Historic Environment (MoRPHE): Project Manager’s Guide; and
- All relevant codes, standards, guidelines, regulations and legislation in force at the time of the works.

4 Project management documents

- 4.1.1 A programme risk log shall be completed and shall consist of a tabulated schedule by site, in spreadsheet format detailing the proposed start and completion dates for the fieldwork and off-site activities including the milestone for the delivery of the draft report. An example format is provided in Appendix A. It is recognised that access arrangements shall be a key factor in determining the availability of survey areas and therefore the development and implementation of the fieldwork programme.

5 Access

- 5.1.1 All access arrangements to undertake the surveys shall be made by HS2 Ltd in liaison with the teams carrying out the surveys. It is the responsibility of the survey teams to ensure that they comply with all of HS2 Ltd access procedures and any specific requirements imposed by land owner and/or their tenants.

6 Health and safety

- 6.1.1 Health and safety shall take priority over archaeological matters. All operatives undertaking fieldwork must comply with all relevant health and safety legislation and HS2 Ltd project procedures. All operatives undertaking the fieldwork shall be appropriately qualified, competent and adequately insured to undertake such projects. Prior to the commencement of any fieldwork activities all health and safety documentation required by HS2 Ltd shall be completed and signed off.

7 Personnel

- 7.1.1 The teams undertaking the survey works shall have the relevant experience and competency to undertake the works required.

8 Monitoring

- 8.1.1 The fieldwork and reporting outputs shall be monitored and reviewed by the routewide geophysics specialist to ensure compliance with this document and industry standards and practice.

Setting out and location of grid¹.

- 8.1.2 For all techniques data shall be collected along regularly spaced traverses within a site survey grid. All recorded survey data shall be collected with reference to the grid or survey baselines. For gradiometer and resistance survey this grid shall normally consist of individual 20m x 20m or 30m x 30m squares. Where the survey area approaches boundaries or obstructions partial grids shall be set out and surveyed using sightlines. For ground penetrating radar (GPR) or other techniques the grid size may vary with the size of the survey area. In some instances, magnetic, resistance and GPR data may be collected with a GPS feed, negating the requirement for a rigid survey grid to be laid out.
- 8.1.3 As standard the survey grid shall be established using Real Time Kinematic (RTK) differential GPS equipment. However, on rare occasions where this is not practicable (i.e. no mobile telephone; trees or buildings present, not lack of equipment), other methods such as Total Station, optical square, ranging rods and tape measures may be used. In this event, details are to be provided of the method/s used and the areas where the survey technique was deployed.
- 8.1.4 The survey grid shall be marked out by appropriate means and grid nodes shall be set out with a positional accuracy of at least 100mm (0.1m) as required by English Heritage (EH) guidelines². A sample of the grid markers should be re-checked at the start of each working day to ensure consistencies in surveying and to ensure that grid markers have not been tampered with.
- 8.1.5 GPS measurements shall be taken to allow the accurate relocation of the survey grid by a third party and for the production of maps and diagrams in the report. On request, written evidence of the calibration of all equipment to be used in the surveys in accordance with the manufactures specification is to be provided. Calibration or reference measurements shall be made using GPS to clearly defined features (such as buildings) that are fixed reference point which appear on the mapping: poorly defined field boundaries or corners shall not be used. In the event that no clearly defined, features are within reasonable distance of the grid, sturdy marker stakes shall be left in situ at boundaries and the co-ordinates recorded by GPS for calibration when re-establishing the grid.
- 8.1.6 On completion of the survey (i.e. when all data have been collected, downloaded to computer, visually examined, and backed up to an external device) all pegs/canes and any other temporary markers shall be removed from the survey area, with the exception of any calibration markers (see 8.1.4 and 8.1.5).
- 8.1.7 A record of the survey grid location should be provided. This should be in the form of a Grid Relocation Plot / Figure, at a suitable scale showing the survey area and grid subdivisions, key GPS co-ordinates and calibration points; all sufficient to enable the accurate location of the grid on mapping and re-establishment in the field. All recorded GPS measurements shall be OSTNo2 co-ordinate format.

¹ For GPS (Global Positioning System) also read GNSS (Global Navigation Satellite System).

² English Heritage (2008), *Geophysical Survey in Archaeological Field Evaluation*.

9 Data Collection

9.1 All techniques

- 9.1.1 During fieldwork a record of surface and weather conditions shall be maintained that may have a bearing upon the quality and the subsequent interpretation of the data. Where appropriate, and in the event that an area is deemed unsuitable for survey, a photographic record shall be maintained.
- 9.1.2 While in the field, the data shall be regularly transferred from the instruments onto a laptop computer using the appropriate software and the results viewed to ensure data integrity. All data shall be copied to an external storage medium as a back-up before deletion from the instrument's memory.

9.2 Magnetometer Survey

- 9.2.1 Instruments to be used for data collection shall be Bartington Grad 601-2. Other magnetometer configuration shall only be used with the prior written agreement of HS2 Ltd.
- 9.2.2 The standard sample interval (along traverse) shall be 0.25m; the standard traverse interval shall be 1.00m. The total number of data points collected shall thus be 1600 readings per 20m x 20m grid square or 3600 per 30m x 30m square. All measurements used and detailed in reports shall be in SI Units and reported in accordance with HS2 Ltd requirements.
- 9.2.3 Data shall not be collected in areas where the operative is unable to maintain an even pace whilst holding the instrument steady, i.e. areas of dense and/or tall vegetation, crop, uneven, deeply ploughed or heavily rutted fields. HS2 Ltd shall be informed as soon as possible should such conditions be encountered.
- 9.2.4 On a weekly basis, a photographic record of all areas deemed unsuitable for survey shall be submitted.

9.3 Resistance Survey

- 9.3.1 Instruments to be used for data collection shall be Geoscan RM15/MPX15 or RM85 meters. Other suitable resistance meters shall only be used with the prior written agreement of HS2 Ltd.
- 9.3.2 The standard array shall be Twin Probe with a probe spacing of 0.5m. The standard sample interval (along the traverse) shall be 1.00m with a standard traverse interval of 1.00m. The total number of data points collected shall thus be 400 readings per 20m x 20m grid square or 900 per 30m x 30m. Alternatively a Geoscan cart system can be employed. Other systems are to be agreed in writing prior to deployment.

9.4 GPR Survey

- 9.4.1 Instruments to be used for data collection shall be agreed with HS2 Ltd prior to survey. Antennas shall typically be in the 200MHz or 800 MHz range with the centre chosen in response to the specific penetration and resolution requirements of the suspected deposits. In some cases it may be necessary to use systems operating

beyond these limits but this would be made clear at the specific site and shall not be undertaken without the prior written agreement of HS2 Ltd.

- 9.4.2 Standard sample intervals (along the traverse) shall be 0.05m and the standard traverse interval shall be 0.50m.
- 9.4.3 Radar equipment shall only be operated under an OfCom "Ground Penetrating Radar" licence – refer to the following information sources:
- <http://licensing.ofcom.org.uk/binaries/spectrum/low-short-devices/ground-probing-radar/ofw350.pdf>, and
 - http://www.eurogpr.org/joomla/images/documents/eg_202730v010101p0909.doc
- 9.4.4 Data shall not be collected in areas unsuitable for survey due to ground conditions, for instance where ground cover does not allow for good 'coupling' of the antenna; where rebar mesh or similar produces near total reflection of the signal; or where soil conditions (either type or water content) result in extreme attenuation of the signal, significantly reducing penetration.

9.5 Other techniques

- 9.5.1 Should other techniques be required, a specification shall be provided for approval prior to the implementation of any such works. This may include metal detector survey where the deployment of this evaluation technique has been selected as an appropriate fieldwork technique.

10 Data Processing

- 10.1.1 Data processing shall be performed using appropriate software. The surveyor shall state whether a commercially available software package (to be identified) or the surveyor's own is used for each technique.
- 10.1.2 Processing shall be the minimum (as defined by Paragraph 4.8 (EH 2008)) i.e. edge matching or step-correction is permissible, but not filtering). There shall be a statement relating to any processing that has been applied. All stages of the processing shall be fully documented in the report. Raw or minimally processed data plots shall be provided as Reference Plots (see section 11.4).
- 10.1.3 Data processes shall be independently analysed and where inappropriate steps have been applied, these shall be communicated to the relevant surveyor who shall be responsible for ensuring implementation of the appropriate actions to rectify any such steps and that data issued to HS2 Ltd is amended accordingly.

11 Reporting

11.1 General

- 11.1.1 A report shall be compiled detailing the findings of the fieldwork for each event. This shall contain a textual narrative supported by a drawing to illustrating the results of the fieldwork. The document shall be issued in accordance with the appropriate document control processes.

- 11.1.2 Each report should identify the unique land parcel identification number that has been allocated by the HS2 Ltd land access team to enable ready identification of the survey area within HS2 Ltd systems.
- 11.1.3 An Online Access to the index of archaeological investigations (OASIS) form shall be completed for each event. Electronic copies of the form are not to be uploaded until instructed and all paper copies shall contain all metadata necessary to complete on line data requirements.
- 11.1.4 A draft copy of the text, greyscale images and interpretations shall be provided to HS2 Ltd in PDF format for review and comment. Each event (discrete area of survey) shall be issued as a separate report. All reports and data sets issued shall be in accordance with HS2 Ltd data standards.
- 11.1.5 The final issue of reports shall consist of:
- One CD containing:
 - a PDF copy of the report;
 - the text of the report in Microsoft Word Format;
 - figures in the format in which they were produced;
 - all processed raw data as separate files as Geoplot raw grid data (plus minimally processed in ASCII³) plus Geoplot mesh and comp files; and
 - One CD containing CAD and GIS data in an Esri format. Metadata comprising the supply of a data sheet on format of grids, meshes and composites or their equivalent shall be provided.
- 11.1.6 All electronic data received shall be transferred for long term storage and retrieval within the projects data management system.
- 11.1.7 The HS2 Ltd data standards shall be adhered to for all reports and data sets that are issued.
- 11.1.8 The format of the plans shall be compliant with HS2 Ltd data standards and in particular the production of plans in GIS format. Plans and figures may be produced in CAD but are also required in GIS format.
- 11.1.9 Copies of the final report are to be issued to HS2 Ltd for submission to the relevant LPA Archaeologists and EH and shall be issued in accordance with HS2 Ltd data standards.

11.2 Report content

- 11.2.1 The headings and contents of each report are to conform to the following structure:
- A summary of the results written for a non-specialist audience;
 - Contents page;
 - Introduction;

³ American standard code for information interchange for transfer of text.

- event location;
- site description; and
- survey objectives - the rationale and circumstances of the work including previous works and other planned or completed HS2 works.
- Methods:
 - survey methods used;
 - date(s) of fieldwork;
 - grid location;
 - instruments used;
 - sampling intervals;
 - equipment configurations;
 - method(s) of data capture;
 - method(s) of data processing; and
 - methods of data presentation.
- Results
 - description of results; and
 - interpretation of results.
- Conclusions;
- Assessment of achievement (or not) of survey objectives;
- Results summarised;
- Plans/plots:
 - survey grid location (1:2,500 minimum)⁴;
 - plot(s) of raw data (1:1,000 minimum);
 - minimally enhanced X-Y traces of magnetic data, where appropriate;
 - plot(s) of enhanced data (1:1,000 minimum); and
 - grey tone (or dot density) interpretation diagram (1:1,000 minimum).

11.2.2 The report text shall:

- describe the site and situation of a survey area and the prevailing local topography, land use, soils and geology;

⁴ 1:2500 is preferred scale; 1:1250 also acceptable as is 1:5000 but not 1:10,000.

- provide a brief description of any known archaeological remains in the vicinity, including the archaeological character zones formulated as part of the compilation of the Risk Model, and their relevance to the survey results;
- state the aims and objectives of the survey;
- list and explain the display formats adopted and the processing applied;
- describe any general factors or complications which must be considered when viewing the data. These shall include any local factors which may hinder the collection or interpretation of the results; and
- assess the results in accordance with the aims of the survey. In the majority of cases, the anomalies shall be interpreted from the perspective of their archaeological potential.

11.2.3 All anomalies identified shall be assessed and classified according to the list of interpretation categories in section 12.1.2.

11.3 Figures

11.3.1 Maps and diagrams may be produced in CAD but shall be submitted in GIS, in accordance with HS2 Ltd data standards and guidance and shall accurately show the various survey blocks against an Ordnance Survey map background.

11.3.2 Report figures may be in A4 or A3 portrait or landscape layout.

11.3.3 All figures shall include a north point, scale bar, stated scale and title panel showing the project title, drawing title, drawing or figure number and initials of CAD draughtsperson.

11.3.4 All figures and CAD drawings shall conform to the CAD layering protocol described in this section, and shown in Appendix B.

11.3.5 An event location diagram at a scale of 1:50,000 or 1:25,000 and a plan showing the site location(s) at a suitable scale shall be provided. Areas of survey as referred to in the report text shall be labelled on the site location plan and on all figures. Survey area numbering shall be agreed before commencement of fieldwork.

11.3.6 Figures including .tif or .jpg images of processed data greyscale (with highest values in black) plots accurately positioned on the mapping shall be provided at a minimum scale of 1:2,500 or 1:1,000 and shall include a scale bar showing the plotting range. GPR data shall be displayed as radargrams and time-slices if appropriate. A representative selection of the latter shall be provided as a minimum.

11.3.7 Colour interpretation figures shall be provided to the same scale as the greyscale figures. The survey area(s) border(s) shall be accurately placed on the mapping, and all anomalies and responses identified and classified in the report text shall be plotted to scale and in the correct locations within the survey area(s). Interpretation classification shall be in accordance with the categories listed below, with each category assigned a specific layer, colour, line type and hatch type as listed below. Each interpretation figure shall include a key to all interpretation categories used in that figure. Where necessary for clarity, anomalies shall be referenced to the report text by means of numbers.

11.3.8 A separate layer shall be used for each interpretation category of anomaly shown on the interpretation diagrams. The layering protocol, colours, hatch type and linetypes shall conform to an appropriate standard.

11.3.9 All layer names shall conform to the following protocol:

- HS2_MAG_(name), HS2_RES_(name), HS2_GPR_(name) for magnetometer, resistance and GPR surveys respectively. Examples are:
 - Archaeology category - HS2_MAG_Archaeology: hatch solid, colour 190.
 - Ridge and furrow category -HS2_MAG_R_F: polyline type ACAD_ISO10W100, linewidth 0.25, scale 0.2, colour 35

11.4 Reference plots

11.4.1 Reference plots shall be used to verify the interpretation figures.

11.4.2 Reference plots may be produced in layouts up to A0, and shall be required on CD in PDF format only: they shall not be required to be bound into the paper copy report.

11.4.3 Reference plots of raw or minimally processed data comprising XY Trace plots and greyscale images, both plotted at ranges to suit the full range of the magnetic data shall be required. For resistance data a range typically -1 to 1 standard deviation shall be used for the greyscale (individual data grids must be edge matched where possible – allowing for effects of rain, for example). When using standard deviation for the plotting scale then actual values should be recorded (not simply '+/-1 Standard Deviation). For both magnetic and resistance data the plots shall be at a scale consistent with the interpretation plots.

11.4.4 Reference plots for GPR surveys shall comprise a full set of minimally processed (i.e. limited to signal correction, removal of instrument noise and gain) radargrams. These may be as image files on the reference CD provided that there is an accompanying diagram showing their relative positions and direction. The radargrams shall have clearly labelled lateral and vertical axes. If the vertical axis is in depth the transmission velocity for the conversion must be apparent. At least a representative selection of any processed radargrams that have been used for interpretation or time-slice production shall be included. If time-slices have been used, a full set of the resultant images shall be included in the archive.

11.4.5 Reference plots shall include a north point, scale bar, stated scale and title panel showing the project title, drawing title, drawing or figure number and initials of CAD draughtsperson. XY trace plots shall include a plotting range bar.

12 Interpretation categories

12.1.1 All identified anomalies and responses shall be assigned to one of the interpretation categories (see Section 12.1.2). Numbers (1, 2 and 3 etc.) shall be cross referenced with the figures in the text of the report and shall be assigned to specific anomalies of interest in the first three categories and subjectively to anomalies in other categories.

12.1.2 In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic

anomalies (e.g. Roman Road, Wall) and where appropriate, such interpretations shall be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

- Archaeology - definitive/probable;
- Archaeology – possible archaeology;
- Industrial/Burnt-Fired;
- Old Field Boundary;
- Agricultural(ploughing / R&F);
- Natural – pedological/geological/topographical;
- Uncertain Origin; and
- Ferrous/Magnetic Disturbance.

12.1.3 The category 'uncertain origin' encompasses those instances where it is not possible to differentiate between archaeology and natural and agricultural anomalies.

12.1.4 Where appropriate some anomalies shall be further classified according to their form (positive or negative) and relative strength and coherence (e.g trend: weak and poorly defined).

13 Archive

13.1.1 Normal industry practice shall be followed for the preparation of all archives generated during the course of the survey work .HS2 Ltd requires compliance with industry archive standards for digital data as well as those of HS2 Ltd (which are more stringent).

Appendix A: Example of Programme/ Progress Report

Event Name	Fieldwork				Reporting						
	Start		Finish		Start		Issue Draft report		Final Report		Summary of Findings
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	

Appendix B: Data Structures

Status	Name	On	Freeze	Lock	Color	Linetype	Lineweight	Transparency	Plot Style	Plot
✓	0	☹	☀	🔒	white	CONTINUOUS	Default	0	Color_7	🖨
🔍	HS2_MAG_Grid_30m	☹	☀	🔒	11	CONTINUOUS	Default	0	Color_11	🖨
🔍	HS2_MAG_Grid_Border	☹	☀	🔒	white	CONTINUOUS	Default	0	Color_7	🖨
🔍	HS2_MAG_Agriculture_Drain	☹	☀	🔒	251	TRACKS	Default	0	Color_251	🖨
🔍	HS2_MAG_Agriculture_PloughEtc	☹	☀	🔒	35	ACAD_ISO03W...	0.25 mm	0	Color_35	🖨
🔍	HS2_MAG_Agriculture_RidgeFurrow	☹	☀	🔒	35	ACAD_ISO10W...	0.25 mm	0	Color_35	🖨
🔍	HS2_MAG_Archaeology	☹	☀	🔒	190	CONTINUOUS	Default	0	Color_190	🖨
🔍	HS2_MAG_Archaeology_Trend	☹	☀	🔒	190	ACAD_ISO02W...	0.25 mm	0	Color_190	🖨
🔍	HS2_MAG_Archaeology_Zone_Ha...	☹	☀	🔒	190	CONTINUOUS	Default	0	Color_190	🖨
🔍	HS2_MAG_Archaeology_Zone_Ou...	☹	☀	🔒	255	CONTINUOUS	Default	0	Color_255	🖨
🔍	HS2_MAG_ArchaeologyPossible	☹	☀	🔒	161	CONTINUOUS	Default	0	Color_161	🖨
🔍	HS2_MAG_ArchaeologyPossible_T...	☹	☀	🔒	161	ACAD_ISO02W...	0.25 mm	0	Color_161	🖨
🔍	HS2_MAG_ArchaeologyPossible_Z...	☹	☀	🔒	161	CONTINUOUS	Default	0	Color_161	🖨
🔍	HS2_MAG_ArchaeologyPossible_Z...	☹	☀	🔒	255	CONTINUOUS	Default	0	Color_255	🖨
🔍	HS2_MAG_Ferrous	☹	☀	🔒	9	CONTINUOUS	Default	0	Color_9	🖨
🔍	HS2_MAG_Ferrous_Zone_Hatch	☹	☀	🔒	253	CONTINUOUS	Default	0	Color_253	🖨
🔍	HS2_MAG_Ferrous_Zone_Outline...	☹	☀	🔒	255	CONTINUOUS	Default	0	Color_255	🖨
🔍	HS2_MAG_Industrial_BurntFired	☹	☀	🔒	14	CONTINUOUS	Default	0	Color_14	🖨
🔍	HS2_MAG_Natural_Hatch	☹	☀	🔒	84	CONTINUOUS	0.09 mm	0	Color_84	🖨
🔍	HS2_MAG_Natural_OutlineHide	☹	☀	🔒	255	CONTINUOUS	Default	0	Color_255	🖨
🔍	HS2_MAG_OldFieldBoundary_Hat...	☹	☀	🔒	35	CONTINUOUS	Default	0	Color_35	🖨
🔍	HS2_MAG_OldFieldBoundary_Out...	☹	☀	🔒	255	CONTINUOUS	Default	0	Color_255	🖨
🔍	HS2_MAG_Pipe	☹	☀	🔒	white	ACAD_ISO14W...	0.40 mm	0	Color_7	🖨
🔍	HS2_MAG_Uncertain	☹	☀	🔒	124	CONTINUOUS	Default	0	Color_124	🖨
🔍	HS2_MAG_Uncertain_Trend	☹	☀	🔒	124	ACAD_ISO02W...	0.25 mm	0	Color_124	🖨
🔍	HS2_MAG_Uncertain_Zone_Hatch	☹	☀	🔒	124	CONTINUOUS	Default	0	Color_124	🖨
🔍	HS2_MAG_Uncertain_Zone_Outlin...	☹	☀	🔒	255	CONTINUOUS	Default	0	Color_255	🖨

grid border and grid divisions (20/30m as appropriate)		Agriculture - Ploughing	
Archaeology (discrete / zone / trend*) *trend = very weak response		Agriculture - Drain	
Possible Archaeology (discrete / zone / trend*) *trend = very weak response		Natural	
Industrial, Burnt-Fired		Uncertain Origin (discrete / zone / trend*) *trend = very weak response	
Old Field Boundary		Pipe	
Agriculture - Ridge & Furrow		Ferrous (discrete / zone)	

Annex D: Ecology – technical notes

1.1.1 The following technical notes are appended to this document:

- Ecological field survey methods and standards
- Ecological assessment method
- Methodology for demonstrating no net loss in biodiversity
- Ecological principles of mitigation



HS2 London-West Midlands

Ecology

Technical note – Ecological field survey methods and standards

A report to HS2 Ltd by Arup/URS

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1 Executive summary

- 1.1.1 This document contains methods for scoping and undertaking ecological surveys for a range of flora and fauna in support of the proposed High Speed Two London-West Midlands (HS2 LWM) scheme (hereafter the 'Proposed Scheme').
- 1.1.2 This document provides standard methodologies for those ecological surveys which will be conducted most frequently along the route of the Proposed Scheme in order to gather baseline information in support of the Ecological Impact Assessment (EIA).
- 1.1.3 It is not intended to provide an exhaustive compendium of all survey methodologies utilised to inform the Environmental Statement (ES) for the Proposed Scheme. Where additional methodologies have been utilised in specific locations these details will be summarised in the ecology chapter of the appropriate Volume 2 Community Forum Area (CFA) reports, and detailed in the accompanying Volume 5 appendices.

2 Introduction

2.1 Purpose of the technical note

- 2.1.1.1 This technical note outlines proposals for the methods and standards to be adopted for baseline ecological field surveys in support of the Environmental Impact Assessment (EIA) for the construction of Phase 1 of Hs2, a new railway line between London and Birmingham (hereafter the 'Proposed Scheme').
- 2.1.1.2 This document contains methods for scoping and undertaking ecological surveys for a range of flora and fauna. It aims to ensure consistency of approach to field survey methods to ensure a robust and coherent EIA.
- 2.1.1.3 Surveys in support of the Ecological Impact Assessment (EclA) baseline will be coordinated by multiple teams of ecological consultants. The following document has been prepared after internal discussion with the consultants commissioned to undertake field surveys and in response to feedback from Natural England and the Environment Agency.
- 2.1.1.4 This document sets out the key survey methodologies and data recording requirements for those field surveys which are considered most likely to be required to inform the ecological impact assessment. It is not intended to be an exhaustive list of surveys that will be conducted. Based on the scale of the proposed works it is likely that in some locations additional surveys, not detailed here, will be required. Where further surveys are conducted these will be listed in the ecology section of the appropriate Volume 2 Community Forum Area (CFA) reports, and detailed in the corresponding Volume 5 appendices.
- 2.1.1.5 The following document deals solely with field survey methodology and standards. Details of the proposed approach for associated desk study are reported within the Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2).

2.2 Land required for the construction of the Proposed Scheme

- 2.2.1.1 The extent of surveys required should in all situations take into consideration the most up to date information available regarding the extent of the land required for the construction of the Proposed Scheme¹. For the purposes of the EclA it is assumed that all land required for the construction of the Proposed Scheme will be lost. This assumption means that survey prescriptions within the land required have been based solely on likely ecological value of the habitats and species present, rather than likely impact.
- 2.2.1.2 As ecological survey commenced in spring 2012 prior to detailed engineering design, in the first instance the extent of the land required for the construction of the Proposed Scheme was assumed. As a consequence, survey extents are in general defined on the basis of buffers from the outer boundary of the land required for the construction of key elements (e.g. the operational railway, all associated infrastructure, site compounds and storage areas) of the Proposed Scheme (e.g. land

¹ Defined as all land that will be required to construct the Proposed Scheme i.e. all areas of land that will be directly affected by the Proposed Scheme, including that required for operation and that required solely during construction.

required + 100m). Due to an evolving design the desired survey extent has therefore altered throughout the period of survey (April 2012 –September 2013). With each design change survey scopes have been revised, and where necessary scoping for survey requirements updated. During 2013 where the extent of land required for the construction of the Proposed Scheme increased it was in some cases possible to rationalise the requirements for extending the extent of the prescribed buffer. The stability of the design at each location was considered in deciding if further extension of the survey extent was necessary in order to be sure all potential significant effects were identified. Professional judgement has been used where appropriate to rationalise the requirements for survey associated with ancillary works, generally those associated with diversions to services that extend away from the route of the Proposed Scheme. For example in many areas land has been included to facilitate minor pylon realignment. Such works may extend several kilometres from the route of the Proposed Scheme and may be unlikely to result in significant effects on ecological receptors. As a consequence, in each case an ecologist has reviewed the extent and nature of the works proposed and applied professional judgement to derive an appropriate survey effort for these elements of the scheme.

2.3 Screening for survey requirements (general)

- 2.3.1 Ecological consultants undertaking survey work to inform the ES are expected to utilise the approach and guidance provided in this document to identify where field surveys are required and what type of survey is appropriate.
- 2.3.2 Ecological field investigations should in the first instance be presumed to be required where:
- a potential ecological receptor is confirmed or it is thought there is a reasonable likelihood that such a receptor may be present; and
 - significant effects on ecological integrity or conservation status may arise from the construction or operation of the Proposed Scheme.
- 2.3.3 Where access is available the presence of existing ecological data (either from biological records centres or pre-existing survey reports) should only be utilised to preclude the requirement for surveys specifically in support of HS2 where:
- it is clear that the survey methodology utilised is consistent with that proposed in this document and the data available; and
 - the pre-existing data set is sufficiently up to date to still be considered valid (see SMR Addendum Volume 5: Appendix CT-001-000/1).
- 2.3.4 In all such cases a precautionary approach should be adopted and field survey repeated where there is any doubt over the validity of existing data.
- 2.3.5 Where surveys in support of another development require survey of the same areas of land the sharing of survey data may be required (e.g. to limit disturbance to a great crested newt breeding pond as a consequence of multiple surveys of the same water body). In all such cases, where there is a requirement to share data consultants should liaise with the project ecologists to ensure that the methods utilised are consistent with those specified in this document.

- 2.3.6 Due to an evolving design the required extent of surveys has varied over the period that surveys have been undertaken. Survey buffers established from the boundary of the land required for the construction of the Proposed Scheme have helped to limit the impact of design changes, as the majority of changes have led to extensions into areas which already fell within the required scope of surveys.
- 2.3.7 Guidance on the ecological assessment methodology is provided in the SMR (Volume 5: Appendix CT-001-000/1) and SMR Addendum (Volume 5: Appendix CT-001-000/2). Where a documented screening/scoping exercise has been conducted, and the outcome indicates that significant adverse effects on a potential ecological receptor are not likely to occur, reduced field survey effort, or scoping is likely to be appropriate.
- 2.3.8 Care should be taken to ensure that receptors potentially subject to indirect effects are also included within the survey scope. For example areas distant from the route of the Proposed Scheme which are potentially subject to impacts arising from hydrological changes.

2.4 Safety

- 2.4.1 The safety of the workforce and the public is paramount. Consultants undertaking field survey will be required to ensure that a health and safety risk assessment is in place prior to commencement of each field survey visit and to satisfy themselves that all appropriate access provisions are made.
- 2.4.2 All risk assessments should address key health and safety issues such as potential for slips, trips and falls; working in close proximity to water; working within fields occupied by livestock; working at height; potential exposure to asbestos; and night time working.
- 2.4.3 In particular, lone working is to be avoided unless consultants can demonstrate adequate safeguards are in place and the risk of harm is acceptable.
- 2.4.4 It is recognised that survey methods may need to be modified in some areas to allow surveys to be conducted safely, for example works on or near highways and railroads, or inspections of structurally unstable buildings. A record should be made of all such deviations.

2.5 Access to Land

- 2.5.1 All access to undertake field surveys will be organised by the land referencing team. A protocol for requesting and reporting upon access will be prepared and provided to consultants undertaking survey work.
- 2.5.2 Consultants undertaking survey work have been briefed on the acceptable use of Public Rights of Way (PRoW) during surveys.

2.6 Biosecurity

- 2.6.1 Field surveyors are to take all reasonable measures to ensure compliance with species specific best practice guidelines for preventing the spread of disease and of invasive species of flora and fauna.

- 2.6.2 This is particularly true of work in water. Current best practice bio-security measures are to be taken throughout, with disinfection of footwear and equipment between surveys, where they are used on more than one watercourse or water body. All amphibian surveys are to follow the guidelines for amphibian survey bio-security as set out in ARG-UK Guidance Note 4 (2008)².

2.7 Invasive non-native species

- 2.7.1 Where non-native animal species occurring on Part 1 Schedule 9 of the Wildlife and Countryside Act (1981 as amended)³ are captured during the surveys in support of the project (in line with legislation) they will not be released back into the wild. Where such species are encountered (but not captured) during surveys the species and location will be recorded.
- 2.7.2 Where non-native animals which are not listed on Part 1 Schedule 9 of the Wildlife and Countryside Act (1981 as amended) are captured during surveys their presence will be noted on recording forms and individuals released.
- 2.7.3 Where plant species occurring on Part 2 Schedule 9 of the Wildlife and Countryside Act (1981 as amended) are encountered during habitat surveys the species, location and extent will be recorded.

2.8 Competency standards

- 2.8.1 Specific competency standards, qualifications and licensing are detailed for each survey type below where applicable. For surveys not dealt with in detail within the following document it is expected that consultants undertaking field surveys must meet the minimum relevant Chartered Institute of Ecology and Environmental Management (CIEEM) Competency for Species Survey (CSS) standards⁴ which apply.

2.9 Combining surveys

- 2.9.1 Although the methodologies for the various surveys are described separately in this document, there is clearly scope for combining surveys and particularly screening to confirm the need to undertake specialist surveys.
- 2.9.2 Whilst combining surveys is encouraged where it is practical, it should not take place where this would result in a lack of adequate focus on particular surveys (e.g. survey for badger signs).

2.10 Identification of potential mitigation areas and receptor sites

- 2.10.1 During the process of screening and conducting field surveys consultants should consider the potential suitability of land within the vicinity of the prescribed survey extents to be utilised to provide mitigation or compensation, including use as receptor sites for protected species translocated from habitats lost as a consequence of the scheme.

² ARG-UK (2008) ARG-UK Advice Note 4: Amphibian disease precautions: a guide for UK fieldworkers. <http://static.zsl.org/files/biosecurity-arguk4-511.PDF> Accessed 18th July 2012.

³ Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office.

⁴ CIEEM (2013) Competencies for species surveys in Britain and Ireland.

http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_OVERVIEW_April_2013.pdf Accessed 02/10/2013.

- 2.10.2 Where ecologists identify potential receptor sites or mitigation areas they should submit details. This should include a brief rationale for their selection and proposals for any additional survey work they consider to be required to confirm the suitability of the identified sites for this purpose (e.g. reptile presence/absence survey).

2.11 Compliance and variations

- 2.11.1 Consultants undertaking field surveys should comply with the methods within this document, with deviations only permitted with approval from HS2 Technical Directorate and their overseeing consultants.
- 2.11.2 It is recognised that limitations in relation to access and health and safety may require a variation in survey scope and method. In particular, there could be access and timing restrictions beyond the control of the consultants. Close liaison between all parties will be required to identify as early as possible any limitations to the work and to discuss appropriate means to mitigate such constraints.
- 2.11.3 It is also recognised that in some areas (particularly suburban and urban areas), it will be appropriate to reduce the spatial scope defined in this document to reflect the fact that any potential significant effects in such areas are likely to be more closely associated with the route of the Proposed Scheme. For example in urban or suburban areas where large numbers of residential dwellings (which are to be retained) are present within the standard survey buffer, it is not anticipated that all such buildings will require internal inspection for bats.
- 2.11.4 In these situations consultants undertaking field surveys are expected to make judgements regarding the required spatial scope on a site by site basis and record the rationale for these decisions.
- 2.11.5 Where requirements arise for surveys not covered in this document, then discussion will be required between all teams of ecological consultants working on the project in order to ensure a consistent approach to survey.

2.12 References

ARG-UK (2008) ARG-UK Advice Note 4: Amphibian disease precautions: a guide for UK fieldworkers. <http://static.zsl.org/files/biosecurity-arguk4-511.PDF> Accessed 18th July 2012.

CIEEM (2013) Competencies for species surveys in Britain and Ireland. http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_OVERVIEW_April_2013.pdf Accessed 02/10/2013.

Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office.

3 Survey referencing and recording (general)

3.1 Survey referencing

3.1.1 Survey information collected has been allocated an ecology survey code to provide a unique identifier for use on project mapping and within Geographical Information Systems (GIS):

Route zone code (3 digits) - Survey type code (3 digits) - Location reference code (6 digits) - (+ 3-digit record number reference where applicable – see Table 2)

3.1.2 The ecology survey codes and reference numbers are listed in Table 1 and

3.1.3 Table 2. The ecology site referencing code will form one of several identifier fields to be included in the final project wide GIS database.

Table 1: Route zone codes

Section of the route	Route zone code
Community Forum Area 1 (CFA1) to CFA6 inclusive	010
CFA7 to CFA15 inclusive	020
CFA16 to CFA22 inclusive	030
CFA 23-26 inclusive	040

Table 2: Survey type codes and reference numbers

Survey	Survey type code	Location reference code	Use of 3-digit record number reference required
Amphibian - Aquatic survey (during mid-March to mid -une)	AA1	3 digit km no. + 3 digit site no.	No
Amphibian - Aquatic survey outside of the period mid-March to mid-June	AA2	3 digit km no. + 3 digit site no.	No
Amphibian – Habitat Suitability Index (HIS)/walkover	AH1	3 digit km no. + 3 digit site no.	No
Amphibian - Terrestrial survey (refuges only)	AT1	3 digit km no. + 3 digit site no.	No
Amphibian - Terrestrial survey (temporary amphibian fencing and pitfall traps/refuges)	AT2	3 digit km no. + 3 digit site no.	No
Badger - Field survey for signs of activity	BD1	3 digit km + 3 digit record no.	No
Badger - Extended field survey in support of territory analysis	BD2	3 digit km + 3 digit record no.	No
Badger - Field survey in support of bait marking exercise	BD3	3 digit km + 3 digit site no.	Yes
Bat - Initial assessment of structures including buildings, bridges and caves	BS1	3 digit km + 3 digit site no.	No
Bat - Further inspection of structures including buildings, bridges and caves	BS2	3 digit km + 3 digit site no.	No
Bat - Emergence survey of structures including buildings, bridges and caves	BS3	3 digit km + 3 digit site no.	No

Survey	Survey type code	Location reference code	Use of 3-digit record number reference required
Bat - Initial assessment of trees	BT1	3 digit km + 3 digit site no.	No
Bat - Further inspection of trees	BT2	3 digit km + 3 digit site no.	No
Bat – Emergence survey of trees	BT3	3 digit km + 3 digit site no.	No
Bat - Activity (transect)	BA1	3 digit km + 3 digit site no.	Yes
Bat - Activity (static detector)	BA2	3 digit km + 3 digit site no.	Yes
Bat - Activity (swarming)	BA3	3 digit km + 3 digit site no.	Yes
Bat - Activity (mist net/harp trapping/radio tracking)	BA4	3 digit km + 3 digit site no.	Yes
Bat – Hibernation	BH1	3 digit km + 3 digit site no.	No
Breeding bird - Discrete area/Common Birds Census	BB1	3 digit km + 3 digit site no.	Yes
Breeding bird – Habitat sampling	BB2	3 digit km + 3 digit site no.	Yes
Breeding bird - Species specific	BB3	3 digit km + 3 digit site no.	Yes
Ditch vegetation survey	DS1	3 digit km + 3 digit site no.	No
Fish survey	Fl1	3 digit km + 3 digit site no.	Yes
Hazel dormouse – Habitat appraisal	HD1	3 digit km + 3 digit site no.	No
Hazel dormouse – Nest tube survey	HD2	3 digit km + 3 digit site no.	No
Hazel dormouse – Nut search	HD3	3 digit km + 3 digit site no.	No
Hedgerow survey	HS1	3 digit km + 3 digit hedge no.	No
Invertebrates - Aquatic survey	IA1	3 digit km + 3 digit site no.	No
Invertebrates - Terrestrial survey	IT1	3 digit km + 3 digit site no.	No
Otter – Habitat appraisal	OT1	3 digit km + 3 digit site no.	No
Otter – Detailed survey	OT2	3 digit km + 3 digit site no.	Yes
Pond survey (Rapid assessment method)	PS1	3 digit km + 3 digit site no.	No
Pond survey (Predictive SYstem for Multimetrics)	PS2	3 digit km + 3 digit site no.	No
Pond survey (National Pond Survey)	PS3	3 digit km + 3 digit site no.	No
Reptiles – Habitat appraisal	RE1	3 digit km + 3 digit site no.	No
Reptiles – Detailed survey	RE2	3 digit km + 3 digit site no.	No

Survey	Survey type code	Location reference code	Use of 3-digit record number reference required
River Corridor Survey	RS1	3 digit km + 3 digit site no.	No
River Habitat Survey	RS2/RH1	3 digit km + 3 digit site no.	No
Scoping survey	SCO	3 digit km + 3 digit site no.	No
Water vole- Habitat appraisal	WV1	3 digit km + 3 digit site no.	No
Water vole – Detailed survey	WV2	3 digit km + 3 digit site no.	Yes
White-clawed crayfish – Habitat appraisal	WC1	3 digit km + 3 digit site no.	No
White-clawed crayfish – Manual search	WC2	3 digit km + 3 digit site no.	No
White-clawed crayfish – Trapping survey	WC3	3 digit km + 3 digit site no.	No
Wintering and passage birds – General	WB1	3 digit km + 3 digit site no.	Yes
Wintering and passage birds - Species specific	WB2	3 digit km + 3 digit site no.	Yes
Phase 1 habitat survey – Habitat parcel/feature	PH1	3 digit km + 3 digit habitat parcel ID	No
Vegetation (Phase 2 – National Vegetation Classification survey)	PH2	3 digit km + 3 digit site number	Yes – 3 digit habitat parcel ID

- 3.1.4 The 6 digit location reference will follow the route and the numbering will sequentially increase. The route has been split into 1 km sections, each of which is allocated a three-digit km number. Surveys of each type conducted within that km of the route have then been sequentially numbered. So the first survey site in the first 1km section would have a location reference of 001001, the first site in the second 1km section would be 002001, and the first site in the 99th 1km section would be 099001.
- 3.1.5 Using these conventions, the third amphibian aquatic survey (conducted during mid-March to mid-June) location in the 200th 1km section within the zone including CFA17 would be:
- 030-AA1-200003
- 3.1.6 The 99th tree subject to initial assessment for bats in the 50th km in the zone including CFA9 would be:
- 020-BT1-050099
- 3.1.7 Where multiple survey visits are required at a discrete location (e.g. six amphibian visits to the same pond) then the results of all visits will be recorded under the single reference code for this survey location.
- 3.1.8 Where the extent of surveys is anticipated to be more continuous (e.g. hedgerow survey, Phase 1 habitat survey, badger survey), and therefore the concept of a site is redundant, the final three digits of the location reference field will be utilised to record the record number (e.g. target note number for Phase 1 habitat survey or field sign number for badger).

- 3.1.9 For example the 47th target note recorded during Phase 1 habitat survey in the 50th km in the zone including CFA11 would be:
- 020-PH1-050047
- 3.1.10 Note that for badgers at a sett location the sett itself should be allocated a record number. Details of individual entrances and other signs of activity associated with the sett (e.g. hairs and prints in entrances etc.) will all be described under a single six digit location reference. Where other field signs are identified away from a sett (e.g. latrine, hair on fence of badger path) these should be allocated a separate six digit location reference.
- 3.1.11 For some surveys it will be necessary to incorporate a fourth section to the code to allow both the site number and record number to be recorded. Surveys requiring this additional field within the referencing code are indicated in Table 2 above.
- 3.1.12 For example records of bat activity at the fourth listening station within the second bat activity transect route within the 54th km of the zone including CFA14 would be:
- 020-BA1-054002-004
- 3.1.13 Where repeat survey visits are conducted (e.g. repeat surveys of a bat activity transect) records from all surveys at the same location will be recorded under the same survey code.

4 Phase 1 (extended) habitat survey

4.1 Introduction and guidelines

- 4.1.1 Set out below are the methods to be used to map the habitats and vegetation present along the route of the Proposed Scheme. As the Phase 1 habitat survey is often the first opportunity to visit the route, also included is the requirement to search for and record signs of protected or otherwise notable species, and to assess habitats for their potential to support protected or otherwise notable species, as well as invasive species of flora and fauna. This information will be used as part of the decision process for targeting future surveys.

4.2 Qualifications and experience

- 4.2.1 Surveyors are to be experienced in Phase 1 habitat survey, be competent botanists and have previously undertaken surveys in the types of habitats likely to be present. For extended⁵ Phase 1 habitat survey, surveyors will also be experienced in the identification of potential for habitats to support protected or otherwise notable species (including badger, otter, hazel dormouse, bats etc.).

4.3 Licensing requirements

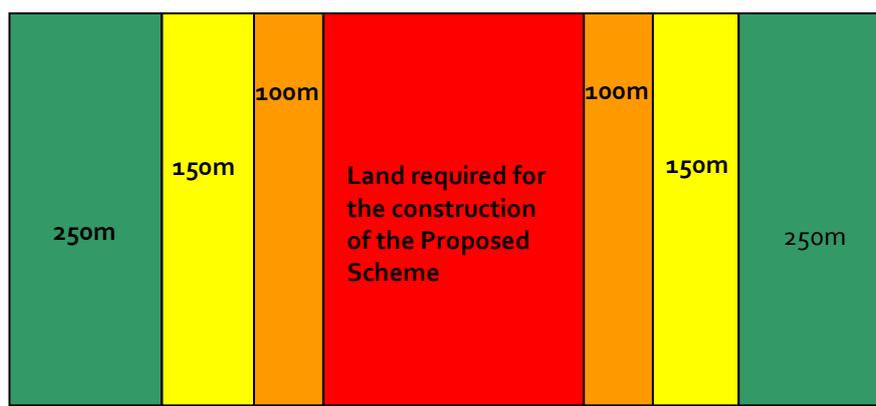
- 4.3.1 There are no licensing requirements for Phase 1 habitat survey.

⁵ Extended Phase 1 habitat survey is the traditional survey of botanical habitats extended to include an evaluation of the potential of the habitats to support protected or otherwise notable species.

4.4 Screening for survey and defining the survey area

- 4.4.1 Subject to access restrictions, Phase 1 habitat survey and mapping is required for the entire London-West Midland route within the survey buffers defined below.
- 4.4.2 As a minimum (subject to the caveats identified in Section 2.11) consultants will be required to produce a set of route maps identifying habitat types within a 500m buffer of the land required for the construction of the Proposed Scheme. The level of field survey required is not the same across the whole 500m buffer either side of the land required, but is zoned according to likely impacts, as described below.
- 4.4.3 The diagram below shows the standard division of zones within the 500m buffer beyond the boundary of the land required for the construction of the Proposed Scheme.

Figure 1: Standard extents of Phase 1 habitat survey



- 4.4.4 In rural areas, within the land required for the construction of the Proposed Scheme and 100m either side, the level of survey should, as a minimum, follow the full, extended Phase 1 habitat survey method.
- 4.4.5 Within a zone extending to a further 150m (i.e. 101-250m from the boundary of the land required for the construction of the Proposed Scheme), a "classic" Phase 1 habitat survey will be undertaken. In this zone, therefore, it is sufficient to map broad habitat types and make target notes of any features of interest.
- 4.4.6 From 250m to 500m from the boundary of land required for the construction of the Proposed Scheme the habitats will be mapped from aerial photograph interpretation alone and there will be no requirement to undertake a field-based Phase 1 habitat survey. However, where possible a note should be made of any obvious changes in habitat type from that shown from interpretation of aerial photographs e.g. woodland felled; hedgerow removed; improved grassland now under arable cultivation.
- 4.4.7 In urban areas the survey zones are likely to be restricted in extent and for many areas limited to the route and areas with public access. Where feasible, up to 100m from the route, the level of survey should follow the full extended Phase 1 habitat survey method but as a minimum, a note should be made of any obvious changes in habitat type from that shown from interpretation of aerial photographs.
- 4.4.8 Following initial site visits and mapping it may be necessary to revisit and modify the survey zones locally in order to capture sufficient information to inform the scope of other investigations and assess likely significant effects. For example, the 100m

survey zone may be expanded to include the whole of a sensitive habitat that is within, but extends beyond the 100m zone described above.

- 4.4.9 The approach described shall be principally applied in relation to the land required for the construction of the key elements (e.g. the operational railway, all associated infrastructure, site compounds and storage areas) of the Proposed Scheme.
- 4.4.10 Professional judgement has been used where appropriate to rationalise the requirements for survey associated with ancillary works, generally associated with diversions to services that extend away from the route of the Proposed Scheme.

4.5 Survey methods

- 4.5.1 The survey is to be undertaken following the published methodology for Phase 1 habitat survey (Joint Nature Conservation Committee, 2010)⁶ and Guidelines for Preliminary Ecological Appraisal (Institute of Ecology and Environmental Management, 2012)⁷. This includes mapping the habitat type according to the definitions in the Handbook for Phase 1 habitat survey (Joint Nature Conservation Committee, 2010); noting dominant species; and providing target notes where appropriate to identify particular features/species.
- 4.5.2 Information on habitats and species composition to be collected during Phase 1 habitat survey has, as far as possible, to be sufficient for an assessment to be made as to requirements for further survey (e.g. National Vegetation Classification). This will apply within the land required for the construction of the Proposed Scheme and a 100m-wide "buffer zone" but further from the land required consultants undertaking field survey are to determine whether such surveys could be required, depending on the value and sensitivity of the habitat (and associated species of flora and fauna) and the nature of the impacts predicted to result from the Proposed Scheme.
- 4.5.3 Target notes should be used to identify modified habitats such as low diversity/value road verge grasslands, to distinguish them from unimproved or other higher value habitats.
- 4.5.4 Invasive plant species such as Japanese knotweed are to be mapped as 'tall ruderal' with associated target notes
- 4.5.5 In addition, the Phase 1 habitat survey is to be extended to include recording signs of and suitability for protected/notable species according to methods in Guidelines for Baseline Ecological Assessment (Institute of Environmental Assessment, 1995)⁸. Such signs and features should be accurately located on a plan and GPS coordinate(s) recorded.
- 4.5.6 Where no access is available for survey, any existing data and review of aerial photography should be used to allocate areas to Phase 1 habitat codes.

4.6 Survey programme and effort

- 4.6.1 Species associated with different habitats are more easily identified at various times in the growing season. In order to identify most habitats accurately, Phase 1 habitat

⁶ Joint Nature Conservation Committee (2010), *Handbook for Phase 1 habitat survey - a technique for environmental audit*. Peterborough.

⁷ Institute of Ecology and Environmental Management (2012). *Guidelines for preliminary ecological appraisal*. Institute for Ecology and Environmental Management. <http://ieem.net/>

⁸ Institute of Environmental Assessment (1995), *Guidelines for Baseline Ecological Assessment*. E and FN Spon, London.

survey should ideally be undertaken between April and early October. However, in order to prevent delay in the identification of protected species constraints, in all cases Phase 1 habitat survey should be completed as early as access is forthcoming (i.e. even when outside of the April to early October window), and repeated during the following optimum window for habitat survey where required.

- 4.6.2 For some habitats (e.g. areas dominated by amenity grassland, hard standing or buildings), it will be possible to gather sufficient information of value outside the April to early October window, and no repeat survey will be required. In these situations consultants should make a clear record in each case of why survey information collected outside of the optimum window is considered to represent a valid survey.

4.7 References

Institute of Environmental Assessment (1995). Guidelines for Baseline Ecological Assessment. E and FN Spon, London

Institute of Ecology and Environmental Management (2012). Guidelines for preliminary Ecological Appraisal. Institute for Ecology and Environmental Management.

Joint Nature Conservation Committee (2010). Handbook for Phase I Habitat Survey: A technique for environmental audit. Joint Nature Conservation Committee, Peterborough

5 National Vegetation Classification survey

5.1 Introduction and guidelines

- 5.1.1 Habitats identified at the Phase 1 stage as being particularly species diverse and/or sensitive, of a type restricted in the UK/Region, and which could be directly or indirectly affected by the Proposed Scheme are likely to require further survey to Phase 2 National Vegetation Classification (NVC) level.
- 5.1.2 Where it is identified that Phase 2 (NVC) surveys are required, the survey methods are as a general rule to follow the published methodology appropriate to the vegetation being surveyed (Rodwell, 1991 et seq)⁹ and Rodwell (2006)¹⁰.
- 5.1.3 Reference should also be made to National Vegetation Classification: User's Handbook (Rodwell et al, 2000)¹¹ and the web site of the Joint Nature Conservation Committee <http://jncc.defra.gov.uk/page-4259> where up-to-date information can be obtained regarding changes/additions to the vegetation types presented in the original published volumes.
- 5.1.4 It is acknowledged that in some habitats NVC may not represent the most appropriate method of Phase 2 vegetation survey to provide quantitative data in support of impact assessment. In all such cases a deviation request should be submitted.

5.2 Qualifications and experience

- 5.2.1 Surveyors are to be competent botanists and experienced in undertaking Phase 2 (NVC) surveys across the range of habitats likely to be encountered .

5.3 Licensing requirements

- 5.3.1 There are no licensing requirements for Phase 2 (NVC) survey.

5.4 Screening for survey and defining the survey area

- 5.4.1 The results of the desk study and/or the Phase 1 habitat survey should be used along with consideration of the nature, location and extent of the habitat within the land required for the construction of the Proposed Scheme and surrounding land to identify areas for survey to NVC level.
- 5.4.2 Habitats that are likely to require survey at Phase 2 include ones where there are:
- potential significant direct or indirect effects on designated statutory and non-statutory wildlife sites; and/or
 - potentially significant effects on habitats of principal importance identified within Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)¹² . As a guide, areas of greater than 1ha in area are more likely to

⁹ Rodwell, J.S. (1991 et seq), *British Plant Communities*. Publication in Five Volumes. Cambridge University Press. Cambridge.

¹⁰ Rodwell, J.S. (2006), *National Vegetation Classification: User's handbook*. Joint Nature Conservation Committee. Peterborough. Downloadable at http://jncc.defra.gov.uk/pdf/pubo6_NVCUsershandbook2006.pdf Accessed 10/04/2012.

¹¹ Rodwell, J.S., Dring, J.C., Averis, A.B.G., Proctor, M.C.F., Malloch, A.J.C., Schaminee, J.H.J. and Dargie, T.C.D. (2000). *Review of coverage of the National Vegetation Classification*. Joint Nature Conservation Committee, Peterborough.

¹² *Natural Environment and Rural Communities Act* (1996), Chapter 16. Her Majesty's Stationery Office, London.

require NVC survey but the consultants undertaking field survey should decide whether areas smaller than this should also be surveyed on a case-by-case basis depending on habitat quality and complexity. It should be noted that even where significant effects are anticipated NVC survey will not be appropriate for all extents of habitats of principal importance (e.g. reedbed);

- potential significant direct effects on other habitats considered to be particularly high quality/value examples of their type or likely to contain uncommon plant species; and/or
- potential indirect impacts on extensive wetland areas.

5.4.3 Where a discrete survey area is not easily determined (for example, where a habitat extends beyond the Phase 1 habitat survey area), comparative data are likely to be required from the wider extent (potentially the whole extent of the habitat 'unit') to enable an assessment of the scale of impact from the development. This will be decided on a case-by-case basis by the consultants undertaking the survey.

5.5 Survey method

5.5.1 At each site identified for survey, homogenous stands of vegetation are to be identified and sampled with a minimum of five quadrats, size appropriate to the vegetation being surveyed (see Rodwell 1991 et seq. or Rodwell, 2006). Quadrats are to be recorded in typical vegetation and are not required to be random or evenly spread.

5.5.2 Where woodland is encountered and is directly impacted by the route, it is expected that NVC level data will be collected. Guidance for sampling woodlands is given in Rodwell (2006). Within small woodland blocks it is likely that five 50m x 50m samples cannot be taken and the whole stand can be the quadrat for canopy and understorey but within such areas replicate 4m x 4m or 10m x 10m quadrats can be recorded for the field and ground layers and then combined.

5.5.3 Within each quadrat all species are to be recorded with an estimate of percentage cover/abundance using the Domin scale (1 = few individuals; 2 = some individuals; 3 = many individuals; 4 = 4% - 10%; 5 = 11% - 25%; 6 = 26% - 33%; 7 = 34% - 50%; 8 = 51% - 75%; 9 = 76% - 90%; 10 = 91% - 100%). Subsequent areas of the same vegetation within a site do not require five additional quadrats but should be sampled for consistency and at least one quadrat recorded and, based on size, possibly more at the discretion of the surveyor.

5.5.4 The location of each quadrat should be recorded accurately on a plan and a GPS coordinate taken.

5.5.5 Voucher specimens should be taken for species for which identification may be contentious, including some bryophytes and lichens.

5.5.6 A sketch plan of the whole area surveyed should be made and a record made of physical parameters including slope and aspect (see Rodwell, 2006) where necessary to allow assessment of significant effects. Consultants undertaking field surveys should also consider whether pH and soil depth data are required to assess effects on the vegetation.

5.6 Data analysis

- 5.6.1 The data collected is to be analysed to provide the 'best' approximation to a published NVC type.
- 5.6.2 The data recorded in the quadrats from each homogenous stand of vegetation are to be tabulated and a constancy value for each species calculated for each defined group of quadrats, as follows:
- Scale: I = 1% - 20%. II = 21% - 40%. III = 41% - 60%. IV = 61% - 80%. V = 81% - 100%.
- 5.6.3 The tables produced will then be used to assign the vegetation types to one of the published plant community types through use of the keys provided in the published volumes and by visual comparison of the collected data with the published data. In addition, there are also computer programs (MATCH or TABLEFIT) that can be used to facilitate comparison of the data sets with published data. Alternative software should not be utilised without prior approval.

5.7 Survey programme and effort

- 5.7.1 The accurate definition of plant communities requires comprehensive species lists, including grasses and lower plants. As far as possible, Phase 2 surveys should therefore take place when most species, and particularly any characteristic species, are at their most visible. For most habitats, this will cover the period May to July.

5.8 References

Natural Environment and Rural Communities Act (1996) Chapter 16. Her Majesty's Stationery Office, London.

Rodwell, J.S. (1991 et seq). British Plant Communities. Published in Five Volumes. Cambridge University Press, Cambridge.

Rodwell, J.S. (2006). National Vegetation Classification: User's Handbook. Joint Nature Conservation Committee, Peterborough. Downloadable at http://jncc.defra.gov.uk/pdf/pubo6_NVCusershandbook2006.pdf Accessed: 10/04/2012.

Rodwell, J.S., Dring, J.C., Averis, A.B.G., Proctor, M.C.F., Malloch, A.J.C., Schaminee, J.H.J. and Dargie, T.C.D. (2000). Review of Coverage of the National Vegetation Classification. Joint Nature Conservation Committee, Peterborough.

6 River Habitat Survey

6.1 Introduction and guidelines

6.1.1 River Habitat Survey (RHS) is a method designed to characterise and assess, in broad terms, the physical structure of freshwater streams and rivers.

6.1.2 The proposed approach will follow the survey methodology outlined within River Habitat Survey in Britain and Ireland; Field Survey Guidance Manual; Version 3 (Environment Agency, 2003)³³. River Corridor Survey (RCS) will be conducted on the same sections of watercourse, and details of this methodology are provided within Section 7.

6.1.3 RHS is carried out along a standard 500m length of river channel. Observations are made at ten equally spaced spot-checks along the channel, whilst information on valley form and land-use in the river corridor provides additional context. (Environment Agency, 2003).

6.2 Qualifications and experience

6.2.1 All initial scoping and subsequent field survey should be conducted by persons who have attended training in the 2003 Version of the Environment Agency methodology and passed an accreditation test.

6.3 Licensing requirements

6.3.1 There are no licensing requirements for RHS.

6.4 Screening for survey and defining the survey area

6.4.1 The desk study will identify watercourses identified as “main” rivers and the results of the Phase 1 habitat survey will indicate the nature of any other watercourses. Lengths of a watercourse should be surveyed if:

- the watercourse is defined as “main” river; or
- the watercourse has flowing water and a channel width of more than 1m;
- the watercourse is not obviously canalised or heavily managed; and
- the watercourse is to be lost/culverted/diverted or potentially experience a significant change in water quality or quantity that could affect the flora and fauna within the watercourse and/or designated wildlife sites downstream.

6.4.2 At each location selected for survey the survey will as a minimum cover a 500m section of the watercourse centred on the centreline of the route of the Proposed Scheme (i.e. 250m either side of the route). Consultants undertaking survey should consider the need to extend this to incorporate further 500m sections at those locations where this extent does not include as a minimum the land required for the construction of the Proposed Scheme and a 100m buffer either side of the boundary

³³ Environment Agency (2003), *River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual; 2003 Version*. Environment Agency, Bristol.

of the land required, or watercourse diversions are proposed and there is considered to be the potential for likely significant effects further upstream or downstream.

6.5 Survey Methods

- 6.5.1 The survey should be undertaken according to the methodology provided in River Habitat Survey in Britain and Ireland; Field Survey Guidance Manual; Version 3 (Environment Agency, 2003).
- 6.5.2 Results should be recorded using the standard 2003 Version survey forms with the survey unique reference recorded (following the conventions shown in Section 3) within the survey number/site reference fields.

6.6 Survey programme and effort

- 6.6.1 Where possible RHS surveys should be undertaken during the months of May or June, in order to avoid vegetation obscuring channel features.
- 6.6.2 Where emergent and bankside vegetation is limited, or regularly managed then survey may be suitable over a much longer season. Where surveys are undertaken outside of the non-optimal months of May and June, subsequent interpretation of the results should take into account the seasonal aquatic and bankside vegetation growth (Environment Agency, 2003).
- 6.6.3 High water levels and turbidity will also obscure many of the features RHS is designed to record (Environment Agency, 2003). Survey should therefore not be conducted during periods following periods of heavy rain and should be delayed until water level and turbidity have returned to acceptable levels.

6.7 References

Environment Agency (2003) River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual; 2003 Version. Environment Agency, Bristol.

7 River Corridor Survey

7.1 Introduction and guidelines

- 7.1.1 River Corridor Survey (RCS) will be conducted in accordance with published guidance (National Rivers Authority, 1992)¹⁴. River Habitat Survey (RHS) (Environment Agency, 2003)¹⁵ will be conducted on the same sections of watercourse, and details of this methodology are provided within Section 6.
- 7.1.2 Invertebrate surveys of affected watercourses may also be a requirement. The methods for these are provided in Section 20.

7.2 Qualifications and experience

- 7.2.1 The surveyors must be experienced in undertaking RCS. Where boats are to be used, they should be manned by appropriately trained/certificated boat handlers and surveyors should all have received adequate training in surveying from a boat.

7.3 Licensing requirements

- 7.3.1 There are no licensing requirements for the RCS but training is available by undertaking the course run by the Environment Agency.

7.4 Screening for survey and defining the survey area

- 7.4.1 The desk study will identify watercourses identified as “main” rivers and the results of the Phase 1 habitat survey will indicate the nature of any other watercourses. Lengths of a watercourse should be surveyed if:
- the watercourse is defined as “main” river; or
 - the watercourse has flowing water and a channel width >1m; and
 - the watercourse is not obviously canalised or heavily managed; and
 - the watercourse is to be lost/culverted/diverted or potentially experience a significant change in water quality or quantity that could affect the flora and fauna within the watercourse and/or designated wildlife sites downstream.
- 7.4.2 The survey will at each location cover a minimum 500m section of watercourse centred on the proposed route (i.e. 250m either side of the route). Consultants undertaking survey work should consider the need to extend this further at those locations where this extent does not include at least a 100m buffer either side of the boundary of land required for the construction of the Proposed Scheme or watercourse diversions are proposed and there is considered to be the potential for likely significant effects further upstream or downstream.

¹⁴ National Rivers Authority (1992), *River Corridor Surveys. Conservation Technical Handbook Number 1.*

¹⁵ Environment Agency (2003), *River Habitat Survey in Britain and Ireland. Field survey Guidance Manual: 2003 Version.* Environment Agency, Bristol.

7.5 Survey method

- 7.5.1 The survey will be undertaken and recorded using the published methodology (National Rivers Authority, 1992), with an annotated map forming the basis of the survey output.
- 7.5.2 GPS coordinates are to be recorded at the beginning and end of each survey section.

7.6 Survey programme and effort

- 7.6.1 Where possible, the survey should be undertaken during the period May - September. This allows adequate survey of the aquatic flora and also survey at the time when high water levels or spate conditions are least likely to occur. Where conducted outside of this period, particular care should be taken to record any limitations to the interpretation of the results obtained.

7.7 References

Environment Agency (2003) River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual; 2003 Version. Environment Agency, Bristol.

National Rivers Authority (1992). River Corridor Surveys. Conservation Technical Handbook Number 1.

8 Hedgerows survey

8.1 Introduction and guidelines

8.1.1 The survey of hedgerows may be undertaken concurrently with the Phase 1 habitat survey but there are specific details to record over and above that usually recorded at Phase 1 level.

8.1.2 Please refer to the Hedgerows Regulations 1997¹⁶ for the full definition and for survey methods.

8.2 Qualifications and experience

8.2.1 Surveyors are to be experienced in Phase 1 habitat survey and able to identify woody hedgerow species and woodland ground flora.

8.3 Licensing requirements

8.3.1 There are no licensing requirements for hedgerow survey.

8.4 Screening for survey and defining the survey area

8.4.1 All hedgerows that fall within or partly within the land required for the construction of the Proposed Scheme and a surrounding 100m buffer are to be surveyed to comply with the requirements of the "Wildlife and Landscape Criteria" in the Hedgerows Regulations (1997). Survey should not be limited to just those hedgerows that are more than 30 years old. However, hedgerows that have obviously been recently planted (e.g. tree guards and stakes still present) may be excluded.

8.4.2 It is recognised that full surveys for all potential fauna species are unlikely to be necessary for all hedgerows; assessment and requirements for further survey is to be based upon the desk-study results and outcomes of the habitat appraisal for protected and notable species.

8.4.3 Hedgerows that fall wholly outside a 100m buffer from the boundary of the land required for the construction of the Proposed Scheme, but which at least partly fall within a buffer of 100-250m should be noted, a list of woody species made and an estimate of general height and width given.

8.4.4 Hedgerows more than 250m from the boundary of the land required for the construction of the Proposed Scheme are unlikely to require full survey. Location of hedgerows will be captured by Phase 1 habitat survey conducted from aerial photographs. Where possible field surveys should seek to confirm that these hedgerows remain present.

8.5 Survey method

8.5.1 Survey is to comply with the requirements of the "Wildlife and Landscape Criteria" in the Hedgerow Regulations 1997.

¹⁶ *The Hedgerows Regulations (1997)*. SI1997 No 1160. Her Majesty's Stationery Office.

- 8.5.2 Depending on length, this involves recording the number of woody species along at least one typical 30m section and recording associated data including hedgerow height and width, number of mature trees, ditch, bank etc.
- 8.5.3 The start and end points of each hedgerow are to be recorded with at least an 8 figure OS grid reference using GPS.
- 8.5.4 The total number of other hedgerow connections to the hedgerow being surveyed should also be recorded, as recommended in the Defra Hedgerow Survey Handbook (Defra, 2007)¹⁷.
- 8.5.5 Hedgerows are to be recorded and mapped with a unique ecology survey code attributed, following the general description given in Section 3. It is helpful to map hedgerows from aerial photography in advance of survey so that survey sections and nodes can be identified.

8.6 Survey programme and effort

- 8.6.1 The survey of the hedgerows is ideally to be undertaken within the timescales required to adequately record both woody vegetation and ground flora.

8.7 References

Department for Environment, Food and Rural Affairs (2007). Hedgerow Survey Handbook. A Standard Procedure for local surveys in the UK. Defra, London.

The Hedgerows Regulations (1997). Statutory Instrument 1997 No 1160. Her Majesty's Stationery Office.

¹⁷ Department for Environment, Food and Rural Affairs (2007), *Hedgerow Survey Handbook*. A Standard Procedure for local survey in the UK. Defra, London.

9 Ditch vegetation survey

9.1 Introduction and guidelines

- 9.1.1 The method to be used to survey the vegetation of ditches is that published in A Manual for the Survey and Evaluation of the Aquatic Plant and invertebrate Assemblages of Ditches Version 4, (Buglife, 2010)¹⁸. This is based on an earlier methodology (Alcock and Palmer, 1985)¹⁹.
- 9.1.2 This methodology has been utilised to provide a uniform approach to obtaining data. It is acknowledged that the method was devised for use in grazing marsh and as such the evaluation of conservation value will not use the criteria which form part of the methodology.
- 9.1.3 The methodology for the selection and sampling of ditches for invertebrate assemblages is provided in Section 20.

9.2 Qualifications and experience

- 9.2.1 Surveyors are to be competent botanists and experienced in undertaking standardised vegetation surveys.

9.3 Licensing requirements

- 9.3.1 There are no licensing requirements for the ditch survey.

9.4 Screening for survey and defining the survey area

- 9.4.1 The results of the Phase 1 habitat survey will indicate the nature of ditches. The surveyor is to judge whether a ditch requires additional survey work in order to assess significant effects. As a guide, further survey is likely to be required where a ditch:
- is likely to hold permanent water; and
 - has not been heavily managed; and
 - supports a diverse and/or otherwise notable aquatic, emergent and marginal flora that cannot be adequately described by Phase 1 habitat survey; and
 - is likely to be subject to significant effects due to habitat loss/culverting/diversion or experience a significant change in water quality or quantity.
- 9.4.2 The requirement for survey is likely to be limited to ditches that fall within or partly within the land required for the construction of the Proposed Scheme and surrounding 100m buffer. Only in exceptional circumstances is it envisaged that survey will be required beyond the 100m buffer. This is likely to be where the ditch network is extensive and part of a large wetland complex. Where there is a complex of ditches, more extensive survey may be required to assess effects on to the wider network,

¹⁸ Buglife – The Invertebrate Conservation Trust (2012), A Manual for the Survey and Evaluation for the Aquatic Plant and UInvertebrate Assemblages of Ditches. Version 4, December 2010.

¹⁹ Alcock, M.R. and Palmer, M.A. (1985), A standard method for the survey of ditch vegetation CST Notes No.37. Nature Conservancy Council, Peterborough.

though sampling rather than survey of every ditch may be sufficient. Judgement is to be made by the surveyors on a case-by-case basis.

9.5 Survey method

9.5.1 A representative 20m section of ditch is chosen for the detailed survey described in 9.5.2 and the whole ditch (as far as access allows) should be surveyed to list other plant species. If the nature of the ditch changes, then further sections are surveyed as necessary. All plants growing in the ditch and on the banks up to the top of the bank are recorded to species level wherever possible, along with their abundance on the DAFOR scale (Dominant, Abundant, Frequent, Occasional or Rare).

9.5.2 As well as vegetation, the following parameters are measured/assessed, as described in the manual:

- adjacent land-use;
- ditch features, bank top width, freeboard, bank angles (above and below water level), water depth, silt depth, water width;
- a cross-section description (sketch);
- conductivity, pH, turbidity, water colour; and
- vegetation cover, grazing/vegetation cover, management.

9.5.3 A standard recording form is completed for each surveyed section.

9.6 Survey programme and effort

9.6.1 Where possible, ditches selected for further survey should be surveyed in the period June to the end of July for ease of identification of plant species but May and August are also often acceptable months.

9.6.2 Where survey has been undertaken outside of the periods identified in 9.6.1 the limitations should be identified and discussed to place any results obtained into context.

9.7 References

Alcock, M.R. and Palmer, M.A. (1985). A standard method for the survey of ditch vegetation. CST Notes No. 37. Nature Conservancy Council, Peterborough.

Buglife - The Invertebrate Conservation Trust (2010). A Manual for the Survey and Evaluation of the Aquatic Plant and invertebrate Assemblages of Ditches. Version 4 December 2010.

10 Pond survey

10.1 Introduction and guidelines

10.1.1 Methods for detailed survey of ponds are based on the methods developed by the Pond Conservation Trust. Details of the methods in the National Pond Monitoring Network can be found at <http://www.pondconservation.org.uk/Data/aboutnprm>.

10.1.2 The method to be used will depend on the preliminary assessment from the Phase 1 habitat survey, the location of the pond in relation to the route and whether the pond is to be lost. All methods involve sampling of the aquatic macro-invertebrate fauna, with some also requiring botanical survey, as well as measurement of physical and chemical parameters.

10.2 Qualifications and experience

10.2.1 Surveyors are to be competent and experienced in undertaking aquatic macro-invertebrate surveys and in botanical identification. There is also a requirement for personnel who can identify invertebrate specimens to the taxonomic level appropriate to the method used but this does not have to be in the field and can be laboratory-based.

10.3 Licensing requirements

10.3.1 There are no licensing requirements for the pond survey unless the surveyor considers that the survey methods could affect protected species utilising the pond.

10.4 Screening for survey and defining the survey area

10.4.1 The results of the Phase 1 habitat survey will identify and provide an initial description of ponds.

10.4.2 Ponds are to be subject to further survey where a pond is likely to experience significant effects and where the pond:

- holds water for four consecutive months or longer; and
- has not been heavily managed; and
- supports a diverse or otherwise notable aquatic, emergent and marginal flora.

10.4.3 Where the pond is likely to be lost or significantly affected then it should be subject to a survey using the Predictive SYstem for Multimetrics (PSYM)²⁰ or National Pond Survey (NPS)²¹ methodology, with the NPS method limited to ponds with the most diverse and/or notable flora, and which, in the professional opinion of the surveyor, cannot be adequately assessed using PSYM. Ponds not threatened with loss and only minor effects should be subject to the rapid assessment method.

10.4.4 Ponds for survey will lie within the land required for the construction of the Proposed Scheme or within a 100m buffer. The consultant undertaking field surveys should also

²⁰ Pond Action (2002), *A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM*. Pond Action, Oxford.

²¹ Pond Action (1998), *Guide to the Methods of the National Pond Survey*. Pond Action, Oxford.

assess whether any ponds outside this area also need to be surveyed, based on the likelihood of significant effects.

10.5 Survey methods

Rapid assessment method

- 10.5.1 The rapid assessment for ponds requires invertebrate sampling only and is a rapid assessment of "naturalness" using invertebrate diversity and families similar to the Biological Monitoring Working Party system for running water.

PSYM

- 10.5.2 The Predictive SYstem for Multimetrics (PSYM) method includes collection of physical data, invertebrate sampling and plant recording (Pond Action, 2002)²². These data are used to undertake an analysis to compare the pond against a national database held by the Pond Conservation Trust (PCT). The data are submitted to PCT for analysis.

National Pond Survey

- 10.5.3 The National Pond Survey (NPS) method provides the most detailed assessment of a pond and includes environmental and chemical data from the pond in addition to plant and invertebrate survey (Pond Action, 1998)²³.

10.6 Survey programme and effort

- 10.6.1 The survey should be undertaken in accordance with the programme recommended in the relevant survey guidelines.

10.7 References

Pond Action (1998). *Guide to the Methods of the National Pond Survey*. Pond Action, Oxford.

Pond Action (2002). *A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM*. Pond Action, Oxford.

²² Pond Action (2002), *A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM*. Pond Action, Oxford.

²³ Pond Action (1998), *Guide to the Methods of the National Pond Survey*. Pond Action, Oxford.

11 Amphibians (great crested newt)

11.1 Introduction and guidelines

- 11.1.1 The Proposed Scheme has the potential to result in adverse effects on populations of amphibians as a consequence of loss and/or disturbance of breeding ponds, loss of terrestrial habitat and severance/fragmentation of habitat. Of particular importance are impacts with the potential to affect great crested newt (*Triturus cristatus*).
- 11.1.2 The survey approach is based on guidance provided within Great Crested Newt Mitigation Guidelines (English Nature, 2001)²⁴, and Natural England's European Protected Species Mitigation Licence (EPSML) application template WML-A14-2 Version March 2011²⁵.
- 11.1.3 The survey methods employed will vary depending on the likely impact to a population utilising the water body in question. Where initial visits confirm the presence of great crested newt, further visits should be undertaken in order to provide an estimate of the size of the population using the pond.
- 11.1.4 Where the seasonal timing of surveys is constrained by access, then non-standard methods will be utilised where appropriate to confirm presence; such methods should not be utilised to assume likely absence.

11.2 Qualifications and experience

- 11.2.1 Surveyors should be experienced in conducting pond surveys and habitat suitability assessment, and able to identify confidently all relevant amphibian species.

11.3 Licensing requirements

- 11.3.1 Amphibian surveys in support of the scheme will involve survey of large numbers of water bodies. As such survey is anticipated to involve work by a large number of licensed surveyors.
- 11.3.2 In all cases survey within a specific geographical area will be coordinated by a holder of a Natural England licence to take and disturb great crested newt (for the purposes of science and conservation) with experience of co-ordinating large scale surveys.
- 11.3.3 Ideally, at least one of the two persons within any survey team will be a holder of a Natural England scientific licence to take and disturb great crested newt. Use of accredited agents to lead pond survey visits (i.e. a team of two accredited agents working together) will only be acceptable where a curriculum vitae demonstrating their suitability for this role is submitted and approved by the overseeing consultants.
- 11.3.4 If survey of terrestrial habitat which would require use of pitfall trapping is required then an application will be submitted to Natural England.

²⁴ English Nature (2001), *Great Crested Newt Mitigation Guidelines*. English Nature, Peterborough.

²⁵ Natural England (2013), *Great crested newt method statement Template WML-A14-3 Version April 2013* downloaded at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls on 2 October 2013.

11.4 Screening for survey and defining the survey area

Desk based scoping exercise

- 11.4.1 A desk based scoping exercise to identify those water bodies requiring amphibian survey, and the likely appropriate survey effort was undertaken in spring 2012 and has been updated periodically in order to take account of on-going changes to the design and extent of land required for the construction of the Proposed Scheme.
- 11.4.2 For the purpose of scoping all impacts on habitats were considered as likely to be permanent based on the anticipated four to six year construction period during which any 'temporary' working areas would be utilised.
- 11.4.3 Geographical Information Systems (GIS) data showing all inland water features (including ponds, lakes, ditches, canals, streams and rivers) located within a 500m radius of the assumed extent of habitat loss were extracted from OS Mastermap data from 2010. The location of any additional water features evident on aerial photographs were then added through a manual review of areas within 500m of the boundary of the land required. Subsequently, GIS was utilised to calculate the distance of each water feature from the boundary of land required for the construction of the Proposed Scheme and the area of land falling within the extent of the land required for the construction of the Proposed Scheme falling within 100m, 250m and 500m of each water feature. This provided an indication of the maximum extent of terrestrial habitat losses that could occur in relation to each pond.
- 11.4.4 Each water feature identified was then examined against aerial photographs and allocated to one of the following survey categories:
- no survey;
 - Habitat Suitability Index (HSI)/walkover only;
 - HSI + presence/absence; and
 - HSI + population size class assessment.
- 11.4.5 The approach taken to scoping sought to ensure that survey effort is proportionate to the predicted level of impact as a consequence of the Proposed Scheme.
- 11.4.6 The 'HSI/Walkover survey only' category should in general only be used as a survey prescription for those features where habitat is considered likely to have marginal potential to support great crested newt (e.g. canals, ditches), but field data are required to confirm this assessment.
- 11.4.7 For ponds located within the land required for the construction of the Proposed Scheme or within a 250m buffer of the boundary of the land required the basis for selecting water bodies requiring survey was in line with current Natural England guidance provided within Survey Data (1) tab of spreadsheet WML_A14_3 Version April 2013 (Natural England, 2013). However, for completeness all surveys incorporated a Habitat Suitability Index (HSI) survey (see Table 3) where this methodology was applicable to the water body in question.

Table 3: Survey guidance for ponds within the land required for the construction of the Proposed Scheme or within 250m of the boundary of the land required

Scenario	Presence/ Absence	Population Size Class Assessment ²⁶	HSI
Pond lost or damaged as a consequence of development	✓	✓	✓
Pond not lost or damaged but within a 50m radius of the land required for the construction of the Proposed Scheme (land required) and terrestrial habitat lost	✓	✓	✓
Pond not lost or damaged but within 50-100m radius of land required and terrestrial habitat losses of ≤0.2ha	✓		✓
Pond not lost or damaged but within 50-100m radius of land required and terrestrial habitat loss of >0.2ha of terrestrial habitat	✓	✓	✓
Pond not lost or damaged but within 100-250m radius of land required and terrestrial habitat loss of ≤0.5ha	✓		✓
Pond not lost or damaged but within 100-250m radius of land required and losses of >0.5ha	✓	✓	✓

Source: Based on survey guidance table provided within Survey Data (1) tab of spreadsheet WML_A14_2 Version March 2011 (Natural England, 2011) available at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls accessed 2 March 2012.

11.4.8 For the vast majority of the alignment the route passes through arable and pasture fields that represent sub-optimal habitat for great crested newt. In general therefore it is considered that newt habitat losses associated with ponds more than 250m from the land required for the construction of the Proposed Scheme are unlikely to be significant.

11.4.9 For the purposes of the initial scoping exercise, survey of those water bodies occurring more than 250m from the boundary of the land required for the construction of the Proposed Scheme has only been proposed where:

- the terrestrial habitat around those ponds appeared to be of poor value for great crested newts, and areas of more suitable terrestrial habitat was present within the Proposed Scheme; or
- the Proposed Scheme was considered to have the potential to fragment connectivity between ponds, such that there was a potential risk of fragmentation of metapopulations²⁷ through loss of terrestrial habitat; or
- a pond was considered to be part of a cluster of linked ponds, and so may form part of the habitat used by a great crested newt metapopulation.

11.4.10 Appendix A details the framework utilised for determining the scope of great crested newt survey for those water features located more than 250m from the boundary of the land required for the construction of the Proposed Scheme. Table 4 details the criteria used to define potential value of terrestrial habitat located more than 250m from the pond, and the scale of barriers to movement relevant to each category.

²⁶ Survey will only progress to Population Size Class Assessment if presence of great crested newt is identified during presence/absence survey.

²⁷ A metapopulation is a group of spatially separated [populations](#) of the same [species](#) which interact at some level.

Table 4: Defining potential value of terrestrial habitats located more than 250m from pond

Potential value of distant terrestrial habitats within the vicinity of the land required for the construction of the Proposed Scheme	Relationship to other suitable habitat
Low/Negligible	<p>Habitats within land required for the construction of the Proposed Scheme of low or negligible suitability for great crested newt foraging and shelter (e.g. bare ground, improved grassland, arable fields, hard standing or buildings);</p> <p>and/or</p> <p>There is poor or no connectivity of suitable habitat with the land required (e.g. presence of a major barrier to movement such as an A road or motorway, or an extensive area of hard-standing and buildings);</p> <p>and/or</p> <p>Where unaffected areas of immediate and intermediate terrestrial habitat offering good connectivity with the water body and good opportunities for foraging and shelter (e.g. rough grassland, scrub, woodland, brown field habitats) are widely available closer to the pond in question such that it is considered unlikely newts would utilise distant habitat in anything other than very low numbers.</p>
Medium	<p>Where areas of immediate and intermediate terrestrial habitat offering at least some connectivity and good opportunities for foraging and shelter (e.g. rough grassland, scrub, woodland, brown field habitats) are available but are sufficiently limited in area (or patchy in distribution) that it is considered possible newts may also utilise distant habitat in low to medium numbers;</p> <p>or</p> <p>Where habitats within the land required and unaffected immediate or intermediate terrestrial habitat associated with the pond in question contain limited features suitable great crested newt foraging and shelter (e.g. bare ground, improved grassland, arable fields, hard standing or buildings).</p>
High	<p>Habitats within land required considered to offer good connectivity of habitat and in general better opportunities for foraging and shelter (e.g. rough grassland, scrub, woodland, brown field habitats) than those located closer to the pond in question. It is therefore considered likely these habitats would be utilised for foraging/shelter;</p> <p>or</p> <p>Availability of immediate and intermediate habitat suitable for foraging and shelter is considered sufficiently limited that alone it would not be sufficient to support any population associated with the pond in question.</p>

11.4.11 In all cases the outputs of the flowchart provided as Appendix A were reviewed by an ecological consultant alongside aerial photography and OS mapping, and taken into consideration alongside a review of the spatial layout of suitable habitat (and the potential for fragmentation effects) and the presence of barriers to dispersal.

11.4.12 Table 5 details the basis for gauging the scale of likely impact of barriers to movement. However, in all cases a final judgement on the importance of the barrier was taken in light of the wider geographical context and its distance from the breeding pond. For example, the presence of a B road in close proximity to a breeding pond would be unlikely to represent an absolute barrier to movement. However, it may be more significant when also located further from the breeding pond, or when habitat located on the far side of the barrier is of low or negligible value to newts.

11.4.13 Following consideration of all the above each water body within the confines of the scoping was allocated to one of the survey prescription categories identified in paragraph 11.4.4.

Table 5: Guide to scale of potential barriers to amphibian movement

Scale of barrier to movement	Examples
Major	Motorway, dual carriageway, A rRoad, river or extensive areas of hard standing or intervening buildings (e.g. housing or industrial estate)
Moderate	B Road, major railway, major stream, moderate expanses of hard standing (e.g. small complexes of buildings or large car park)
Minor	Local road/track, minor railway, canal, minor stream or single buildings and small areas of hard standing

11.4.14 As for those water bodies within 250m the 'HSI/Walkover survey only' category was in general only used for those features where habitat is considered likely to have marginal potential to support great crested newt (e.g. canals, ditches), but field data are required to confirm this assessment.

Ongoing field scoping and survey

11.4.15 Outcomes of the desk based scoping exercise should be used as the basis for requesting land owner access, and survey planning. Where necessary when access is obtained the survey prescription should be reviewed. Where deviations are made a full justification should be documented.

11.4.16 Any additional water bodies identified during the course of other surveys (e.g. those identified during Phase 1 habitat survey) were given an appropriate survey allocation following an HSI/walkover survey.

11.4.17 For all water bodies where 'HSI/Walkover survey' is prescribed an HSI assessment should be conducted (where appropriate) and a record made of the outcome of the survey (i.e. level of further survey prescribed or the rationale for scoping out). Where an HSI score of less than 0.5 (i.e. rating of 'poor') is achieved, and inspection of the water body by an ecologist suggests that it is unlikely to support great crested newt, the water body may be scoped out.

11.4.18 In addition throughout the course of field surveys consideration should be given to the need to increase the level of survey effort at those ponds initially only subject to presence/absence survey, due to changes in design or potential impact. Additional survey effort should be specified where this is considered necessary to provide a robust baseline for the assessment of potential significant effects.

11.5 Survey methods

Presence/absence survey

11.5.1 During each survey visit until presence is confirmed at least three survey methods are to be employed. In the first instance this should consist of the following:

- torchlight survey;
- bottle trapping; and
- egg searching.

11.5.2 In some cases conditions at the pond or physical constraints to access (e.g. presence of dense scrub adjoining part of the ponds, or unstable margins) may mean that it is not possible or appropriate to utilise these preferred methods. In these cases the

unsuitable method should be substituted for an alternative method according to the following:

- netting should be utilised as the first alternative survey methodology; and
- refuge search should only be utilised where two or more other survey methodologies are inappropriate.

11.5.3 In each case where a deviation from the standard three survey methodologies is required, the survey notes are to include a justification for this deviation.

Population size class assessment

11.5.4 All survey visits are to utilise torchlight survey, bottle trapping and egg search unless these methods are not feasible. As soon as presence of great crested newt eggs is confirmed, egg searching will cease.

11.5.5 Where one of the three survey methods identified in paragraph 11.5.1 is considered inappropriate the following guidance should be followed:

- if the peak recorded great crested newt count by a single survey method is fewer than 10 individuals, netting or, if this is not possible, refuge search should be used; but
- if a peak count of 10 or more great crested newt has previously been recorded using a single survey method, then use of alternative survey methodologies is not required.

Terrestrial habitat survey

11.5.6 In a small number of locations where access to a pond is not possible, it may be necessary to deviate from the standard methodology for presence/absence survey and conduct terrestrial habitat survey utilising pitfall traps on adjacent land to determine presence/absence.

11.5.7 In all such cases recommendations for terrestrial habitat survey of this type should be brought to the attention of Natural England immediately, along with recommendations for the proposed terrestrial habitat survey. The default position will be terrestrial presence/absence survey in accordance with Great Crested Newt Mitigation Guidelines (English Nature, 2001).

Late season amphibian survey

11.5.8 Where pond based presence/absence surveys are not completed during the available mid-March to mid-June survey window, at locations within or in close to the land required for the construction of the Proposed Scheme, late season amphibian survey (i.e. survey between mid-June and end of September) should be utilised where possible in order to gain an early indication of where great crested newts are present.

11.5.9 The methodology for late season amphibian survey is provided in Appendix B of this document.

11.5.10 Late season survey will only be used to confirm presence, and will not be utilised to assume absence. All ponds subject to survey of this type during late 2012 will also be subject to full survey during the period mid-March to mid-June 2013.

11.6 Field survey techniques

11.6.1 Field survey techniques to be utilised are based on those provided within Great Crested Newt Mitigation Guidelines (English Nature, 2001), with additional guidance provided in order to ensure consistency.

Torchlight survey

- all torchlight survey should utilise torches of at least 1 million candle power;
- torchlight survey should not commence until at least 1 hour after published local sunset time;
- where areas of the pond are omitted (due to restricted accessibility or health and safety constraints) an estimate of the percentage of the pond margin omitted and a justification for this is to be included within the notes section of the recording form;
- during each survey visit the turbidity and vegetation cover of the water body is to be scored against the five point scales advocated by Natural England;
- where a turbidity or vegetation cover score of 4 is allocated, torchlight survey is still to be conducted but due to potential unreliability it should be complemented by use of an additional survey method (e.g. netting); and
- where a turbidity or vegetation cover score of 5 is allocated, torchlight survey is to be replaced by an appropriate alternative method (e.g. netting).

Egg searching

- egg searching is to be halted when searches confirm presence of great crested newt eggs, and from this point forward not be repeated during subsequent visits; and
- the use of 'egg strips' should only be considered where conventional egg searching is not appropriate and other constraints mean it is not possible to complete survey using three of the remaining available conventional survey methods (i.e. bottle trapping, torching, netting, refuge survey).

Bottle trapping

- all bottle traps used are to be created from clear plastic 2 litre round bottles and be secured utilising a bamboo cane or similar;
- where utilised, bottle traps are to be positioned at a frequency of one every 2m in areas of suitable habitat; for large water bodies where this is not practical, areas of trapping should focus on targeted survey of sections of the margin which support the most suitable habitat;
- where areas of the pond are omitted (due to restricted accessibility or health and safety constraints), an estimate of the percentage of the pond margin omitted and a justification for this is to be included within the notes section of the recording form;

- bottle trapping is only to be utilised on nights where overnight temperature is forecast to be 5°C or above;
- all bottle traps are to be set to include an air bubble; and
- bottle trapping should seek to avoid capture of water shrews; where they are known to occur or are identified during survey, bottle trapping should be replaced by an alternative survey method.

Netting

- all netting is to be conducted at night; as netting causes widespread disturbance of the pond, where used in combination with torchlight survey it should only be conducted following completion of torching; and
- nets utilised should have a mesh size of 2-4mm.

Refuge search

- where utilised as a pond survey methodology refuge search will be conducted during each of the proposed four/six survey visits;
- survey should incorporate checks of both natural refuges (such as logs, bark, rocks, debris) and where possible artificial refugia placed around the margins of the pond; and
- where it is clear that refuge search will be utilised as a survey methodology for subsequent visits, carpet tiles should be placed face down every 2m around the pond margin and the refuges allowed to settle 7 days before the next survey visit.

Habitat Suitability Index

- 11.6.2 A Habitat Suitability Index (HSI) is to be calculated for all ponds within the land required for the construction of the Proposed Scheme, or within a 250m buffer of its boundary that are identified as requiring presence/absence or population size class assessment survey, according to the criteria set out in Table 3, as well as any other ponds that are subject to full survey.
- 11.6.3 All surveyors are to use the simplified HSI methodology described in ARG UK Advice Note 5: Great Crested Newt Habitat Suitability Index (2010)²⁸.
- 11.6.4 Where possible HSI scores for the ten component indices are to be calculated from data collected during a survey visit during the period mid-April to mid-May. During subsequent surveys notes are to be made of factors/events that may have resulted in a significant change to the HSI score previously calculated.
- 11.6.5 Where a suitability index cannot be allotted for any of the ten component indices then a comment should be recorded to explain this. In addition a comment should be recorded where the surveyor considers that the atypical nature of a water body may result in an unreliable HSI score.

²⁸ Amphibian and Reptile Groups of the United Kingdom (2010). *ARG UK Advice Note 5: Great Crested Newt Habitat Sustainability Index*. Amphibian and Reptile Groups of the United Kingdom.

Dealing with non-native amphibians

- 11.6.6 If non-native amphibian species occurring on Schedule 9 Part 1 of the Wildlife and Countryside Act (1981 as amended) are captured during the course of the survey (e.g. within bottle traps or nets) they will not be released back into the wild. For non-natives which do not appear on Schedule 9 their presence should be noted on recording forms and individuals released.

11.7 Survey programme and effort

Presence/absence survey

- 11.7.1 Presence/absence surveys are to comprise four visits in suitable weather conditions as defined in Great Crested Newt Mitigation Guidelines (English Nature, 2001).
- 11.7.2 Visits are to be conducted during the period mid-March to mid-June, with at least two visits during the period mid-April to mid-May.
- 11.7.3 Visits should ideally be well spaced (no more than one per week and no more than four weeks apart). Survey visits to the same pond on consecutive nights should be avoided. In the event that the required survey effort is not completed then the use of non-standard methodologies which may provide early warning to the presence of great crested newts will be considered (see Appendix B). These methods cannot be utilised to determine absence, and in all cases water bodies subject to these methods during late 2012 will be subject to full survey utilising standard methods during the period mid-March to mid-June 2013.
- 11.7.4 Where presence/absence survey is not completed during 2012 then the survey will be repeated in full during the 2013 season (e.g. if only two visits completed during 2012 then a further four visits should be conducted during 2013 season).

Population size class assessment

- 11.7.5 Population size class assessment is to comprise six pond visits in suitable weather conditions (English Nature, 2001). These are to be conducted between mid-March to mid-June, with at least three of these visits during the period mid-April to mid-May.
- 11.7.6 Visits should ideally be well spaced (no more than one per week and no more than four weeks apart). Survey visits to the same pond on consecutive nights should be avoided.
- 11.7.7 In the event that the required survey effort is not completed during 2012 then the survey should be repeated in full during the 2013 season (e.g. if only two visits completed during 2012 then a full six visits should be conducted during 2013 season).

Habitat Suitability Index

- 11.7.8 HSI scores for the ten component indices are to be calculated from data collected during a survey visit. Where constraints allow this should be conducted during the period mid-April to mid-May.

11.8 References

Amphibian and Reptile Groups of the United Kingdom (2010). [ARG UK Advice Note 5: Great Crested Newt Habitat Suitability Index](#). Amphibian and Reptile Groups of the United Kingdom

English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature, Peterborough.

Gent T and Gibson S (2003). Herpetofauna Workers Manual. JNCC, Peterborough.

Natural England (2011) Great crested newt method statement Template WML_A14_2 Version March 2011 available at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls accessed 02/03/12.

Natural England (2013) Great crested newt method statement Template WML-A14-3 Version April 2013 downloaded at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls on 02/10/13.

12 Reptiles

12.1 Introduction and guidelines

12.1.1 It is anticipated that a range of habitats within the land required for the construction of the Proposed Scheme will represent suitable habitat to support widespread reptile species, namely adder (*Vipera berus*), slow worm (*Anguis fragilis*), grass snake (*Natrix natrix*) and common lizard (*Zootoca vivipara*). The route is located outside of areas known to support sand lizard (*Lacerta agilis*) and smooth snake (*Coronella austriaca*). As a consequence it is unlikely that survey for these species will be required.

12.1.2 Reptile survey in support of the scheme will be conducted according to a bespoke methodology which draws heavily upon guidance provided in documents listed in Section 12.7.

12.2 Qualifications and experience

12.2.1 All surveyors involved in screening and scoping for reptiles should be experienced in the following:

- field identification of all widespread reptile species and field signs (e.g. sloughs, burrows and eggs);
- assessing the potential suitability of on-site habitats for widespread reptile species;
- determining appropriate spatial scope for survey; and
- identifying appropriate survey techniques to achieve a robust survey in a variety of habitat types.

12.3 Licensing requirements

12.3.1 Survey is only anticipated to involve widespread reptile species; as such no survey licence is required.

12.4 Screening for survey and defining the survey area

12.4.1 Analysis of aerial photographs was initially undertaken to identify and map the extent of key habitat areas within close proximity to the route of the Proposed Scheme that were considered potentially suitable to support reptiles. Consultants should review preliminary work, alongside desk study data and the results of Phase 1 habitat survey to identify any additional areas of potentially suitable habitat within the land required for the construction of the Proposed Scheme and a surrounding 100m buffer.

12.4.2 For all such areas identified as containing habitat potentially suitable to support reptiles, a walkover survey should be conducted by an appropriately experienced ecologist in order to appraise the suitability of the habitats present on the ground. The habitat assessment should be based on consideration of the following characters:

- location in relation to species range;
- vegetation structure;

- insolation (sun exposure);
- aspect;
- topography;
- surface geology;
- connectivity to nearby good quality habitat;
- prey abundance;
- refuge opportunity;
- hibernation habitat potential;
- disturbance; and
- egg-laying site potential (grass snake only).

12.4.3 For each habitat area the output of the habitat assessment should be a grading of each habitat area as having either 'poor', 'good' or 'exceptional' potential to support widespread reptiles, based on reasoned consideration of the above factors. Examples are provided in Table 6.

Table 6: Grading of reptile habitat suitability

Habitat Grading	Definition
Poor	Habitat which is unfavourable for reptiles based on the majority of the habitat assessment characters listed above, or is limited in size and highly isolated from other areas of suitable habitat.
Good	Habitat which is favourable or sub-optimal for many of the habitat assessment characters listed above; or is sub-optimal for some of the characters and has good connectivity with areas of more suitable habitat.
Exceptional	Habitat which is favourable for reptiles based on the majority of habitat assessment characters listed above.

12.4.4 The grading of each habitat area should note for which species the habitat area is potentially suitable.

12.4.5 Where habitat areas identified for walkover survey are found to contain distinct areas of habitat that do not contribute to the overall value of the habitat parcel for reptiles, the habitat area should be divided. A unique reference code and habitat grading should then be allocated to each habitat area. For example an area of improved grassland within a block of rough grassland and scrub would be given its own unique reference code and graded as being of 'poor' value based principally on the habitat structure.

12.4.6 All habitat areas falling within the identified survey extent identified as having 'good' or 'exceptional' potential to support reptiles and no significant barriers preventing dispersal to land require for the construction of the Proposed Scheme will be selected for further presence/absence survey utilising artificial refugia.

12.5 Survey method

12.5.1 Where health and safety and access constraints allow, all habitat areas identified as having 'good' or 'exceptional' potential to support reptiles using the table above will be subject to survey utilising artificial refugia.

- 12.5.2 In each habitat area a combination of corrugated iron and roofing felt refugia all measuring a minimum of 0.5m x 0.5m are to be placed out in areas identified as suitable habitat. At sites where the habitat assessment has identified potential for grass snake to occur surveyors should deploy an appropriate number (based on extent of suitable habitat) of larger refugia, to increase the likelihood of detecting this species.
- 12.5.3 In non-linear habitats refugia should be placed at a density of at least 100/ha or a minimum 30 mats in very small sites. In linear habitats of less than 10m in width (e.g. hedgerows, road verges etc.) refugia should be placed at a frequency of at least one every 10m of suitable habitat.
- 12.5.4 The default should be a 50 : 50 ratio of corrugated steel/iron to roofing felt. Where varying from this standard a justification should be provided, based on the habitat type and target species concerned.
- 12.5.5 All refugia should be number marked using spray paint and their location accurately recorded to an accuracy of <5m where terrain/vegetation allows, to allow later translation to GIS. It is recommended that locations are recorded using a GPS device.
- 12.5.6 Once placed out artificial refugia will be left to settle for 14 days prior to conducting the first check.
- 12.5.7 Each site containing refugia will then be checked for reptiles on the required number of occasions (see Section 12.6). Binoculars should be used to check for reptiles between refugia, as well as careful checks by lifting each refugium.
- 12.5.8 Each refugia check should be conducted during the following conditions:
- Time: conducted between 07:00 and 18:00;
 - Air temperature: 10°C - 20°C;
 - Wind: Still to moderate (equivalent to Beaufort 4; 13 - 17mph); and
 - Rain: No or light rain only at time of survey. Surveys between periods of heavy rain (when all other conditions are suitable) are also acceptable.
- 12.5.9 During each check the surveyor should record details of all reptiles encountered during the survey, including refugia number, species, number, life stage (adult, sub-adult, juvenile) and when possible, sex.
- 12.5.10 If non-native species listed on Schedule 9 are found during the survey then details will be recorded as described in paragraph 12.5.9. As no handling of reptiles is anticipated as part of the survey all non-native species will be left in-situ. Where necessary provisions for their removal will be included within the Environmental Statement and any subsequent mitigation statements.
- 12.5.11 All records of reptiles should be provided with GPS-derived grid coordinates. Where topography and vegetation structure may have reduced the accuracy of records below an accuracy of <5m, this information should be noted.
- 12.5.12 Where areas of suitable reptile habitat are located within the boundaries of the existing operational rail or road estate it is anticipated that there may be both health and safety and access issues that will prevent refugia survey of all those areas of

habitat identified as potentially suitable for reptiles. In these cases the consultants undertaking surveys will be expected to liaise with the overseeing consultant in order to determine a suitable survey approach for these areas. It is anticipated that this will involve consideration of the following potential approaches:

- sampling of areas of similar adjacent habitat;
- visual search only; and
- risk assessment based on habitat suitability.

12.6 Survey programme and effort

Presence/absence survey

- 12.6.1 At all locations selected for refugia survey initially, seven visits (during suitable weather conditions) should be conducted to determine presence/absence.
- 12.6.2 Each visit should adhere to the weather requirements detailed in paragraph 12.5.8 and should be conducted during the period April to September.
- 12.6.3 Where access allows surveys should be programmed to maximise the number of visits conducted during April, May, June and September, when weather conditions are likely to be more favourable for survey. However, visits during July and August are not precluded assuming they are conducted according to the weather requirements detailed in 12.5.8.
- 12.6.4 There should be at least 30 days between the first and last survey visits and there must be a minimum of two days between each visit.
- 12.6.5 A robust survey to determine likely absence should include at least four visits conducted during the 'optimum' survey months of April, May, June or September. As a consequence at sites where surveys commence during July or August if no reptiles are found during the first three visits then the remainder of visits should be delayed and conducted during September.

Estimating population size class

- 12.6.6 Where presence/absence survey confirms presence of one or more reptile species and all survey visits have been conducted during the 'optimum' survey months of April, May, June or September (under suitable conditions) then (unless the surveyor considers it necessary) no further visits will be required.
- 12.6.7 In order to give a robust estimate of population size where any survey visits have been conducted during the sub-optimal months of July or August, additional visits will be required until at least seven visits (under suitable conditions) have been conducted during optimum months.
- 12.6.8 Where initial survey results suggest that a site has the potential to support a 'high' reptile population then the consultants undertaking the survey should consider the requirement for further visits to provide a robust population size class estimate.
- 12.6.9 Population size class should be assessed utilising the peak adult count for each species across all visits. These figures should be divided by the survey area in ha to give an indication of density identified within the survey, then compared with the criteria

outlined in Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards (HGBl, 1998)²⁹. A summary is provided in Table 7.

Table 7: Estimating population size

Species	Population size class	Density recorded
Slow worm	High	more than 100/ha
	Medium	50-100/ha
	Low	less than 50/ha
Common lizard	High	more than 80/ha
	Medium	20-80/ha
	Low	less than 20/ha
Grass snake	High	more than 4/ha
	Medium	2-4/ha
	Low	less than 2/ha
Adder	High	more than 4/ha
	Medium	2-4/ha
	Low	less than 2/ha

Source: Derived from HGBl (1998) Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards.

Surveys split between seasons

- 12.6.10 Where surveys are commenced during 2012 but not completed, these may be 'topped-up' with visits conducted during 2013, assuming that the resulting data set meets the relevant conditions for timing, survey conditions and number of visits as set out above.

12.7 References

Froglife (1999). Reptile survey; an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.

Gent T and Gibson S eds (2003). Herpetofauna Workers Manual. JNCC, Peterborough.

Herpetofauna Groups of Great Britain and Ireland (1998). Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards. HGBl, Halesworth.

Natural England (2011). Natural England Technical Information Note TIN102: Reptile Mitigation Guidelines. Natural England, Peterborough. (Note this guidance was published and subsequently withdrawn in September 2011).

²⁹ Herpetofauna Groups of Great Britain and Ireland (1998). *Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards*. HGBl, Halesworth.

13 Breeding birds

13.1 Introduction and guidelines

13.1.1 The purpose of breeding bird surveys within the context of environmental impact assessment (EIA) is to establish baseline data on the species, numbers and distribution of birds within and adjacent to the land required for the construction of the Proposed Scheme so that potential significant impacts of the scheme can be assessed. Particular attention is required where species listed on Schedule 1 of the Wildlife and Countryside Act (1981 as amended) are suspected or found.

13.1.2 A review of methods available for survey of breeding birds can be found in Bibby, et al (2000)³⁰. The principal method employed for the EIA of the Proposed Scheme will be a variation of the Common Bird Census (CBC) methodology (Marchant, 1983³¹) involving five visits during the 2013 breeding season. Where initial survey visits were conducted during 2012 in order to provide an early understanding of bird use of the route of the Proposed Scheme, the full five visits should be repeated during 2013 in order to provide reliable data for use in territory analysis. Where appropriate, further specific surveys will be undertaken for protected and/or notable species (e.g. barn owl, hobby, nightjar, black redstart).

13.2 Qualifications and experience

13.2.1 Surveyors should be able: to identify birds confidently from visual observation as well as songs/calls; to identify specific bird habitats that could support nesting birds listed on Schedule 1; to identify bird behaviours, including territorial displays and nesting behaviour; to use with confidence common survey techniques including territory mapping, point counts and transect surveys; and to interpret bird survey data.

13.3 Licensing requirements

13.3.1 A Natural England licence is required where surveys are likely to disturb Schedule 1 species, including nesting barn owls. In the vast majority of cases survey according to the Common Bird Census (CBC) (Marchant, 1983) methodology proposed is considered unlikely to constitute a legal offence. Where it is necessary, survey routes should be sensitively modified in order to limit disturbance. However, ultimately individual surveyors should for all proposed surveys judge where disturbance is likely to occur and provide appropriately licensed survey staff where necessary.

13.4 Screening for survey and defining the survey area

13.4.1 The extent of the CBC style survey (as described in Section 13.5) should be defined by the outcome of Stage 1 and Stage 2 below.

Stage 1 – Sites of known importance for breeding birds

13.4.2 Surveyors should initially undertake a review of existing information (designation details, desk study records of notable species, county bird reports) to identify sites of known importance for birds where there is considered to be the potential for adverse effects as a consequence of the Proposed Scheme. The necessary extent of this search

³⁰ Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). *Bird Census Techniques*, 2nd ed. Academic Press, London.

³¹ Marchant, J.H. (1983). *Common Bird Census Instructions*. BTO, Tring.

area will vary based on the nature of the sites present and the proposed engineering design of the scheme. However, as a minimum this search should encompass a 250m buffer either side of the land required for the construction of the Proposed Scheme.

- 13.4.3 Any such sites where there is considered to be the potential for adverse effects as a consequence of the Proposed Scheme will be included within the scope of the CBC style survey.

Stage 2 – Other areas identified as being of potential importance for breeding birds

- 13.4.4 Surveyors should undertake a review of the following information sources to identify locations of potential importance for breeding birds (i.e. areas which are considered to have potential to support notable species such as those listed on Annex 1 of the Birds Directive, Schedule 1 of the Wildlife and Countryside Act, or red or amber listed species on the Birds of Conservation Concern list; or which may support notable assemblages of common birds) within the land required for the construction of the Proposed Scheme and a 250m buffer either side of it that are potentially subject to adverse effects:

- aerial photography and Ordnance Survey mapping;
- Phase 1 habitat survey results;
- feedback from wintering bird surveys conducted during 2012/2013; and
- discussions with local consultees.

- 13.4.5 Any such sites will be included in the scope of the CBC style survey.

Stage 3 – Sampling of other habitats (i.e. those not covered by Stage 1 and Stage 2)

- 13.4.6 Following completion of Stages 1 and 2 a survey strategy should be established to ensure that survey includes a sample of all other habitats within the land required for the construction of the Proposed Scheme and a 250m buffer either side of it. This is intended to provide an indication of the birds using these habitats and should give preference to areas within the land required for the construction of the Proposed Scheme. As a guide the sampling of other habitats that are not identified in Stage 1 and Stage 2 should seek to achieve a minimum of 20% coverage within each Community Forum Area (CFA). It should be noted that this is in addition to the coverage required to satisfy Stage 1 and Stage 2. Coverage may be increased where appropriate.

Stage 4 – Further detailed survey for protected and/or notable species

- 13.4.7 In addition to the CBC type surveys described above consultants undertaking survey should consider the requirement for additional survey work in order to assess potential impact on species listed on Schedule 1 of the Wildlife and Countryside Act (1981 as amended)³² and Annex 1 of the Birds Directive³³.

³² *Wildlife and Countryside Act (1981) Chapter 69*. Her Majesty's Stationery Office.

³³ *Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds* (2009). Official Journey of the European Union.

- 13.4.8 Consultants should undertake a desk based exercise to identify the likely extent of Schedule 1/Annex 1 species surveys required within the areas for which they are responsible. The results of the desk based exercise should initially consider records from within 5km and a desk based appraisal of suitable habitat availability within 1.5km to determine the scope of detailed field surveys required.

13.5 Survey methods

Common Bird Census style survey

- 13.5.1 Survey will comprise five visits between mid-March and the end of June with at least ten days between each visit. Where access allows these should be spread as evenly as possible throughout the survey season. Unless a site specific deviation is agreed then where access allows the full five survey visits should be conducted during 2013, even if some survey visits were achieved during 2012.
- 13.5.2 Survey visits will be undertaken on dry days with no more than moderate wind. Survey during dawn mist is acceptable but survey during dense fog should be avoided. Site visits should commence no later than one hour after sunrise. In order to avoid confusion and reduce survey bias in areas with high densities of birds the survey should be commenced towards the end of this window. In addition the starting position should be varied between visits in order to reduce survey bias. In all cases survey should ideally be completed by 11am (12 noon at the latest).
- 13.5.3 Due to the scale of the survey proposed it will not be practical to approach all areas within 50m. As a consequence in large expanses of open grassland or arable fields the boundaries will be walked and all birds within the field recorded. In other habitat where access and views allow, efforts will be made to record all bird activity within 50m of the survey route. Where no access is available, Public Rights of Way (PRoW) and local roads (where it is deemed safe to do so) will be utilised.
- 13.5.4 In all cases all birds seen or heard will be identified and recorded on a suitable scale map of the site to allow the information to be clearly recorded using standard British Trust for Ornithology (BTO) species and activity codes.
- 13.5.5 Large wetland areas can be covered by the CBC style survey as proposed above, but will be a combination of recording the activity of individual birds and counts of birds on the water from the lake edge.

Species specific surveys

- 13.5.6 Species specific surveys should be conducted as appropriate, and where considered to be required (based on the results of scoping and results from Phase 1 habitat survey and initial breeding bird surveys) should include both the land required for the construction of the Proposed Scheme and a surrounding 250m buffer. As a minimum this should include consideration of potential nesting locations for Schedule 1 species such as barn owl, red kite, hobby and peregrine.
- 13.5.7 Survey for Schedule 1 species should follow established best practice survey methodologies as follows:

- barn owl – Shawyer (2011);³⁴ and
- red kite/hobby/peregrine/black redstart/nightjar/kingfisher – Gilbert et al (1998)³⁵

13.5.8 Where crepuscular or nocturnal species such as nightjar are suspected then evening survey visits (in addition to those forming part of the CBC survey) should be undertaken. At each appropriate site at least two evening visits including the hour after sunset should be conducted.

13.6 References

Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). *Bird Census Techniques*, 2nd ed. Academic Press, London.

Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (2009). Official Journal of the European Union.

Gilbert, G., Gibbons, D.W., and Evans J (1998). *Bird Monitoring Methods*. RSPB, Sandy.

Marchant, J.H. (1983). *Common Birds Census instructions*. BTO, Tring.

Shawyer, C. R. (2011). *Barn Owl Tyto alba: Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting*. IEEM, Winchester.

Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office.

³⁴ Shawyer, C.R. (2011). *Barn Owl Tyto alba: Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting*. IEEM, Winchester.

³⁵ Gilbert, G., Gibbons, D.W. and Evens, J. (1998). *Bird Monitoring Methods*. RSPB, Sandy.

14 Wintering and passage birds

14.1 Introduction and guidelines

14.1.1 Survey methods are to be appropriate for lowland rural habitats including farmland and wetlands. These should be based on the methods in Gilbert et al (1998)³⁶ and the Wetland Bird Survey (WeBs) methodology (Pollit et al., 2003)³⁷.

14.2 Qualifications and experience

14.2.1 Surveyors are to be experienced in bird survey techniques and identification.

14.3 Licensing requirements

14.3.1 There are no licensing requirements for wintering bird survey.

14.4 Screening for survey and defining the survey area

14.4.1 Consultants undertaking surveys should aim to screen and consider discounting areas from survey where it is likely that the habitats support only low numbers of common birds whose conservation status would not be significantly affected by the Proposed Scheme. It is anticipated that wintering bird survey will focus on survey of water bodies with sampling of woodland and farmland habitats.

14.4.2 The decision on which areas to include within the scope of wintering bird surveys should be based on:

- records of notable species from desk study (bird data from the local Biological Records Centre and the County Bird Report);
- the presence of good quality habitat, as identified during the Phase 1 habitat survey; and
- discussions with local consultees.

14.4.3 All areas identified based on the above criteria should be included within the wintering bird survey. In addition within each 10km section of the route the survey should include a representative sample of approximately 20% of all farmland and woodland habitats located within the land required for the construction of the Proposed Scheme and within a 100m buffer of the land required. Where access is freely available the areas selected for survey should cover a range of different habitat types and focus on locations within or directly adjacent to the land required.

14.4.4 Consultants undertaking surveys should use professional judgement to determine those locations where a more intensive survey sample (i.e. above the level defined in paragraph 13.4.2) is required.

³⁶ Gilbert, G., Gibbons, D.W. and Evans, J. (1998), *Bird Monitoring Methods: A Manual of Techniques for Key UK Species*. Royal Society for the Protection of Birds, The Lodge, Sandy, Beds.

³⁷ Pollit, M.S., Hall, C., Holloway, S.J., Hearn, R.D., Marshall, P.E., Robinson, J.A., Musgrove, A., Robinson, J., and Cranswick, P.A. (2003), *The Wetland Bird Survey 2000-2001: Wildfowl & Wader Counts*. Slimbridge.

14.5 Survey method

- 14.5.1 Wintering and passage bird survey will focus on wetland sites, and will utilise the Wetland Bird Survey (WeBS) methodology (Pollit et al, 2003).
- 14.5.2 In each case the survey is to be undertaken at all wetland sites within the land required for the construction of the Proposed Scheme and within the 100m buffer of the land required. Survey will be conducted once per month through the period October to February, with additional visits during September and/or March where necessary to detect anticipated target species.
- 14.5.3 Outside wetland areas known to be of importance for wintering or passage birds, surveys within farmland, woodland and any other areas of suitable habitat identified by surveyors, will be based on a sampling approach. Outside wetland areas, surveys should aim to sample approximately 20% of the suitable habitat located within 100m of the land required for the construction of the Proposed Scheme for each 10km section. The length of the total survey route required to obtain this coverage will vary depending on the extent of views. Visible areas should be mapped by surveyors during the first survey visit to show the survey extent. Surveyors are to determine whether sampling density needs to increase locally to address habitat variety or complexity.
- 14.5.4 The route of the survey will be chosen to sample the range of suitable habitat types present. All visits are to be completed between one hour after sunrise and one hour before sunset.
- 14.5.5 On each of the survey visits the surveyor is to walk the survey area at a steady pace recording the location of all birds seen or heard on a plan using standard BTO species codes.
- 14.5.6 Vantage point survey should be conducted in wetland areas where construction of viaducts is proposed. Survey should comply with current Natural England guidance as outlined within TINoo8 Assessing ornithological impacts associated with wind farm developments: surveying recommendations³⁸ and include at least 36hrs of survey at each vantage point location over the period September to mid-March inclusive.

14.6 Survey programme and effort

- 14.6.1 The survey programme for wintering bird surveys is described above.

14.7 References

Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). Bird Census Techniques, 2nd ed. Academic Press, London.

Gilbert G., Gibbons D.W. and Evans J. (1998). Bird Monitoring Methods: A Manual of Techniques for Key UK Species. Royal Society for the Protection of Birds, The Lodge, Sandy, Beds.

Marchant, J.H. (1983). Common Birds Census instructions. BTO, Tring.

³⁸ Natural England (2007). *Technical Information Note TINoo8 Assessing ornithological impacts associated with wind farm developments: surveying recommendations*. First edition 15 October 2007, www.naturalengland.org.uk.

Natural England (2007). Technical Information Note TIN008 Assessing ornithological impacts associated with wind farm developments: surveying recommendations. First edition 15 October 2007, www.naturalengland.org.uk.

Pollit, M.S., Hall, C., Holloway, S.J., Hearn, R.D., Marshall, P.E., Robinson, J.A., Musgrove, A., Robinson, J. and Cranswick, P.A. (2003). The Wetland Bird Survey 2000-2001: Wildfowl and Wader Counts. Slimbridge.

15 Hazel dormouse

15.1 Introduction and guidelines

15.1.1 Survey for hazel dormouse (*Muscardinus avellanarius*) will need to consider both perceived optimal woody habitats (e.g. hazel coppice dominated woodland) and areas of fragmented or sub-optimal habitat within the vicinity of the Proposed Scheme. This will include consideration of how habitat losses associated with the scheme may affect the movement of dormice associated with retained habitat through the route corridor.

15.1.2 The proposed approach will broadly follow the nest tube survey methodology developed during the South West Dormouse Project (Chanin and Woods, 2003)³⁹. It will also take into account Natural England's December 2011 interim advice note on dormouse surveys for mitigation licensing (Natural England, 2011)⁴⁰.

15.2 Qualifications and experience

15.2.1 All initial scoping and habitat assessment work should be conducted by persons with previous experience of the range of habitats utilised by dormouse and field signs indicating potential presence of dormouse.

15.2.2 The erection of dormouse nest tubes should be coordinated by persons experienced in nest tube survey.

15.3 Licensing requirements

15.3.1 Checking of nest tubes will require at least one surveyor within a survey team to hold a licence to 'take and disturb' hazel dormouse. Assistants may only be utilised where they are working in close proximity to a licence holder at all times. When working distant from each other (including in different areas of the same survey site) all other surveyors within a survey team should be named accredited agents to the licence holder each of whom has been trained and is experienced in identification and handling of dormouse.

15.4 Screening for survey and defining the survey area

15.4.1 Analysis of aerial photographs has been used to identify and map the extent of key areas of habitat within the route corridor that are considered potentially suitable to support hazel dormouse. Review of desk study data and the results of Phase 1 habitat survey by consultants undertaking survey work may result in additional areas. This assessment should include habitat potentially of value for nesting and foraging, and should take into account fragmented habitats and areas of potentially sub-optimal habitat that may be of importance in a wider landscape context.

15.4.2 For all areas identified as containing habitat potentially suitable to support dormouse, a walkover survey should be conducted by an appropriately experienced ecologist in order to appraise the suitability of the habitats present on the ground, and to

³⁹ Chanin, P. and Woods, M. (2003), *Surveying dormice using nest tubes: results and experiences from the South west Dormice projects*. English Nature Research Report No. 524. English Nature, Peterborough.

⁴⁰ Natural England (2011), *Interim Natural England Advise Note – Dormice surveys for mitigation licensing – best practice and common misconceptions*. Natural England, Peterborough.

determine the need for nest tube survey. The habitat assessment should be based on consideration of the following characters:

- availability of key food sources;
- vegetation structure (in particular the extent of arboreal linkage);
- level of shading; and
- connectivity with other areas of suitable or sub-optimal habitat.

15.4.3 Where walkover survey and habitat assessment indicate that not all of an identified habitat area requires nest tube survey, the habitat area should be subdivided and a unique reference code and assessment outcome allocated to each habitat area.

15.5 Survey method

Nest tube/nest box survey

15.5.1 At each site selected for nest tube survey, tubes of standard design (i.e. made from stiff double walled black plastic measuring approximately 5cm width x 5cm height x 25cm length with a small plywood tray blocking one end and projecting 5cm from the other) are to be deployed in potentially suitable habitat (as defined by the outcome of the habitat assessment).

15.5.2 Tubes should be deployed in clusters 15-20m apart, sampling both areas of best quality habitat and associated areas that may appear less suitable according to traditional concepts of dormouse habitat quality (e.g. hedgerows linking to areas of deciduous woodland).

15.5.3 A revision to the survey methodology made in September 2012 required a minimum of five dormouse nest boxes to be deployed (at a minimum of 20m spacings) in areas of deciduous woodland survey sites to increase the potential for detecting dormouse presence in these locations. This methodology change should be applied to all surveys commenced post September 2012, and all suitable survey sites where tubes have already been deployed.

15.5.4 All tube and box locations should be mapped and OS grid references recorded by GPS to an accuracy of <5m where terrain and vegetation cover allows. Where necessary, markers such as coloured string or high visibility tape should also be deployed to aid the process of locating nest tubes and boxes during subsequent visits.

15.5.5 During each check all nest tubes and boxes should be inspected for potential signs of use by dormouse including the following:

- presence of individuals in-situ;
- characteristic nesting material;
- presence of characteristic gnawed hazel nuts; and
- presence of droppings.

15.5.6 During each check, the above information will be recorded alongside similar information that indicates use of nest tubes or boxes by other species (e.g. squirrel, field mouse etc.).

- 15.5.7 During each visit a record should be made of the number and location of any tubes or boxes that have been dislodged or interfered with since the previous survey visit.
- 15.5.8 The first survey visit should not be conducted until at least one calendar month after completion of tube or box installation in that area.
- 15.5.9 All records of dormouse and other species identified utilising nest tubes or boxes should be provided with GPS-derived grid coordinates accurate to <5m. Where topography and vegetation structure may have reduced the accuracy of records below this level this information should be noted.
- 15.5.10 Where potential dormouse droppings are found that cannot be definitively identified in the field, a small sample (considered to represent droppings from a single species) should be collected and sealed in a plastic bag marked with the following details:
- date sample collected (day/month/year);
 - survey location and tube/boxnumber;
 - GPS coordinates of tube/box concerned;
 - suspected species; and
 - surveyor name.
- 15.5.11 Dropping samples should be stored in a cool, dry place and submitted as soon as possible for DNA analysis to determine if hazel dormouse is present.

Nut searches

- 15.5.12 Nut searches will only be utilised to confirm presence, and will not in the first instance be utilised to assume absence.
- 15.5.13 Nut searches should be conducted prior to the installation of nest tubes or boxes at any new sites. Where nest tube or box survey of sites has commenced and detailed surveys have not confirmed presence by the end of September 2012 then consultants undertaking survey should (where appropriate) conduct nut searches during October or November 2012. Nut searches should be targeted at the location of mature and heavily fruiting hazels where these are present.
- 15.5.14 Where nuts opened by dormice are identified during a nut search a specimen nut should be collected for future reference and sealed in a plastic bag with the following details:
- date sample collected (day/month/year);
 - survey location and survey code (route zone-survey code-6 digit number);
 - suspected species; and
 - surveyor name.
- 15.5.15 Where dormouse presence is confirmed during the nut search any on-going or proposed nest tube/box survey at the survey site may be halted.

15.6 Survey programme and effort

- 15.6.1 Chanin and Woods (2003) defined a scoring system for nest tube and box survey based on the probability of finding dormice in a nest tube or box in any one month (see Table 8). Under this methodology a minimum cumulative score of 20 points must be reached to robustly determine presence/likely absence.

Table 8: Index of probability of finding dormice during nest tube or box survey in any one month

Month	Index of Probability
April	1
May	4
June	2
July	2
August	5
September	7
October	2
November	2

- 15.6.2 All nest tube or box surveys will be expected to obtain a cumulative score of 20 or above. Survey effort is determined by summing the index of probability scores from the month nest tubes or boxes are deployed to when they are removed (i.e. not just the months where the tubes are physically checked) as such nest tubes and boxes should ideally be placed out as soon as possible in the season at the required spacing and left for the duration.
- 15.6.3 All nest tubes and boxes should be checked once during August and again during September. Outside of these months checks should be conducted at least once every two months and immediately prior to removal.
- 15.6.4 Where the minimum cumulative score of 20 points is not achieved by the end of November 2012 and nut searches do not confirm presence then it will be necessary to conduct additional visits during 2013 until the required score is achieved.
- 15.6.5 Where visits during 2013 are required nest tubes and boxes should be left in-situ over the winter months and a check conducted during March 2013 to reposition or replace any tubes or boxes which have been dislodged or damaged.
- 15.6.6 Where conducted, nut searches should be carried until either (a) a confirmed nut opened by dormouse is located; or (b) until 100 nuts opened by other small mammals (i.e. not dormouse) have been found; or (c) until at least one and half hours has been spent searching.
- 15.6.7 Where access restrictions significantly constrain the period available for survey the number of tubes used should be doubled by reducing the spacing interval and thus doubling the monthly score. This will need to be highlighted as a potential limitation of survey.

15.7 References

Bright, P., Morris, P., and Mitchell-Jones, T, (2006). Dormouse Conservation Handbook. Second Edition. English Nature, Peterborough.

Chanin, P. and Woods, M. (2003). Surveying dormice using nest tubes: Results and experiences from the South West Dormouse Project. English Nature Research Report No. 524. English Nature, Peterborough.

Chanin, P. (2012). Personal correspondence.

Natural England (2011) Interim Natural England Advice Note - Dormouse surveys for mitigation licensing – best practice and common misconceptions. Natural England, Peterborough.

16 Bats

16.1 Introduction and guidelines

- 16.1.1 Proposed survey methodologies are largely based on the Bat Workers Manual (Mitchell-Jones and McLeish, 2004)⁴¹, Bat Mitigation Guidelines (Mitchell-Jones 2004)⁴² and Bat Surveys: Good Practice Guidelines 2nd Edition (Hundt, 2012)⁴³. Reference has also been made to the survey methods recommended within Design Manual for Roads and Bridges Volume 10 (Highways Agency 2001)⁴⁴.
- 16.1.2 The following section details the scope of survey work and methodologies for these surveys. Determining the extent of survey will be an iterative process. Results of initial bat survey work are likely to identify the requirement for further surveys in some locations. Bat surveys focus on identifying features used by bats for roosting, as well as understanding how bats use the wider landscape for feeding and moving around. Initially, visual inspection is used to identify features with potential as bat roosts; this may then be supplemented by closer and more detailed inspection of some features with higher potential; and when inspection is not possible or the findings are not conclusive, dusk and dawn bat surveys are undertaken to identify any bats emerging and re-entering roost features. Following desk study, targeted bat activity surveys are used to identify movement and activity by bats around a site, including bat commuting routes and features that may be important in bat navigation/orientation.
- 16.1.3 It is known that bat species listed under Annex II of the EC Habitats Directive occur at locations in proximity to the proposed route. Detailed bespoke methodologies for such locations (and any others where the presence of Annex II species is suspected) will be devised in liaison with Natural England and, where appropriate, with local bat groups and researchers working in the area.
- 16.1.4 Consultants undertaking surveys should ensure that all descriptions of roost types utilised during the project are in line with the terms and definitions provided in Hundt (2012), as detailed in Table 9.

16.2 Qualifications and experience

- 16.2.1 All bat survey work conducted in support of the scheme will be conducted by suitably qualified persons. All work that is considered likely to result in disturbance of bats or their roosts will be conducted by holders of Natural England licences to 'take and disturb' bats for the purpose of science and conservation.
- 16.2.2 Some activities (e.g. initial assessments) may be suitable to be conducted by non-licensed but suitably experienced ecologists.

Initial bat roosting potential assessments

- 16.2.3 Assessment of trees and buildings for roosting potential which does not result in disturbance may be conducted by all suitably qualified persons. All persons

⁴¹ Mitchell-Jones, A.J., and McLeish, A.P. (2004), *Bat Workers' Manual*. Peterborough: Joint Nature Conservancy Council.

⁴² Mitchell-Jones, A.J. (2004), *Bat Mitigation Guidelines (IN136)*. English Nature, Peterborough.

⁴³ Hundt, L. (2012), *Bat surveys – Good Practice Guidelines, 2nd Edition*. Bat Conservation Trust, London.

⁴⁴ Highways Agency (2001), *Design Manual for roads and Bridges – Volume 10, Section 4, Part 3. Nature Conservation Advice in relation to bats*. Highways Agency, London.

conducting such a survey should be experienced in field survey of roosting potential of trees and buildings, including a good knowledge of the following:

- the legislation and protection afforded to bats;
- bat life cycle;
- locating and identifying field signs of roosting bats (droppings, scratch marks, urine staining etc.);
- using signs of bats found to locate likely roosting positions, likely genus of bat and type of roost;
- species-specific and seasonal requirements of roosting bats and the various natural features and manmade structures used for roosting;
- the range of survey methods that can be used to identify and study bats, and their strengths, weaknesses and limitations;
- describing construction of buildings and other structures, including the materials utilised and the form of features present (e.g. hipped roof, gable end, trussed rafters); and
- current relevant guidance for surveying bats.

16.2.4 If non-licensed surveyors identify evidence of an active roost during initial assessments then it will be necessary for them to cease surveying. The survey will subsequently be completed when a licensed surveyor is present.

Internal survey

16.2.5 Surveys of known roosts, or potential hibernation roosts, should be undertaken by ecologists with the appropriate Natural England licence.

16.2.6 Survey teams conducting internal inspection of buildings/structures between May and September (when bats are most likely to be present) should include at least one Natural England licensed bat worker.

Emergence/activity survey

16.2.7 It is recommended that each team of surveyors conducting emergence/return or activity surveys at a discrete location (i.e. a single tree, group of trees, building or structure) should include at least one licensed bat worker to coordinate the survey. At complex or large sites a higher proportion of licensed bat works should be utilised.

16.2.8 All other surveyors assisting in the implementation of emergence/activity surveys should have a sound knowledge and understanding of the following:

- the legislation and protection afforded to bats;
- bat life cycle;
- feeding strategies used by different bat species;
- the physiology and flight characteristics of UK bats;

- the range of survey methods that can be used to identify and study bats, and their strengths, weaknesses and limitations;
- species specific and seasonal requirements of roosting bats and the range of features utilised by each species;
- using a range of bat detectors to identify species and record behaviour; and
- current relevant guidance for surveying bats.

Further surveys

16.2.9 Any subsequent bespoke surveys for Annex II species will be overseen by licensed bat workers who are experienced in surveying, and assessing the impacts of development on, the species concerned. Licensed bat workers devising survey scope and methodologies on the project should have experience of undertaking ecological impact assessment in support of linear infrastructure projects, and designing successful mitigation schemes.

16.3 Licensing requirements

16.3.1 Requirements for the involvement of licensed surveyors are discussed within Section 16.2.

16.4 Screening for survey and defining the survey area

16.4.1 Aerial photograph interpretation (and where available Phase 1 habitat mapping and desk study records) will be utilised to identify all buildings, trees and other features with potential to provide a place of shelter for bats within the land required for the construction of the Proposed Scheme and within a surrounding 100m buffer of the boundary of the land required.

16.4.2 In addition consultants undertaking survey should conduct a review of all habitats, buildings, trees etc., and existing desk study records within a 500m buffer either side of the land required for the construction of the Proposed Scheme to identify any additional features where the following apply:

- there is the potential for significant effects on populations utilising these features; or
- information regarding bat use of the features/habitat in question will be important in determining a robust baseline that allows the significance of impacts within and in proximity to the Proposed Scheme to be accurately assessed.

16.4.3 An assessment of the need for survey of features more than 100m from the boundary of the land required for the construction of the Proposed Scheme should include consideration of the following:

- existing information on bat species, populations and roosts;
- protected sites, for example a Special Area of Conservation designated for bats;
- the context of the site in its surroundings;

- extent and quality of habitat within and around the site including water features, hedges, woodland and/or veteran trees;
- presence of known roosts or suitable buildings and other structures for roosts; and
- types of roost and species present (Hundt, 2012).

16.4.4 The scope of surveys will in the first instance be confined to habitats within a 100m buffer either side of the boundary of the land required for the construction of the Proposed Scheme, and features of particular interest within a 500m buffer of the boundary of the land required that are identified by the consultants responsible for bat survey in the area concerned. As the extent of the land required for construction will alter with design changes it will be necessary to regularly review which features require survey.

16.4.5 In urban sections the scope of survey will be limited to the land required for the construction of the Proposed Scheme (and the adjacent Network Rail Estate where the Proposed Scheme will run adjacent to existing rail lines) and any significant features/areas of semi-natural habitat adjoining the land required for the construction of the Proposed Scheme that are identified during aerial photograph interpretation. Within urban areas survey of retained residential housing adjoining the route should only be conducted where there is considered to be the potential for significant adverse effects.

16.5 Survey methods

16.5.1 The following methodologies are intended to provide robust baseline data on widespread UK bat species. If bat species listed on Annex II of the Habitats Directive⁴⁵ are found/ suspected to be present, additional survey work targeted at these species will be required to supplement the baseline.

Definition of potential to support roosting bats

16.5.2 Whilst undertaking preliminary survey work, the surveyor should assign value to each feature within each building/tree in accordance with the scale set out in Table 9. Where surveyors consider it appropriate, the potential rating of a particular features may be upgraded based on professional judgement and/or prior knowledge of the site (e.g. an optimal feature on a tree located within sub-optimal surrounding habitat may normally be graded as moderate, but may be upgraded to high where the surveyor has prior knowledge of unusually high bat activity in its vicinity).

⁴⁵ Lesser horseshoe bat (*Rhinolophus hipposideros*), Greater horseshoe bat (*Rhinolophus ferrumquinum*), Barbastelle (*Barbastella barbastellus*) and Bechstein's bat (*Myotis bechsteini*).

Table 9: Potential to support roosting bats

Potential to Support Roosting Bats	Equivalent tree categories within Hundt (2012)	Description
Confirmed	Known or confirmed roost	A feature/structure within which bats are seen to be present (either live bats, or bat carcasses) or heard 'chattering' will be classified as a confirmed roost. In addition any feature/structure found to contain droppings during inspections will in the first instance be considered as a confirmed roost. N.B. In some cases it may be appropriate to revise this assessment following further survey (e.g. for buildings containing low numbers or old droppings and showing no evidence of use during emergence surveys).
High	Category 1*	A feature/structure which, due to its size, depth, shape, orientation or other physical properties (such as ability to maintain a constant temperature, accessibility for bats) is considered to be ideal for use by bats. Potential feeding remains, urine staining or scratch marks (in the absence of droppings) within or around the feature are likely to indicate presence of bat occupation and therefore suggest high potential that a roost is present. In the absence of such signs, assigning a feature high potential will also be informed by the surveyor's knowledge of bat ecology and preferred roost types (relative to the feature being assessed). The quality of the surrounding habitat for bats will also be considered. For example, a building within an area of woodland is more likely to be occupied by bats than one adjacent to large areas of hard standing (as the bats would use the woodland for feeding, and potentially roosting). Potential examples of high potential features are: <ul style="list-style-type: none"> a south-facing opening on a tree trunk that appears to form a significant wound within the tree, with uncluttered drop zone and good connectivity to other areas of suitable habitat; or a gap below a ridge tile that provides a potential point of access to a pitched roof, with marked cleaner tile below indicating potential use by bats.
Moderate	Category 1	A feature/structure which would be considered ideal for use by bats were it not for one or more key factors which limit its potential. For example, an ideal feature in sub-optimal surrounding habitat (e.g. within an area of predominantly hard standing) may be considered to have moderate potential.
Low	Category 2	A tree/structure containing features where use by bats cannot be ruled out but is considered unlikely based on size, depth, construction aspect, habitat location etc. For example often metal warehouse structures with suitable access/egress points will be classed as having low potential to support roosting bats.
Negligible	Category 3	A tree/structure which is considered to lack any features suitable for use by roosting bats.

16.5.3 It should be noted that the initial assessment of potential considers only the potential to support any bat roost. As such it is possible to have a feature with a high potential to support roosting bats, even if this feature only has the potential to be utilised by a single bat.

Assessment of buildings/structures for potential to support roosting or swarming bats

16.5.4 Buildings/structures (including natural structures such as caves or adits) identified as requiring survey (according to the criteria provided in Section 16.4) should be given a unique reference code (see Section 3) and assessed for their potential to support bat roosts and/or act as a swarming site. Surveys should include bridges and tunnels passing over/under the route of the Proposed Scheme.

16.5.5 Internal and external inspection of the structure for potential bat access/egress points and signs of bat activity should be undertaken and recorded as shown in Figure 2 (Hundt, 2012). A drawing should be made to show the layout of the structure, and the location, aspect and height of any features/signs of bats, and potential access/egress points.

- 16.5.6 Digital photographs should be taken (cross-referenced to a plan) to record all features within the exterior and interior of the structure for future reference. Photographs should be taken of any evidence of bats (such as distribution of droppings, urine staining etc.). However, all photography should ensure that it does not result in the disturbance of any bats currently in-situ.
- 16.5.7 Reference should be made to the glossary of architectural terms within the Bat Workers Manual (2004) when describing the construction of buildings.
- 16.5.8 Where droppings are found and cannot be identified definitively a small sample (considered to represent droppings from a single species) should be collected and sealed in a plastic bag marked with the following details:
- date sample collected (day/month/year);
 - survey location reference (see Section 3);
 - GPS coordinates;
 - suspected species; and
 - surveyor name.
- 16.5.9 The sample should subsequently be stored in a cool, dry place. DNA analysis will be conducted where appropriate on these samples to help confirm species present.

Figure 2: Standard information to be recorded during roost assessments of buildings and built structures

Box 8.4 Standard information to be recorded in preliminary roost assessments of buildings and built structures

Evidence of use by bats:	Features of the building or built structure:
Location and number of any live bats.	Type.
Location and number of any corpses or skeletons.	Age.
Location and number of droppings.	Aspect.
Notes on relative freshness, shape and size of droppings.	Wall construction, in particular the type of brick or stone used to build the walls and whether it has cavity walls or rubble-filled walls.
Location and quantity of feeding remains.	Form of the roof, in particular the presence of gable ends, hipped roofs, etc. and the nature and condition of the roof covering.
Location of clean, cobweb-free timbers, crevices and holes.	Presence of hanging tiles, weather-boarding or other forms of cladding.
Location of characteristic staining from urine and/or grease marks.	Nature of the eaves, in particular if they are sealed by a soffit or boxed eave and the tightness of the fit to the exterior walls.
Location of known and potential access points to the roost.	Presence and condition of lead flashing.
Location of the characteristic smell of bats if no other evidence is recorded.	Gaps under eaves, around windows, under tiles, lead flashing etc.
	Presence and type of roof lining.
	Presence of roof insulation.
	Presence of water tanks in loft (note if covered or uncovered).
	Structure of the roof including the truss type, age and nature of timber work.
	Information or evidence of work having been undertaken that could affect use of the structure by bats.

Source: Bat Surveys – Good Practice Guidelines 2nd Edition (Hundt, 2012).

- 16.5.10 Wherever possible and safe to do so, surveys should access all areas including cellars/underground structures and loft spaces. High-powered torches with red filters, binoculars and endoscopes should be used to investigate all accessible areas. Where there are any constraints to the survey these should be clearly identified in the survey notes and consideration given to the effect these constraints may have had on the results obtained.

- 16.5.11 Each building/structure should be classified according to its potential to support roosting bats during the active season as confirmed, high, moderate, low or negligible based on Table 9.
- 16.5.12 In addition surveyors should, where possible, also give an indication of the type of roost the building structure is considered most likely to support based on current evidence (e.g. summer maternity roost, transitory roost, feeding perch, swarming site or hibernation roost) and/or the number of bats it is considered to have the potential to support on a three point scale of small, medium or large. It is acknowledged that for many features classification under these criteria may not be possible based on initial inspection alone.
- 16.5.13 Where buildings are confirmed roosts or are considered to have moderate or high potential to support a roost; or where a full inspection cannot be undertaken due to access restrictions (e.g. unsafe structure), then subsequent evening emergence and dawn re-entry surveys will be required. Given the evolving nature of the design, the requirement for emergence survey in relation to buildings applies in the first instance to all buildings within the survey scope (i.e. with the exception of urban areas, those located within the land required for construction of the Proposed Scheme or within a 100m buffer either side of the current boundary of the land required, or specific features within a 500m buffer where potential significant effects are anticipated). As design stabilises professional judgement may be applied to limit survey outside of the land required for the construction of the Proposed Scheme to those locations where there is considered to be the potential for significant effects.
- 16.5.14 No further survey is required of buildings/structures assessed to have low or negligible potential but sufficient information will need to be collected to give confidence to this assessment. As a precaution the procedure for demolition of low potential buildings is likely to include reasonable avoidance measures.
- 16.5.15 Each building/structure subject to initial assessment should also be assessed for its potential to support hibernating bats or act as a swarming site. Assessment should in this case simply classify sites as having potential for hibernation/swarming or lacking hibernation/swarming potential. All buildings/structures identified as having hibernation or swarming potential will require further survey as described later in this section.

Assessment of trees for potential to support roosting bats

- 16.5.16 As a general rule in the first instance all trees of diameter at breast height of 0.25m or above within the land required for the construction of the Proposed Scheme or within a 100m buffer either side of it should be subject to survey from ground level by a suitably experienced ecologist (i.e. one with knowledge of tree roosting in bats). Binoculars will be used to inspect the canopy of the tree for evidence of the features listed in the box overleaf, with each feature graded based on its potential to support roosting bats (see Table 9).
- 16.5.17 All trees should be given unique reference codes (see Section 3), with the location mapped and cross referenced to photographs taken. Preliminary surveys of trees should, ideally, be undertaken before trees come into full leaf. Where this is not possible and leaf cover is considered to significantly obscure initial inspection then

trees should be given a precautionary 'high' grading, triggering the requirement for future climb-and-inspect survey.

- 16.5.18 In addition surveyors should, where possible, also give an indication of the type of roost the feature is considered most likely to support based on current evidence (e.g. summer maternity roost, transitory roost, feeding perch, swarming site or hibernation roost) and/or the number of bats it is considered to have the potential to support on a three point scale of small, medium or large. It is acknowledged that for many features classification under these criteria may not be possible based on initial inspection alone.

Climb-and-inspect survey (trees)

- 16.5.19 Any trees where the presence of a roost has been confirmed during the initial assessment will not be subject to climb-and-inspect survey and should instead progress directly to emergence survey.
- 16.5.20 Subject to the exceptions listed in paragraph 16.5.21 below all trees that are considered to contain the following features will be subject to further inspection:
- trees identified during the initial inspections as containing features with high or moderate potential to support roosting bats during the 'active' period; or
 - features with potential to support hibernating bats.
- 16.5.21 It is acknowledged that not all trees will be considered safe to climb and for all trees where this is true a clear record should be made. In addition where the only features on a tree triggering the requirements for climb-and-inspect survey are either ivy cover or relatively open features that can be viewed fully from the ground using a torch (e.g. a callus roll) then no climb-and-inspect survey is required.
- 16.5.22 All inspections should be conducted either by a trained tree climber who is also a Natural England licensed bat worker, or by a tree climber under the direct supervision of a licensed bat worker. In order to minimise the risk of disturbance during inspections all tree climbers who are not licensed bat workers will be briefed by a bat worker who is experienced in undertaking tree inspections.
- 16.5.23 Climb-and-inspect surveys should, ideally, be undertaken between May and September when bats are more likely to be present. They will continue to provide useful information regarding the exact nature of features outside of this period. However, a more precautionary approach should be taken to the scoping out of further survey when inspections are conducted outside of this ideal period. Based on the results of the climb-and-inspect survey initial gradings will be reviewed and re-graded where necessary according to Table 9.
- 16.5.24 Where confirmed evidence of bats is found during the climb-and-inspect survey, or features cannot be investigated in full, emergence/re-entry surveys will be required. Emergence survey will also be conducted on the following:
- all trees containing high potential features (based on the outcome of the further inspection) which will either be subject to works or may be subject to potentially significant effects (e.g. through severance of habitat features utilised during foraging, commuting or navigation; disturbance through lighting or noise etc.); and

- all trees containing moderate potential features which could not be investigated fully during climb-and-inspect surveys.

16.5.25 Features assessed to have low or negligible potential to support roosting bats (following inspection and re-grading), where no evidence of bats is identified, will be scoped out of further survey work.

16.5.26 Should climbing surveys be deemed unsafe or otherwise not possible, any trees containing either high or moderate potential features should be subject to dusk emergence and dawn re-entry surveys.

Dusk emergence and pre-dawn re-entry surveys

16.5.27 The minimum level of survey for buildings/structures and trees requiring additional survey in the form of evening emergence and dawn re-entry surveys is detailed in Table 10. In each case the level of survey for the tree, building or structure in question will be defined by the highest potential feature which it supports (i.e. survey effort for a tree containing both high and moderate potential features will be three dusk emergence and/or pre-dawn emergence surveys). It should be noted that trees containing moderate potential features should only be subject to emergence survey where it was not possible to fully inspect these features during climb-and-inspect surveys. Surveys should be undertaken between May and August⁴⁶.

Table 10: Minimum number of emergence and re-entry survey visits for high and moderate potential trees and buildings

High bat roosting potential	Moderate bat roosting potential
Three dusk emergence and/or pre-dawn re-entry surveys during May to August	Two dusk emergence and/or pre-dawn re-entry surveys during May to August

Source: Bat Surveys – Good Practice Guidelines 2nd Edition (Hundt, 2012).

16.5.28 In each case at least one of the surveys should be a pre-dawn re-entry survey. In addition it should be noted that two surveys carried out within the same 24 hour period only constitutes one survey (i.e. a dusk emergence immediately followed by a pre-dawn re-entry only represents a single survey visit).

16.5.29 Once the minimum standard is completed consultants undertaking survey work should consider the requirement for additional visits on a case by case basis.

16.5.30 Surveyors will use frequency division or time expansion echolocation detectors. Detectors will be either recording detectors or be connected to a digital recording devices (such as the Edirol R-09), allowing recordings to be made as .WAV files or in a format that can be converted to .WAV format. This will enable calls to be analysed in either Bat Sound or Bat Scan software.

16.5.31 Static monitoring devices such as Anabat or SM2BAT+ may be utilised as a mobile recording device during emergence surveys. However, in all cases surveyors should also be equipped with a stand-alone detector and headphones. Static monitoring devices should only be used to replace surveyors during emergence surveys at locations where there are health and safety issues.

⁴⁶ Based on access constraints and an exceptionally wet summer during 2012 consultants undertaking survey should consider the merits of conducting surveys into September/October 2012 with repeat visits during 2013. In many cases, the minimum requirement in relation to emergence survey will be achieved through a combination of visits from both 2012 and 2013.

- 16.5.32 Surveyors are to be positioned in sufficient numbers that all potential roost features can be seen by at least one surveyor. All surveyors will be briefed prior to the start of survey as to the findings of the preliminary assessment and shown the presence of any potential access/egress points. Surveyors will remain at their survey station throughout the emergence survey period (i.e. dusk emergence and pre-dawn re-entry surveys should not be combined with activity surveys and surveyors moving between multiple roost features during a survey represents insufficient coverage).
- 16.5.33 In some locations consultants undertaking survey may find it useful to conduct emergence survey of trees or buildings which contain suitable features and occur in close proximity as part of a single larger survey. This approach is acceptable assuming that the number of surveyors utilised remains sufficient to ensure that all potential roost features are visible by at least one surveyor at all times.
- 16.5.34 Evening emergence surveys are to be undertaken from 15 minutes before sunset until two hours after sunset; and pre-dawn re-entry surveys undertaken from two hours before sunrise until sunrise. A record of weather conditions including air temperature, cloud cover and wind speed is to be made at the start and end of the survey period together with casual recordings made of any changes in weather conditions for the duration of the period, such as rain showers, and sunset and sunrise times. During the survey, a record of the number of bat passes of each species is to be made together with additional information such as direction of flight, emergence/re-entry point and activity recorded.
- 16.5.35 Following survey work, all recordings are to be analysed by an experienced ecologist using call analysis software to confirm species (where possible) and number of passes made. All recordings are to be retained for future reference.
- 16.5.36 All emergence surveys should be conducted during suitable weather conditions as defined in Hundt (2012).

Back tracking surveys

- 16.5.37 At locations where a group of trees meet the criteria for further survey, it may be appropriate to utilise back tracking survey as an alternative to emergence/pre-dawn re-entry surveys in order to locate roosts and gain a greater understanding of the bat assemblage supported by these features.
- 16.5.38 There is no widely accepted guidance on the number of survey visits required for back tracking survey, or the number of surveyors required in order to conduct reliable back tracking survey; the number of surveys and number of surveyors required will vary depending on the location and nature of the features to be subject to survey. It is expected that there will be no more than a 50m spacing between surveyors.
- 16.5.39 In the evening, back tracking surveys are to cover the period from half an hour before sunset to two hours after sunset, and for pre-dawn surveys the period at least two hours before sunrise.
- 16.5.40 The number of survey visits required to give a robust indication of the location of roosts may vary depending on the survey location. However, as a guide it is anticipated that at all locations this should as a minimum include dusk and pre-dawn

(or pre-dawn and dusk) surveys in the same 24hr period on at least two occasions (i.e. 2 x dusk/dawn or 2 x dawn/dusk) during the period May to August⁴⁷.

- 16.5.41 It is expected that all back tracking exercises will utilise static detectors to augment the total dataset. Where back tracking survey confirms the presence of roosts then emergence survey should be undertaken according to requirements set out in Table 10.
- 16.5.42 In order to ensure that levels of survey effort are comparable for similar survey scenarios consultants undertaking further survey work will be required to submit a deviation request for approval. Each deviation request should include the following details:
- aerial photograph annotated to show the location of features identified which require further survey;
 - proposed number of surveyors;
 - proposed number of survey visits;
 - proposed timing of visits (i.e. one visit during September 2012, one during April 2013 etc.); and
 - brief rationale for use of methodology at this location including summary of results from initial inspections.

Bat activity surveys (walked transect)

- 16.5.43 Within each 10km section of the route, a minimum of 3km of bat activity transect should be undertaken. This does not need to be a continuous 3km, and can be divided into sections to target features of particular interest and potential impact within and outside the land required for the construction of the Proposed Scheme, based on review of desk study data, aerial mapping and Phase 1 habitat survey data (where available). Where the 10km section contains significant extents of bored tunnel the minimum effort may be reduced.
- 16.5.44 In areas of high quality habitat for bats or where significant effects are otherwise considered likely (e.g. as a consequence of severance, loss of foraging habitat or disturbance), the consultant undertaking the survey is to undertake additional transect routes (i.e. in addition to the minimum of 3km within every 10km section) to assess likely significant effects on bats.
- 16.5.45 The aim of the surveys is to give an indication of species and numbers of bats utilising habitat within and in the vicinity of the land required for the construction of the Proposed Scheme, and to give an indication of existing features within the landscape that may be important in bat foraging, navigation and orientation and may be adversely affected as a consequence of the construction and/or operation of the Proposed Scheme.
- 16.5.46 The transect routes should in general focus on features which may act as bat flight lines (such as hedgerows and watercourses) which may be severed or adversely affected as a consequence of construction and/or operation of the Proposed Scheme,

⁴⁷ Based on access constraints and an exceptionally wet summer during 2012 consultants undertaking survey should consider the merits of conducting surveys into September/October 2012 with repeat visits during 2013.

and potential roost sites such as bridges, buildings and mature trees within the land required for the construction of the Proposed Scheme and a 100m buffer either side of it.

- 16.5.47 Features outside the land required + 100m buffer are only to be included where they are considered to be of value in identifying and assessing significant effects on bats (in particular as a consequence of severance).
- 16.5.48 Transect routes should be planned by an experienced bat ecologist utilising aerial photographs, Phase 1 habitat survey data and site photographs. Between 10 and 12 listening station stops (three minutes per stop) should be incorporated per transect route. Each transect route should take two to three hours to complete (Hundt, 2012).
- 16.5.49 Prior to conducting the first survey visit at least one member of the survey team should have visited the transect route during daylight hours in order to ensure that access constraints (e.g. fencing, hedges and other obstacles) have been considered and confirm that the location of listening station stops are appropriate. If one of the survey team is already familiar with the site from previous visits for other surveys then no additional visit will be required. Once the transect route and listening station stops have been selected, transects will be walked at a steady speed by an experienced ecologist using a bat detector and recording device.
- 16.5.50 All surveys should be conducted during suitable weather conditions as defined in Hundt (2012).
- 16.5.51 Surveyors will use frequency division or time expansion echolocation detectors. Detectors will be connected to a digital recording devices (such as the Edirol R-09), allowing recordings to be made as .WAV files or in a format that can be converted to .WAV format. This will enable calls to be analysed in either Bat Sound or Bat Scan software.
- 16.5.52 Monitoring devices such as Titley Anabat SD2 or Wildlife Acoustics SM2BAT+ may be utilised as a mobile recording device during activity survey. However, in all cases at least one surveyor should also carry a hand held detector (and headphones) with frequency division or time expansion capability and linked recording device.
- 16.5.53 Transect surveys are to be undertaken from sunset until two hours after sunset or until the full transect length has been walked (whichever is later) and for at least two hours before sunrise until sunrise. A record of weather conditions including air temperature, cloud cover and wind speed is to be made at the start and end of the survey period together with casual recordings made of any changes in weather conditions for the duration of the period, such as rain showers, along with sunset and sunrise times. During the survey, a record of the number of bat passes of each species is to be made together with additional information such as direction of flight, any emergence/re-entry points and activity recorded.
- 16.5.54 Where access allows each activity transect should be repeated as a minimum on three occasions between June and August with at least one of the three surveys comprising dusk and dawn surveys within one 24-hour period (i.e. dusk activity followed immediately by pre-dawn survey equates to one visit). The consultant undertaking surveys should consider the requirement for additional survey visits in areas of particularly suitable habitat. The start point and direction of transects should be varied between visits.

- 16.5.55 Each activity transect identified should also be subject to a minimum of one dusk/dawn survey (i.e. dusk activity followed immediately by pre-dawn survey) during the following months September 2012, October 2012, April 2013, May 2013, June 2013). Where habitat quality is high, or there is considered to be the potential for significant effects on bats then the requirement to undertake additional visits (i.e. above the 1 per month minimum requirement) should be considered.
- 16.5.56 During activity surveys, where bat roosting is confirmed through observation, additional emergence/re-entry surveys may be required and should be undertaken in line with the methodology outlined above.
- 16.5.57 If Annex II bat species are recorded or suspected, the scope of additional survey work should be agreed through the deviation request process.
- 16.5.58 Following survey work, all recordings are to be analysed by an experienced ecologist and confirmation of species and number of passes made. All recordings are to be retained for future reference.

Bat activity (car-based transect)

- 16.5.59 In those areas of significant land access refusals, driven transects on local roads should be utilised where appropriate to maximise available baseline data.
- 16.5.60 A methodology for car based transects is provided in Appendix C.
- 16.5.61 It should be noted that prior to conducting any car based transects consultants undertaking survey must submit a risk assessment for the proposed survey. It will be the responsibility of the consultant undertaking the survey works to notify the local highways authority and any other necessary parties (including the police as appropriate).
- 16.5.62 It should be noted that in central London and other busy urban areas the use of this methodology is considered unlikely to be acceptable on health and safety grounds.

Automatic detectors

- 16.5.63 Within each 10km of route requiring bat activity surveys, a minimum of two automated echolocation detectors are to be installed at suitable points (e.g. at hedgerow crossings) along the route alignment as determined by an ecologist experienced in their use, in order to provide additional data to assist in assessing the impact of habitat severance.
- 16.5.64 Consultants undertaking the surveys should also consider the requirement for additional echolocation detectors (i.e. in addition to the minimum of two per 10km route section) at suitable points to assist in determining the impact of habitat loss, severance or activity in the vicinity of known/suspected roosts.
- 16.5.65 Where only the minimum number of automated detectors are deployed they should be placed at least 2km apart unless the landscape pattern means that there is good reason to have closer spacing. Where additional detectors are utilised these may be deployed as required in order to help in the assessment of likely significant effects on bats.
- 16.5.66 Detectors should be in place and recording for at least seven consecutive nights per month between May 2012 and October 2012 and during the period April 2013 to June

2013. Detectors will need to be positioned in water-proof cases and checked on a monthly basis to collect data.

- 16.5.67 To give consistency across hardware, automated detectors should either be Titley Anabat SD2 or Wildlife Acoustics SM2BAT+ recording in zero crossing mode. This will allow data from the two types of detectors to be analysed using the Analook software.
- 16.5.68 Analysis should be undertaken using the Analook software, and bat calls recorded tabulated against time and the location of the recording device.

Hibernation site surveys

- 16.5.69 If initial survey identifies buildings/structures with the potential to act as bat hibernation sites, these will need to be surveyed by an ecologist with a Natural England licence to disturb hibernating bats.
- 16.5.70 Two visits are required, one in mid-January 2013 and one in mid-February 2013.
- 16.5.71 The site should be searched systematically from the entrance, with the locations of any bats seen marked on a plan of the site.
- 16.5.72 Careful inspection for droppings or oil staining around cracks and crevices, including rock piles, may also yield evidence of use by bats. Detailed records will be made of the location of any bats and/or signs of bats identified. In addition accurate temperature (°C) and relative humidity (%) readings should be taken during each visit. It is assumed that a full description of the potential hibernation site, including details of construction and potential perching points will have been made as part of the initial assessment.

Autumn swarming survey

- 16.5.73 If initial survey or desk study/consultation identifies potential autumn swarming sites, the following survey methodology should be applied in line with Hundt (2012).
- 16.5.74 One survey per month should be undertaken between August and October. An automated echolocation detector (Anabat SD2 or SM2BAT+ in zero crossing mode) should also be left in place at each potential swarming site under investigation for the period August to October.
- 16.5.75 Surveys should be undertaken on relatively warm, calm and rain-free evenings. Surveys should begin at 1 hour after sunset and continue for up to 4 hours.
- 16.5.76 During the survey, a record of the number of bat passes of each species is to be made together with additional information such as direction of flight, any emergence/re-entry points and activity recorded.
- 16.5.77 Surveyors will use frequency division or time expansion echolocation detectors. Detectors will be connected to a digital recording devices (such as the Edirol R-09), allowing recordings to be made as .WAV files or in a format that can be converted to .WAV format. This will enable calls to be analysed in either Bat Sound or Bat Scan software.

Mist netting/harp trapping/radio-tracking

- 16.5.78 If more detailed survey work including mist netting, harp trapping or radio-tracking is required this will need to be agreed via the deviation request process. Use of such methods will only be accepted where there is no alternative suitable means of collecting these data. In these circumstances an application for a project specific licence to undertake these surveys would need to be submitted to Natural England.

16.6 Survey programme and effort

- 16.6.1 Timing of survey work is detailed in the survey methodology section above, summarised in Table 11 below.

Table 11: Summary of bat survey programme and effort

Survey	Programme	Effort ⁴⁸
Building inspections	Year round (optimum period between May and September)	Any buildings identified during the habitat surveys as likely to be suitable for occupation by bats and which may be affected by the Proposed Scheme (demolition, disturbance, modification) should be investigated in more detail for evidence of use by bats.
Assessment of trees for potential to support roosting bats	Year round (assuming a precautionary approach is adopted during periods of dense leaf cover)	Any tree of 0.25m DBH or above within the land required for the construction of the Proposed Scheme and a 100m buffer either side of the land required and any other significant trees will be investigated in more detail for evidence of use by bats.
Tree climber inspections	Year round (optimum period between May and September)	Trees with moderate or above potential to support roosting bats.
Dusk emergence and dawn re-entry surveys	May to August	High roosting potential: three dusk emergence and or pre-dawn emergence between May and August. Moderate roosting potential two dusk emergence and/or pre-dawn surveys during May to August.
Activity surveys	June 2012 to October 2012 and April 2013 to June 2013.	Minimum of three surveys undertaken between June and August 2012 with at least one of the three surveys comprising dusk and dawn within one 24-hour period. One dusk and dawn (within a 24 hr period) during September 2012, October 2012, April 2013, May 2013 and June 2013.
Automated detector survey	May 2012 to October 2012 and April 2013 to June 2013	Data collected for at least seven consecutive nights per month between May and September. Checked on a monthly basis to collect data.
Autumn swarming	August to October	One survey per month between August and October.
Hibernation survey	January 2013 and February 2013	Two visits are required, one in mid-January and one in mid-February.

16.7 References

Highways Agency (2001). Design Manual for Roads and Bridges – Volume 10- Section 4 Part 3 Nature conservation advice in relation to bats. Highways Agency, London.

Hundt, L. (2012). Bat Surveys – Good Practice Guidelines 2nd Edition. Bat Conservation Trust, London.

Mitchell-Jones A, J. (2004). Bat Mitigation Guidelines (IN136). English Nature, Peterborough.

⁴⁸Access constraints mean that the full survey effort will not be achieved at all sites selected for survey.

Mitchell-Jones, A. J., and McLeish, A. P. (2004). *Bat Workers' Manual*. Peterborough: Joint Nature Conservancy Council.

17 Otter

17.1 Introduction and guidelines

- 17.1.1 There is the potential for adverse effects on otter (*Lutra lutra*) particularly where watercourses pass through or in close proximity to the land required for the construction of the Proposed Scheme. Given the on-going expansion in the distribution of the otter, it is considered important to identify both locations which are currently utilised by otter and those which are suitable for use by otter in the future.
- 17.1.2 In addition, the survey will take into account the use of terrestrial habitat by otter including location of both actual and potential holts (i.e. underground resting sites) and of couches (i.e. above-ground resting sites), and linear routes that may be important for movement between watercourses.
- 17.1.3 The proposed survey methodology draws largely upon the guidance provided in the Design Manual for Roads and Bridges (DMRB) Volume 10 Section 4 Part 4 (Highways Agency, 1999)⁴⁹.

17.2 Qualifications and experience

- 17.2.1 Habitat assessment and selection of sites for further survey is to be conducted by persons with awareness of the range of habitats utilised by otter, including knowledge of terrestrial features utilised during breeding.
- 17.2.2 All surveyors should have experience of the following:
- identification of otter field signs;
 - differences between signs of otter and other species which can be confused with otter, including mink;
 - otter behaviour and habitat requirements; and
 - identifying potential impacts of seasonal conditions or weather conditions on the validity of survey results.
- 17.2.3 An otter specialist is to lead surveys wherever possible due to the complexity of finding and identifying holts and couches in particular when distant from watercourses.

17.3 Licensing requirements

- 17.3.1 No licence is required to conduct otter survey assuming that care is taken to avoid disturbance of potential couches and holt locations. No survey that would result in disturbance of otter, or their places of rest is proposed as part of the current survey. Where monitoring of holts is required, non-invasive techniques such as the use of appropriately placed infra-red cameras will be utilised.

⁴⁹ Highways Agency (1999), *Design Manual for Roads and bridges – Volume 10, Section 4, Part 4. Nature Conservation Advise in relation to Otters*. Highways Agency, London.

17.4 Screening for survey and defining the survey area

- 17.4.1 Initially a review of desk study data, OS mapping and aerial photographs is to be undertaken to identify all watercourses and water bodies that fall within a 100m buffer of the land required for the construction of the Proposed Scheme and any others where there is considered to be the potential for the Proposed Scheme to result in significant adverse effects on otter. Where available, results of the Phase 1 habitat survey, River Corridor Survey, and ditch and pond surveys will inform this screening exercise.
- 17.4.2 It is expected that all watercourses which pass within a 100m buffer of the land required for the construction of the Proposed Scheme will require habitat assessment. Watercourses/water bodies would only be scoped out where significant barriers to movement occur between this feature and the land required for construction of the Proposed Scheme.
- 17.4.3 A walkover of each site selected for survey will be conducted by an experienced surveyor, and a decision taken on the need for subsequent detailed survey. This assessment should include consideration of each site against the following criteria:
- proximity to the land required for construction of the Proposed Scheme;
 - presence of significant barriers to dispersal and movement through the territory;
 - habitats present and suitability for use by otter (including terrestrial habitats);
 - adjoining land use;
 - level of disturbance;
 - features of watercourse/water body (estimated depth, level of flow, width of channel);
 - connectivity with other areas of suitable or sub-optimal habitat; and
 - pollution.

17.5 Survey methods

Aquatic/riparian habitats

- 17.5.1 For watercourses selected for detailed survey, initially a 2km section either side of the boundary of the land required for the construction of the Proposed Scheme was surveyed. Where a confluence with a river was reached more than 1km from the boundary of the land required and there are no signs of otter activity in the vicinity of the confluence, the survey was terminated at this point.
- 17.5.2 Surveys conducted post-November 2012 should utilise a revised survey extent of a minimum of 300m either side of the boundary of the land required for the construction of the Proposed Scheme. The reduction in extent follows correspondence with Natural England. The reduced survey effort is appropriate given that a commitment has been made that the undertaker will ensure that the Proposed Scheme maintains safe passage for otter at all watercourses potentially suitable (i.e. including those which are yet to be repopulated by otter).

- 17.5.3 Where possible both banks should be surveyed. Where necessary spot checks should be conducted at suitable publicly accessible areas within 5km of the land required for the construction of the Proposed Scheme (Highways Agency, 1999).
- 17.5.4 For water bodies, the survey should include all areas that fall within a 100m buffer from the land required for the construction of the Proposed Scheme and a minimum 300m section either side of this (Highways Agency, 1999).
- 17.5.5 For all sections of aquatic/riparian habitat subject to survey, all evidence of otter and other notable species such as water vole and mink should be recorded. This should as a minimum include the number and location of the following field signs:
- natal holts, holts and potential holt sites (using the criteria provided in Appendix D);
 - couches ;
 - spraints;
 - anal jelly;
 - tracks/footprints;
 - silt/sand heaps; and
 - slides.
- 17.5.6 All field signs of otter, along with those of any other notable species (in particular mink and water vole) should be provided with GPS derived grid coordinates accurate to less than 5m. Where topography and vegetation structure may have reduced the accuracy of records below this level, this information should be noted.
- 17.5.7 When searching for potential holt sites the criteria devised by Chanin (2012)⁵⁰ provided in Appendix E should be utilised as the basis for identifying potential holt sites and determining whether or not they are in use.
- 17.5.8 Where the presence of otter is confirmed, and significant adverse effects are likely, there may be a requirement to extend the extent of survey into other adjacent watercourses (which may have been scoped out at an earlier stage), and for the use of additional survey methods including use of camera traps.

Terrestrial habitat

- 17.5.9 Where land required for the construction of the Proposed Scheme is located within 100m of a watercourse or water body that is confirmed as being utilised by otter, a review of aerial photography, and walkover survey (where required) should be conducted to check for the presence of any features within the land required that may be utilised as couches, resting places or natal holts.
- 17.5.10 The following criteria devised by Chanin (2012) should be utilised to identify potential otter breeding sites:
- any single area of extensive concealing habitat (woodland, scrub, reedbed) which is greater than 1ha in area and within 100m of a watercourse; and

⁵⁰ Chanin, P. (2012). Personal correspondence.

- any combination of extensive concealing habitats which are within 100m of one another, total at least 1ha and are within 100m of a watercourse.

17.5.11 For all potential breeding sites identified using these criteria a site visit should be conducted by an experienced otter surveyor to check for signs of breeding activity (e.g. well used paths, play areas, or large accumulations of spraint). During this visit their overall suitability should be scored on a scale of 0= unsuitable to 5 = highly suitable taking into consideration the criteria for assessing cover and suitability of food shown in Appendix D devised by Chanin (2012).

17.5.12 The location of any such feature identified should be recorded, along with details of the feature and associated habitat (e.g. large wood pile within area of semi-natural woodland).

17.5.13 In addition, the survey should look to identify and map any linear features that may be important in the movement of otters between adjacent watercourses.

17.6 Survey programme and effort

17.6.1 Where access restrictions allow, a total of four survey visits should be conducted at approximately three-monthly intervals. However, where no habitat suitable for the creation of holts or couches is present within the land required for the construction of the Proposed Scheme then survey may be curtailed once the presence of otter has been confirmed.

17.6.2 Survey should not be conducted during or following periods of heavy rainfall, as field signs will have been washed away. In general where possible survey visits should be timed to avoid survey when water levels are high.

17.7 References

Chanin P (2003). Monitoring the Otter (*Lutra lutra*). Conserving Natura 2000 Rivers Monitoring Series No. 10, English Nature, Peterborough.

Chanin P (2005). Otter surveillance in SACs: testing the protocol. English Nature Research Reports - Number 664, English Nature, Peterborough.

Chanin P (2012) Personal correspondence.

Highways Agency (1999). Design Manual for Roads and Bridges – Volume 10 – Section 4 Part 4 – Nature Conservation Advice in Relation to Otters. Highways Agency, London.

IEEM (2011). Competencies for Species Surveys: Eurasian otter IEEM, Winchester. Downloaded at <http://www.ieem.net/docs/CSS%20-%20EURASIAN%20OTTER%20%2831.8.2011%29.pdf> on 8 March 2012.

18 Water vole

18.1 Introduction and guidelines

- 18.1.1 Survey for water vole (*Arvicola amphibius*) will need to take account of all watercourses that pass through or in close proximity to the land required for the construction of the Proposed Scheme including canals, where populations are thought to be surviving better than on rivers.
- 18.1.2 The proposed approach will follow the Water Vole Conservation Handbook (Strachan et al, 2011)⁵¹ survey methodology, taking into account current Natural England advice (Natural England, 2008;⁵² Natural England, 2011⁵³).

18.2 Qualifications and experience

- 18.2.1 All initial scoping and habitat assessment work should be conducted by persons with previous experience of the range of habitats utilised by water vole and of field signs indicating potential presence of water vole.
- 18.2.2 A detailed search of the survey area in question should be undertaken by an experienced water vole surveyor. This should be a surveyor who has undertaken sufficient similar surveys in the past to enable a suitable level of confidence in identifying the field signs of water vole.

18.3 Licensing requirements

- 18.3.1 No licence is required to survey for water vole. Care should be taken during survey not to disturb water vole if present.

18.4 Screening for survey and defining the survey area

- 18.4.1 Initially review of desk study data, aerial photography and habitat mapping was undertaken to identify and map all areas of habitat potentially suitable to support water vole that are located within the land required for the construction of the Proposed Scheme, or within a 500m buffer of the boundary of the land required. This initial assessment included identification of all watercourses, ponds and lakes within this extent, and any other suitable riparian habitat (e.g. reedbed).
- 18.4.2 Where the above desk based exercise or the results of other surveys (e.g. Phase 1 habitat survey) identify the potential for, or signs indicating the presence of water vole, a specific walkover survey will be conducted in order to appraise the potential suitability of the habitat present for water vole in more detail, and determine the scope of detailed survey. The habitat assessment should be based on consideration of the following factors:
- bank profile, channel profile and characteristics, and water levels;
 - availability of food sources;

⁵¹ Strachan, R., Moorhouse T. and Gelling, M. (2011). *Water Vole Conservation Handbook – Third edition*. Wildlife Conservation Research Unit, Oxford.

⁵² Natural England (2008). *Water voles – the law in practice. Guidance for planners and developers (NE 86)*. Natural England, Peterborough.

⁵³ Natural England (2011). *Natural England Technical Information. Note TINo42: Water voles and development: licencing policy*. Natural England, Peterborough.

- vegetation structure (in particular the extent of suitable marginal vegetation);
- level of shading;
- disturbance levels;
- bordering land use; and
- connectivity with other areas of suitable or sub-optimal habitat.

18.4.3 Based on the above factors and any others which the surveyor considers to be important in the local context, habitat areas requiring detailed survey are to be determined, as well as areas that can be discounted from further investigation.

18.5 Survey method

18.5.1 At each site selected, a detailed water vole survey should take place following the survey guidelines set out in the Water Vole Conservation Handbook (Strachan et al, 2011).

18.5.2 Survey undertaken up to November 2012 included the land required for the construction of the Proposed Scheme and a 500m upstream and 500m downstream extent from the boundary of the land required where access allowed. This extent has been reduced to the land required and a 300m extent upstream and downstream (where access allowed) for surveys conducted from November 2012 onwards. The reduction in scope followed correspondence with Natural England and a commitment that the undertaker will ensure that all culverts of suitable watercourses will maintain safe passage.

18.5.3 Each survey area should be split into 50m-100m lengths with the start and end of each stretch marked on a map and the GPS coordinate recorded for the beginning and the end of the length. The lengths/areas surveyed are to be mapped and all signs of water vole plotted accurately on a plan with a GPS coordinate taken.

18.5.4 Wherever possible, the survey should be undertaken from within the watercourses, in order to allow for a close search for signs of water vole. Consultants undertaking survey should consider carrying out surveys from a boat in places where water is deep and the margins cannot be safely surveyed from the bank.

18.5.5 During each survey visit the banks of each watercourse/water body (up to a distance of 2m from the edge of the water) should be inspected for signs of use by water vole including the following:

- presence of latrines;
- presence of burrows (both active and inactive);
- presence of runs;
- presence of footprints;
- presence of feeding remains;
- individual droppings; and

- sightings and/or sounds (characteristic sound entering the water) of individuals.
- 18.5.6 As well as marking all signs on a map, a note should be made of the number of each type of sign recorded so that abundance can be estimated.
- 18.5.7 The above information will be recorded alongside similar information indicating use by other species (e.g. bank vole, field vole, mink, otter, brown rat, etc.). The location of all positive evidence of the presence of both water vole and any other species identified during the survey (e.g. bank vole, mink, brown rat, etc.) should be recorded by GPS (to an accuracy of <5m where terrain/vegetation allows).
- 18.5.8 For each watercourse/water body subject to survey the following additional information should be collected during the first survey visit:
- habitat types present;
 - predominant bank substrate;
 - adjoining land use;
 - vegetation types present and indication of abundance of each using DAFOR scale;
 - disturbance at the site;
 - bank profile;
 - depth;
 - width;
 - rate of flow;
 - signs of recent habitat damage; and
 - sketch map of the site.
- 18.5.9 During each subsequent visit this information should be reviewed and any significant changes since the last survey visit recorded.
- 18.5.10 Where there is any uncertainty over water vole droppings found that cannot be definitively identified in the field, a small sample (considered to represent droppings from a single species) should be collected and sealed in a plastic bag marked with the following details:
- date sample collected (day/month/year);
 - survey location;
 - GPS coordinates;
 - suspected species; and
 - surveyor name.
- 18.5.11 The sample should be stored in a cool, dry place until the completion of the survey in that area. DNA analysis will subsequently be conducted if considered appropriate,

that is, on those dropping samples where the survey has found no other definitive evidence of the presence of water vole within the respective survey area in order to help determine presence/absence.

- 18.5.12 Once field sign data have been obtained, the population size of the voles in that stretch of watercourse should be calculated. This should be based on the standard recognised method for calculating the population size, namely Morris et al (1998)⁵⁴.

18.6 Survey programme and effort

- 18.6.1 During 2012 survey should ideally be undertaken between mid-April and September with at least two survey visits to each water body/watercourse undertaken, in one season. Where access consents allow, a survey should be undertaken in the early season (mid-April to June) and another in late season (July to September). Where constraints prevent this timing, attempts should be made to ensure that visits are conducted at least two months apart.
- 18.6.2 At sites where no visits were achieved during the period mid-April to September 2012 then where access is available a single visit during October 2012 should be conducted in an attempt to gain early confirmation of presence.
- 18.6.3 At sites where a single visit has already been conducted during the period mid-April to September 2012 under suitable conditions then no further visit should be conducted during October 2012.
- 18.6.4 During 2013 a single additional visit should be conducted during the period mid-April to mid-June at all sites where any of the following apply:
- only one or no survey visit was completed during the optimum period during 2012; or
 - no survey visit was conducted in the corresponding period during 2012 (i.e. if only an autumn visit was conducted during 2012, then a spring visit should be conducted in 2013); or
 - confirmed evidence of water vole was recorded during either of the survey visits during 2012 surveys.
- 18.6.5 Two survey visits should be conducted during the period mid-April to mid-June 2013 (at least one month apart) if no survey visits are achieved during 2012 during the optimum survey period.
- 18.6.6 Survey should not be conducted during or following periods of heavy rainfall, as field signs will have been washed away. In general where possible survey visits should be timed to avoid survey when water levels are high, or when management works have recently taken place.

⁵⁴ Morris, P., Morris, M., MacPhearson, D., Jefferies, D., Strachan, R., and Woodroff, G. (1998), *Estimating numbers of water voles Arvicola terrestris: a correction to the published method*. *Journal of Zoology*, 246, 61-62.

18.7 References

Morris, P., Morris, M., MacPhearson, D., Jeffries, D., Strachan, R. and Woodroff, G. (1998) Estimating numbers of the water vole *Arvicola terrestris*: a correction to the published method. *Journal of Zoology*. 246, 61-62.

Natural England (2008). Water voles – the law in practice. Guidance for planners and developers (NE 86). Natural England, Peterborough.

Natural England (2011). Natural England Technical Information Note TINo42; Water voles and development: licensing policy. Natural England, Peterborough.

Strachan, R., Moorhouse, T., and Gelling, M. (2011). Water Vole Conservation Handbook – Third Edition. Wildlife Conservation Research Unit, Oxford.

IEEM (2011). Competencies for Species Surveys: Water Vole IEEM, Winchester. Downloaded at <http://www.ieem.net/docs/CSS%20-%20WATER%20VOLE%20%2831.8.2011%29.pdf> on 8 March 2012.

19 Badger

19.1 Introduction and guidelines

- 19.1.1 Potential impacts on badgers are likely to be loss of setts within the land required for the construction of the Proposed Scheme, potential for disturbance of setts in close proximity to the land required, and severance/fragmentation of territories.
- 19.1.2 Survey for badgers will need to identify both sett locations and, where there is the potential for significant severance/fragmentation of territories, an understanding of territory use through detailed survey, including use of bait marking studies if necessary.
- 19.1.3 Sett surveys are to be conducted in line with guidance provided in Harris et al (1989)⁵⁵.

19.2 Qualifications and experience

- 19.2.1 All personnel involved in scoping and defining the survey area should be experienced in assessing habitat potential for badgers, and the potential impacts of severance/fragmentation of territories.
- 19.2.2 All personnel conducting detailed badger survey should be competent and experienced in the identification of the full range of badger field signs including setts, latrines, hairs, badger paths and foraging signs including 'snuffle' holes. In addition they should be competent in identifying field signs of other species, such as foxes, rabbits, otters, dogs and cats.
- 19.2.3 All personnel conducting badger survey should be familiar with the definitions of sett type detailed by Harris et al (1989), and the classification of setts utilising this methodology in the field.
- 19.2.4 All bait marking surveys should be coordinated by ecologists with experience of utilising this technique.

19.3 Licensing requirements

- 19.3.1 Proposed survey methodologies will not involve either the destruction or disturbance of setts, so that no licence is required. If it is necessary to monitor activity at setts, camera traps at sett entrances should be used. Application for a licence to interfere with a badger sett (under the Protection of Badgers Act, 1992)⁵⁶ would only be required if there is a need for the use of more intrusive methods such as internal camera investigations of setts.

19.4 Screening for survey and defining the survey area

- 19.4.1 Utilising results from the Phase 1 habitat survey, desk study records and analysis of aerial photographs, consultants undertaking survey work will identify areas within the land required for the construction of the Proposed Scheme, or within a 100m surrounding buffer that are likely to be used by badgers and where there is the

⁵⁵Harris, S., Cresswell, P., and Jefferies, D. (1989). *Surveying Badgers*. Occasional publication of the Mammals Society.

⁵⁶Protection of Badgers Act (1992) Chapter 51. Her Majesty's Stationery Office.

potential for significant effects to occur. This assessment should take into account the following criteria:

- suitability of habitat and topography for creation of setts;
- availability of other habitat suitable for badger within close proximity to the land required for the construction of the Proposed Scheme;
- connectivity with other areas of suitable habitat; and
- potential for severance/fragmentation of territories.

19.4.2 Areas selected based on the above criteria will be subject to a detailed survey for field signs.

19.4.3 Where main or annex setts are identified within the initial survey area, there is likely to be a need to conduct further survey to establish the likely extent of territories. Such decisions on an acceptable extent of further survey should be determined by an experienced badger surveyor.

19.5 Survey methods

Detailed survey for field signs

19.5.1 For all areas subject to survey, a systematic walkover will be conducted of all suitable habitats to obtain records of the following:

- setts;
- hairs;
- badger paths/runs;
- mammal paths (possible badger);
- foraging signs;
- latrines;
- footprints;
- bedding material; and
- evidence of rabbit and fox.

19.5.2 For all setts identified during the walkover survey, entrances and the orientation of entrance holes should be mapped. The sett should be classified against the criteria laid out in Harris et al (1989) as either a 'main', 'annexe', 'subsidiary' or 'outlying' sett. The level of use for each entrance should be classified as either 'active', 'partially active' or 'disused'.

19.5.3 During the walkover surveyors should also record the location and current use of any large entrances not currently utilised by badger, in order that these entrances can be monitored for future use during the period up to construction.

19.5.4 All field signs of badger, along with those of any other notable species are to be recorded with GPS-derived grid coordinates accurate to less than 5m. Where

topography and vegetation structure may have reduced the accuracy of records below this level this information should be noted.

Territory analysis

- 19.5.5 Following completion of the detailed survey for field signs, results should be reviewed to identify those locations where further survey will be required in order to determine the extent of territories and thus the significance of any effects of the Proposed Scheme on the badger population.
- 19.5.6 The requirement for detailed survey for field signs over an extended area (i.e. beyond a 100m buffer from the land required from the construction of the Proposed Scheme) should be considered at all locations where detailed survey for field signs identifies a main or annex sett within the land required for the construction of the Proposed Scheme or within a 100m buffer of the land required.
- 19.5.7 The aim of such further surveys would be to better understand those territories that may be subject to significant effects as a consequence of the construction or operation of the Proposed Scheme, either through loss or disturbance of setts, loss of foraging habitat, or severance of commuting routes. It is envisaged that in the first instance this would involve extending the survey extent in the vicinity of identified main setts to determine likely territory boundaries, principally through the identification and mapping of boundary latrines. The extent of survey appropriate at each location is likely to vary and should be determined and justified by an experienced badger surveyor.

Bait marking

- 19.5.8 It is likely that in some locations following survey of an extended area for field signs, it will be necessary to conduct bait marking exercises to aid in the identification of territory boundaries. Active main setts and annexes within the survey area that could be significantly affected should be selected for bait-marking studies, with each main sett being designated with a uniquely coloured plastic marker; other setts are to be included as required. On the first two days of feeding, bait should be deposited down any active holes; after this period, bait should be distributed up to a distance of 15 – 20m from active holes.
- 19.5.9 Once the survey is completed, the location of each latrine and the origin of the coloured return are to be charted on a map.

19.6 Survey programme and effort

Survey for field signs

- 19.6.1 Detailed survey for field signs is to be conducted during early spring or autumn/winter, where possible.

Bait marking

- 19.6.2 Bait-marking should generally be conducted during late February, March and April when territorial activity is typically at its peak.
- 19.6.3 Active sett entrances to be baited should be visited daily preferably in the late afternoon. Approximately 25 – 30 bait points should be applied for each main sett.

- 19.6.4 Bait should be laid daily for approximately two weeks. Approximately one week after commencements of baiting, daily checks should commence to identify any latrines containing bait. Latrine checks should continue for approximately seven days after the cessation of baiting. Marked droppings may contain low numbers of beads; therefore each latrine/dropping should be inspected thoroughly using a pallet knife or trowel.

19.7 References

Harris, S., Cresswell, P., and Jefferies, D. (1989). Surveying Badgers. Mammal Society.

IEEM (2011) Competencies for Species Surveys: Badger IEEM, Winchester.

Downloaded at [http://www.ieem.net/docs/CSS%20-%20BADGER%20\(31.8.2011\).pdf](http://www.ieem.net/docs/CSS%20-%20BADGER%20(31.8.2011).pdf) on 8 March 2012.

Protection of Badgers Act (1992) Chapter 51. Her Majesty's Stationery Office.

20 Invertebrates

20.1 Introduction and guidelines

20.1.1 The invertebrate surveys to be conducted are aimed at identifying significant effects on invertebrates as a result of the construction or operation of the Proposed Scheme. Therefore, survey design and analysis should be directed towards the aim of providing sufficient information to allow an assessment of significant effects on invertebrate species and assemblages to be made. Most of the methods described are derived from "Surveying terrestrial and freshwater invertebrates for conservation evaluation" (Natural England, NERR005 2007)⁵⁷, but focussed upon the need to support an EIA.

20.1.2 Many invertebrate taxa are poorly understood in terms of their ecology and distribution. Although records of the presence of such species are a valuable addition to distributional knowledge, it is often not possible to accurately assess the value of a species record in a taxon which does not have a good database of distributional information. Even the first record of a species in a poorly known group does not necessarily confer significance to the site from which it was recorded without suitable contextual information. To avoid unnecessary and/or unhelpful records, the best solution is to use the recommended taxa for each habitat in the NERR005 document.

20.2 Qualifications and experience

20.2.1 Field surveyors should ideally be experienced entomologists but where sample collection is made for later identification, the surveyors are to be trained and/or have extensive experience in the techniques which are to be employed, including the collection, preservation and labelling of specimens. Identification should only be undertaken by experienced taxonomists. There is currently no formal competency framework and so fulfilment of at least one of the following is required:

- member/Fellow of the Royal Entomological Society;
- employed as an entomologist by a museum/local authority/conservation organisation;
- working as a professional consultant entomologist with track record in the groups under consideration; or
- having a substantial record of publications in the groups to be worked.

20.3 Licensing requirements

20.3.1 All surveys should follow the guidelines provided by the Joint Committee for Conservation of British Insects (2002)⁵⁸.

20.3.2 The following legal constraints are based on Natural England research report NERR005 (2007) and should be considered when conducting surveys:

- legally protected invertebrates (see the JNCC website): a license issued by the relevant statutory conservation agency is needed to collect species fully

⁵⁷ Natural England Research Report NERR005 (2007), Surveying terrestrial and freshwater invertebrates for conservation evaluation.

⁵⁸ Joint Committee for Conservation of British Insects (2002). A Code of Conduct for Collecting Insects and other Invertebrates. *British Journal of Entomology and Natural History*. 15 (1), 1-6.

protected under the Wildlife and Countryside Act. This will also cover invertebrates listed in Annex IV of the Habitats and Species Directive and for which a license is required under European regulations;

- legally protected vertebrates: it is an offence to collect or disturb protected species even as an incidental part of a lawful operation. A licence is needed if there is risk of capturing protected species (such as great crested newt) in pitfall and other passive open traps. A wire mesh placed over pitfall and water traps will reduce or prevent this risk, but may also reduce the catch of larger invertebrates;
- bye-laws and rules: capturing animals is prohibited by bye-laws and the rules of several organisations, including the Forestry Commission, Forest Enterprise, the National Trust, the Environment Agency, county wildlife trusts and local authorities (for Nature Reserves). Permission is required for surveys on sites covered by such bye-laws and rules;
- National Nature Reserves and Sites of Special Scientific Interest: collecting on these sites is classed in England as an 'operation likely to damage'. Permission to collect must be obtained from the local office of the statutory conservation agency. Permission is unlikely to be refused for a 'bona fide' survey; and
- criminal damage: under the Wildlife and Countryside Act, it is an offence to uproot a wild plant without the landowner's permission. If surveys require digging up plants, splitting branches etc. it is advisable to inform the landowner in advance.

20.4 Screening for survey and defining the survey area

20.4.1 The requirement for invertebrate surveys will be based on the results of the desk study, habitats identified by the Phase 1 habitat survey and their location, and are likely to be focused at survey within the land required for the construction of the Proposed Scheme and a 100m buffer either side of this.

20.4.2 A survey should be considered if the desk study provides records of protected species, species of principal importance, UK Biodiversity Action Plan species, Red Data Book species, or nationally scarce invertebrates within 2km of the route and the habitats present within the land required for the construction of the Proposed Scheme and surrounding 100m buffer either side of it are capable of:

- providing suitable breeding areas; or
- hold a significant resource for maintenance of at least one part of their life cycle (e.g. foraging habitat, overwintering habitat for eggs/larvae etc.).

20.4.3 Additionally, if the Phase 1 habitat survey identifies potentially significant habitats for invertebrates (e.g. marshy grassland, species-rich grassland, diverse woodland/scrub), then these habitats should be subject to a specific habitat assessment for invertebrate interest and the findings of this assessment used to determine whether specific sampling surveys are required.

20.4.4 Surveys of invertebrates of aquatic habitats (watercourses and standing water bodies) will be targeted to areas with records of significant species (as defined above for

terrestrial surveys) occurring anywhere in the watercourse/catchment and having similar habitat requirements as those present within the land required for the construction of the Proposed Scheme or the 100m buffer surrounding it. In respect of watercourses, additional data from the Environment Agency should be sought. In cases where an assemblage of aquatic macro-invertebrates of high ecological value (as evidenced by an above average BMWP score occurring on a regular basis within a timescale of the last 5-10 years) occurs within the same catchment/tributary as the study site, then aquatic invertebrate surveys should be undertaken.

- 20.4.5 It is recognised that survey areas for invertebrates will vary greatly, dependent upon the habitats considered to be of importance, and the species under consideration, for example a small area of river shingle for certain beetle species or a series of marshy grasslands for marsh fritillary metapopulation assessments. Decisions on survey area should be made by the entomologists conducting the survey, but the key focus of any survey work should be within the land required for the construction of the Proposed Scheme and a 100m buffer either side of it. Outside this zone, consultants undertaking survey works should submit a deviation request where they feel there is the requirement for additional survey to identify potential significant effects.

20.5 Survey methods

- 20.5.1 Species information from each site should be in a format suitable for input to ISIS. This is a computer application developed by Natural England. ISIS interprets species lists by recognising assemblage types within a list and scoring each type according to its conservation value. It provides a standardised, and accepted, method of evaluation across the scheme. Further details on these data requirements are presented in Natural England (2007).

Terrestrial habitat survey

- 20.5.2 Where it is assessed that detailed surveys are required, then the appropriate methods relevant to the taxa and habitats under consideration are to be adopted. These methods could include but are not necessarily limited to:
- sweep netting - standardised through timed netting in appropriate habitats, if required;
 - hand searches of specific host plants (for leaf mines, galls) of particular species;
 - egg searches (e.g. black hairstreak);
 - conspicuous aggregations (e.g. marsh fritillary 'webs');
 - pitfall trapping;
 - white tray trapping;
 - suction sampling; and
 - light trapping.
- 20.5.3 Methods selected are to be as species specific and/or focussed as possible on habitats of actual or potential importance. Natural England (2007) provides details of standard

methodologies, and the selection of appropriate methods in terms of habitats and taxa. The methods adopted should follow this guidance wherever possible. Methods such as light trapping, which attract specimens from a large distance, should be used with caution.

- 20.5.4 In addition, general butterfly surveys will be required in identified suitable habitats and include brownfield sites in urban areas where species such as grizzled and/or dingy skipper are known or suspected.
- 20.5.5 Generally, the surveys for butterflies are to be based upon the establishment of transect walks that are surveyed a minimum of three times (May, June, July) recording species at an appropriate time (10.00-16.00) and during suitable weather conditions (temperatures not below 13°C and 13-17°C only if at least 60% sunshine; clear or light cloud; still or light wind (less than Beaufort Scale 5); no rain).

Aquatic invertebrates

- 20.5.6 Rivers and streams are to be sampled according to the published methodology applicable to the size of the watercourse (e.g. 3-minute kick sampling, surber sampling) and specimens identified to species level or the lowest possible taxonomic unit and counted. Measurements of the environmental variables required for input into RIVPACS are also to be taken and then the data set(s) analysed using the RIVPACS program, if this is considered necessary to predict likely significant effects.
- 20.5.7 Surveys of ditches selected (see Section 9) are to follow the published methodology in "A Manual for the Survey and Evaluation of the Aquatic Plant and Invertebrate Assemblages of Grazing Marsh Ditch Systems" Version 6 May 2013 Buglife – The Invertebrate Conservation Trust⁵⁹.
- 20.5.8 It is acknowledged that the above methodologies were devised for use in a programme of survey and evaluation work relating to the ditches associated with grazing marshes. However, the general survey strategy is considered to remain valid and the evaluation procedures outlined within the manual will be modified so that they are appropriate. A modified version of the evaluation criteria appropriate to the ditch types surveyed are to be utilised.
- 20.5.9 Surveys of ponds (see Section 10 for selection process) are to follow one of the methods in the National Pond Monitoring Network (<http://www.pondconservation.org.uk/about/Areas+of+Expertise/nationalpondmonitoringnetwork>)⁶⁰:
- the rapid assessment for ponds requires invertebrate sampling only and is a rapid assessment of 'naturalness' using invertebrate diversity and families similar to the Biological Monitoring Working Party system for running water;
 - the Predictive SYstem for Multimetrics (PSYM) method includes collection of physical data, invertebrate sampling and plant recording. These data are used to undertake an analysis to compare the pond against a national database held

⁵⁹ Palmer, M., Drake, M., Stewart, N. (2013). *A manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of grazing marsh ditch systems. Version 6.* Buglife.

⁶⁰ National Pond Monitoring Network (2013). *Pond conservation.* Available at <http://www.pondconservation.org.uk/about/Areas+of+Expertise/nationalpondmonitoringnetwork> . Accessed 01 October 2013.

by the Pond Conservation Trust (PCT). The data are submitted to the PCT for analysis; and

- The National Pond Survey method provides a more detailed assessment of a pond and includes environmental and chemical data from the pond in addition to plant and invertebrate survey and ideally requires sampling of the invertebrate fauna over three seasons.

20.5.10 The method used will depend on the location of the pond (e.g. within the land required for the construction of the Proposed Scheme, or outside of it) and the potential impact upon it.

20.6 Survey programme and effort

20.6.1 The number and timing of visits will be dependent on the habitats to be surveyed, and the taxa under consideration. The guidance and advice presented in Natural England (2007) should be used on a case by case basis. Typically, where surveys are required, three sample sessions spaced out between May and September are likely to be appropriate for terrestrial habitats; two visits (spring and autumn) for aquatic habitats.

20.7 References

Joint Committee for Conservation of British Insects (2002). A Code of Conduct for Collecting Insects and Other Invertebrates. *British Journal of Entomology and Natural History* 15(1), 1-6.

Natural England Research Report NERR005 (2007). Surveying terrestrial and freshwater invertebrates for conservation evaluation

National Pond Monitoring Network (2013). Pond Conservation. Available at <http://www.pondconservation.org.uk/about/Areas+of+Expertise/nationalpondmonitoringnetwork>. Accessed 1 October 2013.

Palmer, M., Drake, M., Stewart, N. (2013). A manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of grazing marsh ditch systems. Version 6. Buglife.

21 White-clawed crayfish

21.1 Introduction and guidelines

21.1.1 Where white-clawed crayfish may be present and significant effects could occur, then survey is likely to be required. The scope of survey required is defined in Peay (2004)⁶¹ and is set out below.

21.2 Qualifications and experience

21.2.1 The competency standards for white-clawed crayfish have been issued by the Chartered Institute for Ecology and Environmental Management⁶² and at least one surveyor should meet or exceed those minimum standards and have held and used a survey licence for white-clawed crayfish survey for at least one year. The licence holder will ensure that any assistants have had sufficient training in biosecurity, crayfish habitat appraisal and survey practice to carry out work properly and that they are supervised as appropriate.

21.3 Licensing requirements

21.3.1 The ecologist responsible for the crayfish surveys must hold a protected species survey licence from Natural England for surveys at locations with the potential for white-clawed crayfish. In addition, consent for trapping and manual searching will be required from the Environment Agency Fish Movement Team at Brampton.

21.4 Screening for survey and defining the survey area

21.4.1 The relevant scale for distribution data on white-clawed crayfish is the sub-catchment. Most data are held by the Environment Agency in the Area offices. Desk studies should search for records for white-clawed crayfish, signal crayfish and other non-native crayfish species. The best composite database was compiled for a Defra project and includes a classification of sub-catchments (Rogers and Watson, 2011)⁶³.

21.4.2 Surveys for white-clawed crayfish can be screened out when any of the following apply:

- best available information indicates there are no white-clawed crayfish remaining in the sub-catchment (although allowance should be made for the possibility of small relict populations in headwater streams if the species has been lost from the main river, if there have not been any recent surveys to check status);
- the watercourse within the land required for the construction of the Proposed Scheme and adjoining 100m buffer either side is dry during any period of the year;

⁶¹ Peay, S. (2004), A cost-led evaluation of survey methods and monitoring for white-clawed crayfish – lesson from the UK. Bulletin Français de la Pêche et de la Pisciculture 372-373, 335-352. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk and from free access journal BFPP, now Knowledge and Management of Aquatic Ecosystems).

⁶² CIEEM (2013), Technical Guidance Series. Competencies for Species Survey: White-clawed Crayfish. CIWEEM, Winchester. April 2013.

⁶³ Rogers, D. and Watson, E. (2011). Distribution database for crayfish in England and Wales. In: Rees M, Nightingale J, Holdich (eds) Species survival: securing white-clawed crayfish in a changing environment. Proceedings of a conference held on 16 and 17th November 2010 in Bristol, UK. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk)

- there are confirmed records of non-native crayfish within 1km of the land required for the construction of the Proposed Scheme as measured along a watercourse (note this can include records of non-native crayfish in angling ponds and fish farms where there is an inflow or outflow that offers a potential route for escape, i.e. from almost all sites with non-native crayfish) and other surveys indicate that there have been no white-clawed crayfish present within the past 5 years in the study area;
- there are records of non-native crayfish up to 5 km from the land required for construction of the Proposed Scheme, both upstream and downstream on the same watercourse and there are grounds to expect that there is a continuous population of non-native crayfish between them. Any tributary of a known invaded watercourse should be surveyed unless there are grounds to expect the tributary has been invaded as far as the land required for the construction of the Proposed Scheme and beyond it for a period of 5 years or more;
- water quality is poor (GQA D or less, or WFD equivalent) currently;
- water quality has been poor (GQA D or less, or WFD equivalent) within the past 10 years and there are no populations of white-clawed crayfish in connected tributaries within 2km;
- water chemistry is unsuitable due to mean pH6.5 or less and/or calcium less than 5mg^l⁻¹;
- extended Phase 1 habitat survey and/or River Corridor Survey shows that there is no potentially suitable habitat for white-clawed crayfish (e.g. channel is a highly modified open culvert with walls of mortared stone, intact brick or sheet piling, and a channel bed which also has no refuge potential for crayfish; note however that banks of unmortared stone revetment and damaged brick or concrete can be very favourable habitat, even if there is only small substrate such as sand or gravel);
- there has been an incident of crayfish plague within the past five years and there is no known or potential surviving relict population in the watercourse or connected tributaries within 2km; and/or
- specific surveys for crayfish have been carried out within the past three years in the watercourse at more than one site, at least one of which is within 2km of the land required for the construction of the Proposed Scheme, and no crayfish have been found.

21.4.3 The requirement to survey static water bodies such as farm ponds, quarries and other wholly enclosed still water sites should be considered, taking into account the location, permanence, water quality, degree of isolation from other water bodies, and desk study data for white-clawed and non-native crayfish species in the local area. Where such water bodies are considered potentially suitable to support white-clawed crayfish (including where sites may have been suitable to be utilised as an Ark site⁶⁴)

⁶⁴ One approach to conserving the white-clawed crayfish is to establish isolated new refuge sites, known as 'Ark sites', where new populations can be established, safe from non-native crayfish and crayfish plague.

and full survey is considered to be required the consultant undertaking surveys should submit a deviation request. For all static water bodies scoped out a rationale for this decision should be recorded making reference to the criteria listed above.

- 21.4.4 Records of white-clawed crayfish within the past ten years are of potential value, but even populations surveyed within the past two years are not necessarily present. By contrast, all validated records of signal crayfish or other non-native crayfish should be assumed to be still present and more extensive than they were when last recorded.
- 21.4.5 Watercourses or other water bodies that lie within the land required for the construction of the Proposed Scheme and surrounding 100m buffer either side of it and have not been screened out (as described above) should be surveyed if there is potential for significant effects. Where habitat suitable for survey is limited within this zone, but there is potentially favourable habitat beyond, the survey area should be extended out, up to a 250m buffer from the land required for the construction of the Proposed Scheme. Depending upon predicted impacts, there may be a need to survey more than one site on the watercourse. Selection of reaches to survey should use the approach in Peay (2003)⁶⁵.
- 21.4.6 If there are difficulties in obtaining permission to survey some areas, the location of the survey site can be shifted upstream or downstream in a reach; provided at least part of the site is within 500m of the land required for the construction of the Proposed Scheme and there are no differences in water quality, the habitat is similar and there are no barriers that might affect the distribution of crayfish (e.g. a weir might have been enough to stop an outbreak of crayfish plague infecting the population upstream).

21.5 Survey methods

- 21.5.1 The survey method(s) used are to be the most appropriate for the type of habitat present (see Peay, 2004). The potential habitat for crayfish and the scope for using different survey methods should ideally be assessed in advance, e.g. as part of extended Phase 1 habitat survey.
- 21.5.2 Survey sites will be a minimum of 100m (where there is abundant manually searchable habitat of good quality); generally up to 200m for most small watercourses; or up to a maximum of 400m where suitable areas for survey are localised or widely dispersed, e.g. in large watercourses.
- 21.5.3 A site-scale habitat appraisal for crayfish is to be carried out. This includes a description plus site photographs, but in addition, any water body surveyed within the land required for the construction of the Proposed Scheme should be mapped in the style of a River Corridor Survey with annotation of features relevant to crayfish habitat quality, e.g. pool under bridge with many cobble-sized stones and cracked mortar below water; alder trees with dense swags of submerged roots, sewage fungus downstream of pipe discharge along right bank, etc.
- 21.5.4 Particular attention is to be given to whether conditions will be suitable for manual survey, i.e. there must be ample loose, 'searchable' potential refuges in shallow water less than 0.5m deep in water that is clear, with little settled silt and with extensive

⁶⁵ Peay, S. (2003). *Monitoring the White-Clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers. Monitoring Series No. 1.* English Nature, Peterborough.

lengths (greater than 100m) that can be safely accessed from the bank and waded. Where these conditions are not met, some searching of debris and undercut banks by kicking and netting is to be undertaken where possible. If netting is not feasible, or does not yield crayfish, then trapping is required. If crayfish are identified by manual survey or netting, or by other signs of crayfish, e.g. exuvia, claws etc., it is not necessary to carry out trapping as well.

- 21.5.5 All crayfish surveys are to be carried out in dry weather and normal to low flow. If there is any rainfall overnight during a trapping survey the survey is invalid if rain falls within four hours of sunset.
- 21.5.6 Biosecurity measures are to be implemented throughout, with disinfection (iodine based disinfectant) of all equipment between water bodies (see Environment Agency guidance at www.environment-agency.co.uk/homeandleisure/recreation/fishing/38053.aspx). Where more than one site is surveyed on a watercourse, surveys will be carried out at upstream sites first. If a downstream site is surveyed first, there will be disinfection between sites. As far as practicable, traps are to be placed where they are least likely to be seen or tampered with, to minimize the risk of losses or subsequent use for illegal trapping. Signal crayfish should not be released back to the wild.
- 21.5.7 Where there is a relatively abundant population of crayfish and plenty of stony habitat to search, a standardised manual survey of five habitat patches of ten good refuges gives a high probability of detecting crayfish. However, where populations are at low abundance and conditions are sub-optimal for manual search, the chances of detecting a crayfish with this level of effort are less. Furthermore, as the method described in Peay (2003) includes searching cobbles and pebbles under large cobble and boulder as one refuge, the actual number of stones searched in a standardised survey may be 2-3 times higher. Where status of crayfish is unknown, survey effort is to be double the minimum, preferably with more patches searched rather than just more refuges in one area.
- 21.5.8 Trapping surveys are to target the areas with the highest potential for crayfish, avoiding any areas with fast flow or anoxic silt. Traps need not be wholly immersed, but trap apertures must be entirely below water level throughout the trapping session. Traps should be sited to avoid overlap of trapping zone. Traps will be left for one night only and will be lifted the next morning. Trap mesh size should ideally be less than 22mm.
- 21.5.9 One or more digital photographs are to be taken to confirm the species of crayfish recorded. Photographs should be taken such that the diagnostic features are clearly visible. If there is any doubt about identification, reference specimens should be taken and preserved. This may be necessary with juvenile crayfish especially with the less common non-native species, such as *Orconectes virilis* cf *O. limosus*. Preservation uses 90% ethanol solution, preferably with 10% formalin to fix. Alcohol will need to be changed/topped up, especially if large specimens are preserved.
- 21.5.10 Where signal crayfish are recorded during a survey then that survey session at the location should be completed in full. However, assuming that no white-clawed crayfish are found then no repeat survey sessions should be conducted at that site. If there are other sites to be surveyed in the same watercourse, they should still be surveyed if records or other information suggests that it is likely white-clawed crayfish

were present within the past five years. This is to help find any semi-isolated relict populations of white-clawed crayfish.

21.6 Survey programme and effort

- 21.6.1 All surveys should ideally be carried out in good conditions in the period July to September inclusive. Whilst intensive manual surveys on sites with high densities of crayfish may detect presence at most times of year, nil catches outside the main season of activity are invalid. All surveys conducted outside the July to September period should acknowledge that negative results are not suitable to confirm absence.
- 21.6.2 Manual surveys will use standardised manual survey, extended to double effort where conditions are suitable and crayfish are not detected in the first session. Where there is enough habitat to carry out a manual survey, but 'survey ability' is less than expected and there is potentially good habitat in the banks, a trapping session should be added.
- 21.6.3 At sites where trapping is carried out, a survey will use a minimum of 20 traps per site in favourable habitat. If crayfish are not detected, a second session should be carried out at least one week after first session (provided it is within the survey season).
- 21.6.4 Stages of work on site are as follows:
- walkover of the survey site for prior assessment of potential for crayfish habitat at site scale and safety check;
 - carry out manual survey if suitable habitat is available and suitable for survey. Complete five patch standardised survey, with supplement by netting if necessary;
 - if crayfish are not found, extend the manual survey extent and coverage to double session;
 - if crayfish are not found, or if conditions are not suitable for manual survey, set minimum 20 traps in best habitat;
 - if crayfish not found, repeat trapping session after one week or more; and then
 - if crayfish are not found, conclude that they are likely to be absent.

21.7 References

Rogers, D. and Watson, E. (2011). Distribution database for crayfish in England and Wales. In: Rees M, Nightingale J, Holdich (eds) Species survival: securing white-clawed crayfish in a changing environment. Proceedings of a conference held on 16 and 17th November 2010 in Bristol, UK. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk).

Peay, S. (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers. Monitoring Series No. 1. English Nature, Peterborough.

Peay, S. (2004). A cost-led evaluation of survey methods and monitoring for white-clawed crayfish – lessons from the UK. Bulletin Français de la Pêche et de la

Pisciculture 372-373, 335-352. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk and from free access journal BFPP, now Knowledge and Management of Aquatic Ecosystems).

The following website will also be useful for information on crayfish distribution etc.: <http://www.buglife.org.uk/conservation/currentprojects/Species+Action/UK+Crayfish+Website>

22 Fish

22.1 Introduction and guidelines

22.1.1 The requirements for fish survey are to be assessed following a review of existing data, and where possible an initial habitat assessment. Following the review of existing data, the consultants responsible for survey work will agree with the local Environment Agency team the most appropriate scope and method of survey on a location by location basis for assessing the potential for significant impacts on fish.

22.2 Qualifications and experience

22.2.1 Surveyors are to be appropriately experienced in fish habitat assessment and survey.

22.3 Licensing requirements

22.3.1 No licences are required for the initial habitat assessment.

22.3.2 Relevant consents from the Environment Agency are to be obtained prior to commencement of any further fish surveys such as electrofishing.

22.4 Screening for survey and defining the survey area

22.4.1 Requirements for fish surveys are likely to be strongly influenced by the availability and quality of fisheries data from the Environment Agency (EA). Where insufficient data exist to assess likely effects, surveys are more likely to be required for water bodies meeting one or more of the following criteria:

- water bodies designated under the EC Freshwater Fish Directive (2006/44/EC);
- water bodies designated as Special Areas of Conservation or Site of Special Scientific Interest (SSSIs) for fish species or their water habitat; and/or
- water bodies likely to host protected fish species/fish species of conservation concern.

22.4.2 Water bodies affected by the route should be categorised for fish habitat quality and the potential for utilisation by fish. Surveys may be necessary for moderate and good habitats that could be directly or indirectly affected by the proposals where no existing recent data are held by the Environment Agency. Further surveys are unlikely to be required for poor habitats.

22.4.3 Typical descriptors for good, moderate and poor quality habitats are as follows:

- good: For running waters the habitats include varying flow types to include riffles pools, runs, and glides. Substrate diversity is more complex and there is good cover to provide refuge for juvenile and adult fish (both in-stream/body and marginal vegetation). Substrate is present for spawning salmonids. No evidence of pollution or other degradation. No obvious barriers to migration (where applicable to species concerned);
- moderate: For running waters the habitats include a number of flow types throughout the survey reach. Limited substrate diversity. Sparse cover for

both juvenile and adult fish. Lower in-stream/body and marginal vegetation diversity. Limited substrate present for spawning salmonids. No evidence of pollution; other degradation (e.g. poaching) may be present. Potential barriers to upstream migration present (where applicable to species concerned); and

- poor: Habitats with minimal variation. Substrate diversity limited. No bankside/marginal cover for fish. In-stream and marginal vegetation (where present) typically limited to single dominating species. No substrate available for spawning salmonids. Water body may receive diffuse, land-based pollution (run-off) and exhibit a high degree of other degradation such as poaching. Barriers to upstream migration (debris/man-made dams) present (where applicable to species concerned).

22.4.4 The consultants undertaking survey work should recommend the survey area on a site by site basis depending on habitat quality, upstream and downstream characteristics and likely effects on fish. Where access and seasonal constraints dictate it may be necessary for fish habitat assessments to be undertaken in parallel with detailed survey work.

22.5 Survey method

22.5.1 As most affected water bodies requiring survey are likely to be small the primary method is likely to be electrofishing (utilising stop nets where necessary). This should be undertaken in accordance with British Standard BS EN 14011:2003, BS 6068-5.32:2003 'Water Quality: Sampling of fish with electricity'⁶⁶ and 'Guidelines for Electric Fishing Best Practice (Beaumont et al., 2002)⁶⁷ published by the Environment Agency. It is likely that a single pass of approximately 100m² will be sufficient.

22.5.2 If fish survey is necessary and conditions are not suitable for electrofishing then a seine-netting sweep is likely to be employed. Detailed survey methods used will depend on the watercourse characteristics and will be agreed with the local Environment Agency team.

22.6 Survey programme and effort

22.6.1 Survey programme and effort are to be confirmed following discussion with local Environment Agency teams.

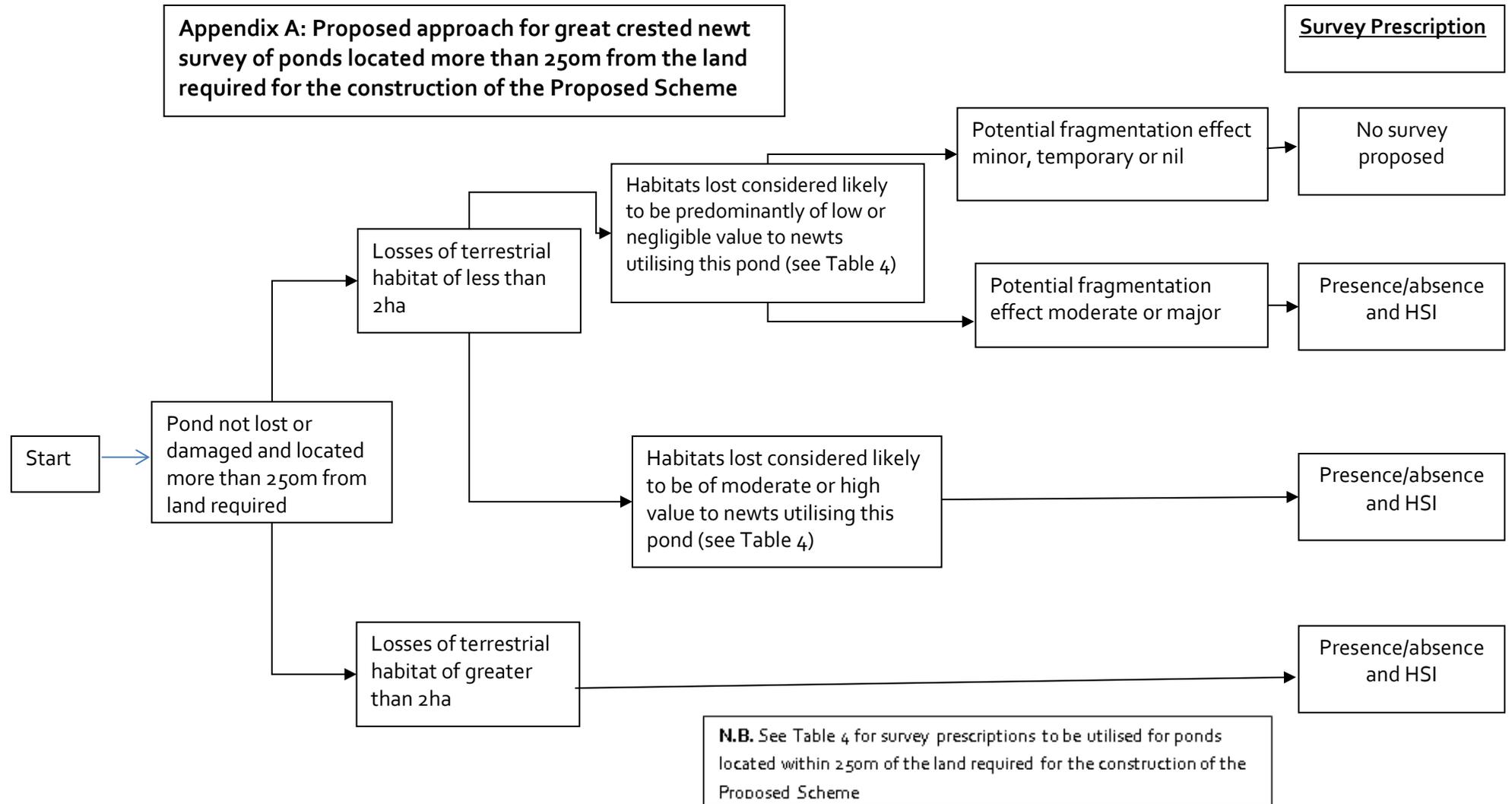
22.7 References

Beaumont, W.R.C., Taylor, A.A.L., Lee, M.J., Welton, J.S. (2002). Guidelines for Electric Fishing Best Practice. RandD Technical Report W2 – 054/TR. Environment Agency, Almondsbury.

⁶⁶ British Standard BS EN 14011:2003, BS 6068-5.32:2003 'Water Quality: Sampling of fish with electricity'.

⁶⁷ Beaumont, W.R.C., Taylor, A.A.L., Lee, M.J., Welton, J.S. (2002). *Guidelines for Electric Fishing Best Practice. RandD Technical Report W2 – 054/TR.* Environment Agency, Almondsbury.

Appendix A: Great crested newt survey decision flowchart



Appendix B: Use of non-standard survey methods to provide early warning of the presence of great crested newt

B.1 Introduction

- 1.1.1 Where it has not been possible to complete amphibian survey of a water body during the mid-March 2012 to mid-June 2012 survey window, efforts will be taken to provide early warning of potential presence of great crested newt through late season surveys.
- 1.1.2 Consultants undertaking surveys should submit their proposals to overseeing consultants for approval where non-standard survey methods can be employed to gain further information prior to the mid-March 2013 to mid-June 2013 survey window. It is unlikely that use of non-standard survey methods will be justifiable at all water bodies. Consultants undertaking surveys should consider the likely potential for significant impacts on any populations that are present and/or for significant mitigation requirements, based on the current assumed land required for the construction of the Proposed Scheme.

Survey method

- 1.1.3 For each pond identified as being suitable for late amphibian survey a single night time visit should be conducted during September 2012 to conduct survey utilising the following methods:
- netting for larvae – netting would utilise a 2-4mm long handled dip net and be conducted during day or night. A single perimeter walk would be conducted with at least 15 minutes of netting conducted per 50m of shoreline; and
 - torching – a single torchlight survey during September 2012.
- 1.1.4 Survey may be conducted on any nights where air temperature is 5°C or above at point of survey until the end of September 2012.
- 1.1.5 It is likely that at some water bodies, the use of one of the above methods may be unsuitable as a consequence of site specific constraints. In all such cases a record should be made of the rationale for excluding a particular method.
- 1.1.6 Late season survey will only be utilised to provide early warning of potential amphibian constraints, and to identify those areas where further mitigation effort may be required.
- 1.1.7 Where access is available, all water bodies where standard pond survey was not completed (or commenced) during 2012 will be subject to full presence/absence or population size class assessment (as appropriate) during the period mid-March to mid-June 2013.

Appendix C: Methodology for car based bat transect surveys

C.1 Screening for survey and defining the survey area

- 1.1.1 Where there are significant restrictions on access, consultants undertaking survey should consider the use of car based transects to provide some baseline information on bat assemblages within these areas. As the methodology will involve driving at slow speed the use of the methodology must be limited to local roads (i.e. excluding motorways, dual carriageways and A roads), and in all cases it will be necessary to submit a detailed risk assessment for the approval of the HS2 Health and Safety Department. It will be the responsibility of the consultant undertaking survey works to notify the appropriate authorities (e.g. local Highways Authority and local police⁶⁸) prior to commencing the survey.

Method

- 1.1.2 All surveys will require a minimum of two surveyors. One of which will be exclusively driving and have no involvement in the operating of bat survey equipment.
- 1.1.3 Car transect routes should be planned using aerial photographs and should focus on local roads passing through the land required for the construction of the Proposed Scheme and a 100m buffer either side. Where appropriate features of particular bat interest within 500m of the land required for the construction of the Proposed Scheme were identified during scoping these should also be included. Where possible the transect route should incorporate stopping points (three minutes per stop) in close proximity to the land required and at other features of potential bat interest. A day time drive through of the proposed survey route should always be conducted prior to the first survey visit in order to identify suitable safe stopping points. The risk assessment will be reviewed and updated after the day time drive through.
- 1.1.4 All car transect surveys should commence at 45 minutes after sunset and continue for at least two hours. The length of each car transect should be planned to ensure that at least two passes of the entire transect route can be completed during each survey visit. In order to maximise recording within close proximity to the land required, the transect route may be not continuous.
- 1.1.5 Car based surveys should be conducted using a GPS enabled EM3 or SM2BAT+ detector recording in full spectrum mode. The microphone should be held within a car mount or clamp at window level at a 45 degree angle on the passenger's side or, where the microphone can be attached (as for the SM2BAT+) to a cable, it may be securely taped to the vehicle at window level.
- 1.1.6 Sections of the transect route subject to survey should be driven at a steady speed of 15mph (24km/h) utilising a vehicle mounted with flashing orange double beacon, reflective chevrons and a reflective sign stating 'Surveying'.

⁶⁸ Where appropriate the police should be contacted via non-emergency number to log details of the route and gain an incident number.

Summary of survey programme and effort

- 1.1.7 Each car based transect route should be subject to a total of two dusk surveys per month during September and October 2012 and April, May and June 2013. The starting point and direction of the transect route should be varied between survey visits.
- 1.1.8 Where habitat quality is high, or the presence of Annex II species is suspected, consideration should be given to the requirement to undertake additional visits each month.

Appendix D: Criteria for potential otter holt locations and determining usage

D.1 Description of criteria

- 1.1.1 The following criteria devised by Paul Chanin (unpublished) should be utilised to identify potential holt locations and determine when they are considered likely to be potentially active.
- 1.1.2 Features meeting the following criteria should be identified during surveys as 'potential holts':
- tunnel with internal diameter of at least 250mm and extending 1m into the bank or where the end is out of sight; or
 - any cavity of similar dimensions: drain pipe; log pile; rock/boulder pile; under structures such as bridges or buildings etc.
- 1.1.3 Where any of the following signs are found at features meeting the potential holt criteria they should be considered potentially active:
- presence of otter spraints or footprints beside or inside tunnel;
 - evidence of an animal's body rubbing against wall or roots;
 - presence of hairs ca 25mm long and mid brown in colour; or
 - presence of scratch marks.

Appendix E: Criteria for assessing potential otter breeding sites

E.1 Description of criteria

1.1.1 The following criteria devised by Paul Chanin (unpublished) should be used in assessing the potential for habitats in the vicinity of the route to support otter breeding sites.

Table E1: Cover

High	Dense impenetrable cover over more than 50% of the area, immediately adjacent to the river bank; or Presence of features with potential to conceal a breeding den such as fallen hollow trees, very large trees with spreading roots on river bank, small dense thickets of impenetrable vegetation, piles of boulders or other debris with space for a den beneath which are immediately adjacent to a waterway or connect to it by concealing routes.
Medium	Dense impenetrable cover over 20-50% of the area, immediately adjacent to the river bank or dense impenetrable cover over less than 50% of the area within 50m of the river with concealing routes between the bank and the area of dense cover; or Presence of features with potential to conceal a breeding den such as fallen hollow trees, small dense thickets of impenetrable vegetation, piles of boulders or other debris which are not adjacent to a waterway or connected to it by concealing routes.
Low	Dense impenetrable cover over less than 20% of the area. No features with potential to conceal a breeding den.
None	No dense impenetrable cover

Table E2: Food supply

High	Within 500m of high quality food supply (pond/lake of at least 1ha or river with depth greater than 0.5m and width greater than 5m).
Moderate	High quality food supply within 2km; or Within 500m of moderate food supply: (pond/lake of at least 0.5ha or productive river with depth greater than 0.3m and width greater than 3m).
Low	High quality food supply > 2km away; or Moderate quality food supply > 500m away.



HS2 London-West Midlands

Ecology

**Technical note – Ecological
assessment method**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 Purpose of the technical note

1.1.1 This technical note sets out the methodology used in assessing the ecological effects of the Proposed Scheme (the Ecological Impact Assessment) within the Environmental Statement (ES) for HS2 London-West Midlands (LWM).

1.1.2 The technical note expands upon the information previously provided in the ecology sections of the HS2 LWM EIA scope and methodology report (SMR)¹ and SMR addendum² which are included as Volume 5 Appendix CT-001-000/1 and CT-001-000/2.

1.2 Purpose of Ecological Impact Assessment

1.2.1 As part of the Environmental Impact Assessment process, the purpose of the Ecological Impact Assessment (EclA) methodology is 'to provide decision-makers with clear and concise information about the likely significant ecological effects associated with a project'.

1.2.2 It is also important that all other interested parties, including members of the public, are able to understand:

- the findings of the assessment;
- the process by which the assessment was undertaken; and
- the actions required to deliver the mitigation and compensation designed to ensure an appropriate biodiversity outcome.

1.2.3 This methodology has therefore been designed with the aim of providing a clear and transparent assessment of the ecological effects of the Proposed Scheme to all readers.

1.3 Other relevant guidance

1.3.1 The impact assessment methodology incorporates the key principles of the standard method for ecology as set out by the Institute of Ecology and Environmental Management (IEEM) in their Guidelines for Ecological Impact Assessment (2006)³ – hereafter referred to as the 'IEEM guidelines'.

1.4 Structure of the report

1.4.1 This technical note provides information on evaluating ecological resources and receptors in Section 2; on predicting impacts of the Proposed Scheme in Section 3 and on defining and assessing the significance of the resulting ecological effects in Section 4. Section 5 introduces the approach to recording mitigation, compensation and enhancement within the assessment and Section 6 provides information on the consideration of residual effects.

¹ Arup/URS (2012), *HS2 London to West Midlands scope and methodology report*.

² Arup/URS (2013), *HS2 London to West Midlands: scope and methodology report addendum*.

³ Institute of Ecology and Environmental Management (2006), *Guidelines for Ecological Impact Assessment in the United Kingdom*. IEEM, Winchester.

1.4.2 This note does not address the earlier stages of EclA, notably definition of the scope of the assessment, as this is covered in other documents such as the SMR and SMR Addendum.

2 Determining value of ecological resources

2.1 Introduction

2.1.1 This section provides guidance on how to assign value to ecological resources. As acknowledged in the IEEM guidelines, defining the value of ecological resources does not follow a simple mechanistic approach but rather derives from professional judgement based on available guidance and information, along with supporting expert opinion. Nonetheless, it is recognised that on this project (given its scale and the number of survey teams involved), guidance is required in order to ensure a consistency of approach.

2.1.2 Ecologists undertaking the assessment should use their knowledge of the local context of the sites, species and habitats they are evaluating in determining the value of ecological resources. Internal discussion between ecological teams about the evaluation of receptors will be encouraged to maximise consistency in evaluation.

2.1.3 In determining the value of ecological resources, the IEEM approach should be adopted, whereby the social and economic values of ecological resources are considered separately from the 'ecological' value, and the significance of any social and economic effects is (where applicable) defined and reported within the Community and Socio-economics sections of the ES.

2.2 Evaluation: scale and reporting

2.2.1 A common difficulty in undertaking EclA for large-scale or linear projects is the need to define a scale at which the baseline evaluation is undertaken or reported, i.e. what constitutes an individual 'receptor'. This is particularly the case where there is a wealth of baseline data which relate to different or overlapping sampling areas.

2.2.2 For a small development site, it is easy to define and present the ecological resources considered within the EclA. Essentially, the development site is evaluated according to:

- any designations;
- other habitats within the site; and
- other species within the site.

2.2.3 Effects are then identified for each of the features (habitats and species) present. However, the geographic boundaries of the site which forms the basis of the assessment do not have any ecological validity – they are defined by the development proposal.

2.2.4 The conclusions of the HS2 EclA will be reported in the ES within 26 separate reports (Volume 2 of the ES), which sub-divide the route and report effects based on Community Forum Area (CFA) boundaries. The cumulative effects on ecological receptors at the route-wide level (i.e. those effects above and beyond those reported within the CFA reports) will be considered in Volume 3 of the ES.

- 2.2.5 Within each CFA, there will be many individual features of ecological significance identified. These will include:
- designated sites;
 - areas of semi-natural habitat; and
 - areas of habitat or other features supporting notable species.
- 2.2.6 The designated sites will be evaluated based on the level of nature conservation value assigned through designation. Impacts and any resulting effects on designated sites will be assessed taking into consideration the combination of habitats and/or species which are identified as reasons for designation.
- 2.2.7 Whilst the CFA boundaries will be used to sub-divide the ES, the evaluation process, including decisions on an appropriate scale to provide evaluation of receptors, will not be defined by their extent.
- 2.2.8 For the habitats, species and other features of interest professional judgement will be used to identify the most ecologically meaningful scale to evaluate the resources/receptors present.
- 2.2.9 In the vast majority of situations evaluation of resources/receptors should be conducted according to one of the two approaches listed below:
- a. the areas of habitat and other features could be evaluated individually (i.e. a discrete block of a particular habitat type, or the population of great crested newt supported by a single pond); or
 - b. grouping blocks of similar habitat, or areas supporting protected species on the basis of sound ecological reasoning (e.g. evaluating blocks of habitat of similar nature that occur in close proximity either side of a CFA boundary as a single receptor; or evaluating the great crested newt population of a series of ponds together when it is clear that these are likely to function as a metapopulation).
- 2.2.10 Evaluation at the CFA level may be appropriate for some widespread resources/receptors. However, this should be the exception and should not be the default approach.

2.3 General principles of evaluation

- 2.3.1 Evaluation of all potential ecological receptors should be conducted against the following frames of geographic reference:
- international;
 - national;
 - regional;
 - county/metropolitan;
 - district/borough;
 - local/parish; and

- negligible.

2.3.2 The above represent a minor variation to those identified within the IEEM guidelines. The frames of reference 'within zone of influence' and 'site' have been omitted for the purposes of this assessment due to potential confusion associated with the use of these terms in relation to a linear scheme on a large scale.

2.3.3 In line with the principles laid out within the IEEM guidelines it is not considered possible to rigidly assign habitats or species to a specific level of value, as the value of the receptor may vary depending on where on the route it occurs. Evaluation should be based on available information and guidance, including published criteria where available and professional judgement. Appendix A seeks to provide an outline framework for the evaluation of receptors.

2.3.4 In line with the IEEM guidelines for valuing resources, a clear rationale for the valuation reached should be presented in all cases.

2.4 Designated sites

2.4.1 For formally designated sites the valuation afforded should be based on the value prescribed by the designating body. Where a feature has value at more than one level, its overriding value is that of the highest level. Where sites overlap and the features for which the site has been designated at each level differ these should be valued and assessed accordingly.

2.4.2 Potential Sites of Special Scientific Interest (pSSSI), candidate Special Areas for Conservation (cSAC)⁴, proposed Special Areas of Conservation (pSAC)⁵, potential Special Protection Areas (pSPAs) and proposed Ramsar sites should be considered to be of the same value as corresponding sites that have already been designated.

2.4.3 Habitats and species occurring within sites which have not been formally designated (e.g. potential local wildlife sites) should as a general rule be evaluated as part of the habitats and species assessments. Where surveys by the designating body have identified that a site meets the criteria for formal designation and it is in the process of being formally designated, then such sites can be assumed to be of the value prescribed by the designating body.

2.4.4 All habitats and species occurring within the boundaries of the designated site (including both features for which the site is designated and those that are not a reason for designation) should also be considered under the evaluation of habitats and species (as described below) to ensure that the subsequent assessment provides a true indication of potential effect on conservation status of these habitats/species.

2.4.5 It is not the role of the EclA process to validate site designations but if a designated site is considered no longer to meet the criteria for designation, then the issue should be discussed with the relevant designating authority. Unless agreement is reached that the site does not match its current designation, then the current designated value should be used in the assessment.

⁴ Sites are submitted to the European Commission as candidate Special Areas of Conservation (cSACs). Only following approval by the European Commission are they designated by the Member State as Special Areas of Conservation.

⁵ Prior to its submission to the European Commission as a cSAC, a proposed SAC (pSAC) is subject to wide consultation.

2.5 Habitats

- 2.5.1 Habitats should be evaluated using published criteria for the recognition of sites supporting habitats of value at particular geographic scales. This will include criteria developed to identify habitats of international⁶ or national⁷ value. Similarly, some County Wildlife Trusts and/or Local Authorities have prepared criteria for the selection of local sites on the basis of their habitats.
- 2.5.2 Published criteria often make reference to UK priority habitats. The UK Biodiversity Action Plan⁸ defines habitats and species that are conservation priorities because of their rarity and rate of decline. A review of the list of priority habitats in 2007 led to the identification of 65 habitats that meet the criteria at UK level. While the UK BAP has now been superseded, the priority habitat definitions remain relevant as they also underpin the Habitats of Principal Importance under Section 41, (S41) of the Natural Environment and Rural Communities Act (2006)⁹ which mirror the categories originally defined for the UK BAP. Fifty-six habitats of principal importance are included on the S41 list. These are all the habitats in England that have been identified as requiring action in the UK Biodiversity Action Plan (UK BAP). They range from habitats such as upland hay meadows to lowland mixed deciduous woodland and from freshwater habitats such as ponds to marine habitats such as subtidal sands and gravels.
- 2.5.3 The published selection criteria typically take account of the following:
- rare or uncommon habitats;
 - typical or characteristic habitats;
 - species-rich habitats;
 - habitats that develop slowly and are thus difficult to replace; and
 - local context.
- 2.5.4 Where criteria for recognising habitat receptors of value at a county or district level do not exist, experience and professional judgement should be used for their evaluation. Justification for the value assigned to any habitat or site should be clearly and concisely set out, focusing on the factors listed in paragraph 2.5.3.
- 2.5.5 The evaluation of habitats should be made independent of any related value that the habitat has as a consequence of the protected species which it supports.
- 2.5.6 Assessment should include consideration not only of similar habitats but also the potential for a greater overall value of a wider habitat mosaic, as a consequence of what might be regarded as a synergistic assessment. Thus, an area that is of district value for several different habitats might be considered, overall, to be of county value as a consequence of the combination of habitats. Such judgements should be documented clearly.

⁶ McLeod, CR, Yeo, M, Brown, AE, Burn, AJ, Hopkins, JJ, & Way, SF (eds.) (2005), *The Habitats Directive: selection of Special Areas of Conservation in the UK*. 2nd edn. Joint Nature Conservation Committee, Peterborough. www.jncc.gov.uk/SACselection.

⁷ JNCC, Guidelines for selection of biological SSSIs. <http://jncc.defra.gov.uk/page-2303> Accessed 06/08/13.

⁸ JNCC (1994), *UK Biodiversity Action Plan*.

⁹ *Natural Environment and Rural Communities Act* (2006), (Chapter 26). HMSO.

2.5.7 Habitats within designated sites should also be considered within the evaluation of the wider habitat resource. Cross referencing to the designated sites section should be used as appropriate to prevent the need to repeat baseline descriptions.

2.6 Species

2.6.1 As with habitats, there will usually be published criteria for assessment of sites supporting species and assemblages of species that are considered as qualifying features for designated sites of nature conservation value at different geographic scales (e.g. The Birds Directive: selection guidelines for Special Protection Areas (JNCC, 1999)¹⁰.

2.6.2 Published criteria often make reference to UK priority species. The UK Biodiversity Action Plan (1994) defines habitats and species that are conservation priorities because of their rarity and rate of decline. A review of the list of priority species in 2007 led to the identification of 1,150 species that meet the criteria at UK level. Species were assessed according to four criteria:

- threatened internationally;
- international responsibility and a 25% decline in the UK;
- more than 50% decline in the UK; or
- other important factors, where quantitative data on decline were lacking but there is other evidence of extreme threat.

2.6.3 While the UK BAP has now been superseded, the priority species definitions remain relevant as they also underpin the Species of Principal Importance under Section 41 of the Natural Environment and Rural Communities Act (2006), which mirror the categories originally defined for the UK BAP. There are 943 species of principal importance included on the S41 list. These are the species found in England which have been identified as requiring action under the UK BAP. In addition, the Hen Harrier has also been included on the S41 list because without continued conservation action it is unlikely that the Hen Harrier population will increase from its current very low levels in England.

2.6.4 Other criteria typically take account of the following:

- rare or uncommon species;
- species suffering a marked decline;
- endemic species;
- typical or characteristic species;
- species for which the area holds a significant proportion (e.g. European species for which England holds a significant proportion); and
- large or notable populations of species.

¹⁰ Joint Nature Conservation Committee (1999), The Birds Directive: Selection Guidelines for Special Protection Areas, 6 pages, A5 leaflet, ISBN 1 86107 477 8

- 2.6.5 Protected and/or notable species should be evaluated wherever possible at the population level. Assessment teams should liaise to ensure that similar assumptions are made in relation to the scale of evaluation for highly mobile species such as bats and birds.
- 2.6.6 Protected species populations occurring within designated sites should also be evaluated within this section at an appropriate scale (i.e. the boundaries of the designated site should not be a constraint to the way in which the resource/receptor is evaluated).
- 2.6.7 Species populations found at the edge of or beyond their natural range may be worthy of valuing highly or not. A case-by-case judgement is likely to be appropriate in this situation and should be briefly explained in the baseline evaluation.
- 2.6.8 All the criteria listed previously should be employed in the context of professional understanding. Some species that have suffered a decline in numbers may still be common or may be expected to recover and so may not be valued as highly as other species in this category.
- 2.6.9 The IEEM Guidance distinguishes between the evaluation of species of biodiversity value and those that are legally protected. In many cases, species fall in to both categories, thus, for example, great crested newt (*Triturus cristatus*) is protected under the Habitats Directive and the Wildlife and Countryside Act because it is considered to be of biodiversity value. The distinction between biodiversity value and legal protection allows one to draw the necessary distinction between the importance of a single pond with great crested newt and a series of ponds with a metapopulation that would qualify for designation as a SSSI.

2.7 Baseline trends

- 2.7.1 The impact assessment considers the baseline conditions that would exist with and without the Proposed Scheme. It is therefore important to predict baseline conditions for the construction period (for construction impacts) and for the date of opening and beyond (for operational impacts). Key dates are provided in Table 1.

Table 1: Assessment years

Phase	Year(s)
Base year	2012/2013
Construction	2017-2026
Operation Year 1	2026

Source: HS2 EIA Scope and Methodology Report

- 2.7.2 Due to the complexity of the scheme and the potential for changes in construction phasing when detailed design is progressed, the ecological assessment will be based on the assumption that construction activity across the route will commence in 2017.
- 2.7.3 In predicting future baseline conditions at the start of construction and operation, consideration should be given to environmental trends (range expansion, population declines etc.) as well as influences such as policy that will influence land use, and consented or highly likely development proposals.
- 2.7.4 Based on current best evidence, it is considered unlikely that ecological features will be significantly different by either 2017 (construction baseline) or 2026 (operational

baseline). The EclA therefore concentrates on reporting the likely effects of climate change at the route-wide level within Volume 3.

2.8 Precautionary valuation

- 2.8.1 Due to access restrictions, access delays and seasonal restrictions on survey, there will be areas of the route where the desired survey scope will not be complete at the point of ES submission.
- 2.8.2 In order to ensure that all likely significant effects of the Proposed Scheme have been identified, where baseline information is incomplete a precautionary approach of assuming a 'reasonable worst-case' valuation should be adopted. This approach should be utilised to assign precautionary valuations to both known receptors, and potential receptors based on the best available information.
- 2.8.3 Where reasonable worst-case valuations are necessary they should be made based on the information available. This should include consideration of any available field or desk study data (including aerial photography), a comparison with similar habitat areas occurring in the wider local area, and a qualitative consideration against any factors that indicate suitability for the particular habitat or species in question. The degree of precaution built into the assessment should be linked to the level of confidence in the existing data upon which the assessment is based. Further guidance is provided in Appendix B.

3 Impacts

3.1 Construction impacts

3.1.1 Site preparation and construction activities will include:

- demolition of buildings;
- clearance of vegetation;
- site levelling;
- earthworks including: excavation, topsoil/subsoil stripping;
- laying of substrates and construction materials;
- introduction of railway infrastructure, including catenary system;
- storage of machinery and materials;
- security and site lighting;
- installation of site fencing (temporary and permanent);
- construction and installation of noise fence barriers;
- planting of landscaping areas;
- construction of roadways, underpasses and bridges where re-alignment of existing roads are required;
- construction of paths, underpasses and bridges where re-alignment of public rights of way (footpaths and bridleways) are required;
- culverting of watercourses under the railway line;
- construction of ditches, drains and watercourses where new or realigned drainage is required; and
- transport of materials and workers to and from site.

3.1.2 The construction area will include land required for mitigation, notably noise barriers and landscaping areas. It will also include land required for road and utility re-alignment.

3.1.3 Impacts arising from the permanent presence of the railway line, associated structures (including catenary), and landscaping etc. are considered to be permanent construction effects and should be reported in the construction section.

3.1.4 Potential impacts resulting from site preparation, construction activities and the permanent presence of the route are likely to include:

- loss of habitat to land required for the construction and operation of the Proposed Scheme;
- severance of ecological corridors and networks, resulting in a reduction in habitat connectivity;

- fragmentation of habitats and sites;
- barrier effects (to movement of fauna);
- direct mortality from collision with overhead structures, including catenary system;
- noise and visual disturbance;
- vibration disturbance;
- disturbance from lighting;
- dust deposition;
- air pollution;
- water quality changes from surface water run-off carrying sediments and pollutants;
- hydrological effects, from changes in water levels and/or flows;
- changes in management, often resulting in habitat degradation;
- changes in public access;
- introduction of 'alien' geology where use of imported substrates results in mixed geologies; and
- introduction and spread of non-native invasive species.

3.1.5 It should be noted that changes in public access may affect sites some distance from the Proposed Scheme. If, for example, an area of much-used public open-space is lost to the community, either temporarily or permanently, other sites may see a consequent increase in use. Thus, the usual potential effects of increased recreational use (disturbance to sensitive species, eutrophication, erosion, increased risk of fire etc.) may occur well away from the Proposed Scheme where alternative sites are in short supply.

3.1.6 It will be assumed for the purposes of the EclA that all existing habitats within the extent of the Proposed Scheme (i.e. both areas of land required for the construction and operation of the Proposed Scheme) would be permanently lost. This represent a precautionary assessment and it is likely that during detailed design it will be possible to identify some features that can be retained.

3.2 Operational impacts

3.2.1 Operational activities will include:

- passage of trains; and
- maintenance activities.

3.2.2 Operational impacts derive only from these activities and do not include the permanent presence of the railway line, associated structures (including catenary, landscaping etc.).

3.2.3 Potential impacts resulting from operational activities are likely to include:

- barrier effects (to movement of fauna);
- direct mortality or injury from collision with trains;
- mortality or injury from potential turbulence effects;
- noise and visual disturbance;
- vibration disturbance;
- water quality changes from surface water run-off carrying sediments and pollutants (both from routine activity and accidental spillages); and
- introduction and spread of non-native invasive species.

3.3 Characterising impacts

3.3.1 Having identified the impacts that are likely to arise from construction and/or operational activities at any one location, it is necessary to consider the characteristics of impacts in terms of:

- positive or negative;
- magnitude;
- spatial extent;
- duration;
- timing (both in terms of time of day and time of year); and
- frequency and periodicity.

3.3.2 These characteristics are important in determining likely ecological effects.

3.3.3 Magnitude refers to the 'size' or 'amount' of the impact and should be reported on a quantitative basis wherever possible. The extent of an impact is the area over which the impact occurs and this again should be reported on a quantitative basis.

3.3.4 The duration of impact should be considered in relation to ecological characteristics (for example species lifecycles) as opposed to human timeframes (IEEM guidelines). It should be noted that the duration of the impact and the resulting effect on receptor may differ. For example if disturbance during construction results in several years of reduced juvenile recruitment for a species then the effect on the conservation status of the species concerned may continue to be significant for generations.

3.3.5 When describing the reversibility of impacts, the terms 'permanent' (i.e. irreversible) and 'temporary' (i.e. reversible) should be used when characterising an impact.

3.3.6 Within the characterisation of impact an indication should be provided of the likelihood that a change/activity will occur as predicted. Only a qualitative description should be provided, as industry experience of adopting the four-point scale provided within the IEEM guidelines has found this scale difficult to apply objectively.

3.3.7 In line with the overall Environmental Impact Assessment of the Proposed Scheme, the EclA will make a clear distinction between the terms 'impact' and 'effect', using the definitions below:

- impact = activity associated with the Proposed Scheme resulting in changes acting on an ecological receptor; and
- effect = outcome resulting from an impact acting upon a receptor.

4 Assessment of effects

4.1 Definition of significance

- 4.1.1 Having defined and assessed both the baseline ecological resources and the predicted impacts, it is necessary to consider how the predicted impacts could affect the valued ecological resources and thus to identify likely significant ecological effects.
- 4.1.2 Following the IEEM guidance, a significant ecological effect is defined as 'an effect (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area'.
- 4.1.3 Impacts on designated sites will be considered in relation to the effect on the integrity of the site involved. Effects on species and habitats will be considered in relation to the concept of 'conservation status'.

4.2 Assessment of whether ecological effects are significant

- 4.2.1 In line with the approach laid out in the IEEM guidelines, the value of resources/receptors will be used to identify the geographic scale at which the effect is significant.
- 4.2.2 Effects of the Proposed Scheme will be assessed following the incorporation of avoidance/mitigation measures that are included within the design. This will include all relevant measures even if their primary purpose was not to reduce or avoid ecological impacts. For example this may include the following:
- changes to the route (i.e. horizontal alignment) of the scheme;
 - changes to the vertical alignment (e.g. depth of cuttings);
 - use of tunnels;
 - design of standard bridges, overpasses etc. (excludes green bridges¹¹ or the greening of structures already proposed);
 - use of specific construction methodology to minimise the land required (e.g. retaining walls);
 - underpasses/conduits where the primary purpose is not for ecological benefit;
 - fencing where the primary purpose is not ecological; and
 - implementation of the Code of Construction Practice (CoCP).
- 4.2.3 Effects should be reported prior to any additional mitigation, compensation or enhancement proposed, which will be introduced later in the assessment process.
- 4.2.4 Key to predicting significant ecological effects is understanding what might affect the integrity of a defined site and/or the conservation status of the habitats or species supported by the defined site or area.

¹¹ Green bridge is a structure with vegetation, providing habitat connectivity across the route of the Proposed Scheme.

- 4.2.5 IEEM Guidance recommends that the process of identifying significant ecological effects should make explicit reference to aspects of ecological structure and function on which the feature depends.
- 4.2.6 The integrity of a site is defined as 'the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified'¹². For all designated sites the assessment of the effect on site integrity should only consider the features for which the site is designated.
- 4.2.7 Once impacts that could affect a site have been identified, they can be evaluated against the environmental factors necessary to maintain the integrity of the site, with consideration being given to the timing, duration, reversibility, extent and magnitude of any effect. Professional judgement will be used, as appropriate, to make the final judgement as to whether there will be a significant effect.
- 4.2.8 For designated sites of international and national importance, assessment of the potential effects on integrity should make explicit reference to any published conservation objectives.
- 4.2.9 Similarly, for some species and habitats (notably those with Biodiversity Action Plans) there may be objectives for the conservation status of the species/habitat.
- 4.2.10 Where impacts are anticipated to result in an adverse effect on site integrity, then this should be considered significant at the same geographical scale at which the site is valued. However, when considering adverse effects on conservation status of habitat and species, where an effect is not found to be significant at the level at which the resource/receptor has been valued, it may in some cases be significant at a lower level.
- 4.2.11 A 'worst case' rule is to be applied to assessment of the future baseline, in order to take account of uncertainty: significance of effect outcomes arising through the future baseline will only be reported where effects worsen over those reported against the current baseline. As a result of this rule, mitigation and compensation will be provided in line with a 'worst case' assessment.

4.3 Cut-offs for reporting purposes

- 4.3.1 Individual effects at the local/parish level are as a general rule not to be reported in Volume 2 CFA reports as they are not considered to represent material considerations in the decision-making process for the Proposed Scheme. Exceptions may be made where it is considered necessary to demonstrate that particular issues have been considered, such as where an adverse effect occurs at a lower geographic scale than that at which the receptor was valued.
- 4.3.2 A register of local/parish level effects will be produced and will form an appendix to the ES (Volume 5 Appendix EC-005-001 to EC-005-004). Potential cumulative and in combination effects of multiple local/parish level effects will be considered in the route-wide assessment (Volume 3 of the ES).

¹² ODPM Circular 06/2005; Biodiversity and geological conservation – Statutory obligations and their impact within the planning system.

4.4 Cumulative effects¹³

4.4.1 Cumulative effects include:

- the combined ecological effect on a single receptor of a number of individual environmental impacts (e.g. the loss of habitat to land required for construction and operation of the Proposed Scheme, combined with noise and airborne dust) arising from the Proposed Scheme;
- the cumulative effects of localised ecological impacts along the length of the Proposed Scheme; and
- interaction between ecological effects arising from the Proposed Scheme and those from other relevant projects and plans which take place during the construction or operational phases.

4.4.2 The cumulative effects resulting from the accumulation of effects summed in a regional context or over the whole route, resulting in an effect or effects of greater significance than the sum of the individual effects, will be reported in the route-wide report (Volume 3 of the ES).

4.4.3 The wider effects of climate change on the likely effects as a consequence of the Proposed Scheme, and the effects of the scheme on the ability of habitats and species to respond to future pressures of climate change, will be reported primarily as part of the route-wide ecology assessment in Volume 3.

4.4.4 Studies concluded that the effects of climate change, when considered in combination with predicted effects arising from construction and operation of the Proposed Scheme, may exacerbate the ecological effects of the Proposed Scheme but are unlikely to result in any effects of greater significance. Nonetheless, consideration will be given to the situations in which ecological effects arising from future climate change may exacerbate the effects of the Proposed Scheme (see Table 6 within the SMR Addendum text relating to climate change) and any consequent changes in levels of significance will be reported within the CFA reports. In particular, if the in-combination analysis suggests that existing mitigation measures need to be enhanced or additional mitigation is required, this will be clearly identified. For the purposes of this analysis, '2020' climate predictions will be used for construction effects and '2050' for operational effects. In addition, any regional or local policies and guidance on climate change impacts, risks and adaptation will be considered.

¹³ A future development is considered to be part of the future baseline if it changes the local environment (or creates additional receptors) prior to 2016 or 2027 (for construction and operational future baselines, respectively); it is considered to contribute cumulative effects if its construction or operation occur contemporaneously with HS2 and increase the effects of HS2 on receptors.

5 Mitigation, compensation and enhancement

5.1 Approach to mitigation, compensation and enhancement

- 5.1.1 Following the assessment of effects the Volume 2 CFA ecology reports will present details of the further mitigation, compensation and enhancement measures (i.e. those in addition to the fundamental engineering design) that are proposed to address the anticipated effects. In describing such measures terminology should explicitly distinguish between mitigation, compensation and enhancement as defined within the IEM guidelines.
- 5.1.2 For each significant adverse ecological effect, appropriate mitigation or compensation will be identified where feasible. This mitigation or compensation proposed will be informed by professional judgement, experience, and an understanding of the factors that contribute to the integrity of a site and to the conservation status of a species or habitat.
- 5.1.3 Overall, in line with Government policy, the project is seeking to achieve no net loss in biodiversity at the route-wide level.
- 5.1.4 In defining and making recommendations for appropriate measures to address significant effects their deliverability should be considered, along with certainty about their likely success. Measures which are unlikely to be successful (probability estimated at below 50%) should not be included. Rather, certain/near-certain (probability estimated at 95% chance or higher) or probable (probability estimated above 50% but below 95%) measures should be recommended. For measures for which the success is regarded as 'probable', recommendations for monitoring/corrective action are likely to be appropriate.
- 5.1.5 Recommendations about timing of mitigation/compensation/enhancement measures should be made where these are relevant to the likely effectiveness of the proposed measures to address predicted adverse effects.
- 5.1.6 Where there remain significant ecological effects that it is not possible to reduce below the level of significance by mitigation, compensation or enhancement will be provided.
- 5.1.7 Proposals for enhancement and measures designed as compensation for residual effects are sometimes confused. They are distinct, in that appropriate compensation measures should address specific residual impacts and should be designed to provide, as far as possible, direct replacement of any habitats lost. In contrast, enhancement measures could be entirely unrelated to any adverse effects of the Proposed Scheme.
- 5.1.8 Planting provided for the primary purpose of landscaping should also be reported as compensation where its provision is also of ecological benefit.

5.2 Location of compensation/enhancement provision

- 5.2.1 The provision of mitigation, compensation and enhancement required to address the effects of the scheme will primarily be reported at the level of the individual CFA (Volume 2 of the ES). However, such provision will not necessarily be provided within

the same CFA as the adverse effects occurred, where greater ecological benefits can be achieved by pooling habitat creation or providing in another location. In such circumstances, compensation/enhancement provisions should be described in the CFA in which the provision will be made. They should then be cross-referenced in the mitigation, compensation and enhancement section of the CFA where the effect occurred, in order to ensure that the reasoning for residual effects is clear.

6 Residual effects

6.1 Introduction

- 6.1.1 Following the description of all mitigation, compensation and enhancement measures proposed, the residual effects section will consider the net effects of the scheme once these measures have been implemented.
- 6.1.2 Significant effects on habitat types which are considered irreplaceable (e.g. ancient woodland) should be listed as a significant residual effect even where compensation or enhancement is proposed. In such cases the loss of irreplaceable habitat should be identified as an adverse effect. Where compensation has been provided to address this effect then a corresponding 'beneficial' effect (and a geographic level of significance) may be identified for any compensation/enhancement provision proposed to offset the losses.
- 6.1.3 This approach is likely to be utilised mainly in relation to impacts of the Proposed Scheme on ancient woodlands. It is intended to reflect the view that some habitats (e.g. ancient woodland) and features are irreplaceable and as such cannot be offset on a 'like for like' basis. In this instance the 'beneficial' effect will be included to demonstrate the positive value of the proposed compensation, while acknowledging that the new habitat cannot replace ancient woodland.
- 6.1.4 For all other significant effects identified prior to the incorporation of mitigation, compensation and enhancement, consideration should be given as to whether the proposed measures are sufficient to offset effects. Where this is the case these effects will be considered to have been addressed, and no significant residual effect will be reported. Where mitigation, compensation or enhancement provision is not likely to reduce the effect below the level of significance, this will be reported as a significant 'residual effect'.

6.2 Consequences of significant residual effects

- 6.2.1 The consequences in legal and policy terms of significant residual effects of the Proposed Scheme will be presented within the route-wide assessment in Volume 3. As described in the IEEM guidelines (paragraph 6.1), such explicit presentation enables the decision-making body to ensure that the Proposed Scheme:
- complies with legal requirements e.g. the need to obtain a licence for any work affecting protected species or the implications in respect of the Conservation (Natural Habitats) Regulations¹⁴;
 - meets international, national and local policy objectives; and
 - requires conditions and legal obligations attached to the consent that deal with aspects of the detailed design and implementation of the project.

¹⁴ HMSO (1994), *The Conservation (Natural Habitats, &c.) Regulations 1994 No. 2716*.

Appendix A: Resource evaluation criteria

Table A1: Resource evaluation criteria table

Value of resource	Selection criteria
International	<p>An internationally designated site or candidate/proposed site (SPA, pSPA, SAC, cSAC, pSAC and/or Ramsar site, pRamsar site).</p> <p>A sustainable area of a habitat which is significant at an international level and which is capable of meeting the criteria for designation as a site of international importance.</p> <p>A sustainable population of a species which is significant at an international level and which is capable of meeting the relevant criteria for designation as a site of international importance.</p>
National	<p>A nationally designated site (SSSI, NNR, Marine Nature Reserve).</p> <p>A sustainable area of a habitat which is significant at a national level and which is capable of meeting the criteria for designation as a site of national importance.</p> <p>A sustainable population of a species which is significant at a national level and which is capable of meeting the relevant criteria for designation as a site of national importance.</p>
Regional	<p>Sites/populations which exceed the County or Metropolitan-level designations but fall short of SSSI selection guidelines.</p> <p>A sustainable population of a species which is significant at a regional level and which is capable of meeting the relevant criteria for designation as a site of regional importance.</p>
County/ metropolitan	<p>Some locally designated sites (including Local Wildlife Sites and Sites of Metropolitan Importance for nature conservation).</p> <p>A sustainable area of a habitat which is significant at a county level and which is capable of meeting the criteria for designation as a site of county importance.</p> <p>A sustainable population of a species which is significant at a county level and which is capable of meeting the criteria for designation as a site of county importance.</p>
District/borough	<p>Some designated sites (e.g. Sites of Borough Importance).</p> <p>Sites/features which are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource.</p>
Local/parish	<p>Sites/populations, which appreciably enrich the immediate vicinity or parish habitat resource (e.g. moderately species-rich hedgerows) but which are not in themselves of district/borough importance.</p>
Negligible	<p>Habitats or species populations that do not appreciably enrich the ecological value of the immediate vicinity.</p>

N.B. Local Nature Reserves may be of value at a range of geographic levels and professional judgement should be applied based on consideration of the specific features for which the site is designated.

Appendix B: Approach to precautionary assessment

1.1.1 Due to access delays and refusals it has not been possible to access all areas identified as falling within the desired scope of ecology surveys. As a consequence the ecological impact assessment (EclA) will in some situations be based upon limited or incomplete data.

1.1.2 In order to comply with requirements of the Environmental Impact Assessment Directive (85/337/EEC) it is necessary for the ecology sections of the Environmental Statement (ES) to identify the 'likely significant effects of the proposed project'. In order to comply with the requirements of the Directive in the absence of a full data set it is necessary to adopt a precautionary approach and attempt to identify those effects which are likely to be significant based on the available information. Case law demonstrates that it is not acceptable to simply rely upon the defence that survey work to be undertaken at a later date will identify where significant effects are likely to occur.

Baseline valuation

1.1.3 The level of information available to inform the valuation of ecological receptors within the EclA will vary widely.

Complete access – complete field survey information available

1.1.4 Where full baseline information (i.e. information to the level that would typically support an environmental statement) is available to inform the valuation process, then the standard approach to valuation as outlined within the IEEM guidelines should be followed.

1.1.5 For all such valuations, receptors should be firmly attributed to the most appropriate geographical frame of reference. The use of precautionary terminology such as 'up to' or 'likely to be' should not be utilised for the valuation of receptors that fall into this category.

Partial or no access – incomplete field survey or desk study information only

1.1.6 Where it has not been possible to complete field survey to a level that would normally be appropriate in support of an environmental statement, then it will be necessary to make a precautionary assessment.

1.1.7 For habitats it is likely that it will be possible to identify potential resources/receptors to a reasonable level of detail through analysis of aerial photography (e.g. woodland at Location 1).

1.1.8 For species receptors where some field survey has been undertaken, but it is incomplete, it is likely to be possible to identify the receptor or potential receptor to a reasonable level of detail.(e.g. bat assemblage at Location 2, or potential amphibian population associated with ponds at Location 3).

- 1.1.9 Where no field survey access has been possible, in the first instance an attempt should be made to identify individual receptors through review of aerial photography and other relevant available existing information (e.g. potential bat assemblage associated with unsurveyed woodland at Location 3).
- 1.1.10 Where this is not possible then it will be necessary to provide a collective precautionary valuation at the community forum area (CFA) level (e.g. other bat populations within the Location₄ area).
- 1.1.11 In all such situations a precautionary valuation that represents a 'reasonable worst-case' is to be provided, i.e. one that is precautionary but it is reasonable to assume could occur, rather than an extreme scenario that is on balance unlikely. In all such cases where the baseline is incomplete the degree of precaution built into the assessment should be linked to the level of confidence in the existing data upon which the assessment is based.
- 1.1.12 For example, it is considered reasonable to assume that, within a network of partially surveyed ponds (in a locality where several small great crested newt populations have been found to occur), further populations of great crested newt may be identified, and that these would likely be of small or medium population size class. However, it would not normally be reasonable to assume that every pond where survey is incomplete is likely to support a high population of great crested newts.
- 1.1.13 For each potential receptor a reasonable worst-case valuation should be attributed based on the information available. This should include consideration of any available field or desk study data (including aerial photography), a comparison with similar habitat areas occurring in the wider local area, and a qualitative consideration against any factors that indicate suitability for the particular habitat or species in question.
- 1.1.14 In all cases throughout the paragraph and table text in Volume 2 (CFA reports) it should be made clear where a precautionary approach has been adopted through the use of the qualifier 'up to' alongside the relevant geographic frame of reference.

Impact assessment

- 1.1.15 Where a precautionary valuation has been made, and an effect significant at the district/borough level or higher is possible, then a description of the likely impacts as a consequence of the Proposed Scheme should be provided. The description of impacts should be as specific as the knowledge of the baseline allows. For example it may be possible to say that a specific pond of up to district/borough value for amphibians is to be lost. However, a general statement may need to be made in relation to bats to say that activities in this area will result in the loss of trees and buildings which could support bat roosts.
- 1.1.16 The term 'could' (as opposed to 'will') is to be utilised in the assessment conclusions wherever a precautionary assessment of 'up to' X value has been necessary (e.g. this could result in an adverse effect that is significant at up to the county/metropolitan level).

Mitigation and compensation provision

- 1.1.17 For habitat losses it is likely that it will be possible to provide a clear indication as to how potential effects occurring on receptors that have not been accessed for survey

will be mitigated or compensated. In most cases, as the broad habitat type will be discernible from aerial photography, it is likely that habitat losses will have been accounted for within the mitigation and compensatory provision that has been incorporated into the mitigation schedules.

- 1.1.18 For protected species, in many cases it will not be possible to specifically identify the required level of mitigation/compensation, as the exact nature of the impacts will not be discernible until it is possible to access land and gain a fuller understanding of the baseline. Therefore, a commitment will be made to providing mitigation/compensation in line with a set of agreed principles of mitigation for the species concerned.



HS2 London-West Midlands

Ecology

Technical note- Ecological principles of mitigation

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This document is a technical note that has been produced in support of the Environmental Impact Assessment (EIA) for Phase One London - West Midlands of the proposed High Speed 2 (HS2), the construction of a new railway line between London and Birmingham (hereafter the 'Proposed Scheme'). It details the ecological principles that will be applied in designing the mitigation and compensation to be provided in support of the Proposed Scheme.
- 1.1.2 Application of the principles outlined in this document to the detailed design of ecological mitigation and compensation aims to ensure that adverse effects that have been identified within the Environmental Statement are addressed and will not be exceeded.
- 1.1.3 During 2012 and 2013 a combination of field survey and desk based study (to identify pre-existing relevant information) has been undertaken to inform the Environmental Statement (ES) for Phase 1. However, due to access delays and refusals in combination with the seasonal constraints to survey, it has not been possible to achieve access to all areas where survey was proposed. As a consequence, in the absence of full data in some cases it has been necessary to apply a precautionary approach within the ES. Available information has been utilised to provide an assessment based on a predicted 'reasonable worst-case' scenario.
- 1.1.4 In addition at hybrid Bill submission the Proposed Scheme will still be subject to completion of detailed design, which includes landscape design. An outline landscape design will be available on submission of the hybrid Bill.
- 1.1.5 For the above reasons the Environmental Statement does not contain all of the details of the mitigation or compensation required for impacts on protected and/or notable habitats and species. As a consequence this document sets out the principles of the ecological mitigation strategy in order to provide decision makers with confidence that the adverse effects will be adequately addressed. It also aims to support conclusions of no significant effect reported in the ES.
- 1.1.6 At all stages in the application of these principles full consideration has been and will be given to the implementation of the mitigation hierarchy (i.e. avoid-reduce-mitigate-compensate). Where it is reasonably practicable to do so then attempts have been made to avoid impacts. Where impacts cannot be avoided then efforts have been made to limit the extent and magnitude of the impact and to mitigate the resultant effects through the provision of appropriate measures. Where effects cannot be mitigated to a level where they are not significant then compensatory measures have been employed to (as far as is reasonably possible) offset any remaining adverse effects.
- 1.1.7 This document deals principally with the last two steps in this mitigation hierarchy namely the provision of mitigation and compensation. The land considered to be required for the implementation of such measures has been included in the Proposed Scheme on a precautionary basis, based on a 'reasonable worst-case'. Application of the principles of mitigation contained within this document will, once access to complete surveys has been gained, act to guide the development of the detailed design of mitigation/compensation measures to be provided in these areas.

- 1.1.8 Where mitigation or compensation are required then the intention is to provide them within the confines of the land required for the construction of the Proposed Scheme as defined on the Parliamentary plans. Where this is not reasonably practicable than further means of providing mitigation/compensation provision beyond the land controlled by the Proposed Scheme will be considered.

2 Great crested newt

2.1 Key principles

- 2.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the favourable conservation status (FCS) of those great crested newt populations located in the vicinity of the route.
- 2.1.2 The nominated undertaker will seek to provide new aquatic and terrestrial habitat for great crested newt primarily within locations that have connectivity with retained habitat that is already utilised by the populations affected (i.e. in-situ). In doing so compensatory habitat creation will seek to avoid any long term effect on FCS through ensuring that the key impacts of habitat loss (both aquatic and terrestrial) and potential severance are addressed. Such provision will include both the creation of new core areas of habitat specifically designed for great crested newt, and the enhancement of compensation areas which have already been incorporated to address losses of particular habitat types. For example, the design of areas of broadleaved woodland planted to compensate for losses of this habitat type may be altered to allow these areas to also incorporate great crested newt breeding ponds.
- 2.1.3 However, for a scheme of this scale it is likely that there will be locations where there is no-satisfactory alternative to providing compensatory habitat in locations that are distant from the impact. Where this approach is necessary then disease screening (including that for chytridiomycosis) will be undertaken in line with current best practice to ensure that all populations involved are free from disease at time of translocation.
- 2.1.4 Where it is not reasonably practicable to address the possible impact of the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. Where reasonably practicable to do so, all such compensation areas would be provided in close proximity to the route, through the creation of areas of high quality terrestrial and aquatic habitat.
- 2.1.5 As well as providing a receptor for those populations where translocation in-situ is not possible due to other constraints, large scale habitat creation areas have been provided within the land required for the construction of the Proposed Scheme to address a 'reasonable worst-case' in relation to those ponds which it is has not been possible to access for survey. Such areas have been provided at regular intervals throughout the route in order to minimise impacts on the conservation status of the populations concerned at the local level.
- 2.1.6 Once constructed the railway is for the majority of the route considered unlikely to form an absolute barrier to great crested newt movement. Amphibians are known to utilise habitats that are common to operational railway corridors, including the use of gaps between ballast as refugia and/or hibernacula. However, the presence of the operational railway is likely to reduce exchange of individuals between water bodies either side of the route, and in some cases (e.g. where the route is in deep cutting or on steep sided embankment) then it has the potential to act as a barrier to movement.
- 2.1.7 Where severance is identified as having the potential to result in an adverse effect on conservation status, the nominated undertaker will seek to minimise its effects

through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape, and maintain the viability of these severed elements, for example by providing linear connectivity and new ponds which will promote connectivity between two previously separate metapopulations.

2.1.8 In extreme situations where it is not considered possible to maintain the viability of severed fragments of a population affected by the Proposed Scheme then the nominated undertaker will consider the trapping of great crested newts from land that lies outside the extent of the Proposed Scheme, in order to allow the full population to be relocated to the same receptor site.

2.1.9 The use of amphibian tunnels as a potential method for addressing the effects of severance will be considered on a case by case basis and reviewed against the current evidence basis for their effectiveness at the time of construction. However, based on the current limited evidence for their effectiveness such measures are currently not relied upon in the mitigation/compensation strategy outlined in the ES.

2.2 Aquatic habitat creation

2.2.1 Where ponds supporting great crested newt are lost then they will be compensated through either:

- provision of two replacement ponds (of similar size) for each pond lost (a minimum pond surface area of 100m² would be applied); or
- provision of approximately double the surface area of suitable aquatic habitat through the creation of larger ponds than those lost (a minimum pond surface area of 100m² and a maximum of 300m² will apply).

2.2.2 Where possible replacement ponds will be provided in locations that maintain connectivity with retained elements already utilised by the populations affected (i.e. in-situ).

2.2.3 The construction schedule will ensure that where ponds are to be lost then any new ponds will (wherever reasonably practicable to do so) be created 6 months prior to the commencement of any translocation works in order to allow the plant and invertebrate populations to establish.

2.2.4 The planting regime will be appropriate to the local area, and in each case will include a variety of marginal, floating and submerged vegetation with some areas of open water. Where possible plant material and/or water from ponds to be lost will be used to promote rapid establishment of newly created ponds.

2.2.5 When siting new ponds those locations which are likely to be subject to high levels of human or animal disturbance will be avoided where practicable to do so. In addition surrounding terrestrial habitat creation and on-going management will be designed to avoid dense shading.

2.3 Terrestrial habitat creation

2.3.1 Where an adverse effect is anticipated on great crested newt as a result of the loss of terrestrial habitat then the nominated undertaker will provide compensatory habitat.

- 2.3.2 Provision will seek to maximise the quality of terrestrial habitat provided with regard to great crested newt, and ensure this is provided in close proximity to either retained or newly created ponds. However, provision of habitat in close proximity must be balanced with the need to ensure that links with other areas of surrounding suitable terrestrial habitat are maintained.
- 2.3.3 The loss of intermediate and distant terrestrial habitat is unlikely to result in adverse effects on those great crested newt populations where the quality and availability of terrestrial habitat in close proximity to the pond is high. However, in some cases such areas may play a key role. As such in all cases the requirement and scale of replacement terrestrial habitat will be considered on a case-by-case basis by ecologists experienced in European protected species mitigation (EPSM) licensing.
- 2.3.4 Where the requirement for compensatory habitat provision is identified, the nominated undertaker will endeavour to provide habitat of equal or higher quality than that which is lost. Habitats of similar type to those that are lost will be provided and hibernacula and other above ground refugia will be provided in each area of terrestrial habitat creation in order to maximise their potential carrying capacity.
- 2.3.5 Where replacement habitat is of equal quality to those areas lost then the area of replacement provision will be at least as large as the area lost (i.e. minimum of 1:1 ratio).
- 2.3.6 Where the quality of the terrestrial habitat to be provided post-construction will clearly be higher than that available pre-development, or habitat will be provided closer to the breeding pond, then compensation habitat areas provided may be on a less than 1:1 ratio. This may only be undertaken where it is not considered to be detrimental, to the population concerned, or the potential movement of amphibians through the wider landscape.
- 2.3.7 Planting of terrestrial compensation areas will utilise species appropriate to the local area, and where possible will seek to maximise the value of such areas for other species, without compromising their value for great crested newt.
- 2.3.8 All hibernacula, bunds and other refugia incorporated into the final designs will be constructed in accordance with current best practice guidelines (e.g. English Nature; 2001¹; Langton et al 2001²).
- 2.3.9 Where newly created habitats are to act as receptor areas for great crested newt these areas will (wherever reasonably practicable to do so) be constructed a minimum of 6-12 months in advance of the commencement of translocation (depending on the type and seasonal timing of the works conducted).

2.4 Capture and exclusion

- 2.4.1 Capture and exclusion works will be undertaken in accordance with best practice guidelines, as currently detailed in Worksheet II E Mitign & Compn (5) of the great crested newt method statement -Form WML-A14-3³. Implementation of these

¹ English Nature (2001). *Great Crested Newt Mitigation Guidelines*. English Nature, Peterborough.

² Langton, T.E.S., Beckett, C.L., and Foster, J.P. (2001). *Great Crested Newt Conservation Handbook*. Froglife, Halesworth.

³ Natural England (2012) *Template for method statement to support application for licence under Regulation 532(2)e in respect of great crested newts Triturus cristatus. Form WML-A14(3) (Version April 2013)*.

<http://www.naturalengland.org.uk/ourwork/regulation/wildlife/species/greatcrestednewt.aspx> Accessed: 02/10/13.

methods will prevent any legal offences resulting from the killing/injury of great crested newt during site clearance.

2.4.2 Novel sustainable solutions to minimise the extents of exclusion fencing required by the Proposed Scheme will be explored and agreed with Natural England. Exclusion fencing (or equivalent) will be maintained for the duration of construction at those locations where there is considered to be a risk of amphibians re-entering construction areas post habitat clearance.

2.4.3 Permanent exclusion fencing will be incorporated in those locations where the operation of the scheme represents a significant risk to the favourable conservation status of the populations concerned, or where the presence of great crested newt within key areas of operational infrastructure has the potential to significantly constrain operational requirements.

2.5 Management, maintenance and monitoring

2.5.1 The nominated undertaker will commit to providing appropriate on-going management, maintenance and monitoring of compensatory habitats.

2.5.2 Details of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the Environmental Minimum Requirements (EMR)⁴ to be agreed at Royal Assent.

2.5.3 Detailed management, maintenance and monitoring strategies would be provided alongside derogation licence applications post Royal Assent.

⁴ The Environmental Minimum Requirements are a series of commitments which will be agreed with stakeholders and made by HS2 Ltd at the point of Royal Assent. They aim to ensure that impacts that have been identified within the Environmental Statement are addressed and will not be exceeded

3 Common amphibians

3.1 Key principles

- 3.1.1 Where populations of common amphibians utilise the same areas of habitat used by great crested newts then effects on these species will be addressed through adherence to the principles of mitigation outlined in Section 2.1.
- 3.1.2 Where common amphibians occur in areas where great crested newt are absent then mitigation and compensatory habitat provision will seek to avoid significant effects on the populations concerned.
- 3.1.3 All new water bodies provided for common amphibians will be placed within areas of suitable terrestrial habitat that are being provided primarily to compensate for habitat losses as a consequence of the Proposed Scheme. These areas will be enhanced as necessary to also provide suitable replacement habitat for common amphibian populations.
- 3.1.4 Where translocation will involve movement of individuals to locations outside of the normal extent of that population then disease screening (including that for chytridiomycosis) will be undertaken in line with current best practice to ensure that all populations involved are free from disease at time of translocation.

3.2 Aquatic habitat creation

- 3.2.1 Where ponds containing other common amphibians are lost then these would be replaced on at least a 1:1 basis, and be of similar size and form to those lost.
- 3.2.2 This will be achieved through the provision of new water bodies suitable for use by common amphibians within the areas identified for provision of ecological mitigation/compensation outlined in Volume 5: Map series CT06.

3.3 Terrestrial habitat creation

- 3.3.1 Where the quality of the terrestrial habitat to be provided post-construction will be higher than that available pre-development, or habitat will be provided closer to the breeding pond, then compensation habitat areas may be on a less than 1:1 ratio. This may be undertaken where it is not considered to be detrimental to the population concerned, or the potential movement of amphibians through the wider landscape.
- 3.3.2 Planting of terrestrial compensation areas will utilise species appropriate to the local area. Hibernacula, bunds and other refugia will be provided as required in line with current best practice guidelines (e.g. English Nature, 2001⁵; Langton et al, 2001⁶).
- 3.3.3 Where newly created habitats are to act as receptor areas for common amphibians, these will wherever reasonably practicable to do so) be constructed a minimum of 6-12 months in advance of the commencement of translocation (depending on the type and seasonal timing of the works conducted).

⁵English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature. Peterborough.

⁶Langton, T.E.S., Beckett, C.L., and Foster, J.P (2001). Great Crested Newt Conservation Handbook, Froglife, Halesworth.

3.4 Capture and exclusion

3.4.1 Wherever it is reasonable to do so a controlled drain down of water bodies known to support breeding populations of common amphibians will be undertaken during the period mid-September to February inclusive, in order to minimise impacts on existing populations.

3.4.2 Based on the legal status of common amphibian the use of exclusion fencing and pitfall trapping will only be utilised where there is considered to be the potential for sufficiently high numbers of common amphibians to be killed or injured during construction that there would be a significant adverse effect on the population concerned. As a general rule the requirement for exclusion fencing and pitfall trapping will be considered in those locations which are known to support good or exceptional common amphibian populations.

3.5 Management, maintenance and monitoring

3.5.1 The nominated undertaker commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

4 Bats

4.1 Key principles

- 4.1.1 The nominated undertaker will ensure that impacts as a consequence of the construction and operation of the Proposed Scheme do not result in any long term adverse effect on the favourable conservation status (FCS) of bat populations in the vicinity of the Proposed Scheme.
- 4.1.2 The nominated undertaker will seek to provide new roosting and commuting habitats for bat species primarily within locations that have connectivity with retained habitat that is already utilised by the populations affected (i.e. in-situ). In doing so compensatory habitat creation will seek to avoid any long term effect on FCS through ensuring that the key impacts of habitat loss (in relation to foraging, commuting and roosting activity), disturbance and potential severance are addressed. Such provision will include both the creation of new roost sites, and the enhancement of those compensation areas provided to address general habitat loss as a consequence of the Proposed Scheme, in order to make these areas more suitable for bats. For example, the design of areas of broadleaved woodland planted to compensate for loss of woodland habitat may be altered to provide a graded woodland edge that will be suitable for foraging activity of a range of bat species, or bat boxes incorporated to provide immediate replacement roosting opportunities.
- 4.1.3 Where it is not reasonably practicable to mitigate the likely effect on the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. All such compensation areas would (where reasonably practicable to do so) be provided in the closest most suitable location taking into consideration the following factors:
- type of roost;
 - position in landscape; and
 - design of the railway (for example in a cutting or at grade).
- 4.1.4 Large scale habitat creation areas have been provided as part of the wider ecological mitigation/compensation package in order to address a 'reasonable worst-case' scenario for all species in those areas where access has prevented full survey being conducted. Such areas have been provided at regular intervals throughout the route in order to minimise impacts on the FCS of the populations concerned at the local level.

4.2 Replacement roosting provision

- 4.2.1 Where bat roosts are lost they will be compensated in a form appropriate to the species of bat and type of roost in accordance with the guidelines provided in Figure 4 of the Bat Mitigation Guidelines (Mitchell-Jones 2004)⁷.
- 4.2.2 Each roost to be lost would be compensated for as part of the mitigation scheme submitted as part of an EPSM licence application. The timing of operations such as provision of new roosting habitat, exclusion from roosts, and destruction will be

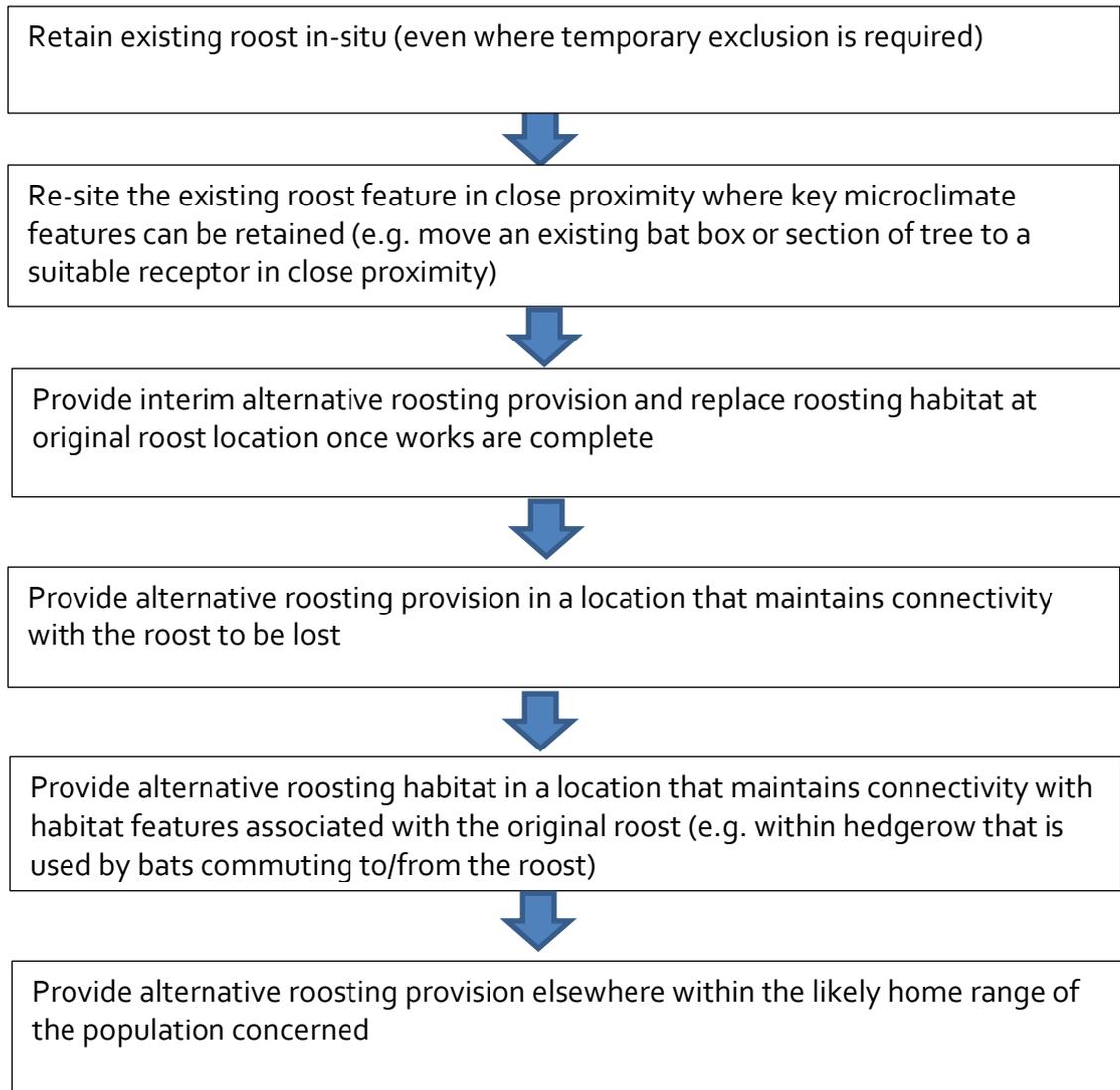
⁷ Mitchell-Jones, A.J. (2004). *Bat Mitigation guidelines*. English Nature, Peterborough.

appropriate to the nature of the roost to be lost with works conducted in accordance with the recommendations of the Bat Workers Manual (JNCC 2004)⁸.

- 4.2.3 Where a roost will be lost or disturbed as a consequence of works required in support of the Proposed Scheme, the hierarchy, shown in Figure 1 will be applied in considering the most appropriate way to mitigate for its loss.

⁸ Joint Nature Conservation Committee (2004). Bat worker's Manual, 3rd Edition, edited by A.J. Mitchell-Jones and A.P. McLeish.

Figure 1: Mitigation hierarchy to be applied when a bat roost is lost



4.2.4 In considering the above hierarchy in relation to individual roosts lost the following key factors will be considered:

- type of roost
- species;
- likely sensitivity to disturbance;
- risk of train strike during operation (including risk of drawing more bats close to the line through the provision of roosting provision in proximity to the Proposed Scheme);
- nature of surrounding habitat;
- likely or known pattern of dispersal within the habitat;
- proposed planting scheme; and
- design of the proposed scheme in this area (e.g. is the line in cutting or at grade).

- 4.2.5 Replacement roosting habitat will be provided in a form and quantum that is most appropriate to the specific location in question. Across the route of the Proposed Scheme it is anticipated that a wide range of replacement roost types will be utilised ranging from the production of bespoke 'bat houses' and hibernation sites, incorporation of roosting habitats into existing structures, the provision of a variety of bat boxes, and the use of tree surgery to provide artificial roosting features within retained trees.
- 4.2.6 Replacement roosting habitat will be provided both where roosts are lost and where there is considered to be a significant reduction in the available potential roosting resource that could affect the long term status of bat assemblages which occur in the local area. Where the reduction in the available roosting resource has the potential to result in significant adverse effects, compensatory roosting provision will be provided at appropriate levels on a case by case basis. No strict provision ratios are proposed (e.g. 2 bat boxes for each high potential tree lost), and efforts will be made to consolidate roosting provision and ensure a range of compensatory habitat provision is provided, rather than simple deployment of bat boxes only.

4.3 Replacement foraging habitat

- 4.3.1 Habitat losses within the land required for the construction of the Proposed Scheme may require some bats to travel further, and expend more energy during regular foraging and movement throughout their home range for the duration of construction. However, such effects alone (in isolation of those resulting from habitat fragmentation/severance resulting from these losses) are for all species considered unlikely to result in sufficient disturbance of the populations concerned during the period of construction to result in an adverse effect on their conservation status.
- 4.3.2 Compensatory habitat creation that will be provided to address significant effects on specific habitat types (e.g. ancient semi-natural woodland) will act to prevent any longer term effect on bat populations as a consequence of the losses anticipated. Compensatory habitats to be created will include a range of new woodland, grassland, and water bodies.
- 4.3.3 No mitigation/compensatory planting will be provided with the primary aim of addressing losses of bat foraging habitat since planting to be provided to address other significant effects will act to fulfil this function. Where there is particular benefit in doing so, the final planting scheme and maintenance regime will, whilst taking account of the multiple functions of such areas, incorporate details that maximises the value of these habitat features in relation to bats (e.g. through scalloping woodland edges to provide sheltered areas that will support concentrations of insects and promote bat foraging).

4.4 Mitigating for habitat fragmentation/severance (construction)

- 4.4.1 The removal or disturbance of habitat features that are utilised by bats during breeding, hibernation or during seasonal migrations between roosts (e.g. moving from hibernation to maternity roost locations) have the potential to result in adverse effects on the bat populations or assemblages during construction. However, the point at which such impacts are likely to result in a significant adverse effect on the

conservation status of the population concerned will differ dependent on the status and behaviour of the species concerned. As such the requirement for mitigation measures to address the effects of habitat fragmentation/severance arising as a result of construction will be considered based on both the species and its conservation status.

4.4.2 Where habitat severance/fragmentation arising as a result of construction is identified as having the potential to result in an adverse effect on bat populations the nominated undertaker will seek (wherever it is reasonably practical to do so) to minimise its effects through:

- influencing the construction programme (where reasonably practicable to do so) in order to ensure works are sensitively seasonally timed in order to minimise impacts;
- retaining key habitat elements that are demonstrated to be of significant value for the movement of bats through the landscape for as long as possible during construction, giving time for replacement linear features to become established and minimising disruption to ecological functionality (e.g. construction of a new over-bridge in parallel with one known to be utilised by bats crossing the existing railway line in order to minimise disruption);
- implement replacement habitat creation/restoration as early as is reasonably practical to do so in project programme, in order to minimise the duration and scale of habitat fragmentation/severance effects;
- use of measures such as 'artificial hedgerows', wattle screens or other artificial measures to provide linear flight lines of use to bats during construction and until such point that planting is sufficiently established to fulfil this function;
- reinstating suitable hedgerows on the route of known existing flight lines and increasing the connectivity with other known areas of suitable habitat in the wider landscape; and
- avoiding night time working in proximity to key commuting/foraging features.

4.5 Minimising disturbance of roosts during construction

4.5.1 During the construction phase the following mitigation measures will (wherever it is reasonably practicable to do so) be implemented in order to prevent the disturbance of retained roosts:

- avoiding night-time working in proximity to known roosts;
- security lighting to be directed away from roost entrances; and
- timing of activities which could result in disturbance of known roosts to be controlled and wherever possible to be conducted during the times of the year when bats would not be present, e.g. October to April inclusive for maternity roosts.

4.5.2 Where this guidance cannot be followed and the proposed works are likely to cause disturbance, a licence will be sought from Natural England.

4.6 Minimising risk of collisions with trains/vortices during operation

4.6.1 The potential for the operation of the Proposed Scheme to result in adverse effects on bats as a consequence of train strike and associated vortices will be considered for each location on a species by species basis taking into account the following factors:

- flight habit and preference;
- position within geographical range of the species;
- conservation status; and
- baseline information on activity of the population concerned.

4.6.2 Where there is considered to be the potential for an adverse effect on the conservation status of the bat species concerned then the following measures will (where reasonably practicable to do so) be utilised to ensure there is no long term effect on the favourable conservation status of the species concerned:

- provision of green bridges, underpasses and culverts, or the enhancement or 'greening' of existing structures in order to facilitate passage of bats across the route;
- where the above features are required efforts will be made to include these early in the construction programme in order to maximise the time available for the establishment of associated landscaping;
- use of planting to create 'hop-overs' at key locations where bats are known to be at risk when crossing the route of the Proposed Scheme;
- provision of new planting to 'funnel' bats to the new crossing points, and the use of artificial measures (e.g. wattle screens) on a temporary basis until establishment of planting, in order to facilitate use of the above features;
- planting to strengthen existing alternative flight routes through the wider landscape that are sufficiently separated from the effects of disturbance or vortices associated with the operational railway;
- degradation and removal of some existing vegetation in proximity to the route of the Proposed Scheme in order to reduce the suitability of habitats for foraging bats in areas of high risk for sensitive species; and
- avoiding operational lighting close to proposed bat crossing points and, conversely, using lighting in other locations in order to direct bats to cross the route at proposed bat crossing points.

4.6.3 Mitigation/compensation provision will be provided at a level appropriate to ensure that by the commencement of operation likely effects are reduced to a level where any killing/injury through train strike and/or the effects of turbulence will be sufficiently low to have confidence that there will be no detrimental effect on the favourable conservation status of the species concerned. As such the level and form of mitigation/compensation required will differ between species based on the status of the populations concerned.

4.7 Management, maintenance and monitoring

4.7.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of mitigation features and compensatory habitat provision.

4.7.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the EMR agreed at Royal Assent.

4.7.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

5 Otter

5.1 Key principles

- 5.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the FCS of otter populations in the vicinity of the route of the Proposed Scheme.
- 5.1.2 The nominated undertaker will seek to provide safe passage for otter across the route of the Proposed Scheme throughout construction and during operation. This commitment will apply to all points at where the Proposed Scheme crosses watercourses that are either known to be utilised by otter, or are considered to have the potential to be utilised by otter in the future. This commitment acknowledges the on-going expansion of otter populations across the UK that is likely to continue during construction and into the period of operation of the Proposed Scheme.
- 5.1.3 Where works are likely to cause disturbance of otter or interference or damage to a holt a EPSM licence will be sought from Natural England.

5.2 Provision of replacement holts

- 5.2.1 Loss of otter holts has the potential to result in an adverse effect on FCS of the population concerned. Where the loss of holts cannot be avoided then the nominated undertaker will seek to mitigate adverse effects on the FCS of the populations concerned by creating artificial holts.
- 5.2.2 Replacement provision will seek to maximise the quality and likelihood of use of an artificial holt, in accordance with the following key principles:
- provision of two new artificial holts for every one lost;
 - artificial holts will be sited in an undisturbed area, free from flooding and close to a good supply of food;
 - where reasonably practicable to do so, one of the replacement holts will be provided in close proximity to the original holt that was lost when construction in the vicinity is complete. The other will be provided in a nearby area of suitable habitat that will not be subject to disturbance during the period of construction;
 - design of replacement holts will seek to replicate the form and complexity of the holt lost, ranging from simple log piles with entrance points, to more complex structures consisting of pipes and engineered cavities;
 - artificial holt will be located on the same watercourse as the holt to be lost; and
 - artificial holts will be created at least 12 months in advance of scheduled holt loss in order to give otter time to investigate and become acclimatised to the artificial holts.

- 5.2.3 The design and siting of artificial holts, alongside the methodology for excluding otters from existing holts will be co-ordinated by a consultant with experience in mitigation design for otters.

5.3 Mitigating disturbance during construction

5.3.1 Where watercourses known to support otter cross the route of the Proposed Scheme there is the potential for disturbance, killing and injury of otter. This will be avoided through implementing the following principles (wherever it is reasonably practicable to do so) at those locations where otters are known to be present:

- avoiding lighting of watercourses known to be utilised by otter through directing lights away from the watercourse and any associated holt locations;
- avoiding placement of site compounds in close proximity to watercourses;
- using fencing to guide otters to temporary safe crossing points for the duration of construction works or watercourse realignment works;
- providing a safe means by which otter can safely escape any deep excavations in the vicinity of suitable watercourses;
- securing chemicals and machinery overnight when working near watercourses; and
- limiting noise and vibration in the vicinity of retained known holts.

5.4 Maintaining safe passage

5.4.1 Design will aim to ensure that where the route of the Proposed Scheme crosses watercourses which support otter (or are potentially suitable to do so in the future) a means of safe passage for otter will be maintained.

5.4.2 All culverts will be designed to be suitable to allow passage for mammals such as otter and water vole, taking into account flood events, or will have an alternative dry tunnel installed.

5.4.3 Mammal proof fencing in line with the specification provided in the Design Manual for Roads and Bridges (Highways Agency, 1999)⁹ will be provided in association with crossing points wherever deemed necessary to ensure their effectiveness, and where necessary to prevent otters gaining access to the active railway line.

5.5 Management, maintenance and monitoring

5.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of mitigation features and compensatory habitat provision.

5.5.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the EMR agreed at Royal Assent.

⁹ Highways Agency (2001). *Design Manual for Roads and Bridges. Volume 10 Environmental design. Section 4 - Nature Conservation. Part 4 HA81/99 Nature Conservation advise in relation to otters.* Her Majesty's Stationery Office.

5.5.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

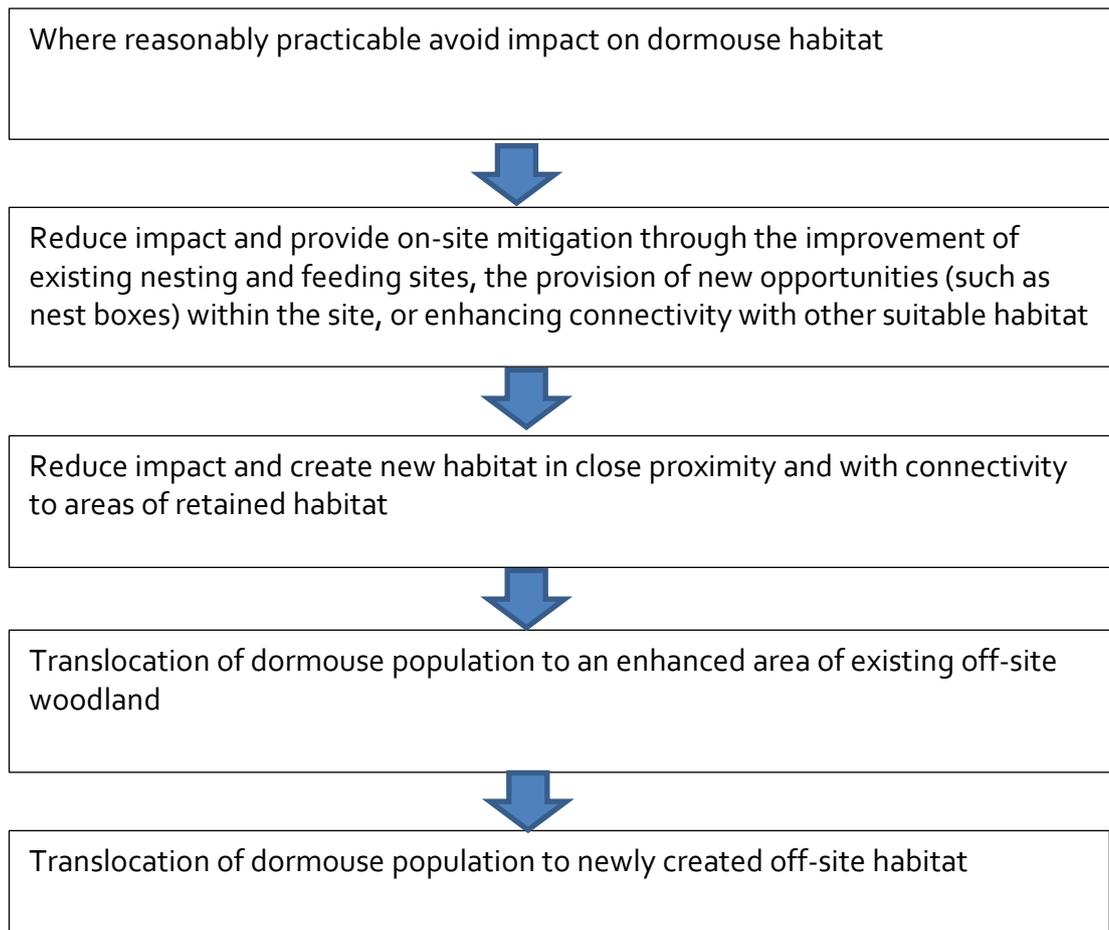
6 Hazel dormouse

6.1 Key principles

- 6.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the FCS of populations of hazel dormouse in the vicinity of the route of the Proposed Scheme.
- 6.1.2 Surveys conducted in support of Phase 1 have yet to identify any signs to indicate that dormouse is present within land required for the construction of the Proposed Scheme. As a consequence it is considered likely that no mitigation or compensation will be required in relation to dormouse.
- 6.1.3 However, as access refusals have prevented access to some areas of potentially suitable habitat, it is not yet possible to confirm that dormouse is absent. As a consequence the following principles of mitigation are provided to demonstrate how the nominated undertaker would seek to mitigate and/or compensate for any effects on dormouse arising from the construction of the Proposed Scheme, if they are found to be present.
- 6.1.4 In line with the approach advocated in Bright *et al* (2006)¹⁰ the mitigation hierarchy in Figure 2 will be applied.

¹⁰ Bright, P., Morris, P., and Mitchell-Jones, T. (2006). *Dormouse Conservation Handbook- Second Edition*. English Nature, Peterborough.

Figure 2: Mitigation hierarchy for hazel dormouse



6.2 Terrestrial habitat creation and/or enhancement

- 6.2.1 Where dormouse are confirmed to be present and the Proposed Scheme will result in losses of suitable habitat the nominated undertaker will act to ensure that these losses do not result in a detrimental effect on the FCS of the population concerned through providing replacement habitat. This may be achieved through either creation of new habitat or the enhancement of existing habitat to increase its potential value for dormouse.
- 6.2.2 Where reasonably practicable the enhancement of existing woodland areas to make them more suitable for use by dormouse will be favoured, in order to reduce the lag-period until these areas reach their target condition. Both habitat creation and enhancement will be undertaken with the aim of seeking to create habitats that meet the majority of the following criteria:
- a diverse, unshaded and productive understorey, preferably dominated by hazel, and including a range of other suitable plants to provide food sources and suitable nesting material;
 - good connectivity to other areas of suitable habitat through either links to existing woodland or wide hedgerow connections;
 - good arboreal connectivity;
 - mixed age range of trees; and

- species rich edge strips or ride sides.

- 6.2.3 Where existing habitat is to be subject to works to increase its suitability to support dormouse then the nominated undertaker will also provide an appropriate number of nest boxes within suitable habitat to augment the availability of suitable habitat.
- 6.2.4 Where habitat creation or enhancement is necessary to compensate for the loss of habitat supporting dormice this new habitat must be of greater value and size than that of the area previously lost.
- 6.2.5 Where reasonably practicable replacement habitat will be provided in locations that maintain connectivity with retained elements already utilised by the populations affected (i.e. in-situ).
- 6.2.6 The construction schedule will ensure that where habitat is to be lost then any associated restoration/enhancement of woodlands will be conducted at least 12 months prior to translocation in order to allow the plant and invertebrate populations to establish.
- 6.2.7 Where new habitat is created then the period until such habitats are suitable for use for dormice will depend on the nature of the adjoining habitat, and the method of habitat creation. This may require a lead in period of several years. Where habitat supporting dormice is to be lost, mature trees and shrubs, in particular hazel coppice stools will (where reasonable and practicable to do so) be translocated and used to speed up the establishment of new habitats.

6.3 Capture/exclusion and persuasion/displacement

- 6.3.1 Where areas of existing dormouse habitat are affected there will be a need to clear dormouse from this area prior to commencement of construction.
- 6.3.2 Where enhanced or new habitat is provided that has connectivity with the areas affected then efforts will be made to persuade dormice to move into newly created habitats. For small to medium sized habitat areas progressive vegetation removal will be used to encourage this, making use of appropriate seasonal windows for undertaking such activities.
- 6.3.3 Where utilised persuasion/habitat degradation will be conducted in accordance with the following key principles (Bright *et al*, 2006):
- clearance should be progressive wherever it is reasonably practicable to do so;
 - where reasonably practicable to do so all clearance should be undertaken using hand tools only in line with best practice guidelines. In all cases clearance work should be attended by a suitably qualified ecologist;
 - each clearance strip should be narrower than the radius of a typical home range for that habitat (an average of 50m);
 - for an area of up to one dormouse home range (approximately one to 1.5 ha of woodland 300m of edge) clearance of bushy vegetation and tree felling in winter (November to March) is recommended as the least damaging option;

- clearance should be planned as a two-stage operation, with removal of surface vegetation in winter (November to March) followed by progressive stump extraction and earth removal in the following summer during periods where dormice are active, and able to respond immediately (i.e. taking into account breeding and presence of dependent young); and
- for small areas (e.g. less than 50m² of high quality woodland, larger areas of low quality woodland and short lengths of hedge (Natural England (undated) Standing Advice)¹¹) small amounts should be taken out each day during the active period to allow animals time to escape and a search should be made for nests; the best periods for this work are May and late September when the presence of young is less likely.

6.3.4 Where large areas of habitat are to be lost, or compensatory habitat will be provided at an off-site receptor with no connectivity to the area affected then translocation will be necessary. If required, translocation will be conducted in accordance with best practice guidelines (Bright *et al*, 2006), which includes the requirement for undertaking appropriate disease risk analysis prior to translocation.

6.3.5 In all cases where areas of dormouse habitat are affected dormice nest boxes will be erected within the receiving area at a density of 20 to 25 boxes per hectare. These measures will increase carrying capacity and provide safe shelter.

6.4 Maintaining habitat connectivity

6.4.1 Where severance is identified as having the potential to result in an adverse effect on conservation status of the population concerned the nominated undertaker will seek to minimise its effects. This will be through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape, and maintain the viability of these severed elements, for example by providing new woodland links and hedgerows. Use of a green bridge would be considered if all other options for maintaining FCS of the population concerned have been exhausted.

6.5 Mitigation, monitoring and management

6.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of mitigation features and compensatory habitat provision.

6.5.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the EMR agreed at Royal Assent.

6.5.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

¹¹ Natural England (undated). Standing Advice Species Sheet: Hazel Dormice. http://www.naturalengland.org.uk/Images/Dormice_tcm6-21704.pdf. Accessed on 21/09/13

7 Badgers

7.1 Key principles

- 7.1.1 The nominated undertaker will ensure that mitigation and compensation provided for badger populations affected by the proposed scheme will avoid significant adverse effects.
- 7.1.2 The nominated undertaker will provide compensation for the loss of main and annex setts and seek to maintain safe passage for badgers across the route of the Proposed Scheme.
- 7.1.3 Due to the limited legal protection afforded to badger and its widespread nature throughout the route of the Proposed Scheme, mitigation/compensation for the effects of habitat severance will only be provided where there it is clear that in the absence of its provision a legal offence would occur.

7.2 Creation of artificial setts

- 7.2.1 Where main or annex setts are to be lost as a consequence of works associated with the construction of the Proposed Scheme the nominated undertaker will provide an artificial sett.
- 7.2.2 As far as is reasonably practicable artificial setts will be provided in locations that maintain connectivity with retained setts, key foraging areas and well used paths utilised by the badgers affected. Artificial setts will be constructed to include chambers and tunnels and will aim to replicate as much as possible the characteristics of the natural setts they replace. In all cases replacement setts will be provided within the appropriate social group territory.
- 7.2.3 Artificial setts will be created at least 6 months prior to closures of the setts they replace in order to provide some time to allow badgers to investigate and become acclimatised to the artificial sett. Baiting will be conducted periodically following the construction of the new sett, up to the point of closure of the existing sett, in order to encourage the badgers to locate and begin to utilise the new sett.
- 7.2.4 Artificial setts will be positioned in suitable locations to ensure that there will be sufficient drainage to avoid flooding and planted to ensure cover and lack of disturbance.
- 7.2.5 When siting new setts those locations which are subject to high levels of human or animal disturbance will be avoided.
- 7.2.6 Where the proposed works are likely to cause sett interference a licence to disturb a badger sett will be sought from Natural England.

7.3 Loss of habitat - maintaining safe passage across the route of the Proposed Scheme

- 7.3.1 No specific habitat creation for badger will be undertaken. Losses in habitats that were suitable for use by badger prior to construction will be addressed through compensation provided to address wider habitat loss as a consequence of the Proposed Scheme. This will provide large areas of woodland and grassland which will

within 5 years (fewer in some cases) become suitable to provide replacement habitat for badger.

7.3.2 Where the territory of a social group will be severed to the extent that it may result in a significant adverse effect on the conservation status of the population concerned then the use of measures to maintain safe passage of badger across the route of the Proposed Scheme will be explored. Where significant effects are anticipated then the effects of habitat severance and fragmentation will be minimised by the installation of appropriately designed and positioned passageways beneath or over the railway.

7.3.3 Where badger tunnels are provided then the following features will be considered:

- siting tunnel on or near a known badger path wherever it is practical to do so;
- good habitat connectivity with existing landscape features such as hedges; and ditches:
- good vegetation cover around the tunnel entrance;
- ensuring adequate drainage is incorporated into the design; and
- tunnel diameter of at least 600mm.

7.4 Mitigating effects arising during the construction of the Proposed Scheme

7.4.1 During the construction phase, activities that may pose a temporary threat to badgers or disturb them whilst they are in nearby setts will be controlled. These will include some or all of the following:

- security lighting to be directed away from setts;
- chemicals to be stored as far away from setts and badger paths as possible;
- trenches to be covered at the end of each working day, or to include a means of escape from the animal falling in,
- water sources for badgers to be safeguarded;
- trees to be felled away from setts and must not block badger paths; and
- disturbances such as loud noise or vibration that might agitate badgers occupying a sett to be avoided or limited to areas well away from setts.

7.5 Management, maintenance and monitoring

7.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

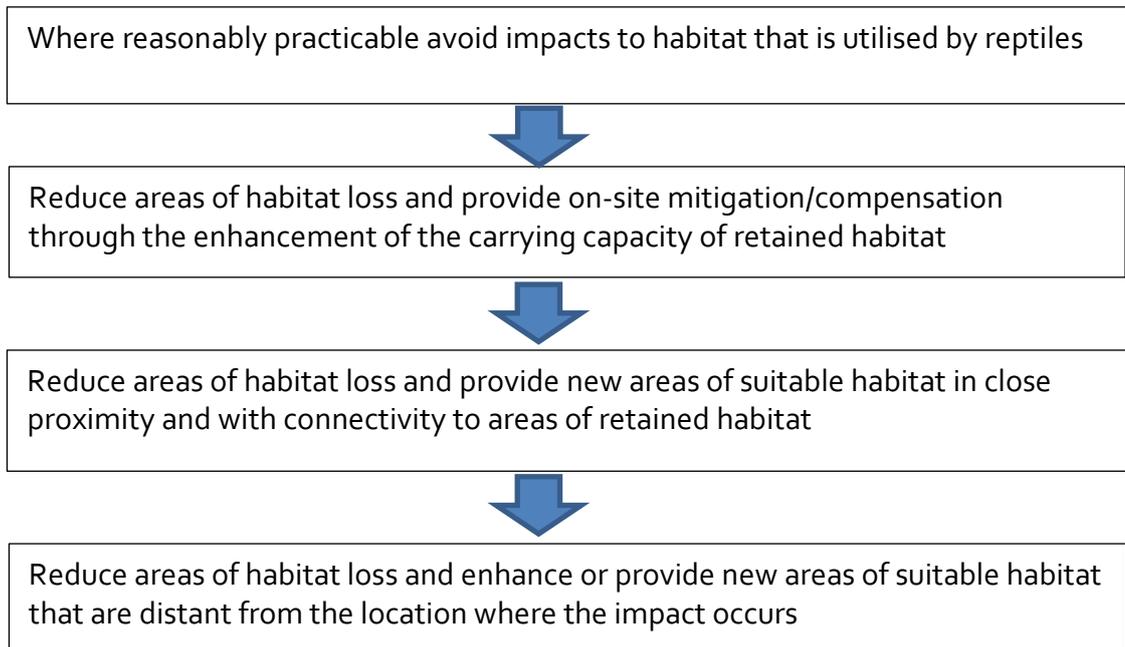
7.5.2 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

8 Reptiles

8.1 Key Principles

- 8.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the conservation status of populations of common reptile (slow worm, adder, grass snake and sand lizard) in the vicinity of the route of the Proposed Scheme.
- 8.1.2 In addressing the potential loss of areas of habitat known to be used by common reptiles, the mitigation hierarchy, shown in Figure 3, will be applied:

Figure 3: Mitigation hierarchy for habitat utilised by reptiles



- 8.1.3 Where translocation will involve movement of individuals to locations outside of the normal extent of that population then disease screening will be undertaken in line with current best practice to ensure that all populations involved are free from disease at time of translocation.
- 8.1.4 Once constructed the railway is for the majority of the route considered unlikely to form an absolute barrier to reptile movement. Reptiles are known to utilise habitats that are common to operational railway corridors such as south facing embankments for basking.
- 8.1.5 Where severance is identified as having the potential to result in an adverse effect on conservation status the nominated undertaker will seek to minimise its effects through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape and maintain the viability of these severed elements.
- 8.1.6 The use of reptile tunnels as a potential method for addressing the effects of severance has been rejected on the basis of a lack of clear evidence demonstrating their effectiveness.

8.2 Creation of replacement habitat

- 8.2.1 Where a significant adverse effect on common reptiles will occur then the nominated undertaker will act to provide sufficient replacement habitat to ensure the conservation status of the population is maintained in the long term.
- 8.2.2 No adherence to a strict ratio for balancing losses to gains is proposed. Consideration of the extent of terrestrial habitat required to address losses as a consequence of the Proposed Scheme will be undertaken by an experienced ecologist and will take into account both the habitat area and quality that is to be provided.
- 8.2.3 Where replacement habitat is of equal quality to those areas lost then the area of replacement provision will be at least as large as the area lost (i.e. minimum of 1:1 ratio).
- 8.2.4 Where it is not reasonably practicable to mitigate the impact on the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. All such compensation areas would be provided (where reasonably practicable to do so) in close proximity to the route, through the creation of high quality areas of terrestrial habitat, integrated with mitigation/compensation provision for other species.
- 8.2.5 Habitats of similar type to those that will be lost will be provided and bunds, hibernacula and other above ground refugia will be provided in each area of terrestrial habitat creation in order to maximise their potential carrying capacity.
- 8.2.6 Planting of terrestrial compensation areas will utilise species appropriate to the local area, and where possible will seek to maximise the value of such areas for other species, without compromising their value for reptiles.
- 8.2.7 All hibernacula, bunds and other refugia incorporated into the final design will be constructed in accordance with current best practice guidelines (e.g. *Herpetofauna Workers Manual*, Gent and Gibson 2003)¹².

8.3 Capture, exclusion and habitat manipulation

- 8.3.1 Where areas of habitat loss are limited and compensation will be provided within areas with direct connectivity to the areas lost then (where reasonably practicable to do) progressive degrading of the habitat to be lost will be conducted in order to encourage reptiles to move into new habitats. The requirement for additional capture and exclusion to augment this process will be considered on a case by case basis taking into consideration the population size, habitat quality and complexity of habitats concerned.
- 8.3.2 Where required capture and exclusion will be undertaken in accordance with the current best practice guidelines at the time of construction.
- 8.3.3 Wherever it is reasonably practicable to do so translocation will commence a minimum of 12 months prior to the required start of construction. For complex sites supporting high population size classes then a longer lead in period may be necessary in order to ensure the site is cleared prior to construction.

¹² Gent, T. and Gibson, S. (2003). *Herpetofauna Workers Manual*. Joint Nature Conservation Committee. Peterborough.

- 8.3.4 Exclusion fencing will be maintained for the duration of construction at those locations where there is considered to be a risk of reptiles re-entering construction areas post habitat clearance.
- 8.3.5 Permanent exclusion fencing will be provided in those locations where the operation of the scheme represents a significant risk to reptile populations or where the presence of reptiles within key areas of operational infrastructure have the potential to significantly constrain operational requirements.

8.4 Management, maintenance and monitoring

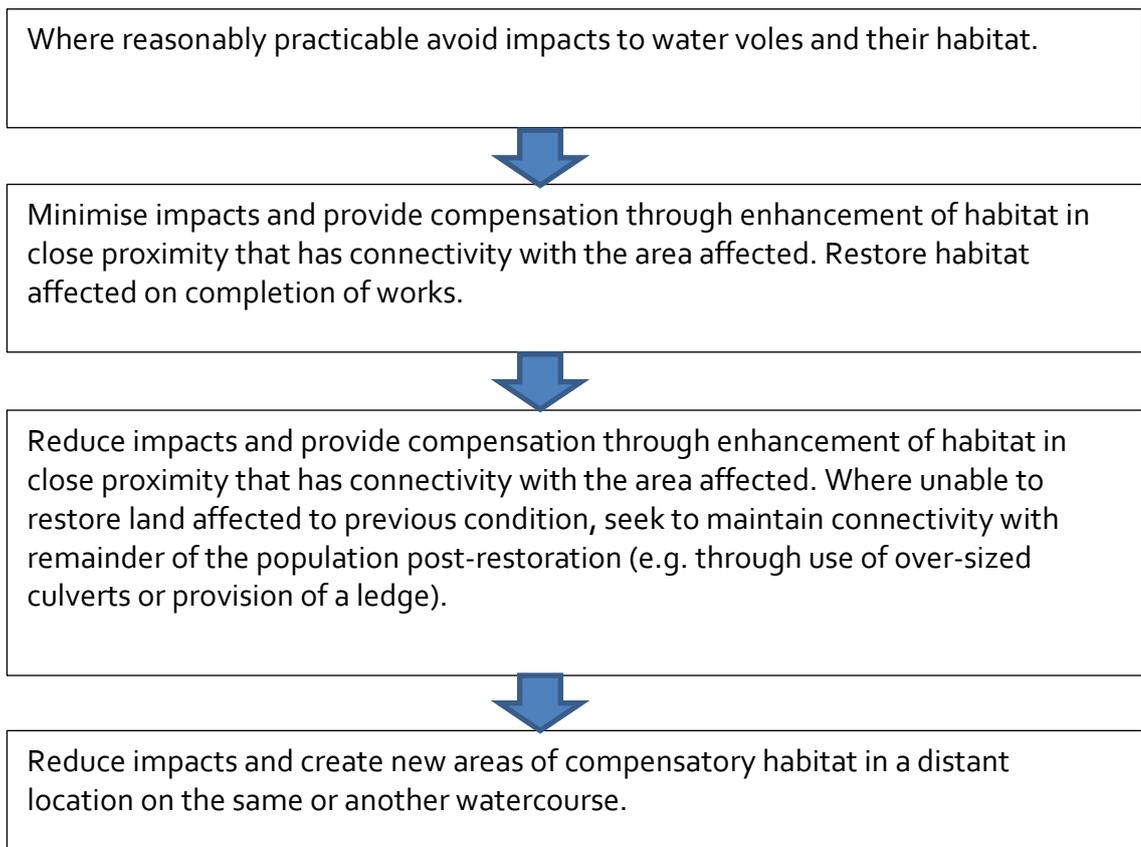
- 8.4.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 8.4.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.
- 8.4.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

9 Water vole

9.1 Key principles

- 9.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any significant effects on the conservation status of water vole populations in the vicinity of the Proposed Route.
- 9.1.2 The nominated undertaker will mitigate for effects on water vole by applying the following mitigation hierarchy, as described in The Water Vole Conservation Handbook (Strachan *et al*, 2011)¹³:

Figure 4: Mitigation hierarchy for water vole



- 9.1.3 Where it is not reasonably practicable to mitigate the impact on the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. All such compensation areas would (where reasonably practicable to do so) be provided in close proximity to the route, through the creation of areas of suitable bank and riparian habitat.

9.2 Provision of replacement habitat

- 9.2.1 Wherever reasonably practicable to do so the undertaker will compensate for the loss and/or disturbance of existing water vole habitat through the creation of replacement habitat of a similar quantity and quality. This may be achieved either through the

¹³ Strachan, R., Moorhouse, T., and Geling, M. (2011). *Water Vole Conservation Handbook - Third Edition*. Wildlife Conservation Research Unit, Abington.

enhancement of existing habitat within the same or linked watercourses, or through the creation of new habitat.

9.2.2 Replacement habitat will be provided as close to the area affected as it is reasonably practicable to do so.

9.2.3 Where it is reasonably practicable to restore the habitats which are to be affected during construction then this will be conducted as soon as possible following the completion of construction.

9.2.4 Where enhancement of existing habitats is proposed and there is likely to be seasonal use then such enhancements works that are required will be undertaken outside of this season in order to avoid potential killing or injury of individuals.

9.2.5 Where replacement habitat or improvement of existing habitat is undertaken then these works will be undertaken prior to the removal of the habitat to be affected by construction. Wherever it is reasonably practicable to do so new habitats will be created at least 12 months in advance of the proposed translocation in order to allow the new areas of habitat to establish.

9.3 Capture, exclusion and habitat manipulation/displacement

9.3.1 The most appropriate method for clearing water voles from areas to be affected by the proposed works will be considered on a site by site basis taking into account the following factors:

- size of habitat area affected;
- likely number of individuals;
- seasonal timing of the works; and
- proposed method of providing mitigation/compensation as defined by the output of the mitigation hierarchy above.

9.3.2 Where it is reasonably practicable to do so, habitat manipulation will be used to encourage the displacement of individuals to areas of suitable retained or enhanced habitat in adjoining sections of the same watercourse through progressive removal of bankside vegetation. Use of displacement will be favoured where the area affected is limited in extent and is only likely to support a relatively small number of animals. Where utilised, habitat manipulation will be conducted in accordance with the best practice guidelines provided in *Water Vole Conservation Handbook* (Strachan *et al*, 2011).

9.3.3 Where displacement is considered unsuitable based on consideration of the factors identified in paragraph 9.3.1, trapping of water voles will be undertaken in accordance with the guidelines provided in *Water Vole Conservation Handbook* (Strachan *et al*, 2011) and Natural England (undated) Standing Advice Species Sheet: water voles¹⁴.

9.3.4 Where translocation to a site distant to the area affected is proposed and there is the potential for interaction of a previously isolated population, appropriate disease

¹⁴ Natural England (undated) *Standing Advice Species Sheet: water vole*. http://www.naturalengland.org.uk/Images/WaterVoles_tcm6-21714.pdf. Accessed on 21/09/2013

screening will be conducted prior to commencement of the full scale capture and release programme.

- 9.3.5 In some circumstances where it is not appropriate to translocate the population or to encourage the use of adjacent habitats, it may be necessary to take voles into a captive breeding programme. This approach may be suitable where it is possible to return water voles to their original location following the completion of temporary works, but no options for displacement or off-site translocation are viable. In addition captive breeding may be appropriate where the trapped population is of limited size and therefore will be of increased risk of detrimental effect from the pressures of immediate translocation. Where this is necessary captive breeding will be undertaken by those experienced and qualified to do so, in order to build up the number of voles to a level where it is considered that the population can be self-sustaining on their release.

9.4 Minimising effects of habitat fragmentation

- 9.4.1 Wherever it is reasonably practicable to do so the nominated undertaker will seek to ensure that the construction of the Proposed Scheme avoids fragmentation of water vole habitat, which has the potential to result in adverse effects on the functioning of the water vole population of the wider local area.
- 9.4.2 The potential for fragmentation will be considered during mitigation design. In extreme situations where it is not reasonably practicable to maintain the viability of severed fragments of a population affected by the Proposed Scheme then the nominated undertaker will consider the trapping of water voles from isolated fragments of habitat outside the extent of Proposed Scheme in order to allow the full population to be relocated to the same receptor site, and maintain its viability in the long term.
- 9.4.3 All culverts will be designed to be suitable to allow passage for mammals such as otter and water vole, taking into account flood events, or will have an alternative dry tunnel installed.

Management, maintenance and monitoring

- 9.4.4 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 9.4.5 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.
- 9.4.6 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

10 White clawed crayfish

10.1 Key principles

- 10.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term significant adverse effects on the conservation status of white clawed crayfish populations in the vicinity of the Proposed Scheme.
- 10.1.2 Where it is reasonably practicable to do so, bank and channel works will be conducted in small sections, with progressive reinstatement to limit the reduction in the availability of suitable habitat. In addition measures will be implemented to prevent siltation and pollution of watercourses.
- 10.1.3 Where it is necessary to conduct works in areas where white clawed crayfish are confirmed to be present, the nominated undertaker will seek to provide replacement suitable habitat in close proximity to the areas of habitat affected (within a few hundred metres) and within sections of the same watercourse (or tributaries of it) that are already used by individuals of the same population. Such provision will be made in advance of the proposed works, allowing any crayfish captured during clearance works to be released into these locations. In doing so the aim will be to avoid any long term effect on the conservation status of the population concerned.

Capture and exclusion

- 10.1.4 Where required crayfish removals will consist of a combination of both trapping and destructive searching of potential refuges prior to construction, and controlled draw-down under ecological supervision. Works would be conducted according to the key principles identified in Peay (2000)¹⁵ which include the following:
- undertaking trapping and destructive clearance of refuges immediately in advance of the proposed works;
 - retention of stones suitable for use during restoration;
 - where possible erect a temporary barrier to prevent access from adjoining sections of the channel which are not subject to works;
 - ecological supervision throughout draw-down to catch crayfish as they emerge from refuges;
 - destructive clearance of all structures and habitats suitable for possible use by crayfish on completion of draw-down; and
 - relocate crayfish to identified receptor site as soon as reasonably practicable.
- 10.1.5 Exclusion of crayfish from construction areas will be conducted during the suitable seasonal windows of either April or from July to October inclusive (Natural England, undated)¹⁶. Current best practice guidance for disease screening and biosecurity will be implemented at all times.

¹⁵ Peay, S. (2002). *Guidance on Habitat for White Clawed Crayfish and its restoration*. Environment Agency Technical Report W1-067/T.

¹⁶ Natural England (undated). Standing Advice Species Sheet: White Clawed Crayfish. http://www.naturalengland.org.uk/Images/Crayfish_tcm6-21618.pdf Accessed on 21/09/2013

Aquatic habitat creation and restoration

- 10.1.6 Where an adverse effect is anticipated on white clawed crayfish then the requirement for creation of replacement habitat in close proximity on the same watercourse will be considered, in order to provide an appropriate receptor site.
- 10.1.7 Where enhancement of existing habitat is undertaken this will seek to achieve the following in order to provide suitable habitat to support crayfish:
- improved water quality;
 - reduced siltation;
 - increased refuge availability;
 - removal of any alien crayfish; and
 - more appropriate type and structure of aquatic and bankside vegetation.
- 10.1.8 All enhancement works will be completed prior to the commencement of the clearance of affected habitat. Suitable measures for each location where such works are required would be agreed in conjunction with Natural England and the Environment Agency prior to the commencement of construction.
- 10.1.9 Where additional refuges are provided these will be of sizes to support both adults and juveniles, and may be provided through a variety of measures including provision of stone on the bed or in banks; engineering suitable crevices into below water man-made structures; and additional wood or vegetation along the banks.
- 10.1.10 Once construction works have been completed, where compatible with the design and operation of the Proposed Scheme, areas of habitat affected by the construction of the Proposed Scheme will be reinstated so that the bank and channel are suitable for white clawed crayfish.
- 10.1.11 If the use of an 'ark site' is deemed necessary, then a suitable site will be selected in consultation with relevant consultees in accordance with the guidance provided in *Ark sites for white clawed crayfish - guidance for the aggregates industry (Whitehouse et al 2009)*³⁷.

Avoiding and mitigating effects during construction phase

- 10.1.12 During the construction phase where white clawed crayfish are known to be present the following measures will be implemented as appropriate with the aim of avoiding or mitigating adverse effects which could occur during construction:
- security lighting to be directed away from riverbanks and watercourses;
 - chemicals to be stored as far away from watercourses as possible;
 - monitoring to ensure no adverse siltation of downstream locations;
 - reducing disturbance to riverbank;
 - maintaining existing water levels and water flow; and

³⁷ Whitehouse, A.T., Peay, S. and Kindemba, V. (2009). *Ark sites for White-Clawed Crayfish - Guidance for the aggregates industry*. Buglife - The invertebrate Conservation Trust, Peterborough.

- reducing removal of bankside vegetation and trees.

10.2 Management, maintenance and monitoring

- 10.2.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 10.2.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.
- 10.2.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

11 Fish

11.1 Key principles

- 11.1.1 The nominated undertaker will ensure that mitigation and compensation provided for fish populations affected by the proposed scheme will seek to ensure no permanent significant adverse effects occur.
- 11.1.2 The extent of areas affected by culverts, watercourse realignment and dewatering will be reduced as far as reasonably practicable. In addition, where reasonably practicable, works will be sensitively timed in order to minimise impacts on the species concerned.

11.2 De-watering

- 11.2.1 Where dewatering is required to facilitate construction then current best practice methods will be implemented to ensure that all fish from such areas are safely removed and relocated. The capture methodology utilised will take into account the physical features of the water course involved; the species involved; likely numbers; and timing of proposed works. The final methodology will be agreed with the Environment Agency.
- 11.2.2 Permits will be obtained from the Environment Agency for all fish movements undertaken in support of the Proposed Scheme. This process includes the requirement for disease screening.

11.3 Fish passage

- 11.3.1 Where reasonably practicable temporary diversions will be utilised to maintain the safe passage of fish and reduce effects during construction. Where appropriate this may involve the creation of a temporary diversion channel with suitable sized replacement substrate or transplanted substrate from the section being dewatered in order to ensure that the size and flow in the diversion channel replicates the existing channel as closely as possible.
- 11.3.2 Reinstated watercourses and new alignments will be designed where reasonably practicable to provide habitats of increased complexity and quality.
- 11.3.3 If potential significant effects on fish populations are identified as a consequence of potential restrictions to fish movement then the potential to provide fish passage will need to be reconsidered. However, no such measures are currently proposed. If required the fish passages will be designed to facilitate the upstream and downstream movement of fish and other aquatic fauna.

11.4 Mitigation during construction

- 11.4.1 During the construction phase activities that may pose a temporary threat to fish (in particular migratory species) or disturb them will be mitigated against. These will include some or all of the following:
- artificial lighting directed away from water surfaces during construction/operation of scheme;

- chemicals to be stored as far away from watercourses as reasonably practicable; and
- activities that may cause pollution and sedimentation will be controlled by approved measures.

11.5 Management and maintenance

- 11.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 11.5.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

12 Invertebrates

12.1 Key principles

- 12.1.1 The nominated undertaker will ensure that mitigation and compensation provided for aquatic and terrestrial invertebrate populations affected by the proposed scheme will ensure no permanent adverse effect on the aquatic and terrestrial invertebrate populations in the vicinity of the Proposed Scheme.
- 12.1.2 Given the wide range of protected and/or notable invertebrate species it is not possible here to provide specific mitigation principles for all species. Instead broad principles are provided that will apply to the majority of aquatic and terrestrial invertebrate species. In all cases where significant effects are identified then specific mitigation proposals will be developed that reflect the limited ecological niche occupied by many invertebrate species.
- 12.1.3 Potential significant effects on protected and/or notable species will be reduced by wherever reasonably practicable ensuring that at least some areas of the existing suitable habitat for the species concerned is retained to provide a 'source' to colonise areas of mitigation/compensatory habitat to be provided.
- 12.1.4 In addition where reasonably practicable to do so, suitable compensatory habitat provided to address significant effects will be created as early as possible within the project programme in order to maximise time available for these areas to establish in advance of losses. Such provision would where reasonably practicable be provided in suitable proximity to allow an element of natural dispersal of the species concerned prior to any habitat loss as a consequence of the Proposed Scheme.
- 12.1.5 Compensatory habitat provision provided to address significant effects on invertebrates will in general look to mimic the structure and form of the existing nearby habitats which support the population concerned.
- 12.1.6 Where reasonably practicable to do so some plant material or elements of the areas affected may be transferred to the area of mitigation/compensatory provision in order to increase the likelihood that the target species will occupy the new habitat areas provided (e.g. the transfer of standing dead wood from ancient woodlands to be lost where this habitat element is known to play an important part in the lifecycle of the species concerned; or the transfer of water or aquatic vegetation to speed the establishment of aquatic invertebrate populations in newly created ponds).
- 12.1.7 In addition the following measures would be implemented where it is reasonably practicable to do so:
- conducting clearance of affected habitats at an appropriate time of the year based on the life-cycle of the species concerned; and
 - retaining elements of suitable habitat for the species concerned as long as reasonably practicable during construction in order to maximise the potential for newly created habitats to become established.
- 12.1.8 Habitat creation to be provided for other primary purposes (i.e. not specifically to address significant effects on invertebrates) will in the longer term also serve to provide habitat suitable for a range of invertebrate species.

12.2 Management and maintenance

- 12.2.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 12.2.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

13 Birds

13.1 Key principles

- 13.1.1 The nominated undertaker will ensure that where reasonably practicable the Proposed Scheme will avoid permanent significant adverse effects on birds, including those species listed in Schedule 1 of the Wildlife and Countryside Act (1981 as amended)¹⁸.
- 13.1.2 Due to the scale and complexity of the Proposed Scheme it will not be feasible to avoid all such impacts and as such mitigation and/or compensation will be provided where in the absence of this provision there is the potential that a significant adverse effect may arise.
- 13.1.3 Where there is a significant reduction in the availability of nesting or roosting habitat as a consequence of the Proposed Scheme then consideration will be given to the requirement for specific mitigation and or compensation in relation to birds, i.e. in addition to those ecological mitigation/compensation measures that will mitigate impacts on birds population but for which they are not the primary purpose.
- 13.1.4 Wherever is reasonably and practicable to do so habitat clearance will be conducted outside of the periods where the species or species concerned will be breeding. Through sensitive timing of works it is aimed to reduce disturbance of birds, and the potential for wasted breeding effort.
- 13.1.5 The loss of potential breeding habitats from within land required for the construction of the Proposed Scheme will as a general rule be addressed in the long term through the replacement habitat provided for landscaping and ecology purposes. Where there is the potential for additional adverse effects to occur prior to these habitats maturing then the option of providing alternative suitable habitat will be considered.
- 13.1.6 Evidence suggests that mortality of barn owl may result in the loss of all breeding populations of barn owls within 1.5km of the Proposed Scheme. As a consequence to address these losses opportunities to provide barn owl nesting boxes in areas greater than 1.5 km from the route will be explored with local landowners to enhance barn owl populations in existing habitats that would not be affected by the Proposed Scheme.

13.2 Management and maintenance

- 13.2.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 13.2.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

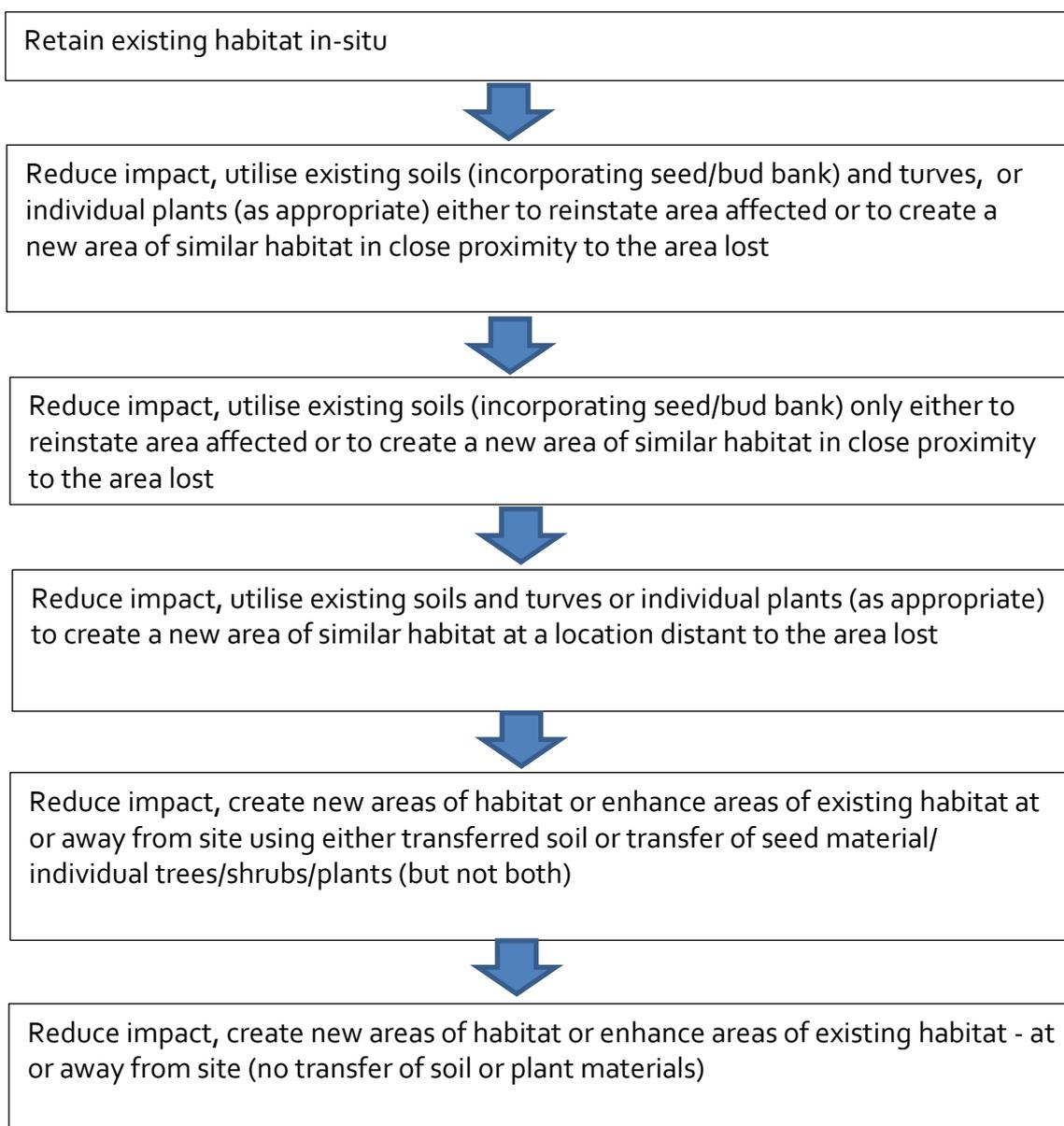
¹⁸ Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office, London.

14 Habitats

14.1 Key principles

- 14.1.1 The nominated undertaker will seek to ensure that at the route-wide level impacts on habitats as a consequence of the Proposed Scheme will not result in a permanent significant adverse effect on the conservation status of the habitats concerned.
- 14.1.2 The following mitigation hierarchy will be applied in considering the most suitable approach to mitigating potential habitat loss:

Figure 5: Mitigation hierarchy for habitats



Translocation

- 14.1.3 Translocation of habitats is a costly process and does not always provide a habitat that is of higher value than that which can be reached through alternative approaches. As such it would not be reasonable or practical, for example, to undertake translocation of all grassland areas affected by the scheme. As a consequence in the consideration

of the hierarchy for each site the following factors will be considered in deciding at which level in the hierarchy it is most appropriate to provide mitigation/compensation provision:

- ecological value/distinctiveness of habitat type;
- designation status;
- size;
- condition;
- nature of available receptors sites (e.g. topography, drainage, underlying soil type and species composition);
- likely content and condition of the seed bank; and
- ease and speed of recreating a similar habitat type through alternative means.

14.1.4 Where there is the potential for significant adverse effects on habitats of high ecological value then translocation of the affected area may be justified. Where translocation is considered to be justified then it will be necessary to determine the most suitable form of translocation for the habitat type and area concerned. There are four main alternative types of translocation as follows (Anderson 2003¹⁹ and JNCC 2003²⁰):

- turf translocation (i.e. where an effort is made partially maintain the integrity of the vegetation layer during the transfer, keeping the vegetation layer and the mass of underlying soil separated);
- soil translocation (where both the soils and the vegetation and scraped up and transferred together with no effort made to separate the two);
- moving trees and shrubs; or
- moving individual plants.

14.1.5 The most appropriate method of compensating for the loss of habitats of ecological value will be considered on a site by site basis taking into account the nature and value of the habitats involved and the financial and other practical implications associated with each of the above methods.

14.1.6 Where translocation is undertaken the turves, soil or plants should be stripped and transferred to the receptor site immediately unless there are clear practical reasons for delay. Storage will increase risk of failure, but where necessary in the short term will be conducted according to best practice guidance (Anderson, 2003).

14.1.7 Detail of proposed translocation strategies for each site will be drawn up by ecologists experienced in works involving the translocation of the habitats concerned, with reference to current best practice guidance (e.g. Anderson, 2003).

¹⁹ Anderson, P. (2003). *Habitat translocation: a best practical guide*. CIRIA, London.

²⁰ Joint Nature Conservation Committee (2003). *A habitats translocation policy for Britain*. JNCC, Peterborough.

Receptor sites

- 14.1.8 When translocating a habitat the process will be dependent upon the suitability of the chosen receptor site. Efforts have been made to select receptor sites that are compatible with the target habitat types concerned based on comparison of the following factors:
- hydrological conditions;
 - soil type;
 - topography;
 - connections to other ecological habitats; and
 - size of site; and
 - accessibility.
- 14.1.9 In all cases prior to translocation soil sampling and works to establish ground water levels should be undertaken and used in the detailed design of mitigation areas. In addition in some instances trials may be necessary in order to establish the content and viability of the seed bank.
- 14.1.10 Where identified receptors sites are not fully compatible with the target community then remedial works will be undertaken to ensure that the surrounding, physical, chemical and hydrological soil and substrate conditions are similar or more suitable than those at the donor site.

14.2 Key habitat types

- 14.2.1 A wide range of habitats will be affected by the Proposed Scheme. Further details are provided here in relation to four key habitat types that will be subject to significant effects as a consequence of the Proposed Scheme. There will be many parallels in the approach adopted for other habitats.
- 14.2.2 Where it is not reasonably practicable to mitigate the impact of local habitat loss in-situ then opportunities will be taken to consolidate compensation provision as parts of larger scale habitat creation areas. All such compensation areas would be provided in close proximity to the route, where it is reasonably practicable to do so.

Woodland

- 14.2.3 Where areas of woodland habitat are affected by the Proposed Scheme the most appropriate form of mitigation has been decided through consideration of the factors identified in paragraph 14.1.3. For woodland areas in particular the consideration of the likely time-lag to establishment and the distinctiveness of the habitat type concerned are likely to be key drivers that mean that translocation is undertaken at some locations.
- 14.2.4 The nominated undertaker recognises that creation of newly planted woodland and translocation of ancient woodland habitat components cannot be considered as mitigation for these impacts. Ancient woodland in its entirety cannot be translocated and as a consequence it is recognised as irreplaceable within the time frame of the Proposed Scheme.

- 14.2.5 However, in order to provide compensation in the long term (outside the timeframe of the Proposed Scheme) the translocation of ancient woodland soils will be undertaken. In addition new areas of woodland that will be created will be targeted at providing new areas of habitat of principal importance as defined under Section 41 of the Natural Environment and Rural Communities Act (1996)²¹.
- 14.2.6 Where translocation is identified as being a reasonable and worthwhile approach for the habitat area concerned then for woodlands this may involve implementation of one or more of the following measures, as appropriate:
- soil translocation;
 - translocation of veteran trees;
 - translocation of coppice stools, and other small trees; and/or
 - translocation of fallen or standing deadwood.
- 14.2.7 Translocation of some or all of the above elements of ancient woodland will enable some of the valuable elements of the existing ancient woodland ecosystems to be retained within the newly created areas.
- 14.2.8 Soil testing and seed viability trials will be conducted prior to translocation at all locations identified in order to ensure that conditions are suitable.
- 14.2.9 The nature of wet woodland means that the methods of translocation differ from that for dry woodlands. Where translocation of wet woodland is proposed the mechanisms and logistics of translocation will have particular emphasis on the consideration of the hydrological, hydrochemical and hydrogeological conditions. In addition the gradient of the land and flooding probability will be explored in detail in order to ensure that the donor site is sufficiently inundated to maintain wet woodland habitat.
- 14.2.10 Woodland translocation should take place in the dormant season in autumn/early winter under normal weather conditions.
- 14.2.11 Where translocation is not a justifiable option based on the factors identified in paragraph 14.1.3 then new woodland habitat will be created.
- 14.2.12 In all cases planting will only utilise native species that are characteristic and appropriate to the area concerned. Both areas of new woodland habitat creation, and those translocated should be planted as early as practicable within the project programme.

Grasslands

- 14.2.13 Where translocation of grassland areas of high ecological value is justified and reasonably practicable then the most suitable method of translocation (as identified in paragraph 14.1.4) will be considered, taking into account the generic factors identified at paragraph 14.1.3.
- 14.2.14 The translocation of turves will normally be the preferred option. However, for grassland areas the cohesiveness of the sward will also be taken into account. Turf translocation will not be reasonably practicable where turf contains significant

²¹ *Natural Environment and Rural Communities Act (1996) Chapter 16. Her Majesty's Stationery Office, London.*

elements of bare ground or lacks turf cohesiveness (Anderson, 2003). In addition it may not be possible to utilise turf translocation where steep slopes or undulating ground are present.

- 14.2.15 Where soil translocation is proposed, prior to translocation a selection of seed bank tests will be conducted in order to test the viability and content of the existing seed bank.
- 14.2.16 Where wet or marshy grassland are to be translocated then specific focus will be given to ensuring that the hydrological regime of the receptor site is manipulated in order that it provides suitable groundwater conditions to support the target habitat in question.
- 14.2.17 The detailed mechanics of each translocation will be influenced by best practice guidance (e.g. Anderson, 2003) in consultation with experienced ecologists, and contractors experienced in large scale habitat translocation.
- 14.2.18 Where translocation is not justified or reasonably practicable taking into consideration the factors outlined in paragraph 14.1.3, compensatory grassland will be provided through the preparation and sowing of a suitable area. Such areas will be targeted at providing new areas of habitat of principal importance as defined under Section 41 of the Natural Environment and Rural Communities Act (1996).
- 14.2.19 In all such cases efforts will be made to ensure that areas identified for provision of grassland habitat creation are compatible with the target community identified. This as a minimum will include consideration of topography, drainage, aspect, and underlying soil type.
- 14.2.20 Only native species will be utilised and seed mixes will aim to broadly mimic the species composition of those areas to be lost. Where enhancement of the sward is proposed through the provision of a more diverse sward than was present previously only native species which are characteristic to the local area will be utilised. Where reasonable and worthwhile to do so, the collection of seed and/or plants from suitable donor sites will be considered.
- 14.2.21 Grassland compensation areas will be planted as early as is reasonably practicable within the construction programme in order to allow maximum time for them to establish prior to the losses associated with the Proposed Scheme.

Heathland

- 14.2.22 The only areas of heathland that will be affected by the Proposed Scheme are those at Whittington Heath Golf Course Site of Borough Importance (SBI). Based on the ecological value of this habitat and the good chances of success at least some of the areas to be lost will be subject to translocation.
- 14.2.23 As for grasslands, the method of translocation and detailed mechanics will be devised by experienced ecologists in combination with contractors that have experience in undertaking heathland/acid grassland translocation.

Hedgerows

- 14.2.24 The translocation of specific hedgerows will be considered where the age, diversity and structure of these features is such that their loss as individual features will result in

significant adverse effects. In addition translocation of hedgerows may be undertaken where there are benefits for other protected species resulting from reducing the lag time for linear features to establish.

- 14.2.25 Where justified, translocation will be undertaken according to current best practice guidance, with detailed mechanisms for these works devised by experienced ecologists, in conjunction with contractors that are experienced in undertaking such works.
- 14.2.26 In order to mitigate for the wider loss of hedgerow habitat, and the associated fragmentation of the existing hedgerow network the undertaker will (where design of the Proposed Scheme and other practical considerations allow) replace those hedgerows which are lost.
- 14.2.27 Reinstatement will utilise species of native provenance and where reasonably practicable will aim to provide hedgerow networks containing a wider range of appropriate native species than are currently present.

14.3 Management and maintenance

- 14.3.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.
- 14.3.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

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HS2 London-West Midlands

Ecology

Technical note – Methodology for demonstrating no net loss in biodiversity

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 Purpose of this document

1.1.1 The UK Government is committed to halting overall loss in biodiversity by 2020. In line with government policy, High Speed Two Limited (HS2 Ltd) is seeking to ensure that the Phase One London and West Midlands route of the proposed High Speed 2 (HS2) railway (hereafter referred to as the Proposed Scheme) results in no net loss in biodiversity at a route-wide level.

1.1.2 Demonstrating no net loss to biodiversity represents a significant challenge to a large project such as HS2 London-West Midlands (LWM). This document sets out the approach that HS2 Ltd proposes to use to compare biodiversity losses and gains, as a consequence of the Proposed Scheme.

1.2 Biodiversity offsetting

1.2.1 Biodiversity offsets are conservation activities designed to deliver biodiversity benefits in compensation for losses, in a measurable way¹. Offsetting methodologies compare the losses resulting from the impact of a development with the gains achieved through the provision of offsets, thus aiming to provide a transparent mechanism by which the impacts of a development can be quantified, and an appropriate level of compensation agreed.

1.2.2 Biodiversity in its entirety is impossible to measure so offsetting utilises a 'metric' to represent, and provide a measure of, overall biodiversity (Defra 2012b)². Metrics are surrogates³, or combinations of measurements, that together provide an assessment of the biodiversity value of a particular area (Defra, 2012b). The metric allows the biodiversity impact of a development to be quantified so that the offset requirement, and the value of the compensatory action, can be clearly defined. Metrics are transferable between sites and habitats, allowing an impact on one habitat type to be offset with conservation action elsewhere, or involving a different habitat type and/or quality of habitat (Defra, 2012b).

1.2.3 Use and further development of offsetting methodologies is considered vital to ensuring that the planning system secures meaningful compensation which can contribute to the Government's commitment to expand and restore the ecological network in England, and to halt overall biodiversity loss by 2020⁴.

1.3 Position within the mitigation hierarchy

1.3.1 In seeking to minimise the effects of the Proposed Scheme on biodiversity, the 'mitigation hierarchy' outlined in Figure 1 will be applied.

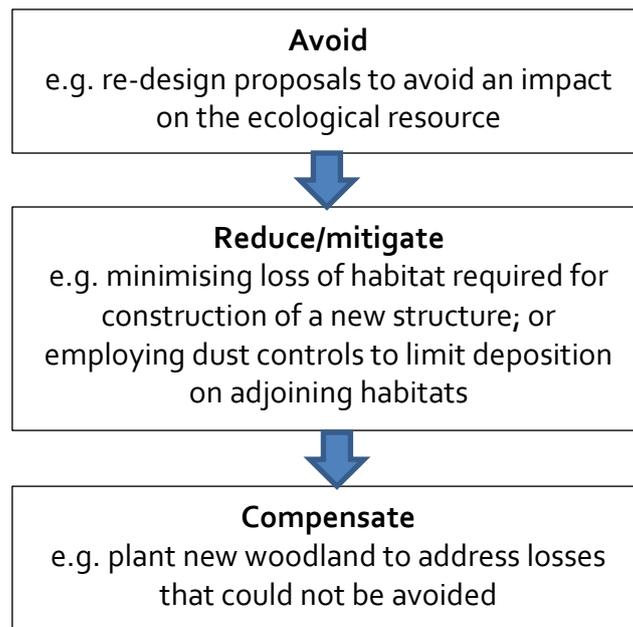
¹ Defra (2012a), *Biodiversity Offsetting Pilots: Information note for Local Authorities*.

² Defra (2012b), *Biodiversity Offsetting Pilots: Technical Paper: the metric for the biodiversity offsetting pilot in England*.

³ Surrogates are measurements that act as substitute for a complete measurement of the total biodiversity found within a particular area.

⁴ Defra (2011), *Biodiversity 2020: A strategy for England's wildlife and ecosystem services*.

Figure 1: Mitigation hierarchy



- 1.3.2 Offsetting (and the use of offsetting metrics) represents a method of defining an acceptable level of compensatory provision. It occupies a position at the bottom of the mitigation hierarchy, providing the opportunity to quantify compensation, when it has been determined that compensation is required. It does not represent an alternative to the normal application of the mitigation hierarchy. In all cases the earlier stages in the mitigation hierarchy should be considered sequentially before the end point of a requirement for compensation, and thus a need to adopt an offsetting approach is reached.
- 1.3.3 Where it is accepted that reasonable efforts have been made to explore alternatives during the design process, and the mitigation hierarchy has been applied then the offsetting metric outlined in this document will be utilised to compare the losses and gains in biodiversity that occur as a consequence of the Proposed Scheme.
- 1.3.4 The approach advocated in the following document should be considered in this context and separated from considerations associated with the avoidance, reduction and mitigation aspects of the hierarchy, which will have been explored in depth independently at earlier stages in the process.

1.4 Defra offsetting pilot

- 1.4.1 The development of a consistent framework for biodiversity offsetting was identified as a priority in the Natural Environment White Paper⁵ (2011). In line with this goal, in April 2012 Defra launched a two-year pilot study to trial the use of offsetting in six test areas. The pilot is based upon use of a habitat based 'metric' for considering losses and gains in biodiversity.
- 1.4.2 The approach involves measuring each area of habitat present before the development against pre-defined scales based on 'distinctiveness' and 'condition'. The scores obtained are then multiplied to give a number of biodiversity units per hectare, and adjusted on the basis of the area of that habitat type present.

⁵ HM Government (2011), *The Natural Choice: Securing the value of nature*. HMSO, London.

1.4.3 For example a development will result in the loss of 6 hectares of lowland meadow in moderate condition (further details of the scoring system are provided in Section 3). The number of biodiversity units is calculated as follows :

$$\begin{aligned} & \text{Distinctiveness score (6) x habitat condition score (2) x habitat extent (6)} \\ & = 72 \text{ biodiversity units} \end{aligned}$$

1.4.4 This step is then repeated for each habitat area within the extent of the development to calculate the number of biodiversity units that will be lost.

1.4.5 The calculation as a whole is then repeated to consider the number of biodiversity units that will be provided by the habitat creation or habitat restoration which has been committed to as part of the proposed development. This calculation considers the extent, distinctiveness and target condition for proposed habitats and a series of multipliers are utilised to ensure the compensation strategy takes into account spatial, temporal and delivery risks associated with the provision of the replacement habitats.

1.5 Biodiversity offsetting and HS2 LWM

1.5.1 The Defra offsetting pilot methodology is considered to represent the best available basis for an offsetting methodology that will allow the biodiversity losses and gains of the Proposed Scheme to be robustly assessed. However, a number of amendments to the published pilot methodology are considered necessary to address feedback that has arisen from use of the methodology within the pilot areas, and to ensure that it is suitable for use in support of a landscape scale project.

1.5.2 The key amendments to the Defra pilot methodology which are proposed are:

- a. adding an additional 'very high' score under habitat distinctiveness to take account of those habitats of principal importance identified in Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)⁶ which cannot be adequately re-created if lost;
- b. Increasing the distinctiveness score attribute to all habitats that form part of an area that qualifies as the habitat of principal importance type open mosaic habitat on previously developed land. Thus ensuring the value of these habitats is fully recognised within the calculation;
- c. removing the application of a variable condition weighting for habitats of low distinctiveness - all low distinctiveness habitats will instead automatically attract a condition weighting of 'poor', thus recognising that condition has negligible effect on the overall value of those habitats which are intrinsically of low distinctiveness;
- d. incorporating greater consideration of the importance of both habitats lost and gained (in relation to the function of ecological networks) into the spatial risk multipliers, in order to recognise the landscape scale of the project and its impacts; and
- e. removing the blanket one-step restriction on the change in condition and replacing this with the condition that for high distinctiveness target habitats a maximum future target condition of moderate can be claimed.

⁶ Natural Environment and Rural Communities Act (2006) Chapter 16. Her Majesty's Stationery Office, London.

- 1.5.3 Details of how these amendments have been incorporated into the metric for the Defra pilot methodology are provided in Sections 2 , 3 and 4 of this report.
- 1.5.4 HS2 Ltd intends to utilise the methodology contained within this report to calculate and compare the likely biodiversity losses and gains that will occur as a consequence of the Proposed Scheme. In doing so, it will seek to demonstrate in a transparent manner the current position that HS2 LWM has reached in relation to its commitment to seek no net loss of biodiversity at the route-wide level.
- 1.5.5 The post-development calculation will include consideration of the bespoke areas of ecological compensation to be provided, areas of planting which have been primarily provided to address landscaping considerations, and those habitats that will form part of the operational railway (e.g. cutting slopes). Both spatial risk and delivery risk multipliers will be applied to address the inherent uncertainty involved in habitat creation. These multipliers will serve to temper the number of biodiversity units that can be achieved through the creation of habitats where there is an increased risk of failure.
- 1.5.6 The focus of ecological compensation for habitat losses to be provided by the Proposed Scheme will be the provision of areas of habitat of principal importance in a manner that will contribute to the 'more, bigger, better' ideals identified in Making Space for Nature (Lawton, 2010)⁷.
- 1.5.7 While an offsetting metric has been used as the means of comparing habitat losses and gains as a consequence of the Proposed Scheme, it is the intention of the project to delivering the new habitats through powers under the hybrid Bill rather than via the establishment of formal offsetting agreements with third parties. The use of formal offsetting agreements with third parties is not envisaged to deliver any of the required measures at this stage, although such agreements may be required to deliver additional measures should these be required.
- 1.5.8 In all cases where impacts on Sites of Special Scientific Interest (SSSI) occur as a consequence of the Proposed Scheme the requirements for mitigation and compensation have been discussed with Natural England, and will be agreed on a site by site basis (as they would be in the absence of an offsetting approach). This process has followed standard implementation of the mitigation hierarchy.
- 1.5.9 For completeness, the final compensation package agreed with Natural England for each SSSI will be scored on the basis of the metric outlined in this document and will be included as part of the calculations to be undertaken to consider the balance of losses and gains at the route-wide level.
- 1.5.10 As the offsetting metric is not being used to drive the level of compensation provided for impacts on SSSI, the inclusion of habitats falling within SSSI within the offsetting calculation is not considered to condone impacts on SSSI, nor act to contradict current planning guidance or Natural England processes for dealing with these impacts.

⁷ Lawton J (Chair) (2010), *Making Space for Nature: A review of England's Wildlife Sites and Ecological Network*. Report to Defra.

2 Units within the metric

2.1 Habitat parcels

2.1.1 The metric to be utilised for HS2 LWM represents a modified version of the Defra pilot methodology, and will predominantly utilise habitat parcels as the basis for comparing losses and gains in biodiversity as a consequence of the Proposed Scheme.

2.1.2 Phase 1 habitat survey and National Vegetation Classification (NVC) data (where available) will be utilised to identify all habitats parcels that meet one of the following criteria:

- habitats located within the extent of the land required for the construction of the Proposed Scheme⁸;
- habitats located within the extent of any areas proposed for habitat creation or habitat enhancement (where these lie outside the boundaries of the land required for the construction of the Proposed Scheme); and
- areas of habitat outside the land required for the construction of the Proposed Scheme where the Environmental Statement (ES) identifies that the habitat is likely to be subject to adverse effects considered to be significant at the district/borough level or above⁹ as a consequence of the Proposed Scheme.

2.1.3 Each habitat parcel which meets one of the criteria identified in paragraph 2.1.3 will be allocated a weighted score on the basis of each of the following criteria:

- habitat distinctiveness;
- habitat condition; and
- position within ecological network.

2.1.4 The modified metric will be used to calculate the number of biodiversity units afforded to the habitat parcels that will be affected by the Proposed Scheme. This total will subsequently be compared with the number of biodiversity units that are achieved by habitat parcels present post-development.

Arable field margins

2.1.5 Arable field margins specifically managed for wildlife and likely to qualify as the habitat of principal importance type arable field margins are infrequent across the route of the Proposed Scheme. Where field survey or interpretation of aerial photographs identifies the presence of margins that may qualify, then a standard width of 10m will be used to provide an estimate of the number of biodiversity units that are contributed by such features.

2.1.6 For all other arable fields falling within the scope of the pre-development calculations it will be assumed that an uncultivated arable margin of 1m width and moderate distinctiveness is present. Such features are too small to map accurately but given the

⁸ The land required for the construction of the Proposed Scheme is defined as the combined extent of all areas of land required either temporarily during construction or permanently during operation.

⁹ The significance of effects described in the ecological impact assessment of the Proposed Scheme follows the methodology set out in: Institute of Ecology and Environmental Management, (2006), *Guidelines for Ecological Impact Assessment in the United Kingdom*. IEEM, Winchester.

scale of the Proposed Scheme could contribute a significant number of biodiversity units at the route-wide level.

- 2.1.7 The biodiversity units generated by arable field margins will be considered as part of the overall biodiversity units score generated by habitat parcels.

2.2 Linear features – hedgerows and watercourses

- 2.2.1 Hedgerows and watercourses will be considered as linear features and each will form a separate aspect of the offsetting calculation.
- 2.2.2 Both hedgerows and watercourses will generate their own number of biodiversity units pre- and post-development. Due to the unique nature of both habitat types it will only be suitable to offset losses on these habitat types through the provision of the same habitat type (i.e. loss of hedgerow can only be offset by creation of more hedgerows).
- 2.2.3 Losses and gains will generate biodiversity units based on the length of hedgerow or watercourse lost or gained. Other multipliers will be utilised where applicable, and in order to ensure clarity, consideration of hedgerows and watercourses as part of the calculation is covered separately in this document.

3 Calculating pre-development biodiversity units

3.1 Habitat distinctiveness

- 3.1.1 Habitat distinctiveness will be scored against a five category scale as detailed in Table 1.
- 3.1.2 Under the Defra pilot methodology all areas of habitat of principal importance fall within a 'high' category which scores a weighting of 6. Under the HS2 LWM methodology this category has been sub-divided to create a new 'very high' distinctiveness category, which will score a weighting of 8.
- 3.1.3 The 'very high' category will be utilised for all examples of habitat of principal importance present prior to development that cannot be adequately re-created if lost. For the Proposed Scheme this category will cover semi-natural ancient woodland, mature heathland and lowland fen.
- 3.1.4 The 'very high' category will not be used in the post-development calculation (see Section 4.2) (i.e. the maximum target distinctiveness weighting available post-development will be 6) in order to acknowledge that such habitat types (including ancient semi-natural woodland) are irreplaceable and losses cannot be addressed within the timeframes of the offsetting calculation. The undertaker will continue to adopt best practice measures to translocate the soils and seed/bud bank from such habitats, in order to give the best possible chance of providing similar habitat in the long term.
- 3.1.5 This approach in relation to irreplaceable habitats is considered acceptable taking into account the position that offsetting occupies within the mitigation hierarchy (i.e. after due consideration of avoidance, reduction and mitigation measures).

Table 1: Habitat type bands

Distinctiveness	Habitats types included	Weighting
Very high	<p>Habitats of principal importance (Tier 1)</p> <p>This category consists of habitats meeting habitat of principal importance definition and which cannot be adequately re-created if lost.</p> <p>Habitats occurring within the HS2 LWM route which fall into this category are as follows³⁰:</p> <p>Ancient semi-natural woodland;</p> <p>Mature lowland heathland;</p> <p>Lowland fen.</p> <p>N.B. Plantation on ancient woodland should be considered to fall under the 'high' distinctiveness category.</p>	8

³⁰ Mature heathland and lowland fen are included here as a precaution due to their known occurrence within proximity to the land required for the construction of the Proposed Scheme.

Distinctiveness	Habitats types included	Weighting
High	Habitats of principal importance (Tier 2) i.e. those which meet the criteria ¹¹ to qualify as habitats of principal importance but do not qualify under the definition for 'very high' category above.	6
Moderate	Other semi-natural habitats that do not fall within the scope of habitats of principal importance definitions, i.e. all other areas of woodland (e.g. non-native coniferous plantation), other grassland (e.g. species poor semi-improved), uncultivated field margins, road verge and railway embankments (excluding those that are intensively managed).	4
Low	Improved grassland, arable fields (excluding any uncultivated margins), built up areas, domestic gardens, regularly disturbed bare ground (e.g. quarry floor, landfill sites etc.), verges associated with transport corridors.	2
None	Transport corridors (without associated verges), landfill sites, spoil heaps.	0

- 3.1.6 Phase 1 habitat survey and National Vegetation Classification (NVC) (where available) data will be utilised as the basis for allocating a distinctiveness score to all habitats parcels that meet the criteria outlined in paragraph 2.1.2.
- 3.1.7 Where Phase 1 habitat data collected during field surveys in support of the Proposed Scheme are available, this data will be utilised. Where no field survey information is available, gaps should be filled utilising either Phase 1 habitat data derived from aerial photography analysis or through use of Phase 1 habitat data derived from habitat inventories (where available).
- 3.1.8 The categories utilised within the metric for the Defra pilot are principally aligned with the use of the Integrated Habitat System (IHS) (an alternative habitat classification methodology) which splits out habitats of principal importance from those that do not qualify under these criteria. Appendix A provides guidance to be utilised in translating Phase 1 habitat data into the habitat distinctiveness categories identified in Table 1. It aims to ensure each habitat type is broadly aligned with the guidance provided in Appendix 1 to the Defra guidance for offset providers and developers.¹²
- 3.1.9 As Phase 1 habitat categories and habitats of principal importance definitions do not always strongly correlate, in some cases a single Phase 1 habitat type could include both areas that qualify as habitats of principal importance and other areas that do not. As a consequence in allocating distinctiveness ratings it will be necessary to subdivide some Phase 1 habitat polygons for the purposes of the offsetting calculation.
- 3.1.10 Phase 1 habitat categories which are recorded as point data (e.g. scattered scrub or individual trees) will be considered on the basis of the distinctiveness rating of the underlying habitat polygon. Where the presence of a point data category is considered to add to the distinctiveness rating of the underlying habitat type (e.g. the presence of the scattered scrub within an area of ephemeral/short perennials) then the distinctiveness rating of the underlying habitat type polygon will be adjusted manually to account for this.
- 3.1.11 For those Phase 1 habitat types where more than one potential weighting score has been identified it will be necessary for an ecologist to review available habitat data

¹¹ UK BAP (2011), UK Biodiversity Action Plan – Priority Habitat Descriptions. http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf Accessed 17 August 2013.

¹² Defra (2012), Appendix 1 - Distinctiveness Bands for the Biodiversity Offsetting Pilot. <http://archive.defra.gov.uk/environment/biodiversity/offsetting/documents/1204-bio-offset-pilot-appendix.pdf> Accessed: 09 Feb 2013.

(including information from any subsequent Phase 2 surveys conducted) and allocate a score, based on the guidance provided in Table 1.

- 3.1.12 When scoring habitat polygons, consideration will be given to those locations where the combination of habitats present may fall within the definition of the habitat of principal importance 'open mosaic habitat on previously developed ground'.
- 3.1.13 Where a combination of habitat polygons are considered to collectively meet the criteria for the open mosaic on previously developed ground (habitat of principal importance type) then all habitat parcels which fall under the scope of the definition should be upgraded to a distinctiveness rating of high (6 points) (e.g. areas of tall ruderals and short ephemerals which may alone have scored 2 for distinctiveness would each be upgraded to scoring 6, while the areas of interconnecting bare ground would continue to score a 2).
- 3.1.14 The habitat definition for open mosaic habitat on previously developed ground sets a minimum threshold for this habitat type of 0.25ha. The minimum size refers to the potential open mosaic habitat which could be part of a larger site, containing other elements such as woodland or developed land.
- 3.1.15 Continuous blocks of a closed plant community greater than 0.25 ha should as a general rule be classified according to the relevant habitat category, although those containing very fine-grained mosaics might qualify under the open mosaic on previously developed ground definition.

3.2 Habitat condition

- 3.2.1 All habitat parcels classified as falling within distinctiveness bands very high, high and moderate will be rated against a three-point condition scale with reference to the Higher Level Stewardship (HLS) agri-environment scheme condition assessment tool (Natural England, 2010)⁴³ utilised within the pilot methodology.
- 3.2.2 The condition scale is basic and where it is applicable, habitat survey notes will be utilised to allocate a condition score to each habitat parcel (see Table 2 below). Where all of the stated criteria are met then a condition assessment category of good (or A rating) is given. Where one of the criteria is missed or failed then a moderate (B rating) is given, and where two or more criteria are failed/missed then a low condition (C rating) is allocated.

Table 2 Condition weighting scale

Condition score	HLS condition assessment category	Framework for those habitats which are not covered by HLS condition assessment
3	A rating	Good
2	B rating	Moderate
1	C rating	Poor

N.B A condition score of 1 will also be automatically applied to all habitats of low distinctiveness

⁴³ Natural England (2010), *Higher Level Stewardship – Farm Environment Plan (FEP) Manual – Technical guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features*. Natural England.

- 3.2.3 The HLS guidance does not cover all habitat types that fall within the scope of this assessment, and where the HLS assessment guidance (Natural England, 2010) provides no relevant criteria then professional judgement will be applied to allocate a condition score against the three-point scale. Ecologists undertaking the condition scoring will be encouraged to discuss those situations where it is necessary to apply professional judgement, and a decision log will be maintained in order to ensure such judgements are consistently applied across the route.
- 3.2.4 All habitats identified as being of low habitat distinctiveness will automatically be allocated a condition weighting of 1. This modification to the metric reflects the view that for habitats of low distinctiveness the condition of the habitat has negligible influence on the overall value of that habitat type. For similar reasons no condition rating will be applied to assumed arable field margins.
- 3.2.5 Where access has not been obtained for survey then it will be necessary to allocate a condition score based on a precautionary approach informed by professional judgement. A condition score of 3 (good) is likely to be achieved only by those habitats which are being actively managed to maximise their value for nature conservation. As a consequence, where existing data suggest that land is likely to be subject to management aimed to maximise its nature conservation value, then a score of 3 will be allocated.
- 3.2.6 As a general rule, in the absence of access to conduct survey a moderate condition (2 points) will be assumed. A condition score of poor (1 point) should be allocated where there is a very clear justification for this conclusion based on the information available.

3.3 Position within existing ecological network

- 3.3.1 A key consideration of current nature conservation policy and guidance is the goal of working towards the creation of 'bigger, better and more joined up'¹⁴ ecological networks.
- 3.3.2 While the offsetting pilot methodology considers spatial risks associated with the location of compensation provision, it does not implicitly consider the importance of the habitats lost to existing ecological networks. Based on the landscape scale of the Proposed Scheme a multiplier will be utilised in both the pre- and post-development calculations to take account of the importance of habitats lost to existing ecological networks.
- 3.3.3 Incorporating consideration of the spatial distribution of habitats both before and after development, and their potential role in the function of ecological networks is considered to represent a more accurate method of quantifying how the project as a whole will affect progress towards the Lawton Review goals of 'bigger, better and more joined up' (Lawton, 2010).
- 3.3.4 Therefore for each habitat parcel a score will be allocated based on the importance of the habitat lost for the surrounding ecological network, according to the criteria shown in Table 3.
- 3.3.5 The criteria utilised seek to acknowledge the inherent value of larger and well-connected habitat blocks, particularly those that support habitats of principal

¹⁴ Lawton J (2010), *Making Space for Nature: A review of England's Wildlife Site's and Ecological Network*.

importance. The criteria are intended as a means of ensuring these broad concepts are taken into account in the offsetting calculation. They should not be interpreted as an attempt to consider species-specific requirements within the calculation.

- 3.3.6 It is envisaged that Geographical Information Systems (GIS) software will be used to write queries to assist in the process of calculating scores relating to the position in the ecological network.

Table 3: Consideration of position within ecological network prior to development

Importance within existing ecological network	Multiplier
<ul style="list-style-type: none"> Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of more than 1ha in size¹⁵ (core habitat block') and have connectivity with other areas of semi-natural habitat¹⁶ 	3
<ul style="list-style-type: none"> Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of more than 1ha in size but have little or no connectivity with other areas of semi-natural habitat (i.e. those that do not fall under score of 3 above); Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of between 0.25ha and 1ha in size (regardless of connectivity – these are considered as 'stepping stones'); Habitat which forms part of an area of semi-natural habitat¹⁷ which provides continuous physical connectivity between existing 'core habitat blocks'¹⁸. 	2
<ul style="list-style-type: none"> Any other areas which do not meet the criteria identified for either a multiplier of 2 or 3 above. 	1

3.4 Hedgerows

- 3.4.1 For hedgerows, as the vast majority of all hedgerows will meet the definition for this habitat of principal importance type, the distinctiveness criteria will not be utilised within the calculation.
- 3.4.2 Gaps of greater than 15m will be considered to represent a break in the hedgerow. Where double hedgerows occur then the length of each constituent hedgerow will be fed into the metric.
- 3.4.3 As in the Defra pilot method the condition of each hedgerow (or hedgerow section) will be scored against a three-point condition scale (see Table 4), with reference to the guidance provided in the Higher Level Stewardship Farm Environmental Plan handbook (Natural England, 2010).

Table 4: Multiplier to be applied for condition of hedgerows and watercourses

Condition of feature lost	Multiplier applied
Good	3
Moderate	2
Poor	1

- 3.4.4 Where field survey was undertaken then notes from hedgerow surveys will be utilised to inform the scoring for habitat condition. Where no access was available for survey

¹⁵ For the purposes of the calculation where areas of habitat of principal importance are separated by gaps of non-qualifying habitat of 15m or less then these should be considered to be contiguous (unless professional judgement of an ecologist considers otherwise).

¹⁶ Based on professional judgement those core areas which have little or no connectivity with other areas of semi-natural habitat should be downgraded to a multiplier of 2 where it is considered that their lack of connectivity is likely to limit their value within the existing ecological network (e.g. for example a severed area of woodland surrounded by an arable field would be downgraded to a multiplier of 2).

¹⁷ Defined for the purposes of this calculation as any area allocated a very high, high or moderate distinctiveness score.

¹⁸ Physical connectivity is defined for this purpose as a 'continuous' corridor of moderate, high or very high distinctiveness habitat parcels. As a general rule a gap in qualifying habitat of more than 15m in extent, or a section where the minimum width of connective habitat drops below 5m in width (note hedgerows are considered as part of a separate calculation) should be considered to represent a break in connectivity.

then this will be informed solely by information obtained from aerial photographs and a precautionary approach will be adopted.

- 3.4.5 In addition to the condition score for hedgerows, a multiplier will be attributed (see Table 5) for the position in the ecological network in order to ensure that the value of the features lost within existing ecological networks are considered fully within the offsetting calculation.

Table 5: Position of hedgerow within existing network

Position within existing network	Multiplier applied
Hedgerows which under the Hedgerows Regulations (1997 ¹⁹) scoring achieves a connection score of 4 points or more ²⁰	3
Hedgerow achieving a connection score of 3 or 2	2
Hedgerow achieving a connection score of 1 point or less	1

3.5 Watercourses

- 3.5.1 For watercourses, it is assumed that all watercourses will be considered as being of high distinctiveness. As a consequence, distinctiveness multipliers are not to be used in the calculation.
- 3.5.2 For watercourses the use of the position in the network multiplier is also not considered worthwhile given that all watercourses will provide linear connectivity along their route, and that compensation will likely be provided through the realignment of the same channel. As such, position in the landscape is unlikely to change.
- 3.5.3 As a consequence the number of biodiversity units generated by the watercourses currently present would be calculated by multiplying the length (m) by a condition score using the scale shown in Table 5. This should utilise the criteria set out in the Higher Level Stewardship Farm Environmental Plan handbook (Natural England, 2010), alongside professional judgement where necessary.

3.6 Deriving the total biodiversity units present pre-development

Habitat parcels/polygons

- 3.6.1 Following the scoring of all habitat parcels for habitat distinctiveness, condition and position within existing ecological networks, the total number of pre-construction biodiversity units will be calculated for each parcel/polygon (including those assumed for arable field margins) using the following formula:
- $$\text{Number of biodiversity units generated by habitat polygon} = \text{Habitat distinctiveness rating} \times \text{habitat condition} \times \text{habitat area} \times \text{position within existing ecological network.}$$
- 3.6.2 The scores generated by each individual habitat parcel will then be summed to provide the total number of biodiversity units generated by the habitat parcels present pre-development.

¹⁹ The Hedgerows Regulations (1997) (SI 1997 No. 1160). Her Majesty's Stationery Office. London.

²⁰ Under the criteria used to define connections within The Hedgerows Regulations (1997) a connection with another hedgerow scores one point and a connection with a pond or a woodland in which the majority of trees are broadleaved trees scores 2 points; and a hedgerow is connected with something not only if it meets it but also if it has a point within 10 metres of it and would meet it if the line of the hedgerow continued.

Linear features

3.6.3 The number of biodiversity units present pre-development should be calculated for both hedgerows and watercourses.

3.6.4 The number of hedgerow units present prior to construction of the Proposed Scheme would be calculated as follows

Number of biodiversity units generated by individual hedgerow feature = length of hedgerow (m) x condition multiplier attributed x position in the network.

3.6.5 For watercourses the number of units present pre-development should be calculated as follows:

Number of biodiversity units generated by individual watercourse = length (m) x condition multiplier attributed

3.6.6 Separate totals will then be calculated for biodiversity units generated by a) hedgerows and b) watercourses present prior to development.

4 Calculating post-development biodiversity units

4.1 General

4.1.1 The post-development side of the no net loss calculation will be based upon the final design, and will incorporate consideration of the habitats that are to be created as part of the Proposed Scheme. This will include both those habitat areas to be created with the primary purpose of providing ecological compensation, and those where the primary purpose is non-ecological (e.g. planting to address landscape effects).

4.2 Habitat distinctiveness

4.2.1 For all habitat parcels to be created as part of the Proposed Scheme a target distinctiveness score will be allocated according to the 'high', 'moderate', 'low' or 'none' categories provided in Table 1.

4.2.2 Where the Proposed Scheme results in the loss of habitats that fall within the 'very high' distinctiveness band then it is acknowledged that such habitats cannot be adequately re-created within the timeframe of the project. As a consequence while habitat creation, restoration and on-going management will still seek to achieve areas of similar distinctiveness in the long term (e.g. through the translocation of ancient woodland soils), for the purposes of the post-development calculations it will not be possible to allocate distinctiveness score of very high.

4.2.3 In line with the principles set out in the Defra pilot methodology, the offsetting approach will seek to improve the extent or condition of the ecological network. Unavoidable losses of habitats within the very high distinctiveness category (e.g. ancient semi-natural woodland) will therefore be addressed through the provision of larger areas of 'high' distinctiveness habitat as compensation.

4.2.4 If the habitat impacted by the Proposed Scheme is in the high distinctiveness band, the offset will usually be 'like for like' i.e. it will aim to create or restore the same type of habitat.

4.2.5 For habitat of medium distinctiveness, the offset will largely be made up of habitat from the same distinctiveness band or higher (i.e. habitat from the medium or high distinctiveness band). Where the habitat lost was low distinctiveness, the offset should involve a 'trade up' in distinctiveness (i.e. be largely made up of habitat from the medium or high distinctiveness band).

4.3 Target condition

4.3.1 The offsetting approach for the Proposed Scheme will not utilise the two-step constraint that has been implemented within the Defra offsetting pilot. Instead a cap will be placed on the target condition that can be predicted for the creation of high distinctiveness habitats, with a maximum of a moderate target condition utilised for any such habitats. This approach seeks to recognise the fact that there can be limited confidence in achieving high distinctiveness habitats.

4.3.2 Where habitat restoration or enhancement is proposed then a habitat condition of high can be targeted for habitats of high, moderate or low distinctiveness.

- 4.3.3 All predictions of target condition should assume that suitable management will be available as a minimum for the period required to ensure target condition is achieved. It should thus be assumed that all habitats that are to be created for the primary purpose of ecological mitigation will aim to achieve the maximum target condition available (i.e. a score of 3 for habitats of moderate distinctiveness and 2 for habitats of high distinctiveness). Given the provision of appropriate management these are considered realistic targets.

4.4 Position within the surrounding ecological network

- 4.4.1 Where new habitats are created or restoration works are undertaken, position within the surrounding ecological network, as defined in Table 6, will be utilised to promote compensation provision that will contribute to the Lawton Review principles of 'bigger, better and more joined up' (Lawton, 2010). The criteria used mirror those used in the pre-development side of the calculation, with the addition that a score of 3 will be gained for areas of compensation that fall within the aims of a specified Nature Improvement Area (NIA) or Biodiversity Opportunity Area (BOA) scheme.
- 4.4.2 Each element of compensation or enhancement provision that is provided as part of the Proposed Scheme should be allocated a score (on a scale of 1-3) to identify the role that the habitat area will play in the ecological network that is present post-development.

Table 6: Consideration of position within ecological network post-development

Importance within ecological network	Multiplier
<ul style="list-style-type: none"> Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is more than 1ha in size²¹ (this may be as a result of either creation of new areas of habitat or the expansion of existing habitat areas) and have connectivity with other areas of semi-natural habitat²²; Areas of habitat creation or expansion within the aims of a specified Nature Improvement Area (NIA) or Biodiversity Opportunity Area (BOA) scheme. 	3
<ul style="list-style-type: none"> Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of more than 1ha in size but have little or no connectivity with other areas of semi-natural habitat (i.e. those that do not fall under score of 3 above); Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is between 0.25ha and 1ha in size (regardless of connectivity – these are considered as 'stepping stones'); Habitat which forms part of an area of semi-natural habitat²³ which provides continuous physical connectivity between existing 'core habitat blocks'.²⁴ 	2
<ul style="list-style-type: none"> any other areas which do not meet the criteria identified for either a multiplier of 2 or 3 above. 	1

4.5 Hedgerows

- 4.5.1 The post-development number of biodiversity units generated by hedgerows should be calculated based on the following criteria:
- length of hedgerow to be created (m);

²¹For the purposes of the calculation where areas of habitat of principal importance are separated by gaps of non-qualifying habitat of 15m or less then these should be considered to be contiguous (unless professional judgement of an ecologist considers otherwise).

²²Based on professional judgement those core areas which have little or no connectivity with other areas of semi-natural habitat should be downgraded to a multiplier of 2 where it is considered that their lack of connectivity is likely to limit their value within the existing ecological network (e.g. for example a severed area of woodland surrounded by an arable field would be downgraded to a multiplier of 2).

²³Defined for the purposes of this calculation as any area allocated a very high, high or moderate distinctiveness score.

²⁴Physical connectivity is defined for this purpose as a 'continuous' corridor of moderate, high or very high distinctiveness habitat parcels. A gap in qualifying habitat of more than 15m in extent, or a section where the minimum width of connective habitat drops below 5m in width (note hedgerows are considered as part of a separate calculation) should as a general rule be considered to represent a break in connectivity.

- target condition – based on the three-point scale provided in Table 4; and
- position of the hedgerow within the post-development network – based on the same criteria used in Table 5.

4.6 Watercourses

4.6.1 For watercourses the post-development number of biodiversity units generated should be calculated through multiplying the length (m) by the multiplier for target condition shown in Table 4.

4.7 Difficulty of re-creating/restoring

4.7.1 The multipliers proposed in the Defra pilot methodology will be utilised to recognise delivery risk. Habitats will be assigned to the following broad categories of re-creation/restoration risk based on professional judgement, input of Natural England specialists and previous research work. Full details are presented in the Technical Paper which accompanies the offsetting pilot methodology (Defra, 2012).

Table 7: Consideration of difficulty of re-creating/restoring

Difficulty of re-creation/restoration	Multiplier
Very High	0.10
High	0.33
Medium	0.75
Low	1.00

4.8 Time to target condition

4.8.1 In delivering offsets there may be a mismatch in the timing of impact and offset. This is defined in the offsetting pilot methodology as the difference in time between the negative impact on biodiversity and the offset reaching the required quality or level of maturity. This mismatch results in loss of biodiversity for a period of time.

4.8.2 It is intended that the time discounting rate of 3.5% proposed in the pilot methodology and detailed in Table 8 below is utilised unchanged for the Proposed Scheme. This is based on the discounting rate recommended in the Treasury's Green Book²⁵. For practical purposes a cap on the multiplier has been placed at 0.33.

Table 8: Consideration of time to target condition

Years to target condition	Multiplier
5	0.83
10	0.71
15	0.58
20	0.50
25	0.41
30	0.36
32 or above	0.33

²⁵ HM Treasury (2011) *The Green Book: Appraisal and Evaluation in Central Government*, Her Majesty's Stationery Office, London.

- 4.8.3 Table 9 provides the main habitat types and associated time to target condition categories that will be applied in the calculation. For hedgerows and grassland the most appropriate category should be selected based on the type of hedgerow/grassland that has been targeted.

Table 9: Time to target condition multipliers for main compensation habitats proposed

Habitat type	Years to target condition category
Open mosaic habitats on previously undeveloped ground	5
Ponds	5
Grasslands	5 or 10
Hedgerows	5 or 10
Woodland (for landscaping)	10
Young heathland/acid grassland	15
Mature heathland	32 or above
Woodland (for ecological purposes)	32 or above

4.9 Deriving the total number of biodiversity units present post-development

Habitat parcels/polygons

- 4.9.1 The scores of each polygon/habitat parcel present post-development will be calculated utilising the following criteria:

Number of biodiversity units generated by habitat polygon post-development = target habitat distinctiveness rating x target habitat condition x habitat area x position within existing ecological network x difficulty of re-creating/restoring x time to target condition

- 4.9.2 The scores of each polygon will then be added to give the total number of biodiversity units provided by the habitats present post-construction.

Linear features

- 4.9.3 The number of biodiversity units present post-development should be calculated for both hedgerows and watercourses as follows:

Number of biodiversity units generated by individual hedgerow feature = length of hedgerow (m) x condition multiplier attributed x position in the network x difficulty of re-creating/restoring x time to target condition

Number of biodiversity units generated by individual watercourse = length (m) x condition

- 4.9.4 The figures for the biodiversity units present post-development will then be compared with the overall pre-development score for the scheme to establish the overall balance of biodiversity units (negative or positive).

4.10 Deriving the change in biodiversity units as a consequence of the Proposed Scheme

4.10.1 In order to establish the change in biodiversity units as a consequence of the Proposed Scheme the number of biodiversity units generated post-development will be subtracted from the number available pre-development:

Net change in biodiversity units = post-development total units – pre-development total units for the same area

4.10.2 This calculation will be conducted at the route wide level for each of the following separate elements of the calculation:

- habitat parcels (including arable field margins);
- hedgerows; and
- watercourses.

5 Undertaking the calculation

- 5.1.1 The principles of the metric described in this document have been utilised to guide the size, location and type of compensatory habitat provision that has been incorporated into the design of the Proposed Scheme. Trial calculations have also been undertaken in order to test use of the revised metric throughout the development of the metric.
- 5.1.2 HS2 Ltd is committed to utilising the metric to provide a calculation showing what the project has achieved in working towards the goal of seeking no net loss in biodiversity.
- 5.1.3 It may be appropriate to repeat the calculation both as the hybrid Bill progresses through Parliament, and as result of detailed design. The metric therefore has the potential to provide an iterative mechanism to review changes in the balance of ecological loss versus compensation associated with the Proposed Scheme.

6 References

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Appendix A: Habitat distinctiveness scores for Phase 1 habitat survey categories

Table A 1: Habitat distinctiveness scores for Phase 1 Habitat categories

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
A1.1.1	Broadleaved woodland - semi-natural	Very high/high	8/6	Very high rating to be applied to all areas qualifying as ancient semi-natural woodland. All other areas to be identified as high distinctiveness.
A1.1.2	Broadleaved woodland - plantation	Moderate	4	-
A1.2.1	Coniferous woodland - semi-natural	High	6	-
A1.2.2	Coniferous woodland - plantation	Moderate	4	-
A1.3.1	Mixed woodland - semi-natural	Very high/high/moderate	8/6/4	Consider potential to split out areas of woodland that qualify as a habitat of principal importance, or as ancient semi-natural woodland (very high) and validity of including as part of the underlying habitat of principal importance where the coniferous cover is less than 25%. Such areas could score a high distinctiveness rating. All others will score a moderate rating.
A1.3.2	Mixed woodland - plantation	High/moderate	6/4	High distinctiveness rating to be allocated to those sites which meet the criteria to qualify under habitat of principal importance type 'traditional orchard'. Moderate rating to be applied for all others.
A2.1	Scrub - dense/continuous	Moderate	4	-
A2.2	Scrub - scattered	Low	2	This habitat type could have been created as either a polygon or point data. Only polygon data should be utilised within the assessment.
A3.1	Broadleaved parkland/ scattered trees	High/moderate	6/4	This habitat type only to be utilised where mapped as a polygon. High distinctiveness rating to be applied to habitats falling under the wood pasture and parkland habitat of principal importance type. Moderate rating to be applied in all other cases.
A3.2	Coniferous parkland/ scattered trees	Moderate	4	This habitat type only to be utilised where mapped as a polygon.
A3.3	Mixed parkland/ scattered trees	Moderate	4	This habitat type only to be utilised where mapped as a polygon.
A4.1	Broadleaved woodland - recently felled	Moderate	4	
A4.2	Coniferous woodland - recently felled	Moderate	4	
A4.3	Mixed woodland - recently felled	Moderate	4	
B1.1	Acid grassland - unimproved	High	6	
B1.2	Acid grassland - semi-improved	High	6	
B2.1	Neutral grassland -	High	6	

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
	unimproved			
B2.2	Neutral grassland - semi-improved	High/moderate	6/4	Split out those areas of grassland that fall within the lowland meadows habitat of principal importance type, and identify these as being of high distinctiveness. Moderate rating to be applied in all other cases.
B3.1	Calcareous grassland - unimproved	High	6	
B3.2	Calcareous grassland - semi-improved	High/moderate	6/4	Split out those areas falling under the definition of lowland calcareous grassland habitat of principal importance type. All other areas of grassland which contain elements of a calcareous sward should be considered to be of moderate distinctiveness.
B4	Improved grassland	Low	2	
B5	Marsh/marshy grassland	High/moderate	6/4	Split out any areas that represent habitats of principal importance (in particular purple moor grass and rush pasture) and identify these as of high distinctiveness. All others should be considered to be of moderate distinctiveness.
B6	Poor semi-improved grassland	Moderate	4	
C1.1	Bracken - continuous	Low	2	
C1.2	Bracken - scattered	Low	2	Only those areas mapped as polygons should be used within the calculation.
C3.1	Other tall herb and fern - ruderal	Low	2	
C3.2	Other tall herb and fern - non ruderal	Low	2	
D1.1	Dry dwarf shrub heath - acid	High	6	
D1.2	Dry dwarf shrub heath - basic	High	6	
D2	Wet dwarf shrub heath	High	6	
D5	Dry heath/acid grassland	Very high/high	8/6	Only mature and diverse areas of heath should be taken as qualifying in the very high category. All other areas to be classified as high.
D6	Wet heath/acid grassland	Very high/high	8/6	Only mature and diverse areas of heath should be taken as qualifying in the very high category. All other areas to be classified as high.
E2.1	Flush and spring - acid/neutral flush	High	6	
E2.2	Flush and spring - basic flush	High	6	
F1	Swamp	High/moderate	6/4	Identify those areas that qualify under the reedbed or purple moor grass and rush pasture habitat of principal importance definitions as being in the high category. Identify all others areas as being of moderate distinctiveness.
F2.1	Marginal and	High/moderate	6/4	This Phase 1 category is defined as strips of

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
	inundation - marginal vegetation			emergent vegetation that are of less than 5m in width. Identify those areas that qualify under purple moor grass and rush pasture habitat of principal importance definitions as being of high distinctiveness.
F2.2	Marginal and inundation - inundation vegetation	High/moderate	6/4	Consider potential for this habitat to fall under any habitat of principal importance definition (considered unlikely). All other to be identified as moderate.
G1	Standing water	High/moderate	6/4	Habitats of principal importance should be identified as being of high distinctiveness. All other occurrences of this habitat type should be identified as being of moderate distinctiveness.
G1.1	Standing water - eutrophic	High/moderate	6/4	
G1.2	Standing water - mesotrophic	High/moderate	6/4	
G1.3	Standing water - oligotrophic	High/moderate	6/4	
G1.4	Standing water - dystrophic	High/moderate	6/4	
G1.5	Standing water - marl	High/moderate	6/4	
I1.1.1	Inland cliff - acid/neutral	High	6	
I1.1.2	Inland cliff – basic	High	6	
I1.4.1	Other exposure - acid/neutral	Moderate	4	
I1.4.2	Other exposure - basic	Moderate	4	
I1.5	Cave	Moderate	4	
I2.1	Quarry	High/moderate/low/none	6/4/2/0	Re-allocate these areas based on the habitats present and score accordingly.
I2.2	Spoil	None	0	
I2.3	Mine	High/moderate/low/none	6/4/2/0	Re-allocate these areas based on the habitats present and score accordingly.
I2.4	Refuse-tip	None	0	-
J1.1	Cultivated/ disturbed land - arable	Moderate/low	4/2	Where uncultivated field margins are present these areas should be split off and classified as of moderate distinctiveness. All other arable or un-vegetated ground should be classified as being of low distinctiveness.
J1.2	Cultivated/ disturbed land - amenity grassland	Low	2	
J1.3	Cultivated/ disturbed land - ephemeral/ short perennial	High/moderate/low	6/4/2	Areas which form part of an open mosaic habitat on previously developed ground (a habitat of principal importance) should be identified as of high distinctiveness. Other stands should be classified as moderate or low distinctiveness based on the species present.
J1.4	Introduced shrub	Low	2	
J2.8	Earth bank	Low	2	

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
J3.4	Caravan site	High/moderate/low/none	6/4/2/0	Re-allocate these areas based on the habitats present and score accordingly.
J3.6	Buildings	Low	2	
J4	Bare ground	Low	2	
J5	Other habitat	High/moderate/low/none	6/4/2/0	Based on habitats and species present.
N/A	Roads and other hardstanding	Low	0	

Annex E: Electromagnetic interference– technical note

1.1.1 The following technical note is appended to this document:

- Electromagnetic interference



HS2 London-West Midlands

Technical note -

**Electromagnetic interference
(EMI)**

A report to HS2 Ltd by Arup/URS

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1 Electromagnetic interference (EMI)

1.1 Introduction

1.1.1 The purpose of this technical note is to provide guidance to undertake the assessment of the likely effects of electromagnetic interference (EMI) generated by the construction and operation of the Proposed Scheme.

1.1.2 Electric and magnetic fields are produced wherever electricity is used. The electric field is produced by voltage and the magnetic field by current. Electromagnetic fields (EMF) cause two types of effect;

- interference to electric and electronic equipment. This is called electromagnetic interference (EMI) and is the disturbance that affects an electrical system due to magnetic and electric fields, electromagnetic induction or electromagnetic radiation emitted from an external source; and
- the potential to cause harmful effects in the human body through EMF.

1.1.3 Electromagnetic compatibility (EMC) is the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to other equipment in that environment

1.1.4 This technical note considers the principal sources of EMI and EMF from the Proposed Scheme that may have an effect on third parties along the route, in particular from the traction power supply system. Emissions from the rolling stock, signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system and are therefore not considered further as having a wider potential effect.

1.1.5 There is also a requirement to address the EMF exposure, and the possible risk from exposures of the general public and workers to electric fields, magnetic fields and electromagnetic fields generated by the Proposed Scheme, in line with current UK Government recommendations.

1.2 Legal context

1.2.1 The Electromagnetic Compatibility Directive¹ 2004 has been incorporated in the UK as Statutory Instrument 3418:2006². The UK regulations require that equipment shall be so designed and manufactured, having regard to the state of the art, as to ensure that:

- the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended; and
- it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

¹ Official Journal of the European Union, (2004), *The Electromagnetic Compatibility Directive 2004/108/EC*.

² *The Electromagnetic Compatibility Regulations 2006*. Her Majesty's Stationery Office.

- 1.2.2 A fixed installation shall be installed applying good engineering practices and respecting the information on the intended use of its components. With regard to the Proposed Scheme, the scope of the assessment is concerned with emissions from the Proposed Scheme only and will be installed with a view to meeting the requirements set out in bullet point 1 of paragraph 1.2.1.
- 1.2.3 A fixed installation is defined as a particular combination of several types of apparatus and where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location.
- 1.2.4 The railway network and its components (e.g. a signalling system) are considered to be a fixed installation under the terms of the regulations.
- 1.2.5 An electrified railway has the potential to introduce additional risks through the generation of EMF, which has the potential to effect human health and interfere with electronic equipment. In addition the transmission of high voltage electricity can induce potentially harmful voltages into adjacent cables, metallic structures and the human body. It is these risks that will affect third parties external to the railway and are to be considered in producing the Environmental Impact Assessment (EIA).
- 1.2.6 For EMF exposure of the general public and workers, the reference levels based on short-term effects are found within the International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines³ for limiting exposure to time varying electric, magnetic, and electromagnetic fields (1Hz to 100kHz) 2010. The limits within these guidelines will consider:
- occupational exposure; applicable to non-residential premises; and
 - public exposure; applicable to residential premises.
- 1.2.7 For the assessment, the generic immunity standards will be applied i.e. BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments and BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments.
- 1.2.8 Immunity for residential, commercial and light industrial environments will be referred to as 'residential' within this technical note.
- 1.2.9 The Proposed Scheme will be built to comply with the BS EN 50121 series of standards, Railway Applications, Electromagnetic Compatibility, which contains the following parts;
- BS EN 50121-1:2006 Part 1: General⁴;
 - BS EN 50121-2:2006 Part 2: Emissions of the whole railway system to the outside world⁵;
 - BS EN 50121-3-1:2006 Part 3-1: Rolling stock - train and complete vehicle⁶;

³ ICNIRP, (2010), *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (1Hz to 100 kHz)*.

⁴ BSI, (2006), *BS EN 50121-1:2006. Railway applications - Electromagnetic compatibility Part 1: General*.

⁵ BSI, (2006), *BS EN 50121-2:2006. Railway applications - Electromagnetic compatibility Part 2: Emissions of the whole railway system to the outside world*.

⁶ BSI, (2006), *BS EN 50121-3-1:2006. Railway applications - Electromagnetic compatibility Part 3-1: Rolling stock - train and complete vehicle*.

- BS EN 50121-3-2:2006 Part 3-2: Rolling stock – apparatus⁷;
- BS EN 50121-4:2006 Part 4: Emissions and immunity of the signalling and telecommunications apparatus⁸; and
- BS EN 50121-5:2006 Part 5: Emissions and immunity of fixed power supply installations and apparatus⁹.

1.2.10 The set of standards in 1.2.9 are intended to permit compliance to the EMC Directive, but also provides a means of prescribing compatibility between the internal parts of the railway. These standards identify maximum limits of electromagnetic disturbance at the railway boundary, which is defined as 10m from the centre of the nearest track (BS EN 50121-1).

1.2.11 The Proposed Scheme will also comply with the BS EN 50122 series of standards, Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit, which consists of:

- BS EN 50122-1:2011 Part 1: Protective provisions against electric shock¹⁰;
- BS EN 50122-2:2010 Part 2: Provisions against the effects of stray currents caused by d.c. traction systems¹¹; and
- BS EN 50122-3:2010 Part 3: Mutual Interaction of a.c. and d.c. traction systems¹².

1.2.12 In addition the following standards are applicable:

- BS EN 50499:2008 Procedure for the assessment of the exposure of workers to electromagnetic fields and covers the essential requirements of the proposed EMF Directive¹³;
- EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz), provides levels for public exposure to EMF¹⁴; and
- The Railways (Interoperability) Regulations 2011¹⁵.

1.2.13 The European Parliament published Directive 2013/35/EU¹⁶ in June 2013 and is closely based on the ICNIRP guidelines. It replaces the earlier 2004 Directive¹⁷, which was

⁷ BSI, (2006), BS EN 50121-3-2:2006. *Railway applications - Electromagnetic compatibility Part 3-2: Rolling stock – apparatus.*

⁸ BSI, (2006), BS EN 50121-4:2006. *Railway applications - Electromagnetic compatibility Part 4: Emissions and immunity of the signalling and telecommunications apparatus.*

⁹ BSI, (2006), BS EN 50121-5:2006. *Railway applications - Electromagnetic compatibility Part 5: Emissions and immunity of fixed power supply installations and apparatus.*

¹⁰ BSI, (2011), BS EN 50122-1:2011. *Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit. Part 1: Protective provisions against electric shock*

¹¹ BSI, (2006), BS EN 50122-2:2010. *Railway applications. Fixed installations. Electrical safety, earthing and the return circuit. Provisions against the effects of stray currents caused by d.c. traction systems*

¹² BSI, (2006), BS EN 50122-3:2010. *Railway applications. Fixed installations. Electrical safety, earthing and the return circuit. Mutual Interaction of a.c. and d.c. traction systems.*

¹³ BSI, (2008), BS EN 50499:2008. *Procedure for the assessment of the exposure of workers to electromagnetic fields.*

¹⁴ Official Journal of the European Union, (1999), *EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz)*

¹⁵ *The Railways (Interoperability) Regulations 2011.* Her Majesty's Stationery Office..

¹⁶ Official Journal of the European Union, Directive 2013/35/EU on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)

¹⁷ Official Journal of the European Union, Directive 2004/40/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)

never implemented. The UK Government will bring the Directive into effect through the Health and Safety Executive in the form of a set of EMF Regulations that will take three years to produce. When it is released it will be evaluated against any proposals that are produced for the EIA, for any additional changes that may be required. It is likely that that by the time of construction and operation of the Proposed Scheme, more stringent standards will apply.

1.3 Requirements

- 1.3.1 The requirements for EMC will be met throughout the life of the Proposed Scheme by adhering to the guidelines, technical specifications and industry best practice at the design, installation, test and commissioning stages.
- 1.3.2 To assist with the environment assessment, baseline data will be collected and evaluated to assess the vulnerability of the existing environment against the effects of the Proposed Scheme and its operation. This will be undertaken as a desk-top study.

2 Scope and methodology

2.1 Electromagnetic risk

- 2.1.1 An electrified railway has the potential to introduce additional EMI and EMF risks through the generation of electromagnetic fields, which have the potential to effect human health and interfere with electronic equipment. In addition the transmission of high voltage electricity can induce potentially harmful voltages into adjacent cables, metallic structures and the human body.
- 2.1.2 Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system and are not considered in this analysis.
- 2.1.3 Power supplies used for construction are generally not sufficient to cause major EMI or EMF problems. Tunnel boring machines, generally use a high voltage supply for their operation, typically 11kV three phase. The levels of EMF emissions are generally insufficient to cause any adverse effect.
- 2.1.4 Due to the construction corridor that will be acquired to build the Proposed Scheme, most buildings that would be potentially at risk will be demolished. It is not therefore, anticipated that any electromagnetic impact on humans is expected. Some buildings may remain close to the Proposed Scheme and there may be risk of interference for some sensitive electrical equipment or equipment in residential properties.
- 2.1.5 EMI and EMF issues during operation of the Proposed Scheme will be limited to those caused by the traction current within the overhead line electrification system. Emissions from rolling stock, signalling and other electrical infrastructure such as trackside non-traction electrical distribution, are not high enough to cause effects outside the railway boundary.
- 2.1.6 There is existing data, from HS1 for example, that can be used to illustrate the minimal effects of EMI and EMF to the environment.

2.2 Areas at risk

2.2.1 An electrified railway has the potential to affect the operation of susceptible equipment adjacent the railway. Examples of potential sensitive sites that may be at risk and are to be considered are:

- universities;
- schools;
- hospitals;
- military establishments;
- airports;
- emergency and commercial radio stations;
- residential properties; and
- industrial properties.

2.2.2 Magnetic fields generated by current flowing within the overhead traction distribution, have the potential to cause harmful effects in the human body.

2.2.3 Power lines and other aerial cable routes that run parallel to the railway for any significant distance may be affected by induced voltages from the overhead line electrification system if placed too close together.

2.2.4 Other services such as underground pipelines are susceptible to induced voltage, if they are metal and run parallel for any significant distance.

2.3 Secondary areas

2.3.1 Where overhead power lines and their supporting structures have to be moved as a result of the Proposed Scheme, an assessment of the effect of the moved power line will be undertaken, to ensure that it does not introduce any EMI or EMF that is detrimental to its new surroundings.

2.3.2 The National Grid in its publication *Development near overhead lines*¹⁸ indicates that magnetic fields generated by 275/400kV overhead power lines are in the order of 4 microTesla (μ T) at 10m from the centreline of the route. It is therefore unlikely that moving an existing power line will have any significant effect.

2.3.3 Changes to the route of the National Grid will be undertaken in accordance with their own environmental and planning standards and procedures.

2.4 Data collection

2.4.1 A desk-top survey of the route will be undertaken to identify any potentially sensitive sites within a 50m corridor either side of the centreline of the nearest HS2 Phase One track, or from the proposed power equipment, e.g. overhead lines and traction substations.

¹⁸ National Grid, (2008), *Development near overhead lines - Planning and amenity aspects of high voltage electricity transmission lines and substations*.

- 2.4.2 The primary causes of EMI and EMF will come from the traction power distribution and overhead line electrification. The extent of any interference or harmful effects will be limited to only a short distance from the railway boundary or the boundary of any traction power substation or switching station. A 50m corridor is to be selected to identify all potential receptors within that area to demonstrate that the level of risk will be limited to a much shorter distance from the railway. Any receptor outside of the 50m corridor will not be affected.
- 2.4.3 Preliminary traction power modelling has been undertaken, which has identified potential electromagnetic emissions data throughout the route. This preliminary EMF data has formed the baseline against which to identify those receptors that may be at risk. The Proposed Scheme will comply with BS EN 50121, which limits the maximum EMF at the railway boundary.
- 2.4.4 The identification of possible third party receptors to EMI and EMF will be done by mapping and analysing the alignment route(s) using the construction drawings for the applicable area, or the alignment map if these are not available. From this information, third party receptors that fall within the 50m corridor either side of the centreline of the nearest track and also the proposed power equipment, e.g. overhead lines and traction substations will be identified.
- 2.4.5 Typical receptors will include (but is not limited to); residential zones, industrial zones, schools, hospitals, emergency services, military establishments, radio transmitters, mobile phone masts, the current National Grid infrastructure and existing railways.
- 2.4.6 Potential receptors in buildings that are to be demolished to make way for the Proposed Scheme will no longer be receptors once the Proposed Scheme is operational and are therefore not included in the assessment.
- 2.4.7 Although a 50m corridor has been selected, the effects of EMI can extend further afield in cases of services running parallel for any significant distances, causing induced voltages. Any such services (National Grid overhead power lines, motorway telecommunication systems, oil and gas pipelines etc.) are to be included in the data collected.
- 2.4.8 If construction drawings are not available i.e. individual track positions are not available, identify those third party receptors that fall within a 60m corridor either side of the centreline of the route.
- 2.4.9 An element of professional judgement must be applied whether to include receptors that fall just outside of the 50m or 60m rule.
- 2.4.10 Other than items identified in 2.4.7, any receptor outside the 50m should not be affected and need not be considered as part of this assessment.
- 2.4.11 Three types of potential receptors shall be recorded:
- locations that could contain electrical equipment that may be susceptible to EMI;
 - locations where people are located that may be affected by EMF; and

- adjacent equipment that may be susceptible to induced currents for example; overhead cables, parallel telecommunications cables, pipelines or metal fencing.

2.4.12 Once each site has been identified, an assessment will be undertaken to categorise the perceived level of risk and to identify the potential mitigation for each site.

2.4.13 Data will be collected to identify potential receptors at risk. Not all data will be presented within the ES, only those deemed to be at risk. The data collected will be kept to demonstrate an extensive search. The data will be tabulated for each type of receptor at risk, showing:

- an identification number;
- its location along the route, in kilometres;
- distance from the centre of the nearest track;
- the receptor; house, industrial unit, hospital, school etc.;
- the receptor type; industrial, residential, railway, overhead power line etc.;
- the reference that defines the immunity limit;
- immunity limit;
- estimated emission level;
- is there an EMI/EMF risk (yes or no);
- mitigation measures; and
- other comments.

2.4.14 From the information identified in 2.4.13, only significant risks will be listed within Volume 5 of the ES (refer to Volume 5: Appendix EM-001-000). As many of the EMF/EMI risks will be mitigated through the design, installation, operation and maintenance of the Proposed Scheme. Risks to be identified for the ES are:

- residential, commercial and light industrial receptors sufficiently close to the proposed scheme that may be susceptible to EMI. Where these are identified, they will be subject to further assessment at detailed design stage. Table A1 in Appendix A will include EMI receptors within 20m of the nearest track, although some of these may not be at risk due to their particular situation e.g. sufficiently below a viaduct such that the EMI is expected to be below 3 Amperes per metre (A/m);
- in exceptional cases, where receptors are sufficiently close to the Proposed Scheme such that the plots in Appendix B do not provide sufficient resolution to conclude that there is no EMF risk to particular receptors (typically, within 10m from the centreline of the nearest rail), Table A2 in Appendix A will include these receptors, which will be further assessed at detailed design stage; and

- infrastructure identified in 2.4.7 which runs parallel to the Proposed Scheme for over 2km and within 200m. This infrastructure may be at risk of induced voltages, which can be mitigated through adherence to applicable standards at the design and installation stages. These receptors will be presented in Table A3 in Appendix A.

2.5 Emission levels

2.5.1 The preliminary results of the traction power modelling show anticipated levels of EMF as contour plots. These plots are reproduced within Appendix B of this document and show key points from the centreline of the railway. The worst case values of EMF will be used in determining the level of risk, which will depend on the receptor location in relation to track level, i.e. in a cutting, on an embankment or viaduct, or in a tunnel.

2.5.2 In any case, the Proposed Scheme will comply with BS EN 50121, which limits the maximum EMF at the railway boundary to below ICNIRP levels.

2.5.3 The relationship between magnetic flux density (B, measured in μT) and magnetic field strength (H, measured in A/m) is given as:

$$B = 1.256H$$

2.5.4 Outside the railway boundary, the levels of radiated electric fields generated from the traction power will not exceed the 5kV/m threshold within the ICNIRP guidelines and will have no adverse effect on human health. It will not therefore be considered further in this assessment. This has been established from the preliminary traction power modelling.

2.5.5 Results from the preliminary modelling estimates a maximum induced voltage per unit length of approximately 30V/km at 20m from the centre of the nearest track. From this data there is therefore the potential for any conductor within 20m exceeding the 60V touch threshold if it ran parallel to the Proposed Scheme for over 2km. Similarly, between 20m and 50m from the centre of the nearest track, there is risk of induced voltages of over 60V where parallel running is over 3km.

2.5.6 Motorways that run parallel for a significant distance, typically more than 2km and up to 500m separation, may have telecommunication lines that could be susceptible to induced voltages. The induced voltage limits for telecommunication lines are recorded in the International Telecommunication Union Directive ITU-T Volume VI¹⁹. For there to be induced voltages, the motorway would have to have continuous metal cable, which is unlikely.

2.6 Risk assessment

2.6.1 The risk assessment will consider the following potential risks against each establishment or location:

- health immunity from the effects of power frequency magnetic fields;
- equipment immunity from the effects of radio frequency electric fields and power frequency magnetic fields; and

¹⁹ International Telecommunication Union, ITU-T Directives, concerning the protection of telecommunication lines against harmful effects from electric power and electrified railway lines: Volume IV Danger, damage and disturbance.

- effects of induced voltages and other effects.

Health immunity

- 2.6.2 The effects of magnetic fields will be assessed against the limits in ICNIRP for electromagnetic exposure to workers and the general public. For exposure compliance, extrapolated magnetic fields will be compared with the ICNIRP reference levels. The magnetic field levels will be taken from the contour plots that are contained within Appendix B of this document.
- 2.6.3 The plots indicate less than 10µT level of EMF at distances of between 7-10m from the centreline of the nearest track. This level is significantly lower than the 200µT ICNIRP recommendation for general public exposure.
- 2.6.4 ICNIRP identifies the reference level for short term exposure, which are the only guidelines set by the UK Government. There are no standards applicable to long term effects. The risk arising from long-term, low level of magnetic field exposure to children is not assessed here as although ICNIRP acknowledges research in this area, it concludes that “a causal relationship between magnetic fields and childhood leukaemia has not been established nor have any other long term effects been established.”

Electrical interference

- 2.6.5 The plots indicate a 4A/m (equivalent to 5µT) level of emissions at approximately 15m from the centre of the nearest track. This level is above the 3A/m limit for residential immunity specified in BS EN 61000-6-1²⁰. Therefore residential receptors within 20m of the centre of the nearest track are considered to be potentially at risk from EMI.
- 2.6.6 The 20m distance identified in 2.6.5 is dependent on the receptor being at the same level as the railway. If the Proposed Scheme is on a viaduct, embankment or in a cutting this would affect the level of risk and should be taken into account when identifying receptors at risk.
- 2.6.7 Exceeding the reference level does not necessarily mean that the prescribed basic restrictions have been exceeded. Where reference levels have been exceeded then mitigation measures will be provided. The prediction of potential interference at this point in time is based on the preliminary traction power modelling. Further models will be generated during detailed design to facilitate further assessment. In some cases, interference may not be known until the testing and commissioning stage, where further mitigation may be necessary. The preliminary modelling is based on worst case levels of generated EMF, which appear as peak levels that may be experienced for very short periods of time.
- 2.6.8 There may be residual effects for people with active medical implants, including pacemakers, where the EMC immunity performance of the active medical implant is less than the immunity performance specified in applicable harmonised standards.

²⁰ BSI, (2007), *BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments.*

- 2.6.9 The effects of EMI will be assessed against the limits in BS EN 61000-6-1 and BS EN 61000-6-2²¹. Table A4 IN Appendix A summarises the limits for both magnetic and electric immunity.

Other effects

- 2.6.10 The effects of induced voltages are mitigated by adherence to British, European Standards and industry best practice throughout the design, installation, operation and maintenance phases.
- 2.6.11 Similarly, any effects on other railways will be mitigated through adherence to British, European Standards and industry best practice throughout the design, installation, operation and maintenance phases. Studies undertaken previously on similar railway projects, suggest that the risk posed by a new electrified railway is well within recommended limits and that the risk of EMI is only confined to the railway infrastructure.

Wildlife

- 2.6.12 The published studies addressing the risk of EMF to wildlife shows little or no evidence of a significant environmental impact. From current information the exposure limits in the ICNIRP guidelines for protection of human health are also protective of wildlife.

2.7 Mitigation

- 2.7.1 Management and control of EMI will be assured by following the process defined within those standards and by adopting best practice for design, installation, maintenance and operation. In particular:
- compliance with the UK EMC Regulations 2004/108/EC²² and UK Statutory Instruments 2006 No3418²³;
 - application of harmonised standards BS EN 50121, BS EN 50122 and BS EN 61000 series of standards;
 - comply with applicable Technical Specifications for Interoperability; and
 - application guidance of Network Rail (NR) code of practice NR/L2/RSE/30041²⁴, which although is not applicable to the Proposed Scheme, is an example of best practice.

EMF and human health

- 2.7.2 It is extremely unlikely that the levels of EMF will exceed those recommended in ICNIRP; even the closest of receptors will be subjected to emissions below 5% of the acceptable ICNIRP levels.
- 2.7.3 For public access where bridges pass over or under the Proposed Scheme, the level of EMF exposure may be higher than that at ground level, however it is unlikely to reach maximum threshold. The level of exposure is also likely to be of a transient and short term nature (e.g. crossing a bridge in a vehicle or on foot).

²¹ BSI, (2005), *BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments.*

²² DTI, (2006), *Implementing the new Electromagnetic Compatibility (EMC) Directive 2004/108/EC in the United Kingdom.*

²³ The Stationery Office, (2006), *The Electromagnetic Compatibility Regulations No3418.*

²⁴ Network Rail, (2012), *NR/L2/RSE/30041 Electromagnetic Compatibility Assurance Process. Issue 2, dated 2 June 2012.*

- 2.7.4 It is therefore expected that in most cases no mitigation against EMF will be required, as the ICNIRP threshold limits will not be exceeded.
- 2.7.5 There may be exceptional cases where receptors are sufficiently close to the Proposed Scheme such that the plots in Appendix B do not provide sufficient resolution to conclude that there is no EMF risk to particular receptors. These receptors will be included in Table A2 and they will be further assessed at detailed design stage. Specifically this may affect the HS1 to HS2 link, however the traction load here will be considerably less than on other sections of the route and there is unlikely to be any significant effect.

Electromagnetic interference

- 2.7.6 Potential mitigations against significant EMI issues for receptors affected by the Proposed Scheme include:
- relocation of the receptor to a location where the impact is reduced below accepted limits;
 - emission control from the Proposed Scheme;
 - screening; and
 - increase the immunity of the receptor (replace equipment designed for residential immunity with that designed for industrial immunity).
- 2.7.7 It is expected that EMI risks may only affect residential receptors within 20m from the centreline of the nearest track or industrial receptors with very sensitive electrical or electronic equipment. Where identified, these receptors will be further evaluated during the detailed design stage of the project and further mitigation taken, which may be in the form of replacement of equipment with less sensitive equipment.

Induced voltages and other effects

- 2.7.8 In addressing the impact of the route running alongside, over or under an existing railway, mitigation will be met by meeting the requirements of both BS EN 50121 and BS EN 50122 suite of standards for design, construction, operation and maintenance. The design solutions will have to be agreed with the railway owner at the detailed design stage through consultation.
- 2.7.9 Induced voltages are mitigated by separation, screening or earthing and bonding. Metallic pipes and conduits that are within 60m from the railway and run parallel for more than 200m can be bonded to earth electrodes at intervals at no greater than 200m. This is in accordance with the NR standard NR/SP/ELP/21085²⁵, which although not applicable to the Proposed Scheme is an example of best practice. Such solutions will be discussed with the infrastructure owner at the design stage for agreement.
- 2.7.10 Where there is parallel operation with an existing motorway for a significant length, typically exceeding 2km, a review is required to be undertaken at the design stage and in discussion with the motorway owner to agree mitigation in accordance with existing British and European Standards and industry best practice.

²⁵ NR/SP/ELP/21085 Electromagnetic compatibility (EMC) assurance process, Network Rail publication.

Construction

- 2.7.11 Mitigation against any specific construction issues will be addressed during the design. It will be the responsibility of the installation contractor to manage these issues on site.
- 2.7.12 High voltage supplies for construction machinery, especially for tunnel boring machines will not emit EMF at harmful levels.
- 2.7.13 Construction machinery and plant, and associated communications (e.g. construction radios) will comply with the applicable standards for EMF and EMC, for example Machinery Directive 2006/42/EC²⁶. Therefore when installed, operated and maintained correctly, the risk of this apparatus producing EMF exceeding published limits for workers and the public or causing EMI is considered to be low.
- 2.7.14 All other electrical equipment used for construction will conform to the EMC Directive and should not cause any adverse effects.
- 2.7.15 It is therefore expected that no mitigation against EMF or EMI will be required for construction.

2.8 Cumulative effects

- 2.8.1 The likely cumulative effects of the Proposed Scheme running alongside an existing railway electrified at 25kV are unknown at this point in time. The electrification design of the Proposed Scheme is not sufficiently developed to make an accurate prediction. In undertaking the assessment of likely receptors the cumulative effects have assumed to be the addition of the respective EMF strengths at any particular point from the railway. The results from the preliminary traction modelling show that the maximum level of EMF at a point 20m from the centre of the nearest track is less than 1.5% of the ICNIRP limit for residential receptors. It is highly unlikely that any cumulative effect will come anywhere near to the ICNIRP level and will be discounted for this assessment.
- 2.8.2 The cumulative level of EMI resulting from running alongside an existing electrified railway may lead to exceeding the recommended 3A/m residential limit identified in BS EN 61000-6-1:2007. Interference at this level is not always certain; other factors can affect the outcome. Where this occurs, individual tests can be undertaken to assess the level of interference once the Proposed Scheme is energised. For the purpose of the risk assessment, those receptors that are within 20m of centreline of the nearest track, are to be considered at risk.
- 2.8.3 It is unlikely that any cumulative effect will exceed the 30A/m industrial limit identified in BS EN 61000-6-2:2005 and will be discounted for this assessment.

2.9 Climate change

- 2.9.1 The levels of generated EMF and EMI are dependent on the traction power, which has been calculated for a worst case scenario based on the maximum trains running per hour. Any change in climate is unlikely to affect the output from the traction power and cause any significant increase in EMF or EMI and will be discounted for this assessment.

²⁶ European Commission, (2006), *EU Directive 2006/42/EC on machinery*.

2.10 Significance

- 2.10.1 The Environmental Statement (ES) must identify all significant risks and it is therefore necessary to describe the level of significance for each type of risk. For EMF and EMI, these are described in this section 2.10.
- 2.10.2 The limit recommended by ICNIRP for short term effects of EMF general public exposure is 200 μ T, for occupational exposure is 1000 μ T. According to the preliminary modelling results, the maximum level of EMF estimated outside of the railway boundary (i.e. between approximately 7-10m from the centre of the nearest track) is less than 10 μ T or 5% of the acceptable limit. The level of significance for EMF is therefore regarded as negligible.
- 2.10.3 The immunity level specified in BS EN 61000-6-1:2007 for significant electromagnetic interference to occur in residential properties is 3A/m. Any value above this is significant; however the effects of EMI on residential electrical or electronic equipment would be classed as moderate; defined as, "limited impact (by extent, duration or magnitude) which may be considered to be potentially significant".
- 2.10.4 From the preliminary modelling results, only residential properties up to 20m from the centreline of the nearest track are to be considered at risk from EMI.
- 2.10.5 Similarly, the immunity level specified in BS EN 61000-6-2:2005 for significant electromagnetic interference to occur in industrial properties is 30A/m. The preliminary modelling results show that this figure is unlikely to be exceeded and therefore the significance of EMI on industrial properties is therefore regarded as negligible.
- 2.10.6 Where there is an impact on an existing railway, overhead power line, motorway telecommunication systems or metallic services running parallel with the Proposed Scheme, all issues will be mitigated through design, installation, operation and maintenance to current British, European Standards and industry best practice. Such design solutions will be developed through consultation with the infrastructure owner. As a result, effects of EMF or EMI on these systems can be disregarded for the purpose of reporting in the ES.

2.11 Results

- 2.11.1 Receptors at risk of EMI are to be included within the table of results, which will go into Volume 5 of the ES (refer to Volume 5: Appendix EM-001-000). Such receptors will be limited to residential properties within 20m from the centreline of the nearest track.
- 2.11.2 Exceptional cases of receptors at risk of EMF will be included within the table of results.
- 2.11.3 Consideration will be given to the position of the receptor relative to the Proposed Scheme as this may affect the risk.
- 2.11.4 Where the Proposed Scheme runs in a tunnel, receptors within 20m are unlikely to be affected. Similarly where the Proposed Scheme runs on a viaduct, embankment or in a cutting the level of EMI may be less than for an equivalent receptor at grade.

- 2.11.5 Infrastructure identified in 2.4.7 which runs parallel to the Proposed Scheme for over 2km and within 200m are to be included within the table of results.
- 2.11.6 Tabulated examples are shown in Tables A1, A2 and A3.

Appendix A: Tables

Table A1: Example of tabulated results (for EMI receptors that are within 20m from the centre of the nearest track)

Electromagnetic Compatibility Assessment (Equipment Immunity to Traction Power Frequency Magnetic Fields)										
ID Number	Railway Chainage km + m	Distance from nearest track centre (m)	Sensitive installation	Receptor	Reference	Immunity limit (A/m)	Estimated emission level	Is there an EMI risk? (Y/N)	Mitigation measures	Comments
A1	148+250	10	School	Residential	BS EN 61000-6-1 BS EN 61000-6-2	3	>3A/m	Y	Replace with less sensitive equipment	Undertake another review once the Proposed Scheme is operational and replace equipment only then
A2	148+550	15	Machine factory	Heavy Industrial	BS EN 61000-6-1 BS EN 61000-6-2	30	<30A/m	N	N/A below recommended levels	The Proposed Scheme in cutting
A3	149+050	20	House	Residential	BS EN 61000-6-1 BS EN 61000-6-2	3	<3A/m	N	N/A below recommended levels	The Proposed Scheme on embankment
A4	149+550	15	Retail Unit	Light Industrial	BS EN 61000-6-1 BS EN 61000-6-2	3	>3A/m	Y	Replace with less sensitive equipment	The Proposed Scheme on embankment. Undertake another review once the Proposed Scheme is operational and replace equipment only then

Table A2: Example of tabulated results (for exceptional EMF receptors that are within 10m from the centre of the nearest track)

Electromagnetic Field Exposure Assessment (Health Immunity)										
ID Number	Railway Chainage km + m	Distance from nearest track centre (m)	Sensitive installation	Receptor	Reference	Immunity limit (μT)	Estimated emission level	Is there an EMF risk? (Y/N)	Mitigation measures	Comments
B1	1+250	5	House	Residential	ICNIRP	200	>7.47μT	unclear	Undertake further review at detailed design stage	The Proposed Scheme on existing viaduct
B2	1+650	5	House	Residential	ICNIRP	200	>7.47μT	unclear	Undertake further review at detailed design stage	The Proposed Scheme on existing viaduct

Table A3: Example of tabulated results (for other receptors that run parallel to the Proposed Scheme for over 2km and within 200m)

Electromagnetic Compatibility Assessment (Induced Voltages and other effects)										
ID Number	Railway Chainage km + m	Distance from nearest track centre (m)	Sensitive installation	Receptor	Reference	Immunity limit (μ T)	Estimated emission level	Is there an EMI risk? (Y/N)	Mitigation measures	Comments
C1	147+900 to 149+180	200	275/400kV Grid overhead line route	Power line	Potential induced voltages. HS2 EMC Strategy Document			N	Earthing and bonding to current standards	Unlikely to cause significant induced voltages, distance from track centre too great.
C2	148+800 to 152+000	50	The Proposed Scheme runs parallel to existing Birmingham Coventry 25kV electrified railway	Railway	BS EN 50121 suite of standards apply as does BS EN 50122			Y	Earthing and bonding to current standards	Design solutions to be agreed with the asset owner.
C3	166+300 to 168+900	50-150	Buried BP Pipeline	Metal pipe line	Potential induced voltages. HS2 EMC Strategy Document			Y	Earthing and bonding to current standards	Design solutions to be agreed with the asset owner.
C3	166+310 to 168+320	100-200	The Proposed Scheme runs parallel to M42 motorway	Motorway telecoms cables	Potential induced voltages. HS2 EMC Strategy Document			N	Earthing and bonding to current standards	Unlikely to cause significant induced voltages, length of parallelism below limit.

Table A4: Assessment limits at 50Hz, taken from ICNIRP, BS EN 61000-6-1 and BS EN 61000-6-2

Basis of Limit	Units	Public Limit	Occupational Limit
Electric fields, limit based on public health considerations	kV/m	5	10
Magnetic fields, limit based on public health considerations	μ T	200	1000
EMC recommendations. Magnetic interference with any electronic equipment:			
Residential, commercial and light industrial limits	A/m	3	
Industrial limits	A/m	30	

Appendix B: EMF contour plots

- 1.1.1 The following plots have been produced from the preliminary traction power modelling undertaken by HS2. The plots show worst case values of EMF along the route. The data cursors indicate the magnetic flux density at distances of about 10 m, 15 m, 20 m and 30 m from the centre line of the nearest track and are measured in microTesla (μT).

Figure B1: EMF Contour Plot -Line km 17.5

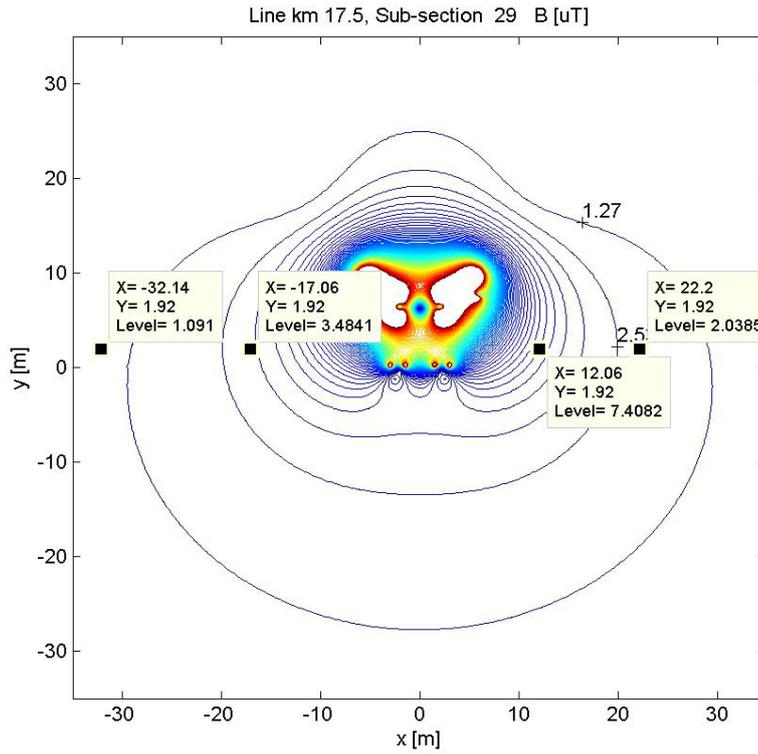


Figure B2: EMF Contour Plot Line km 21.5

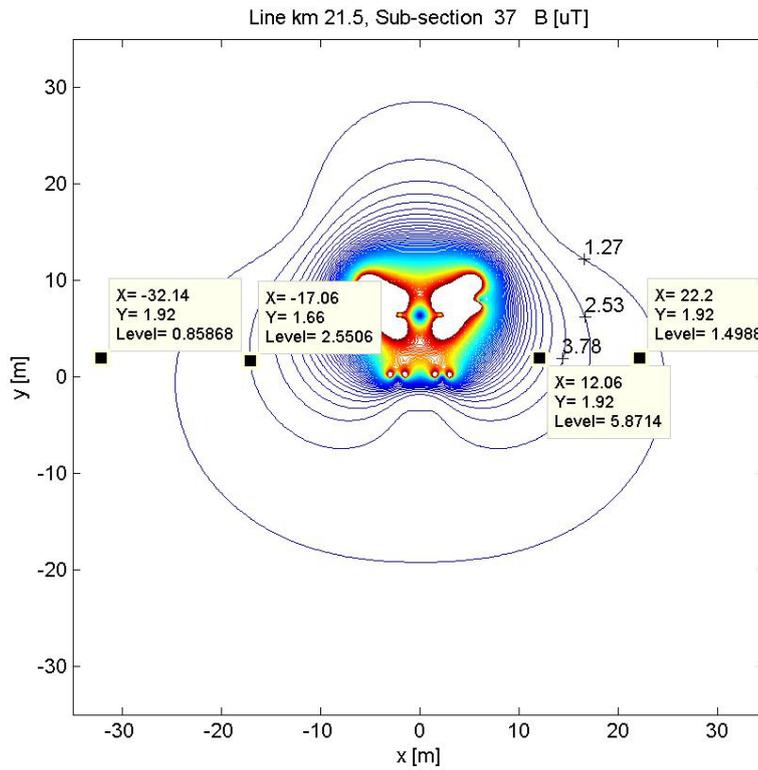


Figure B3: EMF Contour Plot Line km 24

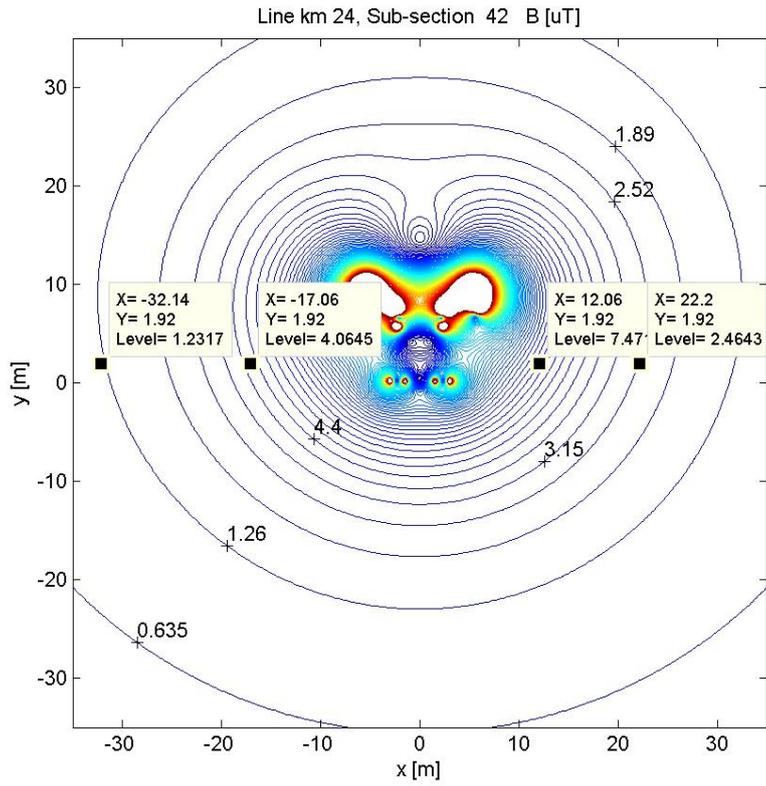


Figure B4: EMF Contour Plot Line km 27.5

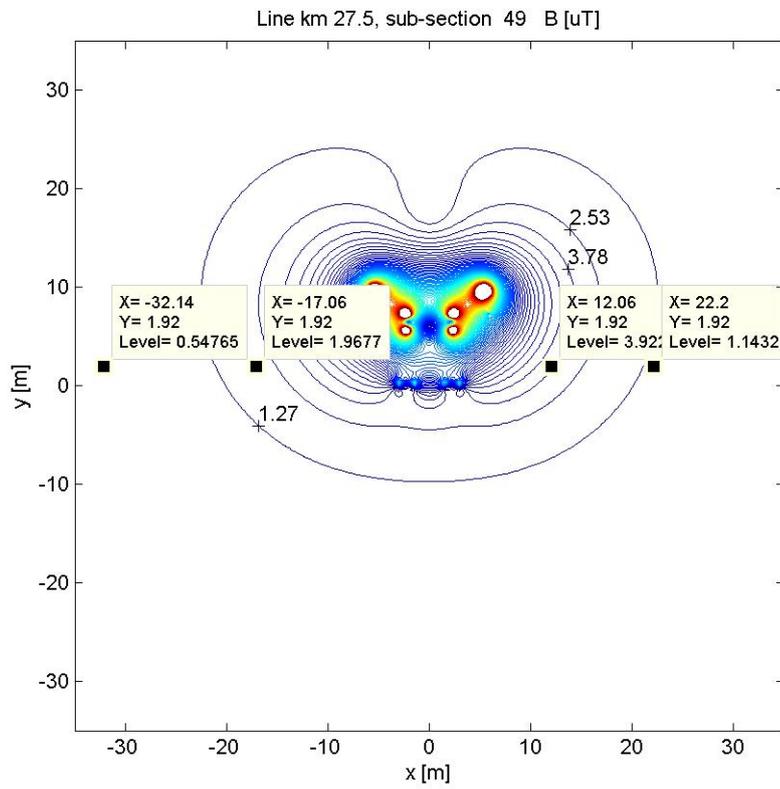


Figure B5: EMF Contour Plot Line km 32.5

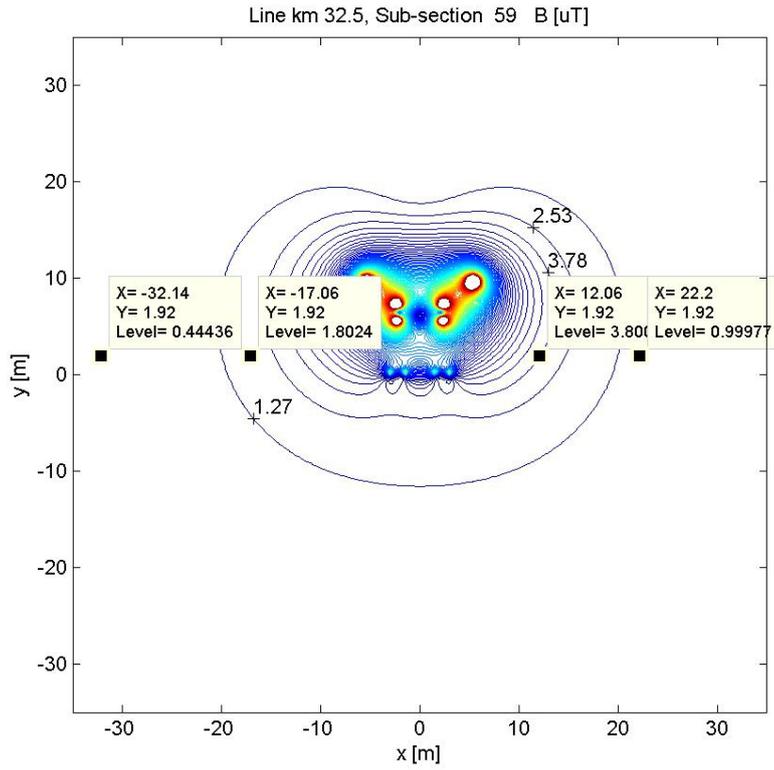


Figure B6: EMF Contour Plot Line km 41.5

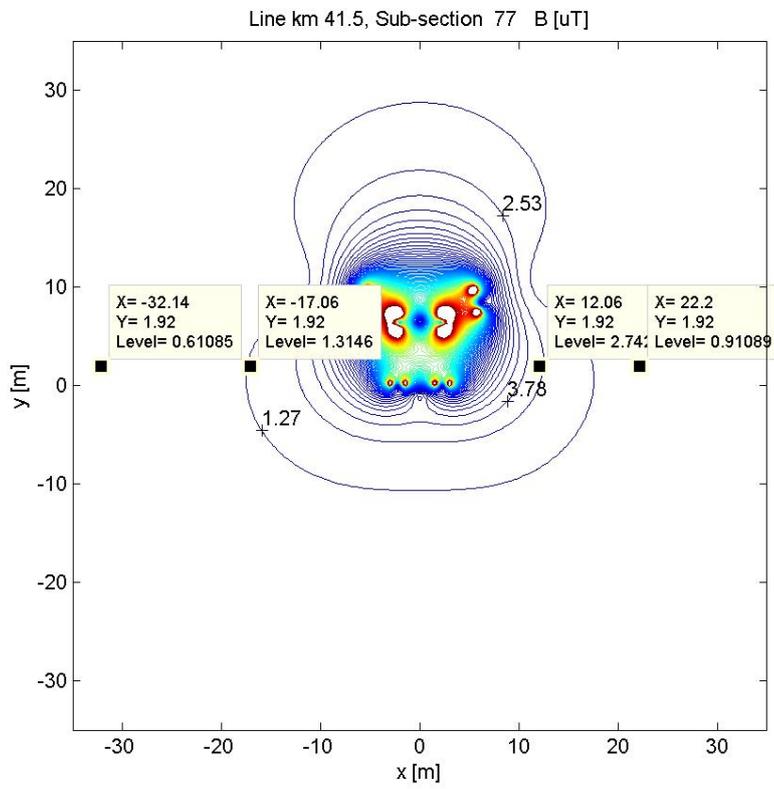
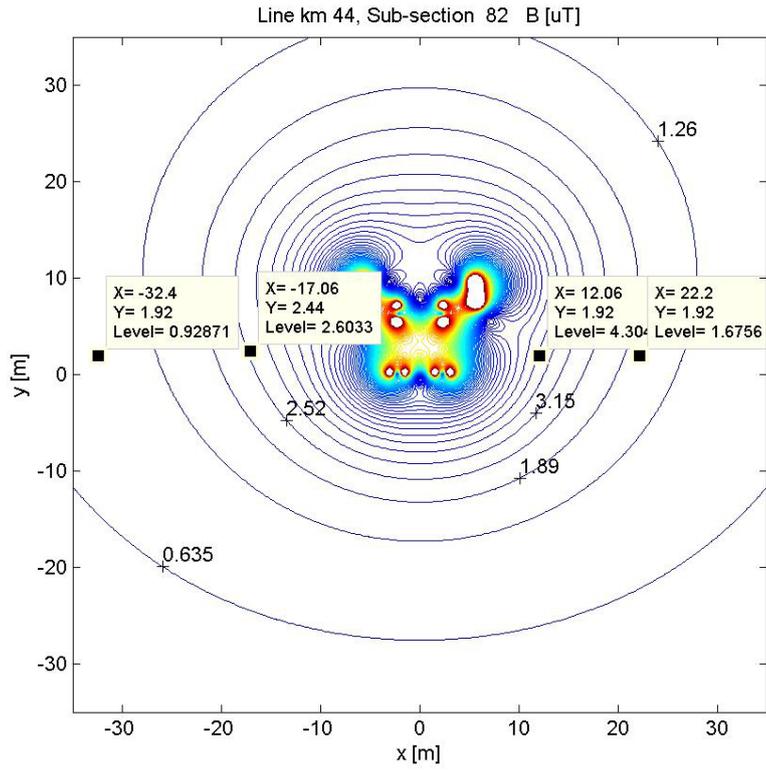


Figure B7: EMF Contour Plot Line km 44



Annex F: Land quality – technical notes

1.1.1 The following technical notes are appended to this document:

- Introduction to land quality assessments
- Detailed methodology for land contamination assessments
- Methodology and significance criteria for geological issues (excluding land contamination)
- Operational issues
- Potential mitigation measures



HS2 London-West Midlands

Land quality

Technical note – Introduction to land quality assessment

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 The land quality assessment considers the quality of the land that the Proposed Scheme will pass over or through, and the resources that the soil or rocks contain. It considers several principal issues, including:
- the presence of existing contamination along or close to the Proposed Scheme that may be disturbed by the construction or operation of the Proposed Scheme;
 - the presence of mining or mineral resources that may be sterilised or otherwise adversely affected; and
 - the presence of geo-conservation resources that may be destroyed or their integrity otherwise affected.
- 1.1.2 In addition, the construction and operation of the Proposed Scheme may give rise to potential contaminative effects. For example, from operations at construction sites during the construction of the Proposed Scheme and work at the main depot sites during the operational period.
- 1.1.3 The land quality assessment identifies those areas or sites along or near to the Proposed Scheme that may have existing contamination present on them. It assesses the potential significance of the contamination, with respect to construction of the Proposed Scheme, and indicates whether specific mitigation may be required during the construction period to contain or remediate the contamination to allow safe construction, and to reduce post construction risks to an acceptable level. It outlines the types of remedial works that may be necessary at certain locations.
- 1.1.4 The assessment also identifies the scale of any impacts on geological, geomorphological, mineral and mining resources, and estimates the significance of the effects that the construction and operation of the Proposed Scheme may have on these resources in the future.
- 1.1.5 Finally it identifies the potential for contamination arising from the construction and operation of the Proposed Scheme, and sets out the operational mitigation measures that will be undertaken to minimise this risk.

2 International and national legislation, policy and guidance

2.1 National EIA guidance on land quality issues

2.1.1 There is no national legislation or policy specifically for the assessment of land quality within an Environmental Impact Assessment (EIA). However, within the UK, the assessment of land or groundwater in general is underpinned by Part IIA of the Environmental Protection Act¹ and subsequent guidance that has been issued to support the Act.

2.1.2 There are a number of national guidance documents on EIA which touch on land quality issues, such as:

- Environmental Impact assessment- A handbook for Scoping Projects²; and
- Assessment and Management of Environmental Effects. Highways Agency Design Manual for Roads and Bridges³.

2.2 Contaminated land

Planning guidance

2.2.1 Until April 2012, the principal guidance document relating to land quality was PPS23 Land Contamination and Pollution⁴, particularly Annex 2 on Contaminated Land. However, in April 2012 PPS 23 was replaced by the National Planning Policy Framework⁵ (NPPF), which is considerably more generalised in nature.

2.2.2 One of the NPPF core planning principles encourages the effective use of land by promoting reuse of previously developed (brownfield) land, provided that it is not of high environmental value. Therefore the NPPF envisages that the planning system should contribute to conserving and enhancing the natural environment by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable ground where appropriate. However, to prevent unacceptable risks to human health and the environment, a new development should be appropriate for its location and, after treatment where necessary, suitable for its new use. After remediation, land should not be capable of being determined as 'contaminated land' under Part IIA of the Environmental Protection Act (1990).

2.2.3 In order to assess risks from contamination, site investigation data needs to be presented during the planning stage. This data should as a minimum contain desk study information and a site reconnaissance. This procedure will be followed as far as possible in this assessment.

¹ Her Majesty's Stationery Office, London, (1990), Environmental Protection Act (1990).

² Environmental Agency, (2002), Environmental Impact Assessment; A Handbook for Scoping Projects.

³ Highways Agency, (2008), Design Manual for Roads and Bridges, Assessment and Management of Environmental Effects. HA205/08 Volume 11, Section 2, Part 5.

⁴ HMSO (2004), Planning Policy Statement 23: Planning and Pollution Control.

⁵ Department for Communities and Local Government (2012), *National Planning Policy Framework*.

Contamination risk assessment guidance

- 2.2.4 There are two complementary systems in the UK for dealing with issues of land contamination. Part IIA of the Environmental Protection Act of 1990 set up a system of control by regulators (either the local authority in the case of human health risks and/or the Environment Agency, which in any case deals separately with Controlled Water risks) who could deal with issues of ongoing contamination of sites within their boundaries by determining land as 'contaminated land' and, if necessary, by issuing a 'remediation notice' to the responsible person (usually the owner or occupier of the site in the absence of the original polluter) to enforce investigation and remediation.
- 2.2.5 Secondly, for those sites that enter the planning and redevelopment process, the regulator will normally require the developer to undertake sufficient assessment of the site to show whether the site is contaminated or not, and if so, to design, undertake and to verify adequate remediation as part of the development. Each stage of the process needs to be agreed with the regulator(s). With respect to the identification, assessment and remediation of contaminated land and groundwater there is a considerable body of knowledge that has been built up over the last 20 or so years, principally by the Environment Agency, Defra, Construction Industry Research and Information Association (CIRIA) and Contaminated Land: Applications in Real Environment (CL:AIRE). The most relevant documentation to a design stage assessment of contaminated land is CLR11 Model Procedures for the Management of Contaminated Land⁶. This sets out the procedures to be undertaken at various stages of a project on land affected by contamination. The Environmental Impact Assessment occurring as it does, at the initial stages of a project, equates, in general, to the definition of the preliminary risk assessment within CLR11.
- 2.2.6 Detailed guidance is given within various Environment Agency and Defra documents, which deal with the detailed risk assessment of sites once direct intrusive ground investigation has been undertaken and the detailed scope and nature of contaminants and the immediate environment is understood.
- 2.2.7 The primary method by which contaminants in soil are assessed is the Contaminated Land Exposure Assessment (CLEA) methodology⁷. This methodology has been prepared by the Environment Agency and sets out the science and assumptions by which critical criteria for contaminants can be estimated for different end-use scenarios and in different soils. A set of criteria, using the most onerous assumptions, are encapsulated within the Soil Guideline Values⁸ (SGVs), also published by the Environment Agency.
- 2.2.8 The primary method by which contaminants in controlled waters are assessed is the methodology published within the Environment Agency document Remedial Targets Methodology 2006⁹.
- 2.2.9 The primary method of assessing the risks to designated ecological receptors from contaminants is contained within a suite of Environment Agency documents (An ecological risk assessment framework for contaminants in soil¹⁰ and associated

⁶ Environment Agency (2004), *Model Procedures for the Management of Land Contamination. CLR11.*

⁷ Environment Agency (2009), *Updated technical background to the CLEA model. Science report SC050021/SR3.*

⁸ Environment Agency (2009), *Using Soil Guideline Values. Science Report SC050021/SGV Introduction.*

⁹ Environment Agency (2006), *Remedial Targets Methodology.*

¹⁰ Environment Agency (2008), *An ecological risk assessment framework for contaminants in soil.*

guidance documents). It sets out a three-tiered risk assessment process that is designed to establish whether pollutant linkages between contamination and ecological receptors exist, and to gather sufficient information for making decisions on whether harm to those receptors could occur.

- 2.2.10 The primary method by which ground gasses are assessed is the CIRIA report C665 *Assessing risks posed by hazardous ground gasses to buildings*¹¹. The methodology includes information on how best to monitor ground gasses over an interval of time, how to interpret the results and what mitigation measures to design to prevent ground gasses entering buildings. Additional information is contained in the British Standard BS8485:2007 *Code of practice for the characterization and remediation from ground gas of affected developments*¹².
- 2.2.11 Below ground concrete (e.g. building foundations) are at risk from various chemical species within the ground, primarily types of sulphates. The sulphates are often naturally occurring, but can also be present as a result of pollution. The assessment and mitigation of this risk is considered as part of the geotechnical assessment of the Proposed Scheme, and is not considered within the Environmental Statement.
- 2.2.12 The result of applying risk assessment methodologies will determine which contaminants in which areas pose a significant risk to which receptors as a result of the construction of the Proposed Scheme. Rational decisions can then be made on the detailed extent and type of mitigation and/or remediation methods applied.
- 2.2.13 In choosing particular remediation methods, a number of factors come into play including:
- the type or types of contamination;
 - their extent;
 - the types of soils they are contained within;
 - the time period for remediation;
 - the site size and other logistical constraints; and
 - the sustainability of the various remedial options.
- 2.2.14 An options appraisal process is usually undertaken to identify the option or options that would be most appropriate and these would then comprise the remedial strategy for the site.

2.3 Mining, mineral and geological resources

- 2.3.1 There is no particular national guidance on assessing geological, mining or mineral resources for EIA purposes.

¹¹ CIRIA, (2007,) *Assessing risks posed by hazardous gasses to buildings. Report C665.*

¹² British Standards BS8485, (2007), *Code of practice for the characterisation and remediation from ground gas affected developments.*

3 Assessment methodology

3.1 Introduction

3.1.1 The land quality topic contains several differing strands of assessment. There is not a single assessment methodology that can be used for the varying sub-topics. Therefore, detailed methodologies have been developed for each sub-topic, based on current best practise and guidance. A summary of these assessment methodologies is set out in this Section. They are given in detail in other technical notes appended to the SMR addendum Annex F: Detailed methodology for land contamination assessments and Methodology and significance criteria for geological issues (excluding contaminated land)

3.1.2 All methodologies are based on the source-pathway-receptor concept, whereby in order to have an environmental effect, there needs to be:

- a source (e.g. of contamination) which can impact a receptor;
- a pathway (between the source and receptor); and
- a receptor or receptors (which may have a varying sensitivity to the impacts from the source).

3.2 Scope

3.2.1 The study area used in the assessment of land quality is the area of land required to construct the Proposed Scheme together with a buffer extending out for a minimum of 250m, but in the case of groundwater data up to 1km. Areas of land required for the Proposed Scheme, but which will entail no or minimal ground disturbance (eg utility diversions within highways and existing remote train stabling areas) have not been assessed.

3.2.2 The impact of existing land contamination during the construction stage has been considered. Any significant existing contamination will be remediated during the construction process; therefore it is not considered further during the operational stage of the project.

3.3 Sources of information

3.3.1 Sources of information for contamination issues, mining and mineral issues, and geological conservation issues are shown in Tables 1, 2 and 3.

Table 1: Sources of information for contamination issues

Source of information	Type of information
Envirocheck Report	Historical mapping, landfill and other waste management activities, surface and groundwater data, pollution control data, Radioactive Substance Act data, previous and current industrial land uses, and hazardous substances planning data.
Local Authorities	Supplementary information on landfills, underground petrol tanks, previous investigation data, potential and/or determined contaminated land sites.
Environment Agency	Supplementary information on landfills, and surface water/groundwater.
Defra	Animal burial sites.

Source of information	Type of information
British Geological Survey (BGS)	Basic geological mapping (1:10,000 and 1:50,000), specialist mapping, memoirs, borehole logs from BGS borehole database.
Network Rail	Previous ground investigation data.
Ministry of Defence	Information on current and former Ministry of Defence land.
Other archive resources	For example in house investigation data, information from waste disposal companies.
Current/historical air photos	Where required, to supplement historical mapping (being flown by HS2).

Table 2: Sources of information for mining and mineral issues

Source of Information	Type of Information
Coal Authority	Details of previous, current and potential future opencast and underground coal mining.
Local authorities	Planning designations regarding mineral extraction.
Mineral extraction companies	Supplementary information.

Table 3: Sources of information for geological conservation issues

Source of Information	Type of Information
Natural England	Data on geological or geomorphological Sites of Special Scientific Interest (SSSI).
Local authorities	Data on Local Geological Sites or other local geological conservation sites.
Geo-Conservation UK	Data on Local Geological Sites or other local geological conservation sites.

3.4 Site inspections

3.4.1 In addition to 'familiarisation visits', following collection of data, site visits will be required to confirm some of the data collected (particularly from key sites). Such visits may require:

- access to Network Rail land;
- access to private land for which access permission will be required; and/or
- access to public land (e.g. highways, public footpaths, amenity land etc).

3.4.2 Because access to private land requires permission, which may not always be granted, access to certain areas may not be available during the preparation of the Environmental Statement.

3.5 Existing land contamination

3.5.1 The methodology for assessing existing potential land contamination along the Proposed Scheme is set out in detail in the technical note Detailed Methodology for land contamination assessment (appended to the SMR addendum - Appendix F). Essentially the process consists of three stages:

- a screening process whereby all potential areas of land contamination identified from the data collected, are assessed against criteria including land

use, the proximity of receptors, the proximity of the potential land contamination to the Proposed Scheme, the nature of construction etc. A scoring system for the screening process identifies those areas that potentially pose a contaminative risk for the Proposed Scheme;

- for these areas, a more detailed risk assessment process, which assesses the risks of potential contamination (using a source-pathway-receptor methodology) and assesses the qualitative degree of risk that they are likely to pose is undertaken; and
- finally, consideration is given to the effects that remediation or mitigation of the contamination will have at each of these areas, and whether this will lead to a longer term beneficial effect (because of containment or removal of contamination).

- 3.5.2 Both during the screening process and the risk assessment process, where potentially contaminated sites are likely to give rise to the same types of risks, they can be grouped and considered together, where appropriate.
- 3.5.3 Potential mitigation measures (including contamination remediation) are described in the technical note 'Potential mitigation measures' (appended to the SMR addendum - Appendix F). It is the intention to treat and re-use as much contaminated soils as possible within the Proposed Scheme. The most likely form of mitigation measures to be used will include the following methodologies.
- 3.5.4 Bio-Remediation: Excavation and placing of contaminated soils in bio-piles or windrows, followed by aeration, and where required, addition of composting materials, nutrients and microbial inocula. This technique is useful for remediation of hydrocarbon contamination. Treatability studies are generally required and remediated soil can be usually re-used on site following treatment.
- 3.5.5 Soil Stabilisation: Excavation and batch treatment of soil with additives such as lime, cement and other proprietary materials to alter the physico-chemical characteristics of the soil, to reduce the leachability of contaminants within the soil and/or reduce the permeability of the soil. Stabilisation is useful for a wide range of contaminants, both organic and inorganic, but significant areas are required for stockpiling of untreated and treated soils. Treatability studies are generally required and remediated soil can be re-used on site following treatment. Stabilisation may be required independently for geotechnical purposes.
- 3.5.6 Soil Washing: Excavation and batch or continuous treatment of soils to remove contaminants (or the soil matrix that contains the contaminants). In practice the finer particles (clays and silts) with contaminants adhered to them are separated from the coarser particles (sands and gravels) which can then be re-used. Wash water can be recycled, but contaminated residues may need to be disposed of at a landfill site. It can be used on soils with a wide range of contaminants, but the soils themselves need to have a reasonably high proportion of re-usable granular materials (>70%) for the process to be economic.
- 3.5.7 Cover systems and vertical cut-offs: Contaminated soils are left in the ground and the pollutant linkage broken by placing a cover system on top of the contaminated soil and/or providing a cut-off around the contaminated soil. Cover systems most often

comprise clay systems sometimes accompanied by geotextiles, capillary break systems etc. Alternative geo-synthetic clay systems are also used. Vertical cut-offs can include bentonite, concrete or sheet steel barriers. No remediation trials are generally necessary and they can be installed quickly. However, contaminants are not removed or destroyed.

- 3.5.8 Some contaminated materials are not amenable to treatment and re-use, and will need to be disposed of off-site.. Such materials may include asbestos containing materials (ACM), radioactive materials and recent domestic waste.
- 3.5.9 Ground gas control: ground gas migration can be controlled by vertical and/or horizontal cut-offs together with controlled venting to the atmosphere. In some cases the removal of gas generating material (eg recent domestic waste) may also be required.
- 3.5.10 Groundwater remediation: there are a wide number of groundwater remediation methodologies. Where groundwater receptors are not immediately at risk monitored natural attenuation (MNA) can be undertaken, whereby the contaminated groundwater is monitored on a regular basis to confirm that natural processes are acting to degrade and disperse the contaminants within the groundwater. Where receptors are at risk, contaminants in the groundwater can be treated using a variety of methods including soil flushing, volatilization, chemical reduction and bio-treatment.

3.6 Construction issues

- 3.6.1 At construction compounds, there will be a variety of materials and liquids being stored, handled and used during the construction period. There is, therefore a risk that such materials could give rise to soil or groundwater contamination through spillage or leakage.
- 3.6.2 In these locations, consideration will be given to the types of operations that would be undertaken, the types of contaminative materials or liquids that would be used or stored (for example fuel oils), and the types of safeguards (mitigation measures) that would be required in order that such materials or liquids would not give rise to significant soil or groundwater contamination. This process has informed the development of environmental management protocols for construction compounds (for example, specific measures within the draft Code of Construction Practice).

3.7 Operational issues

- 3.7.1 The main potential operational sources of contamination will be derived from maintenance works at the Infrastructure Maintenance Depot (IMD), located at Calvert in Buckinghamshire and at the Rolling Stock Maintenance Depot (RSMD) located at Washwood Heath in Birmingham.
- 3.7.2 In these locations, consideration will be given to the types of operations that will be undertaken, the types and volumes of contaminative materials or liquids that will be used or stored (for example fuel oils), and the types of safeguards (mitigation measures) that will be required in order that such materials or liquids will not give rise to significant soil or groundwater contamination.

3.8 Mining, mineral and geological resources

- 3.8.1 Existing mining and/or mineral sites, together with the areas or sites that are likely to be considered as future mining or mineral areas have been identified through review of desk study data as set out in Tables 1-3. These are usually designated as mineral safeguarding areas in county council or unitary authority mineral plans, and indicate that for any planning applications submitted within those areas, there is a need to consider conflicts with the mineral extraction requirements for the county.
- 3.8.2 The methodology for assessing the effects of the Proposed Scheme on current and future mining and mineral resources is contained in detail in the technical note 'Methodology and significance criteria for geological issues (excluding land contamination)' - appended to the SMR addendum, which sets out a method to assess the value of a resource and the magnitude of impact that it will experience, to determine whether there are significant effects.
- 3.8.3 Where significant effects are determined, then mitigation measures will be required to reduce or offset the impacts. Such measures for geological resources may include, for example, prior use of the resource before construction of the Proposed Scheme or, in the case of severance providing additional or alternatives accesses to working sites. In the case of a geo-conservation resource, mitigation may include the creation of a similar geo-conservation site in the near vicinity which replicates the geological features of interest.
- 3.8.4 Further details regarding mitigation measures are contained within the technical note 'Potential mitigation measures'

3.9 Significance criteria

- 3.9.1 The significance criteria for contaminated land issues, mining and mineral issues and geo-conservation issues are set out in technical note's 'Detailed methodology for land contamination assessments' and 'Methodology and significance criteria for geological issues (excluding land contamination)' and also below in Tables 4 and 5.

Table 4: Significance criteria for land contamination

Significance Criteria	Definition
Major adverse effect	An increase in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. from land that has a very low contamination risk in the baseline becomes a high or very high risk.
Moderate adverse effect	An increase in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk.
Minor adverse effect	An increase in contamination risk of 1 risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk.
Negligible effect	No change in contaminated land risks.
Minor beneficial effect	A reduction in contamination risk of 1 risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk.
Moderate beneficial effect	A reduction in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk.
Major beneficial effect	A reduction in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk.

Table 5: Significance criteria for mining/mineral and geological resources

Term	Description
Major adverse	Considerable detrimental or negative impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant.
Moderate adverse	Limited detrimental or negative impact (by extent, duration or magnitude) which may be considered to be significant.
Minor adverse	Slight, very short or highly localised detrimental or negative impact without a significant consequence.
Negligible	Imperceptible impact to an environmental resource or receptor
Minor beneficial	Slight, very short or highly localised advantageous or positive impact without a significant consequence.
Moderate beneficial	Limited advantageous or positive impact (by extent, duration or magnitude) which may be considered to be significant
Major beneficial	Considerable advantageous or positive impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant.

3.10 Assumptions and limitations

- 3.10.1 The assessment will primarily be based on existing documentation (such as historical mapping, geological mapping and a variety of reports) supplemented by site visits. In a number of areas, generally in the Birmingham and London areas, previous ground investigation data may also be available to assist in the assessments. Project specific ground investigation will not be undertaken.
- 3.10.2 Considerable use is made of historical Ordnance Survey mapping to identify previous uses of land. There is the possibility that short term contaminative land uses may not be shown on mapping if it only occurred for a brief period between two subsequent mapping editions.



HS2 London-West Midlands

Land quality

Technical note – Detailed methodology for land contamination assessments

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 General

1.1.1 This technical note presents the proposed detailed methodology for the assessment of existing potential land contamination for the Proposed Scheme. It is based primarily on the assessment of potential sources of contamination identified from current and historical mapping, site inspections where possible and other documentary data made available (for example, information held by local authorities). It includes:

- categorisation of sources;
- categorisation of potential receptors;
- assessment of pathways;
- assessment of potential impacts on sensitive receptors; and
- assessment of environmental effects.

1.1.2 The technical note deals with the assessment of existing potential land contamination. It does not deal with any contamination potentially derived from the operation of the Proposed Scheme (see Operational issues appended to the SMR addendum Annex F), nor with other land quality issues, such as geo-conservation issues (see Methodology and significance criteria for geological issues (excluding land contamination), appended to the SMR addendum Annex F.

1.1.3 The study area for the assessments includes the land required to construct the Proposed Scheme together with a buffer extending out for a minimum of 250m, except in the case of groundwater when a limit of up to 1Km may be considered.

1.1.4 The process used generally follows the procedures outlined in the Environment Agency Report CLR 11 Model Procedures for the Management of Land Contamination¹.

1.2 Layout of Report

1.2.1 Section 2 of this technical note deals with the screening methodology proposed. The screening aims to pre-identify those sites with potential sources of contamination that could have a significant impact on the construction of the Proposed Scheme, and, thereby on the surrounding environment. These sites will be taken through to a more detailed assessment.

1.2.2 Section 3 describes the more detailed assessment applied to these sites. It is essentially a conventional contaminated land risk assessment employing a conceptual site model (CSM) to identify the various types of risk present at the site. The more detailed assessment will be undertaken for baseline (i.e. pre-construction), construction and post construction stages. The construction stage assessment assumes that normal construction mitigation measures (as stated in the draft CoCP see Volume 5: Appendix CT-003-000) will be applied during the construction work.

¹ Environment Agency (2004), *Model Procedures for the Management of Land Contamination*.

The post-construction assessment assumes that appropriate remedial measures have been undertaken during the construction phase.

- 1.2.3 Contamination risks at baseline will then be compared to risks at the construction stage and the post-construction stage. Where the risk has increased (for example during the construction stage) then an adverse effect will be recorded. Where the risk has decreased (for example as a result of the remediation of contamination), then a beneficial effect will be recorded.

2 Screening

2.1 Stage A

2.1.1 The screening process is divided into two stages (A and B). Six steps are involved in Stage A:

- divide the Proposed Scheme into lengths showing similar vertical alignment (see Table A1 in Appendix A);
- divide the area either side of the Proposed Scheme into proximity zones (see Table A2 In Appendix A);
- review mapping and identify potentially contaminative land uses and categorisation (see Table A3 in Appendix A), giving each a unique reference number;
- review landfill information and other land use information and identify any additional potentially contaminative land uses and categorisation, giving each a unique reference number;
- apply impact potential scoring (see Table A4 in Appendix A); and
- determine, from scoring, which sites to take through to Stage B.

2.1.2 The scoring system gives a score between 0 and 5 to each site, based on the type of potentially contaminated land, the proximity of the site to the Proposed Scheme and the vertical alignment.

2.1.3 Scores of 0 to 1 will require no further action. Scores of 3 and above will automatically go through to Stage B. For scores of 2 a sense check will be undertaken to decide whether further assessment is necessary.

2.2 Stage B

2.2.1 There are three further steps in Stage B:

- identify sensitive land uses locations in the study area (see table A5 in Appendix A);
- identify Principal and Secondary A aquifers in the study area; and
- based on impact potential scoring, apply the receptor proximity assessment as described in Paragraph 2.2.2.

- 2.2.2 All sites with an impact potential score of 5 will go forward for a detailed assessment, irrespective of receptor sensitivity. For sites with an impact potential score of 4, if contaminative land use is within 50m of a sensitive land use and overlies a Principal or Secondary A aquifer, then the site will go forward for detailed assessment. For sites with an impact potential score of 3 or 2, if contaminative land use immediately adjoins a sensitive land use and/or overlies a Principal or Secondary A aquifer, then the site will go forward to a more detailed assessment.
- 2.2.3 At each of the above stages professional judgement will need to be used to check that the screening system is highlighting the most significant sites.

3 Contamination Risk assessment

3.1 Stage C

3.1.1 There are two stages (C and D) to the more detailed risk assessment. The first stage has two steps:

- for each site, develop three (baseline, construction and post-construction) Conceptual Site Models (CSMs); and
- estimate the risk magnitude on the contaminant linkages that are considered to exist by assessing the probability (likelihood) of pollution/harm occurring and the consequence of that pollution/harm, through a qualitative risk assessment (see Tables 1 – 3). This is undertaken for the baseline, construction and post construction phases. The estimation of risk is undertaken using the matrix presented in Table A6 in Appendix A, together with the associated definitions in Tables A7 and A8.

3.1.2 The results of these two steps are presented in three CSMs as qualitative risk assessments (baseline, construction and post-construction). The construction and post construction risk assessments assume that appropriate mitigation will have been undertaken.

Table 1: Baseline CSM and Qualitative Risk Assessment

The diagram shows a box labeled 'CLR 11 conceptual site model' with a bracket underneath it. To the right of this box are three smaller boxes: 'Appendix – Table A7', 'Appendix – Table A8', and 'Appendix – Table A6'. Vertical lines connect these three boxes to the 'Probability', 'Consequence', and 'Risk at baseline without mitigation' columns of the table below, respectively.

Source	Receptor	Pathway	Probability	Consequence	Risk at baseline without mitigation
	Contaminant linkages				

Table 2: Construction CSM and Qualitative Risk Assessment

Source	Receptor	Pathway	Probability	Consequence	Risk with construction stage mitigation
	Contaminant linkages				

3.1.3 Table 2 assumes standard construction mitigation practices presented in the draft COCP are applied.

Table 3: Post construction CSM and Qualitative Risk Assessment

Source	Receptor	Pathway	Probability	Consequence	Risk with permanent works mitigation
	Contaminant linkages				

3.1.4 Table 3 assumes remediation has been undertaken and construction works completed.

3.2 Stage D

3.2.1 During Stage D, the significance of the effects of the contamination will be assessed by comparing the difference in risk of each contaminant linkage at baseline to those at construction and at post construction stages. This provides a way of assessing both the adverse and beneficial effects during construction and the post construction period. Table 4 provides a template of how this will be presented using the definitions in Table A7 in Appendix A. Where there has been a decrease in environmental risk, the scheme will be considered to have a beneficial effect on the environment in the long term (even though there may be adverse short term construction effects).

Table 4: Significance of Impact during construction and post construction

Contaminant Linkage	Main Baseline Risks	Main Construction Risks	Main Post-construction Risks	Construction Effects Significance	Post-construction Effects Significance
Overall Significance					

Appendix A: Screening and Contamination Risk Assessment Tables

Table A1: Classes of vertical alignment

Code	Definition
V/E	Viaduct or embankment more than 1.5m high where main intrusion into ground will be from foundations of structures
C/S	Route at grade or in cuttings or cut and cover tunnels
T	Deeper bored tunnels, with no disturbance of surface features

Table A2: Proximity zone definition

Zone no	Definition
Zone 1	All land on or within the footprint of the land required for the construction and operation of the Proposed Scheme and including a 10m margin either side of the centre line of the Proposed Scheme, and including side shoots such as road realignments, spoil borrow or storage areas etc
Zone 2	All land within 50m of the edge of Zone 1 land
Zone 3	All land from between 50 and 250m from the edge of Zone 1 land

Table A3: Potentially Contaminative land uses

Class	Generic description	Typical land-uses
Class 1	Low risk of potential contamination, or less hazardous chemicals in use	Farms
		Warehouses
		Goods yards
		Hospitals
		Builders yards
		Retail and Business Parks
Class 2	Medium risk of potential contamination, more hazardous chemicals in possible use	Engineering workshops
		Conventional railways/disused railway lines
		Brick works (by virtue of their potential backfill)
		Dry Cleaners (retail)
		Sewage works
		Former clay pits and quarries
		Cement/asphalt works
Car breakers		

Class	Generic description	Typical land-uses
		Garage workshops
		Waste transfer facilities
		Paper works
		Power Stations
		Glass works
		Timber treatment works
		Foot and mouth burials
		Metal manufacturing and plating
		Depots
		Scrap yards
Class 3	High risk of potential contamination, hazardous chemicals likely to be present	Gas and cokeworks
		Landfills and historical landfills
		Petrol filling stations
		Oil Depots
		Iron and Steel Works
		Historical Foundries
		Chemical Works
		Tanneries
		Asbestos Works
		Dye Works
		Animal processing and abbatoirs
		Printers
		Evidence of fuel/storage tanks
		Dry Cleaners (industrial)
		Printers (industrial)

Table A4: Impact potential scoring method

Potentially contaminative Land-use Class (see Table 3)	Proximity to route (see Table 1 and below)	Vertical alignment (see Table 2 and below)	Impact potential score
Class 1 Low risk	Zone 1	V/E	2
		C/S	3
		T	0
	Zone 2	V/E	1
		C/S	2
		T	0
	Zone 3	V/E	0
		C/S	1
		T	0
Class 2 Medium risk	Zone 1	V/E	3
		C/S	4

Potentially contaminative Land-use Class (see Table 3)	Proximity to route (see Table 1 and below)	Vertical alignment (see Table 2 and below)	Impact potential score
		T	2
	Zone 2	V/E	2
		C/S	3
		T	2
	Zone 3	V/E	1
		C/S	2
		T	1
Class 3 High risk	Zone 1	V/E	4
		C/S	5
		T	3
	Zone 2	V/E	3
		C/S	4
		T	3
	Zone 3	V/E	2
		C/S	3
		T	2

Table A5: Sensitive Receptors

List of land uses deemed "sensitive"	Sensitive water resources	Geological or Ecological designations	Property
Housing	Principal	SSSI	Mineral Resources (actual or with planning permission)
Schools	Secondary A	Ramsar	Building structures (for gas risks)
Public parks	Watercourses (Main River Status)		Grade 1 Agricultural land
Playgrounds			

Table A6: Estimation of Risk Magnitude

		Consequence			
		Severe	Medium	Minor	Negligible
Probability	High Likelihood	6	5	4	3
	Likely	5	4	3	2
	Low Likelihood	4	3	2	1
	Unlikely	3	2	1	1

Descriptions of classified risks are as follows:

A1.1 6 (Very High Risk)

- 1.1.1 There is a high probability that a contaminant linkage could exist between a source and a designated receptor resulting in detriment to the receptor. Investigation and remediation will be required prior to (or as part of) construction. During construction further mitigation and monitoring measures (in accordance with the draft Code of

Construction Practice (CoCP)) are likely be required. Such sites are considered significant.

A1.2 5 (High Risk)

1.2.1 It is likely that a contaminant linkage exists with potentially a severe affect on designated receptors. Investigation and remediation is very likely to be required. Such sites are considered significant.

A1.3 4 (Moderate Risk)

1.3.1 It is possible that an effect could arise to a designated receptor through a contaminant linkage. However, the effect is most likely to be moderate to minor. Further investigative work is likely to be required to clarify the risk. Some remediation works may be required. Such sites may be considered significant.

A1.4 3 (Moderate/Low Risk)

1.4.1 It is possible that a contaminant linkage could exist, but if it does, any effects would normally be minor. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

A1.5 2 (Low Risk)

1.5.1 It is a low possibility that a contaminant linkage could exist. However, should there be a linkage the effect to the receptor (with regards to controlled waters) would normally be minor or negligible and the effect on human health would be negligible. No investigation or remedial works are likely to be required.

A1.6 1 (Very Low Risk)

1.6.1 It is unlikely that a contaminant linkage could exist between a source and a designated receptor.

Table A7: Classification of Probability

Classification	Definition of the Probability of Harm/Pollution Occurring
High Likelihood	The contaminant linkage exists and it is very likely to occur in the short term, and/or will almost inevitably be realised in the long term, and/or there is current evidence of it being realised.
Likely	The source, pathway and receptor exist for the contaminant linkage and it is probable that this linkage will occur. Circumstances are such that realisation of the linkage is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	The source, pathway and receptor exist and it is possible that it could occur. Circumstances are such that realisation of the linkage is by no means certain in the long term and less likely in the short term.
Unlikely	The source, pathway and receptor exist for the contaminant linkage but it is improbable that it will be realised even in the long term.

Table A8: Classification of Consequence

Classification	Definition of Consequence
Human Health Receptors – Site End Users	
Severe	Acute damage to human health based on the potential effects on the critical human health receptor.
Medium	Chronic damage to human health based on the potential effects on the critical human health receptor.
Minor	Minimal short- term effects on human health based on the potential effects on the critical human health receptor.
Negligible	No appreciable impact on human health based on the potential effects on the critical human health receptor.
Controlled Water Receptors	
Severe	Pollution of a Principal aquifer within a source protection zone (inner and outer) or potable supply characterised by a breach of drinking water standards. Pollution of a surface water course characterised by a breach of an Environmental quality Standard (EQS) at a statutory monitoring location or resulting in a change in the General Quality Assessment (GQA) grade of river reach. Discharge of a hazardous or non-hazardous substance to groundwater.
Medium	Pollution of a Principal aquifer outside a source protection zone (inner and outer) or a Secondary A aquifer characterised by a breach of drinking water standards. Pollution of an industrial groundwater abstraction or irrigation supply that impairs its function. Substantial pollution but insufficient to result in a change in the GQA grade of river reach.
Minor	Low levels of pollution of a Principal aquifer outside a source protection zone or an industrial abstraction, or pollution of a Secondary A or B aquifer. Low levels of pollution insufficient to result in a change in the GQA grade of river reach, pollution of a surface water course without a quality classification.
Negligible	No appreciable pollution, or pollution of a low sensitivity receptor such as a secondary (undifferentiated) aquifer or a surface water course without a quality classification.
Ecosystem Receptors	
Severe	For sites with designations as follows – Site of Special Scientific Interest, National Nature Reserve, Special Protection Area (and potential sites), Special Area of Conservation (and candidate sites) or Ramsar. Irreversible adverse change in the functioning of the ecological system or any species of special interest that forms part of that system.
Medium	For sites with designations as follows – Site of Special Scientific Interest, National Nature Reserve, Special Protection Area (and potential sites), Special Area of Conservation (and candidate sites) or Ramsar. Substantial adverse change in the functioning of the ecological system or any species of special interest that forms part of that system.
Minor	Harm to ecosystems of a low sensitivity such as sites of local importance. No appreciable harm to ecosystems with statutory designations.
Negligible	Limited harm to ecosystems of low sensitivity such as sites of local importance.
Property Receptors – Buildings, Foundations and Services including the operational HS2 scheme	
Severe	Collapse of a building or structure including the services infrastructure from explosion due to ground gasses.
Medium	Significant damage to a building or structure including the services infrastructure impairing their function.
Minor	Damage to buildings/structures and foundations but not resulting in them being unsafe for occupation. Damage to services but not sufficient to impair their function.
Negligible	No appreciable damage to buildings/structures, foundations and services.
Property Receptors – Grade 1 Agricultural land	
Severe	Substantial loss in the value of crops or domestically-grown produce resulting from disease, death or other physical damage. Death to livestock, domesticated animals or wild animals subject to shooting or fishing rights.
Medium	Substantial diminution in yield of crops or domestically-grown produce resulting from disease, death or other physical damage. Serious disease or other serious physical damage to livestock, domesticated animals or wild animals subject to shooting or fishing rights.
Minor	Harm to crops but not resulting in a substantial loss in value or diminution in yield. Limited harm in terms

Classification	Definition of Consequence
	of disease or other physical damage to livestock, domesticated animals or wild animals subject to shooting or fishing rights.
Negligible	No appreciable harm, or harm to a low sensitivity receptor.

Table Ag: Significance Criteria

Significance Criteria	Definition
Major adverse effect	An increase in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. from land that has a very low contamination risk in the baseline becomes a high or very high risk.
Moderate adverse effect	An increase in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk.
Minor adverse effect	An increase in contamination risk of 1 risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk.
Negligible effect	No change in contaminated land risks.
Minor beneficial effect	A reduction in contamination risk of 1 risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk.
Moderate beneficial effect	A reduction in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk.
Major beneficial effect	A reduction in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk.



HS2 London-West Midlands

Land quality

Technical note – Methodology and significance criteria for geological issues (excluding land contamination)

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This technical note explains the basis for the assessment of significance with regard to a number of geological issues, other than existing contaminated land (which is dealt with in a separate technical note - Detailed methodology for contaminated land assessment in the SMR Addendum, Annex F). The issues considered here include:
- geological conservation resources; and
 - mining and mineral resources.
- 1.1.2 Geological conservation resources include geological and geomorphological Sites of Special Scientific Interest (SSSI), Local Geological Sites (previously known as Regionally Important Geological Sites) and other geological conservation resources of a local nature.
- 1.1.3 Mining and mineral resources include both deep and opencast coal mining, sand and gravel production, building stone and aggregate production from quarries, and the exploitation of other geological materials.
- 1.1.4 With regard to historical mining activities, these will not be assessed with regard to any settlement issues, but will be assessed with regard to remnant contamination (e.g. the possibility of contamination within backfilled quarries and pits).
- 1.1.5 Sources of information for mining, minerals and geological conservation resources are given in a technical note entitled Introduction to land quality assessment (see the SMR Addendum Annex F).
- 1.1.6 Groundwater (hydrogeological) resources and flooding are dealt with in a technical note entitled Groundwater assessment method (appended to the SMR addendum Annex K)

2 Proposed methodology

2.1 General

- 2.1.1 Geological and mining/mineral resources will be assessed by considering the sensitivity or value of the resource and the magnitude of the impact on the resource from the construction and operation of the Proposed Scheme. These two issues are then combined in a matrix to provide an estimate of the significance of the effects on the resource.
- 2.1.2 As a guide to the significance of effects, the following definitions in Table 1 are based on those provided in the introduction to the Scope and Methodology Report (see Volume 5:Appendix CT 001-00/1).

Table 1: Significance of effects

Term	Description
Major adverse	Considerable detrimental or negative impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant.
Moderate adverse	Limited detrimental or negative impact (by extent, duration or magnitude) which may be considered to be significant.
Slight adverse	Slight, very short or highly localised detrimental or negative impact without a significant consequence.
Negligible	Imperceptible impact to an environmental resource or receptor
Slight beneficial	Slight, very short or highly localised advantageous or positive impact without a significant consequence.
Moderate beneficial	Limited advantageous or positive impact (by extent, duration or magnitude) which may be considered to be significant
Major beneficial	Considerable advantageous or positive impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant.

2.2 Geological resources

2.2.1 Sections 2.2 and 2.3 present the sensitivity/value and impact magnitude tables for geological resources and mining and mineral resources, together with the significance matrix.

Table 2: Sensitivity/value of geological resources

Sensitivity/value	Description
Very high	Geological or geomorphological Site of Special Scientific Interest (SSSI) of international importance.
High	Geological or geomorphological SSSI
Medium	Local Geological Site (LGS)
Low	Other local geological conservation resource

Table 3: Impact on geological resources

Magnitude	Description
Major	Complete loss of resource
Moderate	Partial loss of feature/resource or a significant impact on its setting, and/or accessibility
Minor	Slight loss of feature/resource, or a slight impact on its setting and/or accessibility.
Negligible	No significant impact
Positive	Creation of a new feature/resource (e.g. a new permanently accessible geological exposure) or a new geological understanding (e.g. through ground investigation)

Table 4: Significance of effects on geological resources

	Sensitivity/Value			
Magnitude	Very high	High	Medium	Low
Major	Major adverse	Major adverse	Moderate adverse	Minor adverse
Moderate	Moderate adverse	Moderate adverse	Minor adverse	Minor adverse
Minor	Minor adverse	Minor adverse	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible
Positive	Moderate benefit	Moderate benefit	Slight benefit	Negligible

2.3 Mining and mineral resources

2.3.1 Sections 2.2 and 2.3 present the sensitivity/value and impact magnitude tables for geological resources and mining and mineral resources, together with the significance matrix.

Table 5: Sensitivity/value of current mining or mineral resources

Sensitivity/value	Description
Very high	Mining or mineral resource of national importance (strategic) currently being worked.
High	Non-strategic mining or mineral resource currently being worked, or Specific Sites/Preferred Area for mining mineral works within a Mineral Planning Authority's (MPA) Local Plan
Medium	Mineral Safeguarding Areas within a MPA Local Plan
Low	Mineral Consultation Areas within a MPA Local Plan

Table 6: Impact on current mining or mineral resources

Magnitude	Description
Major	Complete loss of resource
Moderate	Major loss of resource or significant severance of a resource
Minor	Minor loss of resource with no severance
Negligible	No significant impact
Positive	Project allows definition/exploration/sustainable working of resource, thereby reducing impact (e.g. traffic)

Table 7: Significance of effects on mining or mineral resources

	Sensitivity/Value			
Magnitude	Very High	High	Medium	Low
Major	Major adverse	Moderate adverse	Moderate adverse	Minor adverse
Moderate	Moderate adverse	Moderate adverse	Minor adverse	Minor adverse
Minor	Minor adverse	Minor adverse	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible
Beneficial	Moderate	Moderate	Minor	Negligible



HS2 London-West Midlands

Land quality

Technical note – Operational issues

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1.1 The purpose of this technical note is to set out the scope of the land quality assessment for the operational phase of the Proposed Scheme.

1.1.2 There are several strands to the land quality assessment of operational issues:

- contamination at depots;
- contamination from other buildings/areas (e.g. stations, auto-transformer sites);
- contamination on track areas;
- contamination from the operation of high speed trains on the tracks; and
- Continued sterilisation of minerals located within influencing distance of the railway.

1.1.3 These issues will be addressed in turn in this technical note.

1.1.4 The methodology of assessment of existing contamination on depot sites, railway stations and the track area is covered within a separate technical note 'Detailed methodology for land contamination assessments' (appended to the SMR addendum Annex F).

2 Operational issues

2.1 Depot areas

2.1.1 There are two proposed depot areas:

- the Infrastructure Maintenance Depot (IMD) at Calvert in Buckinghamshire; and
- the proposed depot at Washwood Heath in Birmingham.
- Both will cover significant areas of land (the Washwood Heath depot is approximately 1.6km long by 400m wide and the IMD covers approximately 37ha). At present the Calvert area comprises mainly agricultural land whereas Washwood Heath is a former rail depot and partially developed brownfield land with adjacent residential areas.

2.1.2 The IMD will house all the plant and materials that are required to maintain the track. The site will contain the following main elements:

- workshops;
- maintenance sheds;
- six stabling sidings;
- administration offices; and
- Parking areas and balancing ponds.

2.1.3 As such the IMD site will store, handle and use a variety of potentially contaminative materials which will be used in these operations. Such materials will potentially include:

- clean and used ballast and sub-ballast materials;
- waste storage;
- fuel oils;
- cleaning fluids;
- lubricating and hydraulic oils;
- solvents and degreasers;
- herbicide/pesticide storage; and
- miscellaneous construction materials.

2.1.4 The proposed Washwood Heath depot will be responsible for all maintenance of rolling stock to be used on the route. As such the facilities will contain the following:

- a workshop/maintenance shed;
- carriage cleaning facilities;
- a wheel lathe and plant room;
- a controlled emissions toilet facility;
- rolling stock battery servicing facilities;
- overhead cranes;
- fluid and hazmat storage;
- a water and wash fluid replenishment facility;
- network control centre and administration offices
- water discharge; and
- stabling roads.

2.1.5 The types of contaminative materials that are likely to be present on the Washwood Heath depot site will include:

- fuel oils;
- cleaning fluids;
- metals;
- paints;
- lubricating and hydraulic oils;
- solvents and degreasers; and

- sewage.

2.1.6 Because of their proposed use, an assessment will be undertaken within the land quality section, of their potential for contaminative releases. The operation of the sites will be governed by environmental regulations and good practice, however the assessment will note any particular safeguards (mitigation measures) that may also be required.

2.2 Stations and other buildings/areas

2.2.1 There will also be a number of other buildings or areas which could lead to contamination. These include:

- the stations (Euston, Old Oak Common, Birmingham Interchange, Curzon Street); and
- auto-transformer stations.

2.2.2 The stations will generally give rise to a much smaller range of contaminative materials than depots. Given modern design standards the likelihood of significant contamination from the operation of stations is not considered significant, and can therefore be scoped out of the assessment.

2.2.3 The only contamination risk with transformer station sites is the small potential for ground contamination from accidental spillage of coolants. Where necessary, the transformers will incorporate secondary containment appropriate to the level of risk and to minimise external leakage/spillage. Therefore it is considered that the risk of significant contamination of ground or groundwater in the vicinity of auto transformer stations is very low and can therefore be scoped out of the assessment.

2.3 Track and trackside area maintenance

2.3.1 Contamination from the maintenance of track and trackside areas will be limited. Track switch locations will require maintenance and lubrication. The quantities of lubricants required are low, and the lubricants themselves are water repellent and can be bio-degradable, such that any effects on the underlying ground, groundwater and drainage system may be reduced. Sleepers will be concrete (not wooden) and therefore not subject to protection by wood preservatives. Vegetation maintenance will be required possibly with the use of herbicides to keep vegetation under control. There will be track side parking areas at track access locations and these may be subject to small amounts of oil contamination from fuel or oil leaks

2.3.2 Track and trackside maintenance will be subject to environmental controls and management systems. Overall, the degree of contamination from track and trackside maintenance is not expected to be significant and can therefore be scoped out of the assessment.

2.4 Operations

2.4.1 The operational trains are powered through overhead electric cables. The operation of the trains on the tracks will give rise to local generation of contaminants through wear and tear of contact areas causing mainly metal release. There is also the possibility of

leakage of hydraulic or lubricating oils from the gear boxes and axle boxes of trains or from points machines but this is not expected to be significant.

- 2.4.2 Maintenance trains will be powered by the overhead electrical system, but will also have diesel engines (for motive power whilst the overhead electrical system is switched off) and other ancillary uses.
- 2.4.3 There will be no release of sewage on the track from on-board toilets as these will be sealed systems.
- 2.4.4 The main contact issues are:
- wear of the (mainly) copper contact wire;
 - wear on the pantograph contact (metallised carbon);
 - brake wear (brake pads and wheel linings); and
 - wheel to rail contact and abrasion.
- 2.4.5 Some studies have been undertaken on this issue. The most widespread study was undertaken in Switzerland on their 7,200km network. They estimated abrasion losses of operating components across the network, and presented the data both as annual losses per annum of various metals and oils, and as mass/km length of track. Of the common contaminative metals the greatest losses (and therefore the highest potential for contamination) were from copper which abrades from the contact wire, losses from which were estimated at 5,280 grams/kilometre/year. Because abrasion occurs at a high level (above the train), there is a greater propensity for copper particles to be distributed outside the railway corridor through wind dispersal, in comparison with abrasion losses at track level (e.g. from brakes). Abrasion at track level is predominantly of iron (from wheel and rail) and iron is not considered to be a contaminative material.
- 2.4.6 Dutch railways have also estimated copper losses from contact wire abrasion and have estimated a loss of 0.15 grams/train/kilometre. Assuming 180 trains per day, this would give a rate of loss of 9,860 grams/kilometre/year.
- 2.4.7 In the UK, copper losses have been estimated from typical replacement times for contact wire. The contact wire needs replacement when the abrasion losses on the underside of the wire reduce the wire diameter to two thirds of its original diameter. It is estimated that this occurs after 50 years of use. Based on a contact wire diameter of 13.2mm, this loss equates to 7,120 grams/kilometre/year.
- 2.4.8 The above three estimates, although not identical, are of the same order of magnitude. Differences between estimates would be expected given that there will be a number of variables which contribute to copper losses on the contact wire which may differ between countries and railway operators.
- 2.4.9 Based on the above figures an estimate has been made of the potential copper pollution from the operation of the Proposed Scheme. The copper particles abraded from the contact wire are very small and are likely to be spread over a considerable width both on the track and adjacent to the track. Assuming that the width of deposition is 20m either side of the track centreline and that over a period of time the additional copper becomes mixed with the topsoil to a depth of 300mm, the

additional copper load within the topsoil would be between about 0.2 and 0.4mg/kg copper/ year. This is not considered to be significant.

- 2.4.10 It should be noted that the figures above were generated, in the main, by low speed lines with higher levels of braking and turning which would arguably lead to greater abrasion losses.
- 2.4.11 It should also be noted that trackside drainage systems will be required to cope with all/any contamination in surface run-off to comply with environmental permitting regulations.
- 2.4.12 Taking the above into consideration, the scale of loss of copper from abrasion of the contact wire will lead only to small increases in copper concentrations in near surface topsoils adjacent to the railway. Therefore contamination from abrasion losses will be scoped out of the assessment.

3 Summary

- 3.1.1 Given the nature of the materials used and stored at the two depot sites it is considered that there is a risk of operational contamination. These sites will therefore be considered within the land quality assessment.
- 3.1.2 It is unlikely that stations will give rise to a risk of significant contamination and this aspect will be scoped out of the assessment.
- 3.1.3 There is a minimal risk of contamination from auto-transformers and therefore they will be scoped out of the Land Quality assessment.
- 3.1.4 It is unlikely that track and trackside maintenance will give rise to a risk of significant contamination effects and will be scoped out.
- 3.1.5 The biggest abrasion losses are likely to be those of copper from abrasion of the contact wire. However data from a number of railway operators indicate that the scale of loss of copper from abrasion of the contact wire would lead at most to only small increases in copper concentrations in near surface topsoils adjacent to the railway. Therefore contamination from abrasion losses will be scoped out of the assessment.



HS2 London-West Midlands

Land quality

Technical note – Potential mitigation measures

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 The purpose of this technical note is to provide guidance with regard to potential approaches that could be followed when specifying mitigation or remediation within the Land quality assessment of the ES for the Proposed Scheme.
- 1.1.2 This technical note discusses issues of land contamination first, followed by mitigation of effects on mining/mineral resources and geo-conservation resources. The note supports the general principle that, in the case of the expected forms of contamination (wherever it is found in the Proposed Scheme and when it has been fully defined), this will be mostly amenable to remediation using established technologies in preference to off-site disposal. Mitigation measures for construction and operational effects should be treated separately.
- 1.1.3 The proposed mitigation measures that are anticipated will be described in the ES, together with the significant effects remaining after mitigation (termed the residual significant effects). Where the Proposed Scheme is likely to improve environmental conditions (over and above the baseline), these effects will be identified.
- 1.1.4 In the case of land contamination, the contamination in the ground is often already present. The amount of remediation required need be no more than to allow safe development of the site suitable both for its proposed use and for the wider environment. Once remediated (which may include systems of management and control) there should be no significant adverse residual impacts and there may well be a beneficial effect on the surrounding environment through the removal or immobilisation of contaminants.

2 Land contamination

2.1 Legal basis

- 2.1.1 With regard to contamination, HS2 Ltd may need to remediate land over which the Proposed Scheme passes, where:
- the Proposed Scheme exacerbates any existing pollutant linkage, where these linkages are not the responsibility of HS2;
 - HS2 Ltd becomes the “responsible person” or owner of the pollution;
 - the Proposed Scheme causes a pollutant linkage to be put in place; and/or
 - the Proposed Scheme compromises permanently the ability to remediate existing contamination (within the land required temporarily or non operationally) at some later date.
- 2.1.2 Any remediation or other mitigation undertaken would need to be sufficient such that the land could not be identified currently as ‘contaminated land’ under Part IIA legislation (EPA 1990¹).

¹ Environmental Protection Act 1990. London, Her Majesty’s Stationery Office.

2.2 Guidance

2.2.1 Guidance on the management of investigation, assessment and remediation of contaminated land is contained within the Environment Agency publication CLR11 Model Procedures for the Management of Land Contamination². Detailed guidance on examples of various remediation methodologies is contained within numerous publications produced by the Environment Agency, CIRIA, BRE and other organisations:

- Remedial Treatment Data Sheets³;
- Selection of Remedial Treatments for Contaminated Land. A Guide to Good Practice⁴;
- Remedial Treatment of Contaminated Land Vol I – XII⁵;
- Technical Options for Managing Contaminated Land⁶;
- Definition of Waste: Development Industry Code of Practice⁷; and
- Guidance on the Assessment and Monitoring of Natural Attenuation of Contaminants in Groundwater⁸. Remedial Targets Methodology.

2.2.2 This is not an exhaustive list and there are many other documents which describe methodologies and the basis for choosing between them.

2.3 Development of remedial strategies

2.3.1 It is assumed that prior to a remedial strategy being formulated, sufficient investigation, monitoring and risk assessment will be undertaken in order to identify the nature and extent of contamination that needs to be remediated. The remedial strategy chosen will then address the risks to all receptors affected.

2.3.2 Contamination remediation methodologies for soil will be chosen following the hierarchy given below:

- reuse of un-remediated material in a location where it does not constitute a risk;
- on-site treatment and subsequent reuse on site;
- nearby off-site treatment and re-importation to site and reuse (e.g. use of a hub and cluster approach using a soil treatment centre);
- off-site treatment and reuse on other projects; and
- off-site disposal (with or without treatment).

2.3.3 The last option may be appropriate for materials that cannot be suitably treated (e.g. asbestos, recent domestic waste) or for material for which there is no suitable use

² Environment Agency (2004), *CLR11 Model Procedures for the Management of Land Contamination*.

³ Environment Agency *Remedial Treatment Data Sheets*.

⁴ CIRIA (2004), *Selection of Remedial Treatments for Contaminated Land. A Guide to Good Practice*.

⁵ CIRIA (2005), *Remedial Treatment of Contaminated Land Vol I – XII*.

⁶ Safegrounds/CIRIA (2004), *Technical Options for Managing Contaminated Land*.

⁷ Contaminated Land: Applications in Real Environments (CL:AIRE) (2011), *Definition of Waste: Development Industry Code of Practice*.

⁸ Environment Agency (2000), *Guidance on the assessment and monitoring of natural attenuation of contaminants in groundwater*.

(even after treatment) in the vicinity of its source area (i.e. it is not economically feasible to treat).

2.3.4 The choice of contamination remediation methodologies for groundwater will depend on a number of factors including:

- the nature of the contaminants and their variability within a plume;
- the nature of the aquifer;
- access to all relevant areas at the ground surface;
- the time allowed for remediation (which may include monitored natural attenuation (MNA), see Paragraph 2.4.9); and
- the target criteria to be used.

2.3.5 The choice of remediation methodologies for ground gasses may include any or a combination of the following:

- vertical or horizontal gas cut-offs;
- gas membranes within building floor slabs;
- active or passive gas venting; and
- monitoring systems.

2.3.6 Sustainability factors will be taken into account in the choice of methodology. Guidance on sustainable remediation is obtainable from Sustainable Remediation Forum (SURF), a non-profit corporation which aims to develop and disseminate best practice in sustainable remediation.

2.3.7 It is envisaged that there will be no requirement for land contamination mitigation during the operational stage. However, it is likely that where mitigation works have been carried out during the construction stage, there may be a requirement for on-going monitoring (e.g. of groundwater and/or gas) extending into the operational stage.

2.3.8 A number of treatment technologies may be used at any one site in order to treat one or more contaminants in one or more media (e.g. in soils and in groundwater).

2.4 Remedial methodologies

2.4.1 There are a wide variety of potential treatment methodologies; those that are most likely to be used for the Proposed Scheme are given in this section 2.4. This is not an exhaustive list, and other technologies may be considered where appropriate.

Soil remediation technologies

Reuse

2.4.2 Contaminated soils may be reused, whether treated or not, as long as a risk assessment shows that they are suitable for use in the area in which they are to be

used. Rules governing the reuse of soils are contained within the 'The Definition of Waste; Development Industry Code of Practice'⁹.

Bio-remediation

- 2.4.3 Excavation and placing of contaminated soils in bio-piles or windrows, followed by aeration, and where required, addition of composting materials, nutrients and microbial inocula. This technique is useful for remediation of hydrocarbon contamination. Treatability studies are generally required and remediated soil can be usually reused on site following treatment.

Soil stabilisation

- 2.4.4 Excavation and batch treatment of soil with additives such as lime, cement and other proprietary materials to alter the physico-chemical characteristics of the soil, to reduce the leachability of contaminants within the soil and/or reduce the permeability of the soil. Useful for a wide range of contaminants, both organic and inorganic. Significant areas required for stockpiling of untreated and treated soils. Treatability studies are generally required and remediated soil can be reused on site following treatment. Stabilisation may be required independently for geotechnical purposes.

Soil washing

- 2.4.5 Excavation and batch or continuous treatment of soils to remove contaminants (or the soil matrix that contains the contaminants). In practice the finer particles (clays and silts) with contaminants adhered to them are separated from the coarser particles (sands and gravels) which can then be reused. Wash water can be recycled, but contaminated residues may need to be disposed of at a landfill site. It can be used on soils with a wide range of contaminants, but the soils themselves need to have a reasonably high proportion of re-usable granular materials (>70%) for the process to be economic.

Thermal desorption

- 2.4.6 Contaminated soils are heated up to increase the volatility of contaminants such that they can be removed from the solid residues and collected/treated. It is generally used for complex organic compounds (such as pesticides) which are not amenable to bio-remediation.

Cover systems and vertical cut-offs

- 2.4.7 Contaminated soils are left in the ground and the pollutant linkage broken by placing a cover system on top of the contaminated soil and/or providing a cut-off around the contaminated soil. Cover systems most often comprise clay systems sometimes accompanied by geotextiles, capillary break systems etc. Alternative geo-synthetic clay systems are also used. Vertical cut-offs comprise bentonite, concrete or sheet steel barriers. No remediation trials are generally necessary and they can be installed quickly if required. However, contaminants are not removed or destroyed.

⁹ CL:AIRE (2011), *The Definition of Waste: Development Industry Code of Practice Version 2*.

Off-site disposal

- 2.4.8 Some contaminated materials are not amenable to treatment and reuse, and will need to be disposed of off-site in appropriately licensed landfill sites. Such materials may include asbestos containing materials (ACM) and recent domestic waste.

Groundwater remediation technologies

Monitored natural attenuation (MNA)

- 2.4.9 MNA consists of the monitoring of groundwater to confirm whether natural attenuation processes (physical, chemical and biological) are acting at a sufficient rate to ensure that the wider environment (external to the immediate area of the contamination plume) is essentially unaffected (i.e. within agreed remedial targets) such that remedial objectives will be achieved within a reasonable timescale, typically less than 30 years.

Impermeable and permeable reactive barriers

- 2.4.10 Installation of a (generally) vertical barrier system to either control groundwater flow or to channel contaminated groundwater (a contaminant plume) through one or more permeable parts of the wall where contaminants will be removed or deactivated by chemical and/or biological means, by constituents of the wall (such as zero valent iron).

In situ groundwater remediation

- 2.4.11 Groundwater may be treated in situ by a number of different methods which may be used in combination. Typically such methods will involve one or more of the following:
- soil flushing (to remove hydrocarbon contaminants from the unsaturated zone);
 - vacuum extraction of vapours in the unsaturated zone;
 - removal of floating product (non aqueous phase liquids - NAPL) by pumping, vacuum extraction etc.;
 - introduction of compressed air into the groundwater to volatilize dissolved organics (air-sparging), followed by vacuum extraction;
 - introduction of reducing and/or oxidising chemicals into the water to promote breakdown of hydrocarbon contamination (e.g. reductive dechlorinisation); and
 - introduction of additional microbes into the unsaturated zone or groundwater to promote breakdown of hydrocarbon contamination.

Pump and treat

- 2.4.12 Pumping and removal of contaminated groundwater from the ground, ex situ treatment (e.g. air-stripping, carbon adsorption) and re-injection of the treated water. The distribution of the pumping and re-injection wells can be used to create a hydraulic control of the aquifer to prevent further migration of the contaminated groundwater.

Ground gas remediation

Ground gas cut-offs

- 2.4.13 Cut-offs to prevent ground gas migration may be either vertical or horizontal and typically comprise an impermeable membrane (such as HDPE) through which the gasses cannot penetrate. The biggest issue in using such systems is ensuring that during placement (and subsequently) the membrane is not damaged or torn, such as to allow migration pathway. Cut-offs are often used in conjunction with venting layers.

Ground gas venting

- 2.4.14 Ground gas venting controls the migration of ground gasses such that they can vent to atmosphere in a location which does not cause any significant risks. Venting materials includes natural soils (gravel, aggregates) and man-made materials (such as polystyrene vent formers). Often used in conjunction with cut-offs.

Removal

- 2.4.15 Gas generating material (such as domestic waste, peats) may be excavated and removed. This is often undertaken when the gas generating material also causes other problems such as intolerable settlement.

Monitoring

- 2.4.16 Gas monitoring may be used when gas concentrations are generally low enough not to cause an issue, but occasional high concentrations may occur. The monitoring needs to be linked to a management plan. Within buildings, such systems monitor gasses on a semi-continuous basis and can sound alarms when concentrations rise above pre-set criteria.

3 Mining and minerals

- 3.1.1 Mitigation of mining and mineral affects will depend on the type of impacts suffered by the mining or mineral resource:

- complete or partial sterilisation of the resource;
- severance¹⁰ of the resource; and
- constraint on use of the resource (e.g. cutting an access road).

- 3.1.2 The mitigation measures to be considered are therefore likely to include:

- use of the resource prior to or during construction of the Proposed Scheme (e.g. use of sands and gravels within the Proposed Scheme by excavating and stockpiling the resource for later use). Over-excavation may be required in order to remove all the usable resource, followed by infilling with suitable materials);
- provision of additional access to a site (in the case of severance); and

¹⁰ In this context, severance refers to the Proposed Scheme splitting an actual or proposed mining/mineral site into two or more areas, such that separate accesses would be required to work the whole site.

- provision of alternative access to a site.

4 Geo-conservation

4.1.1 Mitigation of geo-conservation effects will depend on the type of impacts suffered by the geo-conservation resource:

- complete or partial loss of the resource;
- severance of the resource; and
- constraint on access to the resource (e.g. cutting an access road).

4.1.2 The mitigation measures to be considered are therefore likely to include:

- partial or full replacement of a geological resource at the same stratigraphical horizon but in a geographically different area (could be either adjacent to the scheme or remote from it);
- if an alternative location cannot be found then intensive investigation and recording of the site before it is constructed upon, including removal of rock and fossil specimens; and
- providing alternative or additional access to sites where the access or the site has been severed.

5 Mitigation interactions

5.1.1 An important aspect of the identification of mitigation measures is that there is appropriate consideration of the effects that mitigation measures may have on the environment.

5.1.2 Table 1 presents some of these potential effects, taking examples from the mitigation measures described above.

Table 1: Examples of other effects arising from mitigation measures

Mitigation/remediation method	Effects
Bio-remediation, soil washing, soil stabilisation	Typically these require large areas for stockpiling and equipment, which may require additional temporary land –use and effects on ecology, agricultural land, landscape etc.
Off-site disposal	Will increase total required amount of soil to be landfilled (to be taken into account in waste topic) and traffic impacts/air quality impacts
All groundwater methods	Effects on groundwater, such as changes to levels and yields at springs or wells.
Replacement of geological resources	Will require additional land and therefore may have effects on ecology, agriculture, landscape

Annex G: Landscape and visual assessment – technical notes

1.1.1 The following technical notes are appended to this document:

- Approach to tranquillity assessment
- Zone of theoretical visibility production methodology
- Approach to verifiable photomontages



HS2 London-West Midlands

**Landscape and visual
assessment**

**Technical note – Approach to
tranquillity assessment**

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This note has been prepared to provide further detail on how the tranquillity of landscape character areas has been determined through applying the general methodology set out in the landscape and visual sections 12.2.12 and 12.2.13 of the Scope and Methodology Report (SMR) (Volume 5; Appendix CT -001-000/1)
- 1.1.2 In the context of the landscape assessment, tranquillity is defined by the interrelationship of the criteria provided in section 2.1.2. Defining tranquillity enables a determination of the sensitivity of a character area, alongside consideration of character, condition and value (as described in the SMR).
- 1.1.3 While the criteria that influence tranquillity remain constant, they are considered differently for urban and rural scenarios. In rural locations, the absence of visually detracting features, built form and noise from man-made sources may be associated with valued areas of high tranquillity. In urban areas, enclosure and vegetation may be associated with valued areas of high tranquillity, despite the presence of built form and sources of noise.
- 1.1.4 The parameters which have influences on how the level of tranquillity has been determined are provided below for urban areas (Section 2) and rural areas (Section 3).

2 Determining tranquillity in urban areas

- 2.1.1 In urban areas, the qualities that people value by virtue of the seclusion offered from surrounding development, infrastructure and activity have been identified. Areas that display these qualities may therefore be considered to have a high level of tranquillity, which may in turn contribute to a character area which is highly sensitive to change.
- 2.1.2 As set out in the SMR, the criteria that influence tranquillity are:
- land use;
 - level of seclusion or isolation, including perception of nature;
 - extent and type of enclosure by surrounding land uses;
 - level of screening afforded by vegetation, ground level change or boundary treatments;
 - levels and types of vehicular traffic and noise within, or close to the character area;
 - levels of pedestrian traffic and noise within, or close to the character area;
 - level of light pollution; and
 - the absence or presence of major infrastructure routes within or in the vicinity of the character area.
- 2.1.3 Further detail on how these criteria have been applied in an urban environment is provided in Table 1. The presence of any combination of criteria may be considered when assessing the tranquillity of a character area.

Table 1: Determining tranquillity in urban areas

Criteria	Level of tranquillity		
	High	Medium	Low
Land use	Open space or an area that is characterised by low density residential development set amongst large/frequent open spaces.	Medium density residential land uses with some open spaces.	High density residential land uses. Industrial/ commercial uses. Leisure uses. Widespread presence of hard standing.
Seclusion/isolation (also associated with levels of pedestrian traffic)	Quiet green locations with a noticeable presence of nature. Infrequent use by local communities. Areas dominated by substantial water bodies absent of leisure uses.	Areas principally used by local communities (local parks, residential communities). Discernible presence of nature.	Areas with a high frequency of use by people – city/town centres, retail areas, places of employment, leisure uses. Often associated with relatively high levels of sound from activity.
Enclosure / Screening	Strong enclosure from surrounding development by dense vegetation/ substantial avenues of street trees/dense vegetation within private gardens. No/few overlooking buildings.	Localised enclosure provided by residential buildings (for example residential suburbs). Presence of street trees and vegetation within front/rear gardens.	Dense development with numerous overlooking buildings. Open vistas across urban areas. No/few street trees/private gardens/front gardens in residential areas.
Vehicular traffic	Very limited levels – no overly noticeable presence of vehicles or the sound of vehicles.	Relatively light levels of traffic and traffic noise associated with the local residential area only (i.e. no/few through routes/main roads. No or very limited HGV traffic. Some on-street parking associated with local residential use only.	Presence of busy routes (rail or road) forming a key part of the character area or boundaries of the character area. Presence of HGV traffic. Presence of substantial levels of parking. High levels of noise from traffic.
Light pollution	Largely unlit. Potentially some residential areas with very low levels of street lighting.	Residential street lighting and low levels of light spill from low/medium density residential development.	Substantial levels of public realm lighting/street lighting/light spill from large commercial/retail/ civic buildings. Substantial lighting of industrial compounds/hard standings/car parking.
Major infrastructure routes	Absence of noticeable major infrastructure (road, rail, utility) or noise from major routes within the character area or within the immediate setting of the character area.	Absence of noticeable major infrastructure road/rail/utility routes or noise from major routes within the character area. Some presence of electricity pylons/A roads/relatively infrequently used railway lines within parts of the wider setting.	Noticeable presence of major routes within the character area, including heavily trafficked roads, railway lines and electricity pylons. Noticeable presence of major routes and/or noise from major routes as a substantial part of the immediate setting of the area.

2.1.1.4 In an urban environment, any combination of the criteria described in Table 1 may be used to determine the tranquillity of a landscape character area. Each character area must be analysed in turn, with the key criteria identified. The key characteristics of the

area, in line with the criteria above, will be the primary influence on the level of tranquillity – for example:

- an industrial area is likely to have a **low** level of tranquillity despite the possible presence of lots of trees, little lighting and no noticeable major infrastructure routes;
- a low density residential area in very close proximity to a poorly screened (noise and/or visual) motorway/busy road or busy railway is likely to have a **low** level of tranquillity despite limited light pollution, an abundance of street trees/gardens etc.;
- a park or open space with an abundance of dense mature boundary trees and vegetation may have a **medium** or even **low** level of tranquillity if totally surrounded by dense commercial/retail/industrial land uses and/or noticeable major infrastructure routes;

2.1.5 Therefore, in line with the examples provided above, any one criterion within the **low** column of Table 1, may be considered sufficient to describe a character area as having a **low** level of tranquillity if dominant enough. If these factors do not overly dominate, then it may be more appropriate to consider a medium level of tranquillity for the area, should it fall into some of the criteria described in the medium column of Table 1.

2.1.6 In order for a character area to be considered to have a **high** level of tranquillity, it is likely that it will need to display most or all of the criteria described in the **high** column of Table 1.

3 Determining tranquillity in rural areas

3.1.1 In rural areas, initial reference has been made to the Tranquil Areas Maps UK¹ and the 2007 Intrusion Map² undertaken by the Campaign to Protect Rural England (CPRE). However, a clear judgement has been reached on the level of tranquillity for each landscape character area. Therefore, the work of CPRE has been used (where relevant) to help inform decisions in line with Table 2.

3.1.2 As set out in the SMR, the criteria that influence tranquillity are:

- land use;
- level of seclusion or isolation, including perception of nature;
- extent and type of enclosure by surrounding land uses;
- level of screening afforded by vegetation, ground level change or boundary treatments;
- levels and types of vehicular traffic and noise within, or close to the character area;
- levels of pedestrian traffic and noise within, or close to the character area;

¹ 2005-2006 CPRE (Campaign for the Protection of Rural England) with support from the Countryside Agency.

² Developing an intrusion Map of England, September 2007; CPRE and Land use Consultants.

- level of light pollution; and
- the absence or presence of major infrastructure routes within or in the vicinity of the character area.

3.1.3 Further detail on how these criteria have been applied in rural areas is provided in Table 2. The presence of any combination of criteria may be considered when assessing the tranquillity of a character area.

Table 2: Determining tranquillity in rural areas

Criteria	Level of tranquillity		
	High	Medium	Low
Land use	Open countryside with little or no noticeable built form. Agricultural landscapes with a small field pattern.	Intense agricultural landscapes. Landscapes with intermittent built form (small settlements, agricultural buildings).	Dominance of built form.
Seclusion / isolation (also associated with levels of pedestrian traffic)	Quiet green locations with a noticeable presence of nature. Little evidence of any intense uses by people. Limited sound levels from people.	Areas principally used by local communities (local parks, residential communities). Low levels of sound from people. Discernible presence of nature. Fairly intense presence of agricultural activities.	Areas with a high frequency of use by people – heavily used recreational spaces and urban fringes. Often associated with relatively high levels of sound from activity.
Enclosure / Screening	Presence of woodland cover and regular hedgerows, defining small field patterns. Wooded skylines. Also, wide open vistas across unspoilt countryside with no/little evidence of development/ infrastructure.	Large scale field patterns with limited presence of hedgerows. Evidence of some development/ infrastructure within parts of the wider setting of the area. Presence of electricity pylons through the character area.	Open vistas with a noticeable presence of development/ infrastructure across the setting of the area.
Vehicular traffic	Very limited levels – no overly noticeable presence of vehicles or sound from vehicles. No major road or rail routes.	Relatively light levels of traffic and traffic noise associated with relatively minor roads/railways with substantial vegetation providing screening. Presence of some larger infrastructure routes as part of the wider setting.	Presence of busy routes (rail or road) forming a key part of the character area or boundaries of the character area. Presence of HGV traffic. High levels of noise from traffic.
Light pollution	Unlit countryside. Some sources of low level light within parts of the wider setting.	Some sources of low level light from intermittent traffic on minor roads or development/ infrastructure on the fringes of the character area or within the wider setting.	Substantial levels of light within or across the fringes/setting of the area, from development or major infrastructure routes.
Major infrastructure routes	Absence of noticeable major infrastructure (road, rail, utility) within the character area or within the immediate setting of the character area.	Absence of noticeable major infrastructure road/rail/utility routes within the character area. Some presence of electricity pylons / A roads / relatively infrequently used railway lines within parts of the wider setting. Presence of noise from aircraft / flight paths.	Noticeable presence of major routes within the character area, including heavily trafficked roads, railway lines and/or electricity pylons. Noticeable presence of major routes as a substantial part of the immediate setting of the area.

- 3.1.4 In a rural area, any combination of the criteria described above may be used to determine the tranquillity of a landscape character area. Each character area must be analysed in turn, with the key criteria identified. The key characteristics of the area, in line with the criteria above, will be the primary influence on the level of tranquillity – for example:
- an area of open countryside is likely to have a **low** level of tranquillity if there are a number of noticeable major infrastructure routes within the character area or dominating the setting, also introducing high levels of light pollution;
- 3.1.5 Therefore, in line with the example provided above, any one criterion within the **low** column of Table 2, may be considered sufficient to describe a character area as having a **low** level of tranquillity if sufficiently dominant. If these factors do not overly dominate, then it may be more appropriate to consider a **medium** level of tranquillity for the area, should it fall into some of the criteria described in the **medium** column of Table 2.
- 3.1.6 In order for a character area to be considered to have a **high** level of tranquillity, it is likely that it will need to display most or all of the criteria described in the **high** column of Table 2.



HS2 London-West Midlands

**Landscape and visual
assessment**

**Technical note – Zone of
theoretical visibility production
methodology**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1.1 This note has been prepared to describe in detail the methodology used to produce the zones of theoretical visibility (ZTV) of the Proposed Scheme.

1.1.2 The broad methodology for producing the ZTV is described in Section 12.5 of the Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001-000/1). ZTVs have been produced to indicate the extent of the theoretical visibility of the Proposed Scheme during both construction and operation. The ZTVs have been produced using one model for the whole route to ensure route-wide consistency.

1.1.3 ZTVs have been prepared to show:

- the theoretical visibility of the Proposed Scheme during construction. This excludes cranes on the basis that these would indicate widespread visibility and take emphasis away from understanding the potential extent of significant effects. Cranes have been considered, where relevant, in the assessment of effects (see section 3.1.3).
- the theoretical visibility of the Proposed Scheme during 2026 .
- the theoretical visibility of the Proposed Scheme during 2041, taking into account the benefit maturing vegetation may have on restricting visibility.

1.1.4 The ZTVs are based on the Proposed Scheme used for the assessment of effects as presented in the ES.

2 Production of the base model

2.1.1 A base topographic model was produced using ArcGIS software. It used the highest resolution and most recently available digital terrain model¹ (DTM) data across the Proposed Scheme. Within approximately 350m either side of the centre line of the Proposed Scheme, the DTM utilised was a 25cm resolution LIDAR survey flown specifically for the Proposed Scheme. Beyond the Lidar data, in most urban areas, 1m resolution data was available and was utilised. In rural areas, typically only 5m resolution data was available. These datasets were combined together to create the base model. The base model extends 3km either side of the centre line of the Proposed Scheme. This model shows the ground topography only, excluding any vegetation, buildings or other structures.

2.1.2 Within the 700-750m corridor along the route (surveyed specifically for the Proposed Scheme), and for most urban areas within the 6km corridor as described above, digital surface model² (DSM) data was also available. The OS Mastermap product³ was used to extract building heights from this DSM, which were added to the base topographic model. All available data sets relating to areas of woodland and linear belts of trees wider than 20m were used to extract tree cover heights from the same DSM, with the data also added to the base topographic model. The extent of vegetation cover used in the ZTV was verified on site and adjusted where possible. Any vegetation to be

¹ A digital terrain model represents the topography of the ground excluding any buildings, vegetation, vehicles etc.

² A digital surface model contains topographic information incorporating anything on the surface of the ground when the survey was undertaken (e.g. buildings, vegetation, vehicles).

³ Ordnance Survey Mastermap 2013, 1:2,500 scale.

removed during construction of the Proposed Scheme was removed from the vegetation cover used in the ZTV.

- 2.1.3 There were many areas along the route where a DSM has not been recorded and therefore no data on building or tree heights was available. In these instances, building heights were extracted from the OS Mastermap product, and added to the base topographic model using an assumed height of 8m above ground. Outside of areas with a DSM, the same woodland and tree cover datasets described in Paragraph 2.1.2 were added to the base topographic model using an assumed height of 12m above ground.
- 2.1.4 These processes resulted in a base model incorporating accurate, surveyed information on topography, accurate surveyed information on building and tree heights in urban areas (where a DSM was available) and assumed building and tree heights outside of urban areas (where no DSM was available).

3 Modelling the construction phase ZTV

- 3.1.1 The extent of the visibility of the Proposed Scheme during construction was modelled on the basis of conservative assumptions about the height of typical construction plant operating along the length of the route, and at stations, depots, ventilation shafts, head houses, road diversions and any other known proposed works. These heights were added as a series of points into ArcGIS to enable the ZTVs to be produced using the 'Viewshed' tool⁴. For the purposes of modelling the construction phase ZTV that focuses on the likely distribution of significant effects, heights of very tall construction plant such as cranes have been excluded.
- 3.1.2 Elements modelled to enable production of the construction phase ZTV are detailed below:
- assumption of 5m above existing ground levels for the route above ground, whether it is at grade, on embankments or in cutting. This was selected on the basis of the possible height of typical construction plant expected to be used along the route;
 - assumption of 5m above existing ground levels for the length of proposed green tunnels, selected on the basis of the possible height of typical construction plant expected to be used at these structures, excluding cranes;
 - assumption of 8m above existing ground levels around the boundary of any known construction compounds, on the basis of the possible height of typical construction plant, storage, stacked welfare facilities etc. that may be present within these areas;
 - assumption of 5m above existing ground levels at the location of all tunnel portals, selected on the basis of the possible height of typical construction plant expected to be used at these structures, excluding cranes;

⁴ An ArcGIS tool which analyses where any given point is visible from.

- assumption of 8m above existing ground levels at the location of all ventilation shafts, selected on the basis of the possible height of typical construction plant expected to be used at these structures, excluding cranes;
- assumption of 5m above existing ground levels at the location of any road diversion works, new road bridge works or utility diversion works, on the basis of the possible height of typical construction plant required;
- assumption of 2m above the height of proposed viaducts and road bridges to take account of construction plant and scaffolding required to build the structures, excluding cranes;
- assumption of 2m above the height of proposed station buildings to take account of construction plant and scaffolding required to build the structures, excluding cranes;
- assumption of 2m above the height of any demolitions required, to take account of construction plant and any scaffolding that may be required, excluding cranes; and
- assumption of 2.4m above existing ground levels (i.e. the standard hoarding height) of the temporary extent of land required to construct the Proposed Scheme.

3.1.3 Cranes have been excluded from the construction phase ZTV on the basis that these indicate widespread visibility but rarely give rise to significant effects if they are the only elements visible. With the exclusion of cranes, the construction phase ZTV gives a better indication of the possible spread of significant effects and therefore better informs the assessment process.

4 Modelling the operational phase ZTV

4.1.1 The extent of the visibility of the Proposed Scheme during operation was modelled on the basis of the height of operational structures along the line of route, including stations, permanent depots, ventilation shafts, headhouses, road diversions and any other proposed works. The heights modelled take into account where the Proposed Scheme is in cutting, at grade, on embankment, on viaduct etc. These heights were added as a series of points into ArcGIS to enable the ZTV to be produced using the 'Viewshed' tool.

4.1.2 The base model produced for the construction phase ZTV was amended by:

- removing any buildings to be demolished during construction of the Proposed Scheme, to ensure they did not falsely block potential views when the operational ZTV was run; and
- adding new mitigation earthworks designed to screen the Proposed Scheme into the base model.

4.1.3 Elements modelled to enable production of the 2026 operational phase ZTV are detailed below:

- 4m above proposed track bed levels for trains;

- the designed height of all station buildings (excluding any possible over station development);
- the designed height of all tunnel portal buildings, headhouses and ventilation shafts (excluding any possible over station development);
- the designed height of all buildings located within permanent operational depots;
- the height of road diversions or new road bridges, excluding lighting etc.; and
- the height of any new fencing and noise barriers.

4.1.4 Overhead line equipment have been excluded from the operational phase ZTV on the basis that these indicate widespread visibility but rarely give rise to significant effects if they are the only elements visible. With the exclusion of overhead line equipment, the operational phase ZTV gives a better indication of the possible spread of significant effects and therefore better informs the assessment process.

4.1.5 The 2041 operational phase ZTV was produced using the same parameters as above, but proposed tree planting was incorporated into the base model at an assumed height of 7.5m, serving to reduce visibility of the Proposed Scheme in some locations.



HS2 London-West Midlands

**Landscape and visual
assessment**

**Technical note – Approach to
verifiable photomontages**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1.1 This document has been prepared to describe the technical process undertaken to prepare verifiable photomontages in support of the landscape and visual assessment of the Proposed Scheme.

1.1.2 The methodologies described are based on current best practice and follow recommendations from The Landscape Institute's Guidelines for Landscape and Visual Impact Assessment Advice Note 01/11¹ and the London View Management Framework Supplementary Planning Guidance².

1.2 Verifiable photomontage

1.2.1 A photomontage is the superimposition of an image onto a photograph for the purposes of creating a representation of potential changes to any view.

1.2.2 "The objective of a photomontage is to simulate the likely visual changes that would result from a proposed development, and to produce printed images of a size and resolution sufficient to match the perspective in the same view in the field."¹

1.2.3 A verifiable photomontage is a photomontage based on a replicable, transparent and structured process, so that the accuracy of the representation can be verified by an independent party. Collaboration between all organisations and disciplines is essential throughout the whole project to ensure that the visualisation information is consistent and robust.

2 Selection of photomontages

2.1 Selection of viewpoints

2.1.1 Viewpoints form the receptors for the visual assessment within the Environmental Statement, and represent what people having a view of the Proposed Scheme may be able to see during construction or operation. The process for selecting viewpoints is described in Section 12.2 of the Scope and Methodology Report (SMR) see Volume 5:Appendix CT-001-000/1).

2.1.2 Verifiable photomontages have been prepared from a selection of these viewpoints, based on:

- viewpoints where the level of effect is difficult to ascertain without reference to a verifiable photomontage;
- viewpoints from receptors which are highly sensitive to change (the sensitivity of visual receptors is described in Section 12.2 of the SMR); and
- viewpoints where a verifiable photomontage aids the readers understanding of the appearance of the Proposed Scheme and the level of effect.

¹ The Landscape Institute (2011) *Photography and photomontage in landscape and visual impact assessment, Landscape Institute Advice Note 01/11.*

² Greater London Authority (2012) *London View Management Framework Supplementary Planning Guidance.*

2.2 Verifiable photomontage types

2.2.1 The landscape and visual assessment considers effects for a number of different scenarios through the construction and operational phases of the Proposed Scheme. Verifiable photomontages have been prepared for the following scenarios:

- construction, winter, daytime – Illustrative representations of how the site may look during the peak phase of construction taking into account:
 - demolition, tree removal and vegetation clearance required;
 - the extent of land required temporarily to build the Proposed Scheme;
 - the type of structure being built in the view;
 - the types of operations and construction plant likely to be present in order to construct the structure in the view; and
 - any measures contained within the draft Code of Construction Practice (CoCP) relevant to the particular view.
- operation, year 2026, winter, daytime – Illustrative representations of how the Proposed Scheme may look during the winter of 2026, taking into account:
 - the accurate 3D models prepared to show the geometry of elements of the Proposed Scheme, including the route, earthworks, retaining walls, proposed highways including earthworks, balancing ponds, viaducts and bridges, ventilation shafts and head houses;
 - the accurate 2D lines prepared to show the geometry of elements of the Proposed Scheme, including fences, noise barriers, planting and habitat creation areas; and
 - design principles / intent relating to the appearance of structures described above, including retaining walls, viaducts, bridges, ventilation shafts, head houses, fencing, noise barriers, planting and habitat creation areas.
- operation, 2026, summer, daytime – Illustrative representations of how the Proposed Scheme may look during the summer of 2026 taking into account the same elements as above. These have only been prepared where it was not possible to obtain a winter photograph due to limitations such as site access.
- operation, 2041, summer, daytime – Illustrative representations of how the Proposed Scheme may look in the summer of 2041 of operation, taking into account (in addition to the above) how the new planting will grow and mature.

2.2.2 Construction photomontages were only prepared for winter in line with the methodology for undertaking the visual assessment described in the SMR.

3 Verifiable photography and survey

3.1 Methodology

3.1.1 The verifiable photomontages have been based on accurately captured and surveyed verifiable photography. Winter photography was captured between December 2012

and April 2013. Summer photography was captured in September 2012 and between July and September in 2013. The horizontal field of view was determined by the extent of visibility of the Proposed Scheme from each viewpoint. All images have a vertical field of view of 38 degrees.

- 3.1.2 Where viewpoints were located on a solid surface (e.g. in urban areas or along surfaced roads), the photography was captured first with a marker left on the ground. These locations were then subsequently surveyed. In rural locations, the photography and surveying was undertaken simultaneously in order to avoid problems with markers in soft ground moving or being removed altogether.

3.2 Verifiable photography specification

3.2.1 Image resolution:

- single frame images were supplied at a minimum of 5000 pixels wide at 300dpi; and
- panoramic images were supplied at a minimum of 15,000 pixels wide at 300dpi.

3.2.2 Image quality:

- processed tagged image file formats³ (TIFF files) containing corrections for lens distortions⁴, vignetting⁵ and chromatic aberrations⁶;
- any necessary sharpening was applied uniformly across images; and
- all panoramic images were free from parallax errors⁷.

3.2.3 Data requirements:

- Exchangeable image format⁸ (EXIF) data was provided in the file properties:
 - focal length;
 - aperture, shutter speed, ISO;
 - lens and camera body; and
 - date and time.

3.2.4 Other data (marked on each file in a separate layer):

- focal length (to three decimal places where applicable);
- the lens axis;
- the details of height over survey point (between 1.55m and 1.70m high);
- field of view;

³ A type of file particularly suited to high resolution images.

⁴ Displacement or errors in the images caused by irregularities in camera lens.

⁵ Reduction of an image's brightness or saturation at the periphery when compared to the centre of the image.

⁶ Colour distortion in an image caused by the inability of the camera lens to bring the various colours of light to focus at a single point.

⁷ Apparent change in the direction of an object caused by changes in the camera location.

⁸ Data embedded within the properties of an image.

- image dimensions;
- film gate size; and
- date and time.

3.2.5 Accuracy: Generally each individual observation set-up achieved an accuracy of + or – 45mm to Ordnance Survey grid / datum.

3.3 Verifiable surveying specification

3.3.1 Each camera location is surveyed together with a series of clearly defined detail points within the image (e.g. corners of road markings, features on road signs, corners of building features etc.). Each image has a minimum of 10-12 clearly defined detail points taken across the width of the image and at near, mid and far distance (i.e. a balance of points across the photograph).

3.3.2 Information provided to the surveyors:

- the camera positions for each viewpoint are marked by the photographer for the surveyor to be able to locate an exact survey position and
- prints of the images are supplied in advance in order to reference the detail points taken.

3.3.3 Surveyors deliverables:

- point for the camera locations and each detail point were given a unique number that related to the viewpoint number;
- a CAD file was provided containing the detail points and camera positions as vertical lines;
- a spreadsheet of the camera locations and detail points was provided with annotated descriptions; and
- an image of the photo showing the detail points marked on was provided.

4 Production of 3D model

4.1.1 The 3D model of the Proposed Scheme was produced in a series of tiles along the route. All data was moved to these offsets defined by a grid to avoid accuracy problems caused in 3D Studio Max (3DS Max) when working on images at a distance from the global origin point. This process improved how 3DS Max handled the data in the later stages of modelling and ensured accuracy. The CAD drawing units were in metres.

4.1.2 The 3D model of the Proposed Scheme was created using:

- the designers 3D model of the Proposed Scheme including the centreline, rail earthworks, highway centrelines, kerblines, highway earthworks, mitigation earthworks and balancing ponds. These elements form the digital terrain model of the Proposed Scheme;

- models of all structures including viaducts, highway bridges, pedestrian bridges, tunnel portals, auto-transformer stations;
- models of all buildings including headhouses and ventilation shafts, buildings within maintenance depots and stations; and
- models of all further elements including noise fence barriers, fencing, planting, overhead line equipment, new/relocated pylons etc.

4.1.3 Models of structures and buildings were created using the designer's 3D models or 2D elevations, sections and plans depending on what was available.

4.1.4 All elements of the 3D model were resolved from all angles, for example the abutment of bridges and viaducts were modelled in full to ensure the robustness of the overall 3D model.

4.1.5 Within 3DS Max, all surfaces created as part of the 3D model were checked to ensure no co-planar faces existed anywhere in the model, with all faces appropriately subdivided.

4.1.6 All elements within the 3DS Max model files were named appropriately. There were no generic names within the model files e.g. box, circle, cylinder etc. to ensure all objects can be selected and all users have full control of the 3DS Max scene.

4.1.7 Textures were applied at a real world scale to ensure they appeared at the correct scale for the image and 3D model.

4.2 Model assembly

4.2.1 A 3DS Max model file for each viewpoint was assembled before rendering. The assembled model contains the relevant Proposed Scheme digital terrain model tiles and any structures, buildings or further elements (as defined above) that can be seen in the viewpoint.

5 Camera matching

5.1.1 The process of camera matching creates a virtual camera in the same location and height, and pointing in the same direction as the physical camera used on site to capture the image.

5.1.2 The process involved accurately positioning the three-dimensional model of the Proposed Scheme within each existing view. This was achieved through a process of matching the surveyed points in the digitised image with those recorded by the survey team on the existing photographs. The central horizon line in each of the existing views was then calculated and imported into 3DS Max as a backdrop to the 3D model. The survey points and specifications of the lens type relating to each view were also entered into 3DS Max.

5.1.3 The survey points of the camera position and each clearly defined detail point (relating to specified objects in the view) were then highlighted on the digitised image. A further check of the accuracy of the survey points in each digitised view was carried out by overlaying the central horizon line of each view with the digitised survey points prepared in 3DS Max. This additional check ensured that the survey points

matched precisely. This process was undertaken independently by two different designers, with the results cross referenced to provide a further check on accuracy.

- 5.1.4 Once the process of camera matching was completed, the 3D model of the Proposed Scheme was accurately positioned within each of the views captured. This was achieved by rendering the camera matched 3D model of the Proposed Scheme within 3DS Max at the same size as the digitised existing view.

6 Rendering

- 6.1.1 Each of the views was rendered using the Vray Rendering Engine software. This utilised the physical sun and sky and compass system to provide physically accurate full global illumination in line with the light conditions present in the existing photo. The best lighting match with the existing photo was achieved by adjusting the settings of the default daylight system in the rendering engine.
- 6.1.2 Individual elements were rendered out using different map channels to create masks (for example mask for the digital terrain model, earthworks, overhead line equipment, fencing, shadows etc.). These masks ensured each visible element of the Proposed Scheme could be independently selected when individually placed into the Adobe Photoshop file for final production.

7 Post production

- 7.1.1 The renders of the 3D model were superimposed on the existing photos in Adobe Photoshop. The foreground of the existing photos visible in front of the Proposed Scheme were then carefully copied and masked to ensure the render of the 3D model sits accurately within the depth of the view.
- 7.1.2 The textured render of the 3D model was then further adjusted to match the resolution, colouring and saturation of the photograph captured to create an accurate impression of what the textures of the buildings and structures will look like. This was a qualitative exercise and required interpretation by the designer on how the structures will look. A final qualitative check of all of the verifiable photomontages was undertaken to ensure that they provided objectively accurate views of the Proposed Scheme.

8 Recommended viewing distances

- 8.1.1 It is recommended that the panoramic verified images are viewed at an optimum viewing distance in relation to the size of printed photomontage, to give a correct sense of scale.
- 8.1.2 In order for the viewer at the camera location to use the images, they must be printed large enough to hold at a comfortable 400-500mm viewing distance which, for the whole panorama is often impractical because of the size. The images are provided at A3 in the Environmental Statement for practicality, and do not lend themselves to direct comparison out in the field.
- 8.1.3 For viewing in the field, it is more practical to use a set of 40 degree sections from the panorama, printed on A3 landscape sheets (with the image filling the full height of the paper). These can then be held up at the correct distance from the eye (as noted

above) and at the height photographed from, and this would then match what is being seen in the field. It is crucial that the viewer is standing in the precise location of where the photograph was captured from.

8.1.4 If the panoramas are to be used in the field, they should be viewed by curving them either with the use of a cylindrical object or simply by hand with a radius of 450mm. With a standard vertical field of view, panoramas should be printed at the following sizes for true representation:

- 80deg – 630mm x 300mm
- 120deg – 950mm x 300mm
- 160deg – 1200mm x 300mm

Annex H: Socio-economics – technical note

- 1.1.1 It should be noted that for the purpose of the technical notes, the topic areas of community and socio-economics have been combined and can be found within Annex B to the SMR Addendum.

Annex I: Traffic and transport – technical note

1.1.1 The following technical note is appended to this document:

- Guidance on further development of significance criteria



HS2 London-West Midlands

Traffic and transport

**Technical note - Guidance on
further development of
significance criteria**

A report to HS2 Ltd by Arup/URS

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1 Introduction and methodology

1.1.1 This technical note provides guidance on how traffic and transport effects will be determined for the Environmental Statement (ES) for the Proposed Scheme. It is based on criteria already specified in the Scope and Methodology Report (SMR – see Volume 5: Appendix CT-001-000/1 and the SMR Addendum).

1.1.1 The methodology builds on that described in the SMR and SMR Addendum and further describes the process by which the significance of traffic and transport impacts and effects will be determined and applied in the ES.

1.1.2 The assessment process includes:

- establishing a future baseline that includes traffic and transport; and
- undertaking an impact assessment to understand the ability of the receptors to adapt to future transport demands during the construction and operation of the Proposed Scheme.

1.2 Use of this guidance

1.2.1 Use of this guidance will require analysis of transport data, technical assessments and professional judgments to be made and assessors should use this report to provide guidance rather than as a series of strict rules. Judgements which result in an effect being assessed as more than one category higher or lower than indicated should be exceptional and any variation will need clear justification. Where specific types of information referred to in this guidance are not available, the assessments can be based on alternative datasets so long as these are judged to be robust and appropriate for the needs of the ES.

1.3 Prediction and evaluation of impacts and effects

1.3.1 The ES will describe the likely significant effects including the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the Proposed Scheme.

1.3.2 A distinction has been made in the assessment between impacts and effects, where:

- **Impacts** are defined as the predicted change to the baseline environment attributable to the scheme (e.g. changes in traffic levels or delays); and
- **Effects** are the consequence of impacts on environmental resources or receptors of particular value or sensitivity and, most commonly for transport, the number of people affected or the importance of a link affected.

1.3.3 The primary objective of the assessment is to identify “significant” effects. This will be achieved by firstly assessing the magnitude of an impact and then by reviewing the extent (e.g. temporal and spatial) to which it affects receptors. The process for determining whether the result is deemed to be significant is described below.

1.4 Impact assessment

1.4.1 Table 1 shows the impacts that will be assessed, for both the construction and operational stages of the Proposed Scheme.

Table 1: Impacts to be assessed

Traffic and transport impacts
Public transport delay
Disruption at stations/interchanges
Traffic flows and delays to vehicle occupants
Parking and loading
Vulnerable road user delay, amenity and ambience
Accidents and safety
Severance
Waterways

1.4.2 The SMR identifies significant effects on receptors in two ways, when:

- a particular threshold is passed; or
- there is a particular combination of impacts that taken together create a significant effect.

1.4.3 The scheme-related impacts on the receptors can be measured on a spatial and temporal basis, and will be numerically quantified or employ a qualitative judgement. The SMR and Local Transport Assessment modelling should be used as the prime sources of information from which to identify the traffic and transport impacts.

1.5 Thresholds

1.5.1 In assessing traffic and transport impacts, thresholds are needed to define the point at which such impacts become significant effects. These effects can then be classified as of minor, moderate or major significance. The level of 'graduation' employed to define significance is therefore a key consideration of how to measure each effect.

1.6 In-combination impacts

1.6.1 The significance of a traffic and transport effect can be considered as the combination of the magnitude of the impact and the number of people affected, the duration of the impact (temporal) or the extent of its locational effects. The number of travellers affected will be important, as may be the sensitivity and/or value of the population or receptor. These criteria and thresholds and their measurement will be defined based on professional judgement and existing industry accepted practice.

1.6.2 Further guidance on this aspect is given in the tables that follow for each criteria. In some cases a proxy measure is included that reflects the number of travellers affected.

1.6.3 The magnitude of the impact can be measured according to the typical generic definitions in Table 2 below.

Table 2: Impact magnitude criteria for traffic and transport

Impact magnitude	Definitions
Not significant	An impact that is unlikely to measurably affect the well-being of travellers so that the existing base case remains constant
Minor	An impact that is likely to or may affect a low number of travellers (with the number depending on the local context)
Moderate	An impact that is likely to affect a moderate number of travellers (with the number depending on the local context)
Major	An impact that will be high, and/or very likely to affect a major number of travellers (with the number depending on the local context)

1.6.4 It will be necessary to use qualitative (or, where possible, quantitative) categories for assessing the number of travellers affected (e.g. low, medium, or high). Further guidance on this aspect is also given in the tables that follow for each criteria.

1.6.5 Where relevant, receptors may in addition be considered valuable and/or sensitive if:

- they could be easily affected by, or are dependent on, specific current traffic and transport characteristics or flows; and/or
- they could be adversely affected if they are subject to long-term changes in the traffic and transport flows that differ from historic norms.

1.7 Mitigation plan

1.7.1 For in-combination effects that are classified as major significant or moderate significant, a mitigation plan should be developed that addresses the traffic and transport scenarios and potential impacts that have been identified. It is assumed that minor effects will be mitigated during the detailed design process for the Proposed Scheme.

1.7.2 For any in-combination effects which cannot be mitigated within the scheme design (i.e. a residual impact), the consequences of proceeding with the Proposed Scheme for the receptors (i.e. travellers) should be described.

2 Further definition of significance criteria

2.1 Approach to definition

2.1.1 The SMR criteria to judge significance are to be applied as:

- a binary threshold approach to significance, i.e. an effect is either significant or not significant;
- a graduated approach which defines the 'degree' of significance.

2.1.2 The key issues to resolve in further developing the definition of the SMR significance criteria are:

- How to extend the assessment of each impact to determine the degrees of significance.
- Where numerical measures can be applied.

2.2 Additional methodology for assessing significance

2.2.1 Set out below is the approach which should be followed to further refine the definition of the significant effects which are being assessed.

2.2.2 When using the tables throughout this document, if a value lies exactly on the boundary between two categories, the upper (i.e. most severe) category should be used to provide a 'worst case' assessment.

2.2.3 This is a two stage process as follows:

- Stage one – SMR criteria

Utilise the existing SMR criteria to determine whether the effect is significant and therefore should be reported within the ES.

- Stage two – refinement of assessment

2.2.4 Where the effects are deemed to be significant in the Stage 1 assessment, the Stage 2 assessment will enable them to be further categorised as being of minor, moderate or major significance.

2.2.5 The Stage 2 criteria thus build on the Stage 1 assessment, and all criteria (i.e. tabulated, bulleted or in text) need to be considered and assessed.

2.2.6 An example is shown in Table 3.

Table 3: Significance of effect - criteria for traffic and transport receptors – example 1

Significance - impact magnitude		Not Significant	Minor		Moderate		Major
Diversion		< 100m	100 – 200m		200 – 400m		400m or more
Duration of Impact		< 4 weeks	4 weeks – 4 months	4 months or more	4 weeks – 4 months	4 months or more	Over 4 weeks
Number of travellers affected	Low	Not Significant	Minor effect	Minor effect	Minor effect	Moderate effect	Moderate effect
	Medium	Not Significant	Minor effect	Moderate effect	Moderate effect	Major effect	Major effect
	High	Not Significant	Moderate effect	Moderate effect	Major effect	Major effect	Major effect

2.2.7 An example of the application is shown in Table 4. In example (a) there is a diversion of 200-400m, with a duration in excess of 4 months and affecting a medium number of travellers. As the duration exceeds 4 months the effect is assessed as Major. If the duration had been for between 4 weeks and 4 months the effect would have been Moderate. However in example (b) the distance is identified as over 400m and therefore the effect would be classed as Major regardless of duration so long as it is in excess of four weeks.

2.2.8 Many of the criteria as set out in the SMR have a temporal scope to the assessment of an impact, which is a 'fixed' criteria that should be applied in combination with all other 'variable' criteria such as changes in journey times, numbers, percentages etc.

Table 4: Significance of effect - criteria for traffic and transport receptors – example 2

Significance - impact magnitude		Not Significant	Minor		Moderate		Major
Diversion		< 100m	100 – 200m		200 – 400m		400m or more
Duration of Impact		< 4 weeks	4 weeks – 4 months	4 months or more	4 weeks – 4 months	4 months or more	Over 4 weeks
Number of travellers affected	Low	Not Significant	Minor effect	Minor effect	Minor effect	Moderate effect	Moderate effect
	Medium	Not Significant	Minor effect	Moderate effect	Moderate effect	Major effect (a)	Major effect (b)
	High	Not Significant	Moderate effect	Moderate effect	Major effect	Major effect	Major effect

3 Significance criteria for construction assessment

3.1 Introduction

3.1.1 The criteria outlined below will be used to assess the significance of traffic and transport impacts and effects during construction of the Proposed Scheme.

3.1.2 Any permanent effects of construction have been considered in the operations phase assessments for traffic and transport. Thus, the impact of any ongoing increases in travel demand and the wider effects of the operations phase have been considered together.

3.2 Public transport delay

3.2.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

3.2.2 A significant impact on journeys by bus, heavy and light rail, and the London Underground caused by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results and is defined as any of the following where this lasts for more than four consecutive weeks in any 12 month period:

- changes of more than 10% in a majority of journey times by rail or London Underground;
- changes in journey distance by bus of more than 400m in urban areas and 1km in rural areas;
- a relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area; and
- a relevant change to service frequency, capacity, loss of through connections or reduction in hours of operation.

Stage 2 – refinement of criteria

3.2.3 The bus journey times to be considered are the typical journey times that would be expected over the additional distance introduced as a result of the intervention, rather than specifically those of individual passengers journeys.

3.2.4 The criteria shown in Tables 5 and 6 should be applied in Stage 2, with different criteria being applied in the rural and urban areas. The bus and train profiles relating to low, medium and high frequencies are intended to reflect the numbers of people using the routes.

Table 5: Criteria for Stage 2 assessment - public transport delay, rural

ASSESSMENT OF PUBLIC TRANSPORT DELAY DURING CONSTRUCTION - RURAL							
Criteria		Magnitude of impacts					
		Not significant	Minor	Moderate	Major		
Percentage change in route end-to-end journey time		<10%	10-20%	20-40%	40% or more		
Distance change		<1km	1-2km	2-4km	4km or more		
No. of travellers affected/duration of impact		Significance of effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
<3 buses or trains/hr	Low	Not significant	Minor	Minor	Minor	Moderate	Moderate
Between 3-6 buses or trains/hr	Medium	Not significant	Minor	Moderate	Moderate	Major	Major
>6 buses or trains/hr	High	Not significant	Moderate	Moderate	Major	Major	Major

Table 6: Criteria for Stage 2 assessment - public transport delay, urban

ASSESSMENT OF PUBLIC TRANSPORT DELAY EFFECTS DURING CONSTRUCTION - URBAN							
Criteria		Magnitude of impacts					
		Not significant	Minor	Moderate	Major		
Percentage change in route end-to-end journey time		<10%	10-20%	20-40%	40% or more		
Distance change		<400m	400-800m	800-1,200m	1,200m or more		
No. of travellers affected/duration of impact		Significance of effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
<8 buses or trains/hr OR less than 5,000 passengers/day	Low	Not significant	Minor	Minor	Minor	Moderate	Moderate
Between 8-20 buses or trains/hr OR between 5,000 and 10,000 passengers/day	Medium	Not significant	Minor	Moderate	Moderate	Major	Major
>20 buses or trains/hr OR more than 10,000 passengers/day	High	Not significant	Moderate	Moderate	Major	Major	Major

Guidance on terminology

3.2.5 The following guidance on terminology is highlighted:

- a relevant delay, disruption or overcrowding impact are those caused by the Proposed Scheme during the construction phase;
- the loss of a through connection or direct linkage resulting in the inability to make a direct connection, so requiring some form of interchange to be made.

3.3 Disruption at stations/interchanges

3.3.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR Criteria

3.3.2 A significant impact on stations/interchanges is defined as a change in the vicinity that lasts for more than four consecutive weeks in any 12 month period including:

- loss of physical linkage for the next stage of the journey;
- loss of or relocation of more than 100m of bus facilities and operations (e.g. of bus stops, passenger waiting facilities, bus stands or operator facilities);
- loss of or relocation of more than 100m of taxi facilities and operations (e.g. taxi stands, passenger waiting facilities or operator facilities); and
- loss of or relocation of more than 100m of 'park-and-ride' facilities or operations (e.g. dropping off areas).

Stage 2 – refinement of criteria

3.3.3 The criteria shown in Table 7 below should be applied in Stage 2.

Table 7: Criteria for Stage 2 assessment - disruption at stations/interchanges

Assessment of disruption at stations/ interchanges during construction							
Criteria		Magnitude of impacts					
		Not significant	Minor	Moderate		Major	
Change in distance to replacement facility		<100m	100-200m	200-400m		400m or more	
No. of travellers affected/duration of impact		Significance of effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
See Table 8 below	Low	Not significant	Minor	Minor	Minor	Moderate	Moderate
See Table 8 below	Medium	Not significant	Minor	Moderate	Moderate	Major	Major
See Table 8 below	High	Not significant	Moderate	Moderate	Major	Major	Major

3.3.4 In considering relocation the convenience of any alternative location should be taken account of and the distance should relate to the change in convenience.

3.3.5 An example description for disruption at stations/interchanges is set out in Table 8, this distinguishes the number of people using the station per day in rural and urban situations. The bus and train profiles relating to low, medium and high usage are again intended to reflect the numbers of people using the routes.

Table 8: Description for disruption at stations/interchanges

	Rural	Urban
Low	<3 buses or trains/hr	<8 buses or trains/hr OR less than 5,000 passengers/day
Medium	Between 3-6 buses or trains/hr	Between 8-20 buses or trains/hr OR between 5,000 and 10,000 passengers/day
High	>6 buses or trains/hr	>20 buses or trains/hr OR more than 10,000 passengers/day

3.3.6 The loss of a through connection or physical linkage results in the inability to make a direct connection, requiring some form of interchange movement to be made. If this occurs, then a judgement should be made as to how the movement would be made and this should then be assessed using the public transport delay criteria in Tables 5 and 6.

3.4 Traffic flows and delays to vehicle occupants

3.4.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

3.4.2 A significant increase in traffic levels and driver/vehicle passenger delay (including delays to bus and coach passengers) is defined as any one of the following:

- a 30% increase in traffic flows (i.e. HGVs or all vehicles) ¹, where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas;
- a diversion for more than four consecutive weeks in any 12 month period that leads to an increase in journey length of more than 1km on a route carrying more than 100 vehicles per day, or 5km on a route carrying more than 40 vehicles per day, or 10km on any other route; and
- where a significant change in delay relating to junction congestion resulting from the construction of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local highways authority, based on the increase in the level of congestion at the relevant location. This will be measured either as the forecast ratio of flow to capacity or degree of saturation.

¹ Based on The Institute of Environmental Assessment, *Guidelines for the Environmental Assessment of Road Traffic*, 1993.

Stage 2 – refinement of criteria

- 3.4.3 The above three criteria will be used to reflect the impacts that increased traffic flows will cause in terms of increased difficulty (severance) for pedestrians crossing the road, where there may be a lack of safe adequate pedestrian crossing facilities; increased journey lengths due to diversions; and increased congestion.
- 3.4.4 Effects that are of duration less than 4 consecutive weeks in any 12 month period will be assessed as being not significant.
- 3.4.5 Changes in flows will be related to the Annual Average Weekday Traffic (AAWT) flows (where AAWT flows are not available, the criteria should be applied for those periods assessed e.g. such as 12 hour, AM or PM peak hour, with the vehicle number thresholds adjusted accordingly). As well as considering overall changes in flows, congestion indicators will be measured based on the forecast ratio of flow to capacity (RFC), degree of saturation (DoS) or the practical reserve capacity (PRC).
- 3.4.6 The transport assessment will provide the following information on assessed capacities of a junction, as follows:
- the congestion indicator for an approach where it increases to over 85% during the construction of the Proposed Scheme and the increase is 2% or more due to the Proposed Scheme; or
 - where the congestion indicator for an approach is over 85% in the baseline and during the construction of the Proposed Scheme increases by 2% or more in the construction period.
- 3.4.7 This process will identify those junctions affected by construction of the scheme. The criteria shown in Tables 9 to 12 should be applied in Stage 2 as appropriate. These tables relate to the changes associated with the introduction of the Proposed Scheme, over and above those without the scheme.
- 3.4.8 The assessment of the change in junction capacity will draw upon a range of techniques as appropriate to the location. Where a network traffic model is available this would generally be used to identify the impacts.
- 3.4.9 In instances where a network traffic model is not available (e.g. in rural areas), there may be a difficulty in establishing the congestion indicators for the junctions potentially impacted by the additional traffic. In these situations 'rule of thumb' assessments based on professional judgement (such as those set out in Table 11) of junction throughputs and link capacity can be used to identify potential areas of concern and where this is the case local models should be considered as necessary. Junction capacities of minor roads with other roads will not be modelled, they will be qualitatively assessed.

Table 9: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic severance)

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Severance) DURING CONSTRUCTION							
Criteria		Magnitude of impacts					
		Not significant	Minor		Moderate		Major
Increase in traffic flows (HGVs or all vehicles), where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas		<30%	30-60%		60-120%		120% or more
No. of travellers affected/duration of impact		Significance of effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
Road can be safely and easily crossed (<250 veh/hr inc. Proposed Scheme traffic), safe crossing facilities available	Low	Not significant	Minor	Minor	Minor	Moderate	Moderate
Road moderately difficult to cross safely (250-750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available	Medium	Not significant	Minor	Moderate	Moderate	Major	Major
Road difficult to cross safely, controlled crossing facility required (>750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available	High	Not significant	Moderate	Moderate	Major	Major	Major

Table 10: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic diversions)

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Diversions) DURING CONSTRUCTION							
Criteria		Magnitude of impacts					
		Not significant	Minor	Moderate		Major	
Diversion distance change	Roads carrying >100 veh/day	<1km	1-2km	2-4km		>4km	
	Roads carrying >40 veh/day	<5km	5-7.5km	7.5-15km		>15km	
	Any other route	<10km	10-15km	15-20km		>20km	
No. of travellers diverted/duration of impact		Significance of effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
Between 100-1,000 veh/day	Low	Not significant	Minor	Minor	Minor	Moderate	Moderate
Between 1,000-10,000 veh/day	Medium	Not significant	Minor	Moderate	Moderate	Major	Major
>10,000 veh/day	High	Not significant	Moderate	Moderate	Major	Major	Major

Table 11: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic congestion), rural

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Congestion) DURING CONSTRUCTION – RURAL (where modelling not available)								
Criteria		Magnitude of impacts						
		Not significant	Minor	Moderate		Major		
Change in peak hour two-way traffic flow		<5%	<100 veh/hr	100-250 veh/hr		>250 veh/hr		
Peak hour two-way traffic flow including Proposed Scheme traffic		<500 veh/hr	>500 veh/hr	>500 veh/hr		>500 veh/hr		
Reserve capacity (including Proposed Scheme traffic) at non-minor road junctions		>15%	8-15%	2-8%		<2%		
No. of travellers affected/duration of impact		Significance of effect						
		<4 weeks	4 weeks – 4 months	more than 4 months	4 weeks – 4 months	more than 4 months	4 weeks – 4 months	more than 4 months
<2% change in reserve capacity	Very Low	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
2 -5 % change in reserve capacity	Low	Not significant	Minor	Minor	Minor	Minor	Minor	Moderate
Between 5-10% change in reserve capacity	Medium	Not significant	Minor	Minor	Minor	Moderate	Moderate	Major
>10% change in reserve capacity	High	Not significant	Minor	Minor	Moderate	Major	Moderate	Major

Table 12: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic congestion), urban

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Congestion) DURING CONSTRUCTION - URBAN								
Criteria		Magnitude of impacts						
		Not significant	Minor	Moderate		Major		
Future with-scheme Congestion Indicator		<87%	87 - 92%	92 - 98%		98% or more		
No. of travellers affected/duration of impact		Significance of effect						
		<4 weeks	4 weeks – 4 months	more than 4 months	4 weeks – 4 months	more than 4 months	4 weeks – 4 months	more than 4 months
<2% change in congestion indicator	Very Low	Not significant	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
2-5% change in congestion indicator	Low	Not significant	Minor	Minor	Minor	Minor	Minor	Moderate
Between 5-10% change in congestion indicator	Medium	Not significant	Minor	Minor	Minor	Moderate	Moderate	Major
>10% change in congestion indicator	High	Not significant	Minor	Minor	Moderate	Major	Moderate	Major

3.5 Parking and loading

3.5.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

3.5.2 The SMR defines the significance criteria as set out below:

3.5.3 A significant impact arising from the Proposed Scheme on parking and loading, where facilities are identified to be heavily used, is defined as a change for more than four consecutive weeks in any 12 month period of:

- a predicted increase of 10 or more, or 10%, whichever is the greater, in on-street parking demand in the vicinity of a station or interchange;
- a loss of any designated on-street or off-street spaces, including spaces for disabled persons, buses, taxis, doctors, ambulances, police vehicles and car club bays;
- a loss of ten or more, or 10%, whichever is the greater, private off-street car parking spaces;
- a loss of ten or more, or 10%, whichever is the greater, off-street station car parking spaces;

- a loss of ten or more, or 10%, whichever is the greater, pedal or motorcycle parking spaces; and
- a loss of 10% or more designated loading bay spaces or facilities.

3.5.4 Any loss of parking should, where relevant, be judged against both the absolute and the percentage change and whichever calculation results in the greater number of spaces takes precedence. As an example, with a 50 space car park the absolute trigger would be a loss of 10 spaces while the 10% reduction would be five. The significance criteria would be met only with a 10 space reduction. Conversely, with a 1,000 space car park, a 10% reduction would be 100 spaces and it is this level of reduction that would be required to create a significant effect.

Stage 2 – refinement of criteria

3.5.5 The criteria shown in Table 13 should be applied in Stage 2.

Table 13: Criteria for Stage 2 assessment – parking and loading

ASSESSMENT OF PARKING AND LOADING DURING CONSTRUCTION							
Criteria		Magnitude of impacts					
		Not significant	Minor		Moderate		Major
Change in parking demand (number or %)		<10	10-20		20-40		>40
Change in number of designated parking spaces		0	1		2-4		4 or more
Change in availability of cycle or motorcycle spaces (number or %)		<10	10-20		20-40		>40
Proximity of alternative parking spaces/duration of impact		Significance of effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
<100m	Low	Not significant	Minor	Minor	Minor	Moderate	Moderate
Between 100-250m	Medium	Not significant	Minor	Moderate	Moderate	Major	Major
>250m	High	Not significant	Moderate	Moderate	Major	Major	Major

Guidance on terminology

3.5.6 The following guidance on terminology is highlighted:

- Heavily used – does a loss of spaces cause a deficit that cannot be accommodated.
- Loss of designated spaces – where possible these should be replaced and if necessary reallocated from other nearby provision.

3.6 Vulnerable road user delay, amenity and ambience

3.6.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

3.6.2 The terminology of vulnerable road user within this section relates to all pedestrian, cyclists and equestrians and should not be considered to relate solely to those with mobility impairment.

Stage 1 - SMR criteria

- 3.6.3 Where there are changes to routes used by vulnerable road users, impacts of delays to pedestrians, cyclists, equestrians and others will be assessed based on changes in the 'person-minutes' of the journey times of pedestrians and other non-motorised travellers (based on Department for Transport WebTag Unit 3.5.5)². The following information will be addressed:
- numbers of pedestrians, cyclists equestrians and others; and
 - changes in journey time in minutes arising from the delays.
- 3.6.4 Additional delays and changes in ambience will be defined in proportion to the scale of the impacts being assessed, for example as minor (less than one minute), moderate (between one and two minutes) and major (greater than three minutes); and the numbers of travellers affected per day as: minor (less than 200 in total), moderate (between 200 and 1000) and major (greater than 1000).
- 3.6.5 The significance of the impacts of changes in journey time is based on the matrix shown in Table 14, which has been taken from the SMR Addendum.

Table 14: Significance levels for travellers affected by delay during construction

	Journey time changes		
Number of travellers affected	Minor	Moderate	Major
Minor	Neutral	Neutral	Minor
Moderate	Neutral	Minor	Moderate
Major	Minor	Moderate	Major

Source: SMR Addendum

- 3.6.6 WebTAG Unit 3.3.13 the Journey Ambience Sub-objective, describes the assessment of ambience, which includes travellers amenity. Travellers journey ambience can be affected by:
- traveller care;
 - travellers' views; and
 - traveller stress.
- 3.6.7 Traveller care for pedestrians, cyclists, equestrians and others will be assessed through the provision and design of dedicated facilities (e.g. footpaths, cycle lanes and crossings, information), as well as their cleanliness and environment.
- 3.6.8 The extent to which travellers can see the landscape or townscape view will vary with the relative height of the Proposed Scheme and the surrounding ground, vegetation, buildings and structures. Views can be categorised as providing:
- no view - where the route is in a deep cutting, a tunnel or surrounded by environmental barriers;
 - restricted view - where there are frequent cuttings, tunnels or barriers;
 - intermittent view - where there are shallow cuttings or barriers; and

² Department for Transport, WebTAG; www.dft.gov.uk/webtag/index.php; Accessed 08 July 2013.

- open view - where the view extends over many miles.

3.6.9 Traveller stress is the adverse mental and physiological effects experienced by travellers. Three main factors influence traveller stress:

- frustration;
- fear of potential accidents; and
- route uncertainty.

3.6.10 Taken together, these can lead to feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the quality and safety of a journey.

3.6.11 Assessments will be made of the traveller care, travellers' views and traveller stress ambience factors in relation to the topics in Table 15. These assessments will consider changes due to the impact of the Proposed Scheme on each of these sub-factors as relevant using a simple three point scale (i.e. better, neutral or worse than existing ambience).

Table 15: Environment - Journey Ambience

Factor	Sub-factor	Better	Neutral	Worse
Traveller care	Cleanliness			
	Facilities			
	Information			
	Environment			
Travellers' views	-			
Traveller stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

3.6.12 An overall impact score for the quality of a journey will be determined using the following guidelines:

- the overall assessment is likely to be neutral if the assessment is neutral for all or most of the sub-factors, or improvements on some sub-factors are generally balanced by deterioration on others;
- if the change in impact across the sub-factors is, on balance, for the better, the assessment is likely to be beneficial, and, conversely, it is likely to be adverse if there is an overall change for the worse;
- the overall assessment is likely to be minor (beneficial or adverse) where the numbers of travellers affected is low (less than 200 a day);
- the overall assessment is likely to be major (beneficial or adverse) where the numbers of travellers affected is high (more than 1,000 per day); and
- the overall assessment is likely to be moderate (beneficial or adverse) in all other cases.

3.6.13 The methodology set out above will be applied to the Proposed Scheme on a locational basis where ambience issues for pedestrian, cyclists, equestrians and others are considered likely to be of concern. In addition, it is likely that more general conclusions in relation to more aggregated areas will also be reached.

Stage 2 – refinement of criteria

3.6.14 Where there are impacts in delays to pedestrians, cyclists, equestrians and other vulnerable road users they will be assessed based on changes in the 'person-minutes' of the journey times of pedestrians and other non-motorised travellers.

3.6.15 To avoid double counting, increased journey times arising from, for example, diversion of footpaths or cycle routes, should be reported only once and this will be undertaken against the severance topic discussed in Section 3.8. Against this topic, changes in journey time due to delays arising from, for example, increased crowding and congestion or new signal controls should be reported.

3.6.16 Effects that are of duration less than 4 consecutive weeks in any 12 month period will be assessed as being not significant.

3.6.17 The thresholds specified in paragraph 3.6.4 of the SMR addendum have been amended to read as follows: additional delays and changes in ambience will be defined in proportion to the scale of the impacts being assessed, for example as not significant (less than 1 minute), minor (between one and two minutes), moderate (between two and three minutes) and major (greater than three minutes); and the numbers of travellers affected per day as: low (less than 200 in total), medium (between 200 and 1000) and high (greater than 1000).

3.6.18 The criteria shown in Table 16 should be applied in Stage 2.

Table 16: Criteria for Stage 2 assessment – vulnerable road user delay, amenity and ambience

ASSESSMENT OF VULNERABLE ROAD USER DELAY, AMENITY AND AMBIENCE EFFECT DURING CONSTRUCTION							
Criteria		Magnitude of impacts					
		Not significant	Minor	Moderate	Major		
Additional journey time delay		< 1 min	1-2 mins	2-3 mins	3 or more mins		
No. travellers affected/ Duration of impact		Significance of Effect					
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	>4 weeks
<200 /day	Low	Not significant	Not significant	Not significant	Not significant	Not significant	Minor
Between 200-1,000 /day	Medium	Not significant	Not significant	Not significant	Minor	Minor	Moderate
>1,000 /day	High	Not significant	Minor	Minor	Moderate	Moderate	Major

3.7 Accidents and safety

3.7.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

3.7.2 Significant impacts on accidents and safety risks will be defined for links and junctions as follows:

- links and junctions for which data is available that have experienced on average more than nine personal injury accidents (PIA) in total, in a three-year period ending in 2011-12 and which would be subject to an increase of 30% or more in total traffic flow during construction for a period of more than four consecutive weeks in any 12 month period.

Stage 2 – refinement of criteria

3.7.3 Where accident data has been collected for a period greater than three years, the number of accidents should be pro-rata to represent three years worth of data. Thus, for example, if five years worth of data were available, the number of accidents being considered would be multiplied by 3/5 (i.e. 0.6) and then the resultant number would be compared to the threshold of 9 accidents in total in the desired three year period.

3.7.4 The criteria shown in Table 17 should be applied in Stage 2.

Table 17: Criteria for Stage 2 assessment – accidents and safety

ASSESSMENT OF ACCIDENTS AND SAFETY DURING CONSTRUCTION					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Change in Annual Average Daily Traffic (AADT) flow		<30%	30-60%	60-120%	120% or more
Number of PIAs within 20m of any impacted junctions		<9	9 or more	9 or more	9 or more
Number of PIAs within any 150m section of impacted road links		<9	9 or more	9 or more	9 or more
Number of travellers affected		Significance of effect			
10% or more below average benchmark national accident rate for category of road	Low	Not significant	Minor	Minor	Moderate*
Within +/- 10% of the average benchmark national accident rate for category of road	Medium	Not significant	Minor	Moderate*	Major*
10% or more above average benchmark national accident rate for category of road	High	Not significant	Moderate*	Major*	Major*

Note: * needs to be subject to further analysis within the Transport Assessment process.

3.7.5 Professional judgement should be used in considering whether or not the future flows are likely to increase the risks of accidents. This should include consideration of the local conditions on the highways and junctions and the factors causing the accidents. Sections of roads or junctions that have an identifiable cluster or gathering of accidents should be identified and addressed as necessary. Consideration should be given to the expected typical national average accident rate on this category of road, and whether or not this is being exceeded.

- 3.7.6 The grouping of accidents to establish whether the criteria of nine or more recorded PIA in total over a three year period is exceeded, should be based upon the following definition of clusters of accidents:
- nine or more recorded PIA in total over a three year period within about 20m of any road junction; or
 - nine or more recorded PIA in total over a three year period within about 150m along any road link.

3.8 Severance

- 3.8.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

- 3.8.2 Severance can affect travellers using non-motorised modes, especially pedestrians. Where reasonable, practically and economically, public footpaths and routes will be reinstated or alternatives provided. Cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although there may still be significant impacts on these groups. Severance³ effects will be classified according to the following four broad levels: no impact, minor, moderate and major.
- 3.8.3 To ensure a consistent approach, the classification and assessment will be based only on the characteristics that would exist assuming the movement was made by a pedestrian. The proposed categories of effect are discussed below.
- 3.8.4 Minor: In general the current journey pattern is likely to be maintained, but there may be some hindrance to movement for example:
- pedestrians at-grade crossing of a new road carrying less than 8,000 vehicles per day (annual average daily traffic - AADT); or
 - a new bridge which will need to be climbed or a sub-way traversed; and/or
 - journey lengths being increased by up to 100-250m (less than 100m increase in journey length is considered to be of no impact).
- 3.8.5 Moderate: Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive, for example:
- two or more of the hindrances set out under 'minor' applying to an individual journey; or
 - pedestrians at-grade crossing of a new road accommodating between 8,000-16,000 vehicles per day (AADT) in the opening year; and/or
 - journey lengths being increased by 250 – 500m.

³Based on Department for Transport (DfT) WebTAG Unit 3.6.2 and Design Manual for Roads and Bridges (DMRB) Volume 11, Section 11, Part 8.

- Major: People are likely to be deterred from making trips to an extent sufficient to induce a change in their habits. This could lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be caused to people making their existing journeys. Such impacts can result from:
 - pedestrians at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT) in the opening year;
 - journey lengths being increased by over 500m; and/or
 - three or more of the hindrances set out under 'minor' or two or more set out under 'moderate'.

3.8.6 An overall assessment for the option will then be based on the following guidelines (in each case, the assessment is beneficial if severance is reduced and adverse if severance is increased):

- the overall assessment is likely to be of negligible impact if increases in severance are broadly balanced by relief of severance;
- the overall assessment is likely to be minor where change in severance is slight or the total numbers of people affected across all levels of severance is minor (less than 200 per day);
- the overall assessment is likely to be major where the change in severance is major, and affects a moderate or high number of people or the total numbers of people affected across all levels of severance is major (greater than 1,000 per day); and
- the overall assessment is likely to be moderate where greater than 200 and less than 1,000 people per day are affected.

3.8.7 Table 18 sets out the criteria presented in the SMR Addendum. This is equivalent to Webtag's guidance on how severance without and with schemes are combined to estimate the significance of the effects in terms of severance.

Table 18: Assessment of Change in Severance Scoring

	Change in severance scoring with the Proposed Scheme			
Numbers of travellers affected	Not significant	Minor	Moderate	Major
Minor	Not significant	Minor	Minor	Minor*/Moderate**
Moderate	Not significant	Minor	Moderate	Major
Major	Not significant	Minor	Major	Major

Notes: * duration between 4 weeks and 4 months; and
 ** duration 4 months or more

Source: SMR Addendum

Stage 2 – refinement of criteria

3.8.8 Effects that are of duration less than 4 consecutive weeks in any 12 month period will be assessed as being not significant.

3.8.9 The definition of significance in Table 19 includes the criteria in paragraphs 3.8.4 to 3.8.6 to assess the change in severance impact and the numbers of travellers affected as from paragraph 3.8.7.

3.8.10 The assessment criteria shown in Table 19 should be applied in Stage 2.

Table 19: Criteria for Stage 2 assessment – severance

ASSESSMENT OF SEVERANCE DURING CONSTRUCTION								
Criteria		Magnitude of impacts						
		Not significant	Minor	Moderate	Major			
Incremental hindrances		N/A	As below	2 or more minor	3 or more minor or 2 or more moderate			
Veh/day for additional at grade crossings to be traversed		N/A	<8,000	8,000-16,000	16,000 or more			
Change in journey length		<100m	100-250m	250-500m	500-1,500m	1,500m or more		
No. travellers affected/ Duration of impact		Significance of Effect						
		<4 weeks	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more	4 weeks-4 months	4 months or more
<200 people/day	Low	Not significant	Minor	Minor	Minor	Minor	Minor	Moderate
Between 200-1,000 people/day	Medium	Not significant	Minor	Minor	Moderate	Moderate	Major	Major
>1,000 people/day	High	Not significant	Minor	Minor	Major	Major	Major	Major

3.9 Waterways

3.9.1 The SMR criteria have been considered with further refinement being added in Stage 2 in terms of how the extent of the numerical measures should be judged and the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

3.9.2 The document *Third Party Works Procedures, Section 2, Code of Practice, British Waterways, 2012*⁴ (in Sections 4.1 – 4.3) identifies the requirements that have to be followed in relation to works affecting the navigation or amenity of canals. In summary, these are that generally no stoppages of the canal or navigation or towpath will be allowable, except for technical reasons. Stoppages must be discussed and agreed in advance with Canal and River Trust (formerly known as British Waterways) and all stoppages must be of minimised duration. For the purpose of the ES, a significant stoppage is defined as occurring when an unbroken stoppage exceeding six weeks in duration is required, as this is when specific arrangements regarding the transfer of boats around the works by road may be required.

Stage 2 – refinement of criteria

3.9.3 For the purpose of the ES, a stoppage of less than six weeks will be considered not significant. Significant effects arising from stoppages are defined as:

⁴ British Waterways (2012), *Third Party Works Procedures*.

- minor: when an unbroken stoppage exceeding six weeks in duration is required;
- moderate: when an unbroken stoppage exceeding 12 weeks is required; and
- major: when an unbroken stoppage exceeding 24 weeks is required.

3.9.4 The Canal and River Trust also require that towing paths must remain open wherever possible. If a diversion is unavoidable, these should be localised. They may be used by the Canal and River Trust maintenance plant and be of a standard to allow continued use by existing visitors – walkers, anglers, people with disabilities, cyclists etc. Only as an unusual event would towing paths be permitted to be used for access to the temporary and permanent works for the Proposed Scheme because of conflict with visitors and the unsuitability of the towing path for vehicular use. Any impacts on pedestrians, cyclists, mobility impaired persons and equestrians using the towing paths should be assessed in relation to the vulnerable road user and ambience heading and associated criteria.

4 Significance criteria for operational assessment

4.1 Introduction

4.1.1 The criteria outlined in this chapter will be used to assess the significance of traffic and transport impacts and effects during the operational phase of the Proposed Scheme.

4.2 Public transport delay

4.2.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

4.2.2 Significant permanent impacts on journeys by bus, heavy and light rail, and London Underground affected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling result; and are defined as any of the following:

- a 10% change in a majority of journey times by any public transport mode; and
- a change in journey distances by bus of more than 400m in urban areas and 1km in rural areas.

Stage 2 – refinement of criteria

4.2.3 In the consideration of these criteria for the construction phase, as described in paragraph 3.2.2, account was taken of changes in journey times and distances; delays, disruption, overcrowding; and changes to service frequencies, capacity, loss of through connections and reductions in hours of services. Whilst many of these impacts will be taken account of within the design of the facilities, they will also be assessed for the operational phase of the Proposed Scheme. If there are any significant effects these will be reported.

- 4.2.4 The bus journey times to be considered are the typical journey times that would be expected over the additional distance introduced as a result of the intervention, rather than specifically those of individual passengers journeys.
- 4.2.5 The criteria shown in Tables 20 and 21 should be applied in Stage 2, respectively in rural and urban situations.

Table 20: Criteria for Stage 2 assessment – public transport delay, rural

ASSESSMENT OF PUBLIC TRANSPORT DELAY DURING OPERATION - RURAL					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Percentage change in route end-to-end journey time		<10%	10-20%	20-40%	40% or more
Distance change		<1km	1-2km	2-4km	4km or more
No. of travellers affected		Significance of effect			
<3 buses or trains/hr	Low	Not significant	Minor	Moderate	Moderate
Between 3-6 buses or trains/hr	Medium	Not significant	Moderate	Major	Major
>6 buses or trains/hr	High	Not significant	Moderate	Major	Major

Table 21: Criteria for Stage 2 assessment – public transport delay, urban

ASSESSMENT OF PUBLIC TRANSPORT DELAY EFFECTS DURING OPERATION - URBAN					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Percentage change in route end-to-end journey time		<10%	10-20%	20-40%	40% or more
Distance change		<400m	400-800m	800-1,200m	1,200m or more
No. of travellers affected		Significance of effect			
<8 buses or trains/hr OR <5,000 passengers/day	Low	Not significant	Minor	Moderate	Moderate
Between 8-20 buses or trains/hr OR Between 5,000 and 10,000 passengers/day	Medium	Not significant	Moderate	Major	Major
>20 buses or trains/hr OR Over 10,000 passengers/day	High	Not significant	Moderate	Major	Major

4.3 Station/interchange impacts

4.3.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

4.3.2 The SMR defines the significance criteria as impacts that may be caused by additional passengers of the Proposed Scheme arriving and departing at the stations/interchanges. This will be assessed using modelling information, taking account of:

- forecast numbers of additional passengers using the Proposed Scheme;
- local transport conditions at each location;
- resulting increases in crowding and congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme; and
- any loss of physical linkage for the next stage of the journey.

Stage 2 – refinement of criteria

4.3.3 The results from the traffic and transport assessment and modelling will be used to identify if there are any significant journey time, interchange and accessibility changes for travellers. This will include consideration of:

- resulting increases in crowding and congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme. Where relevant these will be quantitatively assessed using the transport models developed within the Transport Assessment. Criteria that will be assessed include:
 - Results of pedestrian capacity modelling, where there is a change (increase) of at least one Fruin Level of Service (LoS), based on TfL station passenger standards and guidelines.⁵
 - Likelihood of congestion causing delays at the kerbside or at station facilities e.g. bus station or taxi ranks.
- Any loss of physical linkage for the next stage of the journey.

4.3.4 It is however expected that the new transport infrastructure will be designed to cater for the forecast levels of future demands and mitigate any impacts that the Proposed Scheme might otherwise have been expected to cause.

4.3.5 The criteria shown in Table 22 should be applied in Stage 2

⁵ TfL London Underground S1371 Station Planning, Issue A5, Issue date: June 2011.

Table 22: Criteria for Stage 2 assessment – station/interchange impacts

ASSESSMENT OF DISRUPTION AT STATIONS/ INTERCHANGES DURING OPERATION					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Pedestrian modelling (Fruin LoS)		C or less	D increased by 2 or more levels or E increased by 1 level	E increased by 2 or more levels or F increased by 1 level	F increased by 2 or more levels
No. of travellers affected		Significance of effect			
See Table 8 above	Low	Not significant	Minor	Moderate	Moderate
See Table 8 above	Medium	Not significant	Moderate	Major	Major
See Table 8 above	High	Not significant	Moderate	Major	Major

Guidance on terminology

4.3.6 The following guidance on terminology is highlighted:

- resulting increases in congestion levels will be as assessed and informed by the transport assessment and modelling;
- the loss of a physical linkage is the inability to make a direct connection.

4.4 Traffic flows and delays to vehicle occupants

4.4.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

Stage 1 - SMR criteria

4.4.2 The SMR criteria include that a significant impact in traffic levels (i.e. HGVs and all vehicles) and driver and vehicle passenger delay will be defined as any of the following:

- a 10% increase in peak hour two-way traffic flows;
- increases in traffic flows that cause the design capacity to become exceeded, on links that would not otherwise be congested;
- a 30% increase in the average off-peak hour two-way traffic flows;
- a permanent diversion that results in an increase in journey length of more than 1km; and
- where a significant change in delay relating to junction congestion resulting from the operation of the Proposed Scheme is forecast in the traffic and transport Assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local Highways Authority, based on the increase in the level of congestion at the location. This will be measured with congestion indicators based on the forecast ratio of flow to

capacity (RFC), degree of saturation (DoS) or the practical reserve capacity (PRC).

Stage 2 – Refinement of Criteria

- 4.4.3 The criteria shown in Tables 23 to 26 should be applied in Stage 2 in relation to the impacts and effects during the operational stage of the Proposed Scheme.
- 4.4.4 These criteria have been further developed, and slightly amended from those in the SMR, to include in the assessment of the operational scenario the same application of “HGV or all vehicle” thresholds as adopted in the assessment of the construction scenario. This has been adopted to clarify that these two categories of vehicles both need to be assessed, separately.
- 4.4.5 The daily HGV or all vehicle thresholds in Table 23 will, where relevant, be adjusted accordingly to peak hour flows, if necessary, to correspond with the peak hour data that will be used in this assessment.

Table 23: Criteria for Stage 2 assessment –traffic flows and delays to vehicle occupants (traffic severance)

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Severance) DURING OPERATION					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Increase in peak hour traffic flows (HGVs or all vehicles) where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas		<10%	10-20%	20-40%	40% or more
Increase in off-peak hour traffic flows (HGVs or all vehicles) where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas		<30%	30-60%	60-120%	120% or more
No. of travellers affected		Significance of effect			
Road can be safely and easily crossed (<250 veh/hr inc. Proposed Scheme traffic), safe crossing facilities available	Low	Not significant	Minor	Moderate	Moderate
Road moderately difficult to cross safely (250-750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available	Medium	Not significant	Moderate	Major	Major
Road difficult to cross safely, controlled crossing facility required (>750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available	High	Not significant	Moderate	Major	Major

Table 24: Criteria for Stage 2 assessment –traffic flows and delays to vehicle occupants (traffic diversion)

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Diversions) DURING OPERATIONS					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Diverted distance		<1km	1-5km	5-10km	10km or more
No. of travellers affected		Significance of effect			
Between 100-1,000 veh/day	Low	Not significant	Minor	Moderate	Moderate
Between 1,000-	Medium	Not significant	Moderate	Major	Major

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Diversions) DURING OPERATIONS					
10,000 veh/day					
>10,000 veh/day	High	Not significant	Moderate	Major	Major

Table 25: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic congestion), rural

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (traffic congestion) DURING OPERATION - RURAL					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Change in peak hour traffic flow		<2%	N/A	N/A	N/A
Reserve junction capacity (including Proposed Scheme traffic)		>15%	8-15%	2-8%	<2%
No. of travellers affected		Significance of effect			
<2% change in reserve capacity	Very Low	Not significant	Not significant	Not significant	Not significant
2-5% change in reserve capacity	Low	Not significant	Minor	Minor	Moderate
Between 5-10% change in reserve capacity	Medium	Not significant	Minor	Moderate	Major
>10% change in reserve capacity	High	Not significant	Minor	Major	Major

Table 26: Criteria for Stage 2 Assessment – traffic flows and delays to vehicle occupants (traffic congestion), urban

ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Congestion) DURING OPERATION - URBAN					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Future with-scheme Congestion Indicator		<85%	85 - 92%	92 - 98%	98% or more
No. of travellers affected		Significance of effect			
<2% change in reserve capacity	Very Low	Not significant	Not significant	Not significant	Not significant
2-5% change in Congestion Indicator	Low	Not significant	Minor	Minor	Moderate
Between 5-10% change in Congestion Indicator	Medium	Not significant	Minor	Moderate	Major
>10% change in Congestion Indicator	High	Not significant	Minor	Major	Major

Guidance on terminology

4.4.6 The following guidance on terminology is highlighted:

- a significant change in delay will be as assessed and informed by the Transport Assessment.

4.5 Parking and loading

4.5.1 The assessment criteria for the operational phase of the Proposed Scheme will be the same as those described for the longer term impacts that may occur during the construction phase. . These are shown in Table 27 below.

Table 27: Criteria for Stage 2 Assessment – Parking and loading

ASSESSMENT OF PARKING AND LOADING DURING OPERATION					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Change in parking demand (number or %)		<10	10-20	20-40	>40
Change in number of designated parking spaces		0	1	2-4	4 or more
Change in availability of cycle or motorcycle spaces (number or %)		<10	10-20	20-40	>40
Proximity of alternative parking spaces		Significance of Effect			
<100m	Low	Not significant	Minor	Moderate	Moderate
Between 100-250m	Medium	Not significant	Moderate	Major	Major
>250m	High	Not significant	Moderate	Major	Major

4.6 Vulnerable road user delay, amenity and ambience

4.6.1 The assessment criteria for the operational phase of the Proposed Scheme are the same as those described for the longer term impacts that may occur during the construction phase. These are shown in Table 28.

Table 28: Criteria for Stage 2 assessment – vulnerable road user delay, amenity and ambience

ASSESSMENT OF VULNERABLE ROAD USER DELAY, AMENITY AND AMBIENCE EFFECT DURING OPERATION					
Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
Additional journey time delay		< 1 min	1-2 mins	2-3 mins	3 or more mins
No. of travellers affected		Significance of effect			
<200 /day	Low	Not significant	Not Significant	Not Significant	Minor
Between 200-1,000 /day	Medium	Not significant	Not significant	Minor	Moderate
>1,000 /day	High	Not significant	Minor	Moderate	Major

4.7 Accidents and safety

4.7.1 The assessment criteria for the operational phase of the Proposed Scheme will be the same as those described in Section 3.7 for the construction phase (see Table 17).

4.8 Severance

4.8.1 The assessment criteria for the operational phase of the Proposed Scheme are the same as those described for the longer term impacts that may occur during the construction phase. These are shown in Table 29.

Table 29: Criteria for Stage 2 Assessment – Severance

ASSESSMENT OF SEVERANCE DURING OPERATION						
Criteria		Magnitude of impacts				
		Not significant	Minor	Moderate	Major	
Incremental hindrances		N/A	As below	2 or more minor	3 or more minor or 2 or more moderate	
Veh/day for additional at grade crossings to be traversed		N/A	<8,000	8,000-16,000	16,000 or more	
Change in journey length		<100m	100-250m	250-500m	500-1,500m	1,500m or more
No. of travellers affected		Significance of effect				
<200 people/day	Low	Not significant	Minor	Minor	Minor	Moderate
200-1,000 people/day	Medium	Not significant	Minor	Moderate	Major	Major
>1,000 people/day	High	Not significant	Minor	Major	Major	Major

4.9 Waterways

4.9.1 The assessment criteria for the operational phase of the Proposed Scheme will be the same as those described above for the construction phase (see Section 3.9).

Annex J: Waste and material resources– technical notes

1.1.1 The following technical notes are appended to this document:

- Rationale for landfill significance criteria
- Waste forecast and assessment methodology



HS2 London-West Midlands

Waste and material resources

**Technical note – Rationale for
landfill significance criteria**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 General

- 1.1.1 This technical note sets out the rationale for the development of the significance criteria for inert, non-hazardous and hazardous landfill to be used in the assessment of the likely significant environmental effects associated with the disposal of solid waste arising from the Proposed Scheme.
- 1.1.2 There is no Environmental Impact Assessment (EIA) guidance in the UK which provides an authoritative methodology and waste significance criteria for the assessment of the likely significant environmental effects of solid waste generation. EIA guidance for other countries exists (for example Hong Kong) but this sets out significance criteria based on qualitative factors.
- 1.1.3 'CLG Circular 02/99: Environmental impact assessment'¹ states that an EIA is likely to be required for a landfill site for the disposal of household, industrial and/or commercial waste where new capacity is created to hold more than 50,000 tonnes per annum, or to hold waste of 10 hectares or more. More importantly, it also states that sites seeking only to accept inert wastes (demolition waste etc.) are unlikely to require an EIA (see Appendix A).
- 1.1.4 The Design Manual for Roads and Bridges² does not set any criteria for assessing waste arising as a result of the construction of roads or bridges.

2 Rationale for inert landfill significance criteria

2.1 General

- 2.1.1 This section of the technical note sets out the rationale for the development of the significance criteria for inert landfill to be used in the assessment of the significance of environmental effects associated with the disposal of inert waste arising from the Proposed Scheme.

2.2 Inert waste legislative guidance

- 2.2.1 Guidance by the Environment Agency provides a definition for inert waste as per the EU Landfill Directive, article 2(e):³

'Inert waste' means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater;'

¹ Department for Communities and Local Government (1999), *Environmental impact assessment: circular 02/1999*.

² Department of Transport (2001), *The Design Manual for Roads and Bridges, Volume 11, Section 3, Part 6*.

³ Environment Agency (June 2009), *Environmental Permitting Regulations: Inert Waste Guidance. Standards and Measures for the Deposit of Inert Waste on Land*.

- 2.2.2 The EU Landfill Directive sets rigorous standards to reduce the impact from waste disposed of to landfill including inert waste acceptance criteria.
- 2.2.3 The Environment Agency Technical Guidance WM2 'Hazardous Waste',⁴ although intended for hazardous waste assessment, provides a useful waste assessment methodology and guidance on waste classification using the European Waste Catalogue, transposed into English legislation by the List of Wastes (England) Regulations 2005 (SI 2005 No. 895) (as amended).
- 2.2.4 Inert waste is likely to comprise those wastes stated in the List of Wastes (England) Regulations 2005 (SI 2005 No. 895) (as amended) in Chapter 17 'Construction and Demolition Wastes (including excavated soils from contaminated sites)'.⁵ However, if no suitable waste codes are available in Chapter 17 then other chapters will need to be explored, for example, Chapter 1 'Wastes Resulting from Exploration, Mining, Quarrying, and Physical and Chemical Treatment of Minerals' or Chapter 19 'Waste from Waste Treatment Facilities'.
- 2.2.5 The EU Landfill Directive [99/31/EC](#) defines landfill as waste disposal sites for the deposit of waste onto or into land and divides landfill into three classes: (i) landfills for hazardous waste; (ii) landfills for non-hazardous waste; and (iii) landfill for inert waste.

2.3 Other major infrastructure projects

- 2.3.1 EIAs for other major infrastructure projects such as Crossrail have relied on a qualitative assessment. The Crossrail target for diverting excavation materials from landfill is 95% with a stretch target of 100%. The target for diverting construction and demolition waste from landfill is 90%. The forecast material generation for Crossrail is set out in Table 1 below. The figures include a bulking factor (i.e. increase in volume following excavation).

Table 1: Crossrail excavated material classification

Material Classification	Volume (m ³)
Clean excavated material (non-contaminated)*	6.0 million
Construction material	1.2 million
Contaminated material	0.5 million
Demolition material	0.3 million

*Crossrail has stated the following: 'All of Crossrail's 5.6 million m³ of clean excavated material will be beneficially reused'.

- 2.3.2 The Olympic Delivery Authority (ODA) set targets of reclaiming 90% of demolition waste by weight for reuse and recycling, and to divert 90% of construction waste from landfill for construction of the facilities for the London 2012 Olympic Games. The ODA recycled 97.7% of demolition waste and achieved their target for diversion of construction waste from landfill. Additionally, 80% of contaminated soil was cleaned and reused through the use of soil washing and bioremediation technologies. This equated to 1.3 million tonnes of soil.
- 2.3.3 The Thames Tunnel project has a target to divert a minimum of 90% of construction, demolition and excavated material from landfill. The 'Preliminary Environmental Information Report (Volume 5: Assessment methodologies)'⁶ does not provide a

⁴ Environment Agency (April 2011), Technical Guidance WM2: Hazardous Waste.

⁵ HMSO (2005), *The List of Wastes (England) Regulations*.

⁶ Thames Water (2011), *Preliminary Environmental Information Report: Volume 5 Assessment Methodology*.

specific assessment methodology for waste. It is stated that: 'Contaminated and uncontaminated soils from excavations will be required to be handled and managed as part of the waste strategy for the project.' The draft waste strategy (Phase 2 Consultation, Autumn 2011)⁷ does also not include an assessment methodology or criteria for waste. However, it includes an appraisal of the disposal of waste on the 'Impact on regional self-sufficiency and apportionment' but does not provide any statement on its significance.

2.4 Inert waste management infrastructure

- 2.4.1 The number of material recovery facilities for inert and non-inert (mixed) construction and demolition materials has increased over the past 10 years contributing to improved resource efficiency in the construction industry. It is possible for a single construction and demolition waste recovery facility to be capable of processing significantly in excess of one million tonnes of inert waste per annum. For example, the Powerday facility in North West London is licensed to process 1.6 million tonnes per annum on a site of approximately 3.5 hectares⁸. The Bedrock Thames Wharf site in East London is licensed to process 750,000 tonnes per annum on a 1.36 hectare site⁹.
- 2.4.2 Typically, a large proportion of inert waste, which is destined for landfill disposal, is used for landfill engineering and capping purposes.
- 2.4.3 Latest available data published by the Environment Agency¹⁰ shows that inert landfill capacity in England has almost doubled over a period of 10 years from 93 million tonnes in 2001 to over 181 million tonnes in 2011, as shown in Figure 1. The data show that inert landfill capacity in the five former planning regions (i.e. Greater London, South East, East of England, East Midlands and West Midlands) along the route corridor of the Proposed Scheme (hereafter referred to as the 'five regions') has also increased from almost 65 million tonnes in 2001 to over 104 million tonnes in 2011 but has declined slightly since 2009 (see Figure 1).
- 2.4.4 The data show that inert landfill inputs in England between 2000 and 2011 have been relatively stable on average with just under 11 million tonnes per annum. The average total of the five regions was slightly over six million tonnes over the same period (see Figure 1).

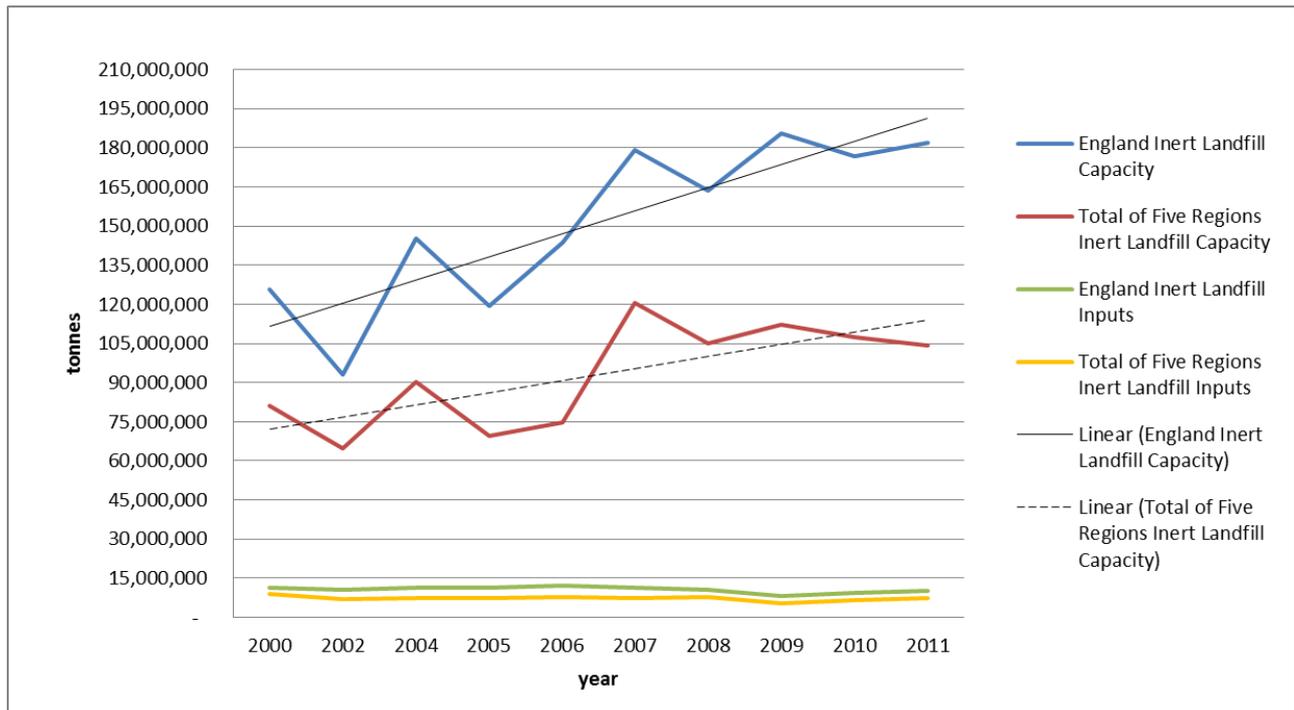
⁷ Thames Water (2011), *Thames Tunnel Draft Waste Strategy*.

⁸ Powerday; Construction & Demolition; <http://www.powerday.co.uk/recycling-solutions/construction-demolition>; accessed: 5 July 2013

⁹ Greater London Authority; Planning Reports PDU/1125/01 & 1555/01, 7 November 2006 – Thames Wharf Olympic Business Relocations, Dock Road, Silvertown; http://legacy.london.gov.uk/mayor/planning_decisions/strategic_dev/2006/20061129/thames_wharf_report.pdf; accessed 8 July 2013.

¹⁰ Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; <http://www.environment-agency.gov.uk/research/library/data/142773.aspx>; accessed: 24 June 2013.

Figure 1: Inert landfill capacity and inputs in England/five regions (2000 to 2011)



2.5 Inert landfill significance criteria

2.5.1 The significance criteria in Table 2 have been developed for inert landfill (excluding hazardous substances) as part of the Scope and Methodology Report (SMR - see Volume 5 Appendix CToo1-000/1). They are relevant for inert waste, which may arise from site clearance works, demolition of existing buildings and structures, and the earthworks associated with the construction of the Proposed Scheme.

Table 2: Inert landfill significance criteria (excluding hazardous substances)

Degree of significance	Inert landfill criteria
Major adverse	Net increase in waste arisings relative to the future baseline leading to a severe, national and regional scale reduction in inert landfill void space capacity. Need for additional large-scale waste treatment and/or disposal capacity of greater than 10,000,000 tonnes per annum. Effect may be judged to be of importance in the national planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision making.
Moderate adverse	Net increase in waste arisings relative to the future baseline leading to a regional scale reduction in inert landfill void space capacity. Need for additional medium to large scale waste treatment and/or disposal capacity of between 2,000,000 to 10,000,000 tonnes per annum. Effect may be judged to be important in the regional planning context, for example, where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the future baseline leading to local scale reduction in inert landfill void space capacity. Need for additional small scale waste treatment and/or disposal capacity of up to 2,000,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the future baseline or reduction in inert landfill void space capacity. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in waste arisings and diversion of waste from inert landfill relative to the future baseline resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure.

- 2.5.2 The upper 'threshold value' for minor adverse effects has been set as 2,000,000 tonnes per annum of inert landfill disposal capacity. This threshold has been based on providing additional small scale inert landfill disposal capacity equivalent to a 10 hectare inert landfill site assuming an inert waste thickness of approximately 15m (i.e. 1,500,000m³ of inert landfill capacity or approximately 2,000,000 tonnes using a volume to mass density conversion factor of 1.5 tonnes/m³)¹¹. Based on the threshold described in Circular 02/99 and the inert nature of the waste (i.e. reduced potential of generating greenhouse gas emissions and leachate), it is considered unlikely that landfill and/or land raise would result in pollution of the environment and/or harm to human health. This would need to be confirmed when applying for an environmental permit for an individual site.
- 2.5.3 The disposal of 2,000,000 tonnes per annum of inert waste would represent about 2% of the inert landfill capacity in the combined five regions, and 1% of the national inert landfill capacity, based on the most recently available figures for 2011 from the Environment Agency¹².
- 2.5.4 The threshold values for moderate and major adverse environmental effects have been based on professional judgement. These are extrapolations of the threshold value for minor adverse environmental effects based on an incremental increase of the total inert waste quantity to be disposed of by applying a factor of five to define the moderate adverse environmental effects threshold value (i.e. 2,000,000 to 10,000,000 tonnes per annum), and the major adverse environmental effects threshold value (i.e. greater than 10,000,000 tonnes per annum).
- 2.5.5 The disposal of 10,000,000 tonnes per annum of inert waste represents approximately 10% of the total inert landfill capacity in the combined five regions, and approximately 6% of inert landfill capacity in England based on the 2011 inert landfill capacity data from the Environment Agency.
- 2.5.6 The Proposed Scheme would be constructed over a period of approximately nine years (i.e. 2017 to 2025) starting initially with enabling works followed by the earthworks such as tunnelling etc. Any inert surplus excavated material generated by the Proposed Scheme would not occur all in a single year but extend over several years reducing the pressure on inert landfill capacity.
- 2.5.7 A wide range of factors influence the available landfill capacity such as the regulatory regime, fiscal measures, waste generation rates and measures to divert waste from landfill (e.g. reuse, recycling/composting and energy recovery). This makes the forecasting of future landfill capacity difficult and inexact. It is recognised that landfill capacity is a limited resource, however, data from the Environment Agency indicates an increase in inert landfill capacity in the combined five regions and England between 2000 and 2011 (see Figure 1).

¹¹ Department of the Environment (1995), Waste Management Paper 26B, Landfill Design, Construction and Operational Practice.

¹² Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; <http://www.environment-agency.gov.uk/research/library/data/142773.aspx>; accessed: 24 June 2013.

3 Rationale for non-hazardous landfill significance criteria

3.1 General

3.1.1 This section of the technical note sets out the rationale for the development of the significance criteria for non-hazardous landfill to be used in the assessment of the significance of environmental effects associated with the disposal of non-hazardous waste arising from the Proposed Scheme.

3.2 Non-hazardous waste legislative guidance

3.2.1 Non-hazardous waste means waste which is not hazardous (see Section 4 for hazardous). It will comprise waste generated during the construction (e.g. worker accommodation site waste) and operation (e.g. railway station and train waste) of the Proposed Scheme.

3.2.2 Non-hazardous waste is also covered by the revised EU Waste Framework Directive [2008/98/EC](#) (rWFD), and UK waste policy, legislation and guidance.

3.2.3 Non-hazardous waste landfill sites typically accepted municipal solid waste along with non-hazardous waste (including inert waste) from any other sources. There are no numerical waste acceptance criteria for non-hazardous waste but the List of Waste Regulations provides absolute non-hazardous waste entries for wastes which are deemed to be non-hazardous. However, the main requirement is to ensure that the waste landfilled is not hazardous.

3.3 Other major infrastructure projects

3.3.1 As stated in Section 2, EIAs for other major infrastructure projects such as Crossrail have relied on a qualitative assessment, and have not developed assessment criteria for the disposal of non-hazardous waste.

3.4 Non-hazardous waste management infrastructure

3.4.1 Latest available data published by the Environment Agency¹³ shows a downward trend of non-hazardous waste landfill capacity in England (indicated by the linear trend line) with about 450 million tonnes in 2005 declining to approximately 340 million tonnes in 2011 (approximately 24% reduction), as shown in Figure 2. Over the same period, the non-hazardous waste input rates have decreased even more steeply from 56 million tonnes to 34 million tonnes (approximately 39% reduction).

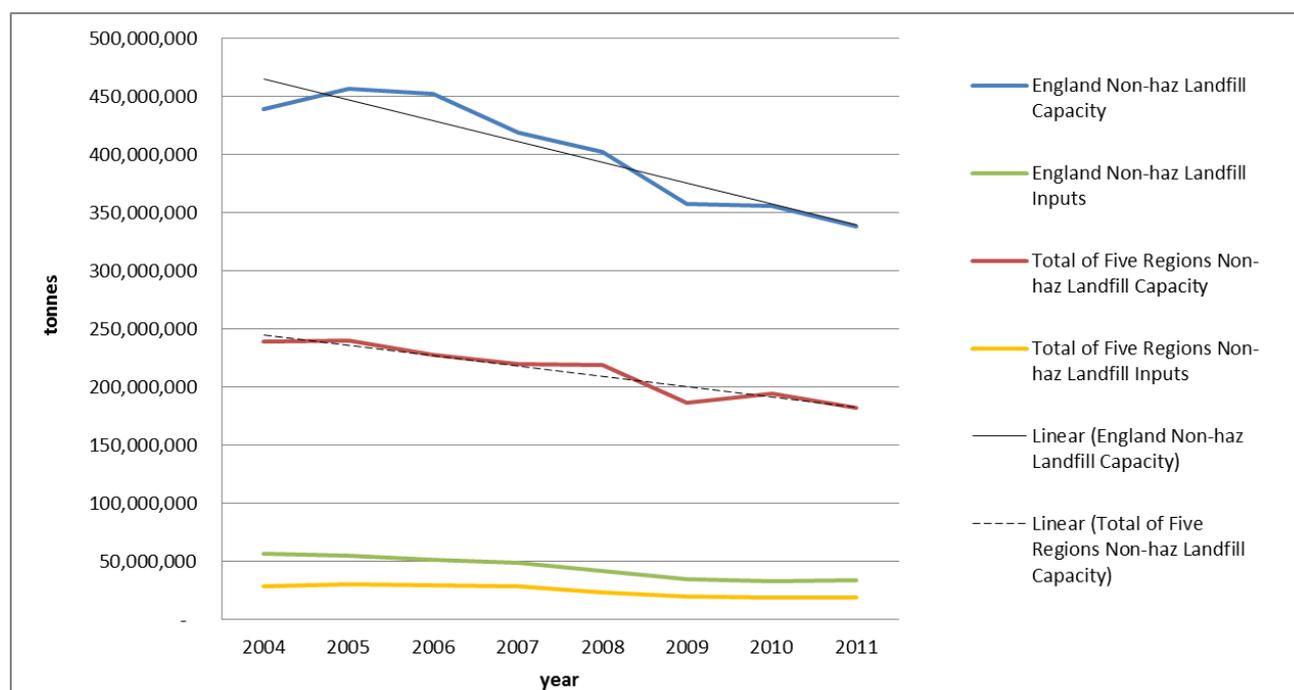
3.4.2 This downward trend is mainly driven by EU and UK sustainable waste management policy promoting the reduction and reuse of waste, increasing recycling and energy recovery and thereby reducing the quantity of biodegradable municipal waste being disposed of to landfill.

3.4.3 There has been a significant increase in the provision of alternative waste treatment infrastructure (e.g. materials recovery facilities, composting and anaerobic digestion

¹³ Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2006-2011; <http://www.environment-agency.gov.uk/research/library/data/142773.aspx> (accessed 25/07/2013).

plants and waste to energy facilities) to enable the diversion of waste away from landfill.

Figure 2: Non-hazardous landfill capacity and inputs in England/five regions (2004 to 2011)



3.5 Non-hazardous landfill significance criteria

3.5.1 The significance criteria in Table 3 have been developed for non-hazardous waste landfill as part of the Scope and Methodology Report Addendum for the Proposed Scheme. They are relevant for non-hazardous waste, which will arise from the construction and operation of the Proposed Scheme.

Table 3: Non-hazardous landfill significance criteria

Degree of significance	Non-hazardous landfill criteria
Major adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to a severe national and regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 250,000 tonnes per annum. Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in decision-making.
Moderate adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 50,000 to 250,000 tonnes per annum. Effect may be judged to be important in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to local-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional small scale waste treatment and/or disposal capacity of up to 50,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the future baseline without the Proposed Scheme or reduction in landfill void space capacity for non-hazardous waste. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure.

- 3.5.2 For minor adverse environmental effects, the upper threshold value has been set as 50,000 tonnes per annum. This threshold value has been selected with reference to the EIA Circular 02/99: Environmental Impact Assessment, which states in Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA, 'Installation for the disposal of non-hazardous waste' A36: "...EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year...".
- 3.5.3 The threshold values for moderate and major adverse environmental effects have been based on professional judgement. These are extrapolations of the threshold value for minor adverse environmental effects based on an incremental increase of the total non-hazardous waste quantity to be disposed of by applying a factor of five to define the moderate adverse environmental effects threshold value of (i.e. 50,000 to 250,000 tonnes per annum), and the major adverse environmental effects threshold value (i.e. greater than 250,000 tonnes per annum).
- 3.5.4 The disposal of 250,000 tonnes of non-hazardous waste represents approximately 0.14% of the total non-hazardous landfill capacity in the combined five regions, and approximately 0.07% of non-hazardous landfill capacity in England based on the 2011 inert landfill capacity data from the Environment Agency¹⁴. Non-hazardous waste generated by the Proposed Scheme will arise during the nine year construction period (2017 to 2025), and also during the operational period starting in 2026.
- 3.5.5 The Proposed Scheme would be constructed over a period of nine years (i.e. 2017 to 2025) starting initially with enabling works followed by the earthworks such as tunnelling etc. Any non-hazardous waste generated during the construction period of the Proposed Scheme would not occur all in a single year, which will reduce the pressure on non-hazardous landfill capacity.

4 Rationale for hazardous landfill significance criteria

4.1 General

- 4.1.1 This section of the technical note sets out the rationale for the development of the significance criteria for the disposal of hazardous waste to be used in the assessment of the significance of environmental effects associated with the disposal of hazardous waste arising from the Proposed Scheme.
- 4.1.2 In determining the quantity of hazardous waste, the designers of the Proposed Scheme have considered the treatment of the hazardous waste on- and off-site to reduce its hazardousness and moving waste management up the waste hierarchy.
- 4.1.3 Hazardous waste covered by this technical note comprises contaminated soils (i.e. unacceptable material Class U2)¹⁵, which cannot be remediated on- or off-site, and therefore are unacceptable for reuse within the engineering or environmental mitigation earthworks of the Proposed Scheme. It also covers hazardous waste

¹⁴ Environment Agency, Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; <http://www.environment-agency.gov.uk/research/library/data/142773.aspx> (accessed 25/07/2013).

¹⁵ Department for Transport (2009), Highways Agency, Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks. <http://www.dft.gov.uk/ha/standards/mchw/vol1/> (accessed 26/06/2013).

generated from demolition works associated with the construction of the Proposed Scheme. However, it does not include, for example, radioactive contaminated land or track ballast containing dangerous substances etc.

4.2 Hazardous waste legislative guidance

- 4.2.1 The rWFD provides a European-wide definition of hazardous waste. Hazardous waste is defined as a waste possessing one or more of the 15 hazardous properties set out in Annex III of the rWFD.
- 4.2.2 The rWFD also provides a list of wastes, known as the European Waste Catalogue (EWC), to classify wastes and identify those which are considered to be hazardous because of the hazardous properties set out in Annex III of the rWFD.
- 4.2.3 The EWC is a catalogue of all wastes, grouped according to generic industry, process or waste type. It differentiates between non-hazardous and hazardous by identifying hazardous waste entries with an asterisk (*).
- 4.2.4 The Hazardous Waste (England and Wales) Regulations 2005 (as amended) set out the regime for the control and tracking of the movement of hazardous waste for the purpose of implementing the EU Hazardous Waste Directive 91/689/EC¹⁶.
- 4.2.5 The Environment Agency Technical Guidance WM2 'Hazardous Waste'¹⁷ provides a definition for hazardous waste as per the rWFD. The technical guidance also provides a useful waste assessment methodology and guidance on waste classification using the EWC, transposed into English legislation by the List of Wastes (England) Regulations 2005 (SI 2005 No. 895) (as amended)¹⁸.

4.3 National Policy Statement for hazardous waste

- 4.3.1 The Department for Environment, Food and Rural Affairs (Defra) National Policy Statement (NPS) for Hazardous Waste¹⁹ provides planning guidance in relation to nationally significant hazardous waste infrastructure. The capacity threshold²⁰ stated in the NPS for hazardous waste landfill is 100,000 tonnes per annum, which in turn reflects the threshold set out in s.30 Planning Act 2008²¹. This threshold is based on total weight of waste and not just on the weight of any hazardous components.

4.4 Other major infrastructure projects

- 4.4.1 The London 2012 Olympic Park is constructed on land previously used by a variety of industries, which left a legacy of soil and groundwater contamination. The ODA used in-situ and ex-situ soil cleaning techniques to enable the reuse of 80% of contaminated soil thereby reducing the quantity of hazardous waste that required landfill disposal.

¹⁶ The Hazardous Waste (England and Wales) Regulations 2005 (as amended). <http://www.legislation.gov.uk/ukksi/2005/894/contents/made> (accessed 17/09/2013).

¹⁷ Environment Agency (August 2013), *Technical Guidance WM2: Interpretation of the definition and classification of hazardous waste*. <http://www.environment-agency.gov.uk/business/topics/waste/32180.aspx> (accessed 17/09/2013).

¹⁸ HMSO (2005), *The List of Wastes (England) Regulations 2005*.

¹⁹ Department for Environment, Food and Rural Affairs (June 2013), *National Policy Statement for Hazardous Waste: A framework document for planning decisions on nationally significant hazardous waste infrastructure*.

²⁰ This is the capacity threshold at which the construction of new hazardous waste landfill disposal capacity becomes nationally significant.

²¹ See <http://www.legislation.gov.uk/ukpga/2008/29/introduction> (accessed 17/09/2013).

4.5 Hazardous waste management infrastructure

4.5.1 In 2011, a total of 4,193,218 tonnes of hazardous waste was sent for treatment/ disposal in England of which 910,640 tonnes was landfilled (i.e. 22%). Of this total, 733,716 tonnes (i.e. 81%) comprised construction and demolition waste (including asbestos and excavated soils from contaminated sites). Environment Agency hazardous waste data for England and Wales for the period 2006 to 2011 is shown in Table 4.

4.5.2 The List of Wastes (England) Regulations 2005 includes Chapter 17 'Construction and Demolition Waste (including excavated soils from contaminated sites)'. The nature of the Proposed Scheme suggests that the majority of hazardous waste for disposal will be construction and demolition waste.

Table 4: Construction and demolition waste (including excavated soils from contaminated sites) to hazardous landfill for England and Wales²²

Year	2006	2007	2008	2009	2010	2011
Tonnes	643,989	642,303	771,599	372,801	328,395	733,716
As % of total hazardous waste to landfill	88%	114% ²³	84%	68%	62%	81%

4.5.3 There are a number of off-site soil treatment centres in England for the treatment and reuse of contaminated soils. There are also on-site treatment technologies available depending on the nature of the soil contamination.

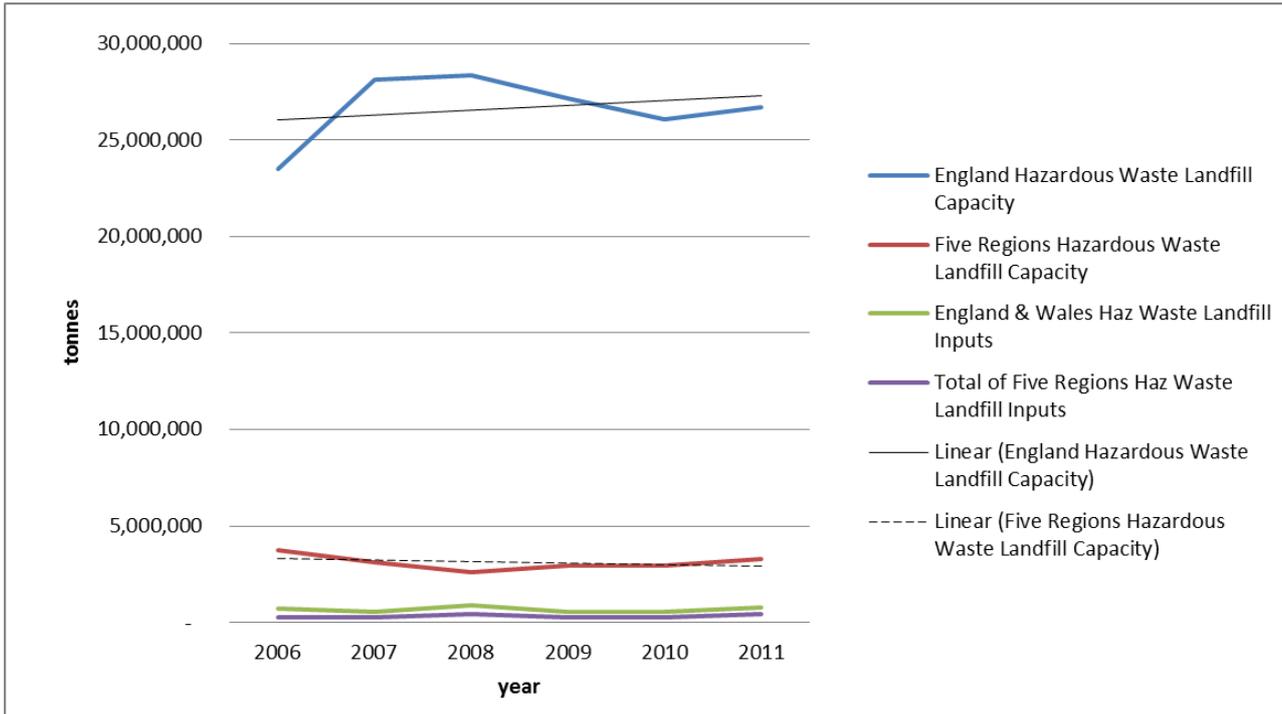
4.5.4 Latest available data published by the Environment Agency²⁴ shows a slightly upward trend of hazardous waste landfill capacity in England (indicated by the linear trend line) with about 24 million tonnes in 2006 increasing to almost 27 million tonnes in 2011, as shown in Figure 3.

²² Environment Agency Waste Data Tables. <http://www.environment-agency.gov.uk/research/library/data/142773.aspx> (accessed 26/06/2013).

²³ Assumes difference sent to non-hazardous SNRHW landfill – see Section 2.4.

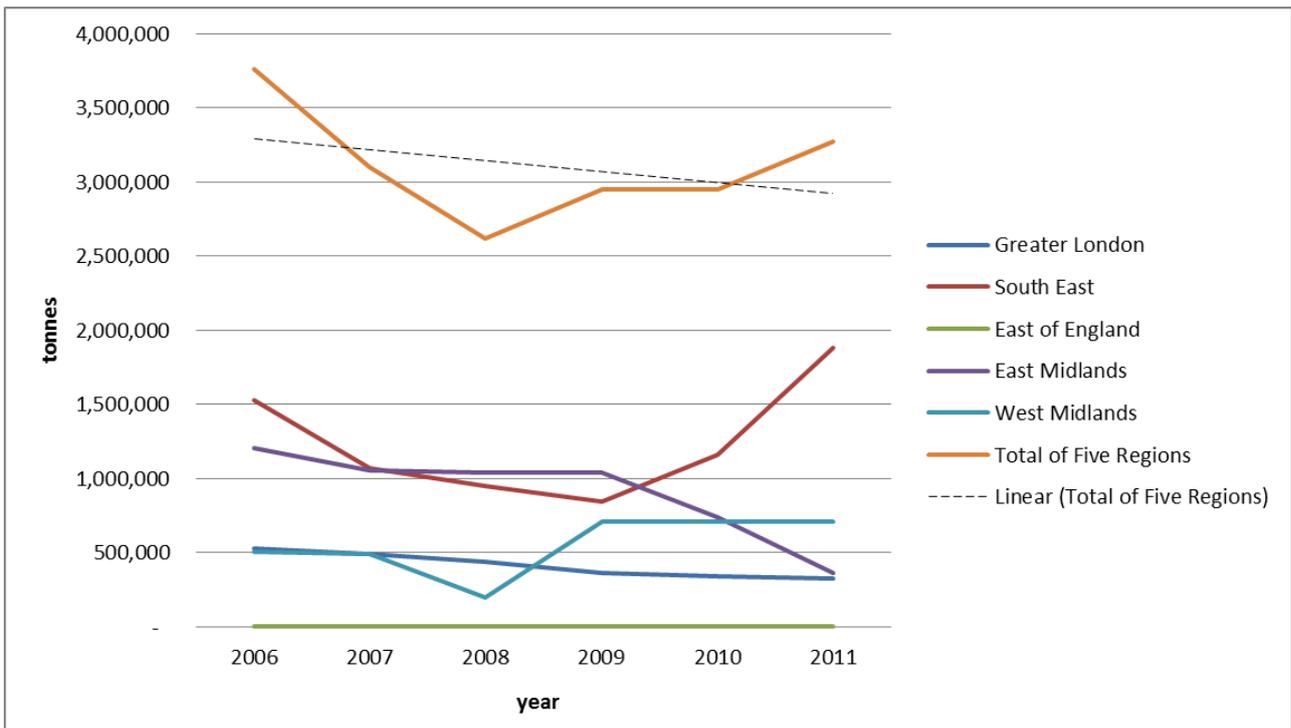
²⁴ Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2006-2011; <http://www.environment-agency.gov.uk/research/library/data/142773.aspx> (accessed 25/07/2013).

Figure 3: Hazardous landfill capacity and inputs in England/five regions (2006 to 2011)



4.5.5 The hazardous waste landfill capacity data for the combined five regions indicates an overall slight downward trend (indicated by the linear trend line) from almost four million tonnes in 2006 to just over three million tonnes in 2011. However, since 2008 there has been a slight upward trend in available annual capacity as indicated by the linear trend line (see Figure 4). There has been a reduction in capacity in the East Midlands but an increase in capacity in the South East and West Midlands. There is no hazardous waste landfill capacity in the East of England region.

Figure 4: Hazardous landfill capacity trend of the five regions



4.6 Hazardous landfill significance criteria

4.6.1 The significance criteria in Table 5 have been developed for hazardous waste landfill as part of the Scope and Methodology Report Addendum, to which this technical note is appended. They are relevant for hazardous waste, which will arise from the construction of the Proposed Scheme associated with the excavation of contaminated land.

Table 5: Hazardous landfill significance criteria

Degree of significance	Hazardous landfill criteria
Major adverse	Net increase in waste arisings relative to the future baseline leading to a severe national and regional-scale reduction in hazardous waste landfill void space capacity. Need for additional large-scale hazardous waste disposal capacity of greater than 100,000 tonnes per annum ²⁵ . Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making process.
Moderate adverse	Net increase in waste arisings relative to the future baseline leading to regional-scale reduction in hazardous waste landfill void space capacity or need for additional medium-scale waste hazardous waste disposal capacity of between 20,000 to 100,000 tonnes per annum. Effect may be judged to be important in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the future baseline leading to local-scale reduction in hazardous waste landfill void space capacity or need for additional small scale hazardous waste disposal capacity of up to 20,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the future baseline or reduction in landfill void space capacity. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in hazardous waste arisings and diversion of waste from landfill relative to the future baseline resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of hazardous waste treatment and disposal infrastructure.

4.6.2 The threshold value of 100,000 tonnes per annum has been chosen for major adverse environmental effects based on the nationally significant hazardous waste infrastructure limit given in the NPS for hazardous waste.

4.6.3 The disposal of 100,000 tonnes of hazardous waste would represent about 0.4% of the hazardous landfill capacity in England, and about 3% of the combined five regions, based on the most recently available data for 2011 from the Environment Agency²⁶.

4.6.4 The threshold values for minor and moderate adverse environmental effects have been based on professional judgement. These are extrapolations of the threshold value for major adverse environmental effects based on an incremental decrease of the total hazardous waste quantity to be disposed of using a reduction factor of five to define the upper threshold value for minor environmental effects of 20,000 tonnes per annum. The moderate adverse threshold value is 20,000 to 100,000 tonnes per annum.

4.6.5 Landfill for non-hazardous waste may be used to dispose of stable non-reactive hazardous waste (SNRHW) providing such disposal does not occur in the same landfill cell as non-hazardous waste. SNRHW must exhibit leaching behaviour equivalent to non-hazardous waste. In practice, this restricts the disposal of hazardous wastes to non-hazardous landfill to material such as asbestos waste (e.g. asbestos cement

²⁵ Figure is threshold value given in s.30 Planning Act 2008 and referenced in National Policy Statement for Hazardous Waste.

²⁶ Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; <http://www.environment-agency.gov.uk/research/library/data/142773.aspx> (accessed 25/07/2013).

board). Environment Agency landfill data does not quantify the amounts of hazardous waste sent to non-hazardous SNRHW landfill but does state it is usually a small part of the overall capacity of the site.

- 4.6.6 The Proposed Scheme would be constructed over a period of nine years (i.e. 2017 to 2025) starting initially with enabling works followed by the earthworks such as tunnelling etc. Any hazardous waste generated by the Proposed Scheme would not occur all in a single year but extend over at least a two year period, which will reduce the pressure on hazardous landfill capacity.

Appendix A: EIA Guidance

- 1.1.1 Extract taken from Department for Communities and Local Government, Circular 02/99: Environmental impact assessment: 'Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA.'

Installations for the disposal of non-hazardous waste

- 1.1.2 **A36.** The likelihood of significant effects will generally depend on the scale of the development and the nature of the potential impact in terms of discharges, emissions or odour. For installations (including landfill sites) for the deposit, recovery and/or disposal of household, industrial and/or commercial wastes (as defined by the Controlled Waste Regulations 1992) EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per annum, or to hold waste on a site of 10 hectares or more. Sites taking smaller quantities of these wastes, sites seeking only to accept inert wastes (demolition rubble etc.) or Civic Amenity sites, are unlikely to require EIA.



HS2 London-West Midlands

Waste and material resources

Technical note – Waste forecast and assessment methodology

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1 General

1.1.1 This technical note sets out the detailed methodology for the forecasting of waste arisings and the route-wide assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that will be generated by construction and operation the Proposed Scheme.

1.1.2 The scope of this technical note covers:

- waste that will be generated by excavation, demolition and construction activities undertaken during the proposed construction period;
- waste that will be generated by occupants of worker accommodation sites during the proposed construction period; and
- operation of the Proposed Scheme.

2 Waste forecast

2.1 General

2.1.1 This section sets out how the quantities of waste likely to be generated during the construction and operational phases of the Proposed Scheme will be forecast.

2.1.2 All waste arisings will be reported in tonnes rounded to the nearest whole number.

2.2 Excavated material

2.2.1 Excavated material will be generated to accommodate cuttings, foundation construction sites, drainage excavations and through tunnelling operations etc.

2.2.2 The volume of excavated material to be generated will be determined and converted to mass using a density conversion factor of 2.058tonnes/m³.¹

2.2.3 The quantity of hazardous waste (i.e. unacceptable material Class U2)² that will be generated as a result of the excavation of contaminated soils, and which cannot be remediated and reused on- or off-site, will be determined. It will be assumed that all hazardous waste generated by the excavation of contaminated soils will require off-site disposal to a hazardous waste landfill.

2.2.4 Quantities of both excavated material to be reused and surplus excavated material for disposal will be presented in Volume 5: Appendix WM-001-000 (Annex I). The likely significant environmental effects associated with the off-site disposal to landfill of surplus excavated material will be assessed.

¹ In line with evidence-based research undertaken to inform value of the density conversion factor.

² Department for Transport; *Highways Agency, Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*; <http://www.dft.gov.uk/ha/standards/mchw/vol1/>; Accessed 26 June 2013.

2.3 Demolition waste

2.3.1 Demolition waste will be generated by the removal of existing buildings, structures and infrastructure elements such as bridges, roads, railways and utilities.

2.3.2 The quantity of waste (in tonnes) that will be generated by specified demolition activities within each CFA will be forecast using the WRAP (Waste and Resources Action Programme) 'Demolition bill of quantities estimator' that uses the basic dimensions and typology of buildings to forecast waste arisings.

2.4 Construction waste

2.4.1 Waste will be generated by the construction of track, buildings and other structures, including stations, maintenance sheds and stabling yards.

2.4.2 The quantity of waste (in tonnes) that will be generated by specified construction activities within each CFA will be forecast using a waste generation rate of 26.4tonnes/£100,000 of construction value. This waste generation rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment.³

2.5 Worker accommodation site waste

2.5.1 The quantity of waste (in tonnes) that will be generated at worker accommodation sites within each CFA will be forecast using a waste generation rate of 0.031tonnes/person/month according to the number of workers to be accommodated and the duration of occupation. This waste generation rate was derived from the average annual household waste generation in the UK of 466kg/person/year in 2009/10 and has been adjusted assuming an average working week of five and a half days.⁴

2.6 Operational waste

2.6.1 All operational waste forecasts for the Proposed Scheme will be on an annual basis and an assumption of maximum capacity in the first year of operation (2026).

2.6.2 The scope of operational waste forecasting covers:

- railway station and train waste;
- rolling stock maintenance waste;
- track maintenance waste; and
- ancillary infrastructure waste (relating to waste arising from depots, signalling locations and operations and maintenance sites). Waste from 'maintenance sites' in this context excludes the aforementioned rolling stock maintenance waste and track maintenance waste.

2.6.3 Individual waste forecasts for each of the above listed categories will be combined to provide an overall forecast of operational waste arisings.

³ Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

⁴ Department for Environment, Food and Rural Affairs; *Waste and Recycling Statistics*;

<https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/series/waste-and-recycling-statistics>; Accessed 25 February 2013.

Railway station and train waste

- 2.6.4 Railway station and train waste refers to waste that will arise at each station and includes:
- waste from individual functions within stations such as retail units, food and beverage outlets etc.; and
 - waste removed from trains, which will be the case at terminating stations only.
- 2.6.5 The waste generation rate used to forecast railway station and train waste has been formulated on the basis of actual annual waste data (including both railway station and train waste) from Network Rail and the numbers of people using stations from the Office of Rail Regulation. The number of people using stations has been provided on the basis of the number of entries and exits through ticket barriers.
- 2.6.6 The annual quantity of waste (in tonnes) that will be generated in railway stations and on trains will be forecasted using a waste generation rate of 0.085kg per station entry and exit.
- 2.6.7 Based on the Network Rail target to divert 60% of operational waste from landfill by 2014:
- 0.051kg of waste will be diverted from landfill per station entry and exit; and
 - 0.034kg of waste will be landfilled per station entry and exit.
- 2.6.8 This forecasting methodology does not make any distinction between station types; i.e. between terminating stations that include train waste or non-terminating stations that do not include train waste. This is because the majority of waste produced will be station waste (regardless of the type of station) and so there is no consistently discernible difference between the two station types.

Rolling stock maintenance waste

- 2.6.9 Rolling stock maintenance waste is that which will be generated by the relevant train operating company (or its fleet maintenance contractor) and thus reported separately to ancillary infrastructure waste and track maintenance waste that will be generated by Network Rail.
- 2.6.10 In the absence of actual data from existing train operating companies, the waste generation rate that will be used to forecast rolling stock maintenance waste has been adopted from British Standard (BS) 5906:2005 Waste Management in Buildings – Code of Practice. This relates to a waste generation rate of 5litres/m²/week for an industrial unit, which has been converted to an annual tonnage rate using a waste density conversion factor of 1.16tonnes/m³.⁵
- 2.6.11 The annual quantity of rolling stock maintenance waste (in tonnes) that will be generated will be forecast and reported according to the CFA in which it will arise. This will be done using a waste generation rate of 0.3tonnes/m²/year applied to the gross floor area of each rolling stock depot within a CFA.

⁵ Based on an average of waste density conversion factors for heavy scrap metal (1.78tonnes/m³), light scrap metal (0.74tonnes/m³) and oils, tars and asphalts (0.95t/m³); taken from Tchobanoglous, G., Theisen, H., Vigil, S.A. (1993), *Integrated Solid Waste Management. Engineering Principles and Management Issues*. McGraw-Hill.

- 2.6.12 Where a rolling stock maintenance depot forms part of a larger depot (e.g. that also incorporates ancillary infrastructure and track maintenance facilities), the proportion of floor space provided solely for rolling stock maintenance will be used in the waste generation forecast.
- 2.6.13 A landfill diversion rate of 80% will apply to rolling stock maintenance waste. This figure has been assumed on the basis of professional judgement taking into account the following information:
- Network Rail's target to divert 60% of operational waste from landfill by 2014 (as applied to ancillary infrastructure waste for this assessment);
 - Network Rail's average landfill diversion rate (85%) for track maintenance wastes; and
 - generic landfill diversion data published by Alstom⁶ and Bombardier⁷ (both of which have significant business activities in rolling stock maintenance) ranging from 78% to 90%.

Track maintenance waste

- 2.6.14 Track maintenance waste is that which will be generated and reported separately to ancillary infrastructure waste and rolling stock maintenance waste.
- 2.6.15 The waste generation rate that will be used to forecast track maintenance waste has been formulated on the basis of data provided by Network Rail.
- 2.6.16 The annual quantity of track maintenance waste (in tonnes) that will be generated will be forecast according to the total length of track within each CFA using a waste generation rate of 8.23tonnes/km/year.
- 2.6.17 For any track sections with two or more lines, the distance vector will be scaled up according to the number of lines (e.g. doubled for a twin track, trebled for three lines etc.). This is because the waste generation rate to be used is based on the length of a composite track comprising of two rails, sleepers, clips and ballast etc.
- 2.6.18 Based on Network's Rails average landfill diversion rate of 85% across a range of material types for track maintenance waste:
- 7.00tonnes/km/year of waste will be diverted from landfill; and
 - 1.23tonnes/km/year of waste will be landfilled.

Ancillary infrastructure waste

- 2.6.19 Ancillary infrastructure waste refers to waste that will arise from depots, signalling locations, operations and maintenance sites excluding track maintenance waste and rolling stock maintenance waste (according to the scope of the waste generation rate used).

⁶ Alstom has a target to achieve 80% landfill diversion of total waste generated by 2015, against which it had achieved 78% by 2011. See – Alstom; <http://www.alstom.com/Sustainability/Our-commitment/Environment/Waste-Management/>; Accessed 7 July 2013.

⁷ Data reported by Bombardier's Transportation Group indicates a landfill diversion performance of 84% in 2010, and 90% in both 2011 and 2012. See – Bombardier; *2012 Performance Data Summary*; <http://csr.bombardier.com/en/csr-approach/2012-performance-data-summary>; Accessed 7 July 2013.

- 2.6.20 The waste generation rate that will be used to forecast ancillary infrastructure waste has been formulated on the basis of data provided by Network Rail.
- 2.6.21 The annual quantity of ancillary infrastructure waste (in tonnes) that will be generated will be forecast according to the total length of track within each CFA using a waste generation rate of 0.692tonnes/km/year.
- 2.6.22 For any sections with two or more lines, the distance vector will be scaled up according to the number of lines (e.g. doubled for a twin track, trebled for three lines etc.). This is because the waste generation rate to be used is based on the length of a composite track comprising of two rails, sleepers, clips and ballast etc.
- 2.6.23 Based on the Network Rail target to divert 60% of operational waste from landfill by 2014:
- 0.415tonnes/km/year of waste will be diverted from landfill; and
 - 0.277tonnes/km/year of waste will be landfilled.

3 Assessment methodology

3.1 Background

- 3.1.1 There is no recognised methodology or waste significance criteria available to assess the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that will be generated by construction and operation of the Proposed Scheme.
- 3.1.2 The assessment methodology that will be used is based on professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects.
- 3.1.3 The assessment will consider the types and quantities of waste that will be generated during construction and operation and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring off-site disposal to landfill (this being the least preferred waste management option).
- 3.1.4 This approach takes into account the overall quantity of waste likely to be generated, the types and quantities of waste likely to require off-site disposal to landfill and the projected availability of landfill disposal capacity in the defined study area.

3.2 Legislation and guidance

- 3.2.1 Assessment and mitigation of the likely significant environmental effects of waste generation will be considered with respect to relevant legislation, policy and guidance governing the management of waste in England. A summary of applicable legislation, policy and guidance is provided further in sections 3.2.2 to 3.2.12.

Legislation

- 3.2.2 The key items of relevant legislation are as follows:
- The Waste (England and Wales) Regulations 2011 SI No. 988 (as amended), which transpose the provisions of the 'EU Waste Framework Directive' (2008/98/EC)⁸ into England and Wales.
 - The Controlled Waste (England and Wales) Regulations 2012 SI No. 811 (as amended), which sets out the definition of controlled waste to which waste management regulatory controls apply.
 - The Environmental Permitting (England and Wales) Regulations 2010 SI No. 675 (as amended), which provide a consolidated system for permitting of waste operations (amongst other activities not relevant in this context).
 - The Hazardous Waste (England and Wales) Regulations 2005 SI. No 894 (as amended), which set out the regime for the control and tracking of the movement of hazardous waste.
 - The List of Wastes (England) Regulations 2005 SI No. 895 (as amended), which provides for the classification of wastes and determination of hazardous wastes.

⁸ Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives.

- The Site Waste Management Plans Regulations 2008 SI No. 314, which require the preparation of a site waste management plan (SWMP) for any construction project with an estimated capital cost of over £300,000. The purpose of the SWMP is to identify opportunities to design out waste; identify the types and quantities of waste likely to be produced during construction; identify opportunities for sustainable management of the waste identified; and to monitor and report on the actual management of these wastes throughout the construction period.
- The Site Waste Management Plans Regulations 2008 SI No. 314 are likely to be repealed as a result of consultations proposed by the Defra Red Tape Challenge.⁹ However, HS2 Ltd will apply an integrated approach to the design of the Proposed Scheme aiming to maximise the beneficial reuse of materials where possible and minimise the generation of waste. This will be facilitated through the implementation of the Code of Construction Practice for the Proposed Scheme.

Policy

- 3.2.3 The Government Review of Waste Policy in England 2011¹⁰ sets out the Government's long-term strategy for the prevention and management of waste in England. It follows the waste hierarchy approach set out in the EU Waste Framework Directive.
- 3.2.4 Planning Policy Statement 10: Planning for Sustainable Waste Management,¹¹ as exempted within the NPPF, sets out Government policy on waste planning which is of relevance to the management strategy for waste generated during the construction and operation of the Proposed Scheme.
- 3.2.5 Regional and local policy, such as the London Plan: Spatial Development Strategy for London,¹² sets out strategic planning policies for the management of waste generated in Greater London and elsewhere along the route of the Proposed Scheme. Specifically, these policies seek to minimise the amount of waste generated, increase the reuse and recycling of waste and reduce waste to landfill.

Guidance

- 3.2.6 Relevant guidance includes The Definition of Waste: Development Industry Code of Practice¹³ and the Waste & Resources Action Programme (WRAP) guidance and tools developed to achieve better resource efficiency in construction projects. This includes designing out waste tools such as the Designing out Waste Tool for Civil Engineering and the Net Waste Tool¹⁴.

⁹ Department for Environment, Food and Rural Affairs; *Red Tape Challenge: Environment Theme Proposals*; <https://www.gov.uk/government/publications/red-tape-challenge-environment-theme-proposals>; Accessed 7 July 2013.

¹⁰ Department for Environment, Food and Rural Affairs; *Government Review of Waste Policy in England*; <https://www.gov.uk/government/publications/government-review-of-waste-policy-in-england-2011>; Accessed 7 July 2013.

¹¹ Department for Communities and Local Government; *Planning for Sustainable Waste Management: Planning Policy Statement 10*; <https://www.gov.uk/government/publications/planning-for-sustainable-waste-management-planning-policy-statement-10>; Accessed 7 July 2013.

¹² Greater London Authority; *The London Plan*; <http://www.london.gov.uk/priorities/planning/london-plan>; Accessed 7 July 2013.

¹³ Contaminated Land: Applications in Real Environments; *Definition of Waste: Development Industry Code of Practice*; http://www.claire.co.uk/index.php?option=com_content&view=article&id=210&Itemid=82; Accessed 7 July 2013.

¹⁴ Waste and Resources Action Programme; *Construction*; <http://www.wrap.org.uk/category/sector/construction>; Accessed 7 July 2013.

3.3 Significance criteria

- 3.3.1 There are no recognised significance criteria against which the likely significant environmental effects associated with the off-site disposal to landfill of solid waste from construction and operation can be assessed.
- 3.3.2 Significance criteria for the assessment have been derived based on professional judgement and as previously applied to large-scale infrastructure projects. Significance criteria take into account the change in waste arisings overall as a result of the Proposed Scheme and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring off-site disposal to landfill.
- 3.3.3 A technical note, Rationale for landfill significance criteria setting out the significance criteria to be used has been developed and should be read in conjunction with this technical note (see Annex J of the SMR addendum).

3.4 Construction effects

- 3.4.1 The basis of the assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste from construction will be the forecast of the quantity of construction, demolition and excavation waste to be generated during the proposed construction period. The forecast will also include waste generation associated with the worker accommodation sites.
- 3.4.2 The methodology for forecasting construction, demolition and excavation waste, as well as waste generation associated with worker accommodation sites, is outlined in Section 2 of this technical note.
- 3.4.3 In quantifying waste arisings to landfill, evidence-based assumptions will be applied for construction, demolition and worker accommodation site waste as follows:
- construction waste – landfill diversion rate of 90%;
 - demolition waste – landfill diversion rate of 90%; and
 - worker accommodation site – landfill diversion rate of 50%.
- 3.4.4 The quantity of excavated material requiring disposal (surplus excavated material) will be based on the cut and fill balance for the Proposed Scheme.
- 3.4.5 It will be assumed that 100% of any hazardous waste arisings will require off-site disposal to a hazardous waste landfill (i.e. zero landfill diversion rate).
- 3.4.6 Following this, the total quantity of waste requiring off-site disposal to landfill during the proposed construction period (2017 to 2025) will be assessed in relation to the significance criteria to be used.

3.5 Operational effects

- 3.5.1 The assessment of operational effects will rely on the total annual quantity of waste forecast to be generated during the first full year of operation of the Proposed Scheme (i.e. 2026). The operational waste forecast will be undertaken as described in Section 2 of this technical note.

- 3.5.2 In quantifying waste arisings to landfill, assumptions will be applied as set out within Section 2.6 of this technical note. These assumptions will be:
- railway station and train waste – landfill diversion rate of 60%;
 - ancillary infrastructure waste – landfill diversion rate of 60%;
 - track maintenance waste – landfill diversion rate of 85%; and
 - rolling stock maintenance waste – landfill diversion rate of 80%.
- 3.5.3 Following this, the total quantity of waste requiring off-site disposal to landfill during the year of operation (2026) will be assessed in relation to the significance criteria to be used for non-hazardous waste.

3.6 Cumulative effects

- 3.6.1 The assessment of cumulative effects with respect to waste and material resources will focus on inter-project effects, i.e. effects that will arise as a result of interactions between the Proposed Scheme and other projects.
- 3.6.2 Such interactions in this context will be the combined quantity of waste requiring off-site disposal to landfill as a result of the construction and / or operation of the Proposed Scheme and other committed developments (i.e. other reasonably foreseeable developments that are likely to be under construction or will be completed at the same time as the Proposed Scheme).
- 3.6.3 The total quantity of waste likely to be generated by other committed developments (including that which will require subsequent off-site disposal to landfill) will be assessed qualitatively according to professional judgement based on the known type and extent of development. This is because:
- forecast waste arisings and landfill disposal assumptions may not have been published for other committed developments; and
 - published forecast waste arisings and landfill disposal assumptions may not have been developed on the same basis as for the Proposed Scheme and hence may not be directly comparable.

3.7 Off-route effects

- 3.7.1 Where relevant, this technical note will also apply to the assessment of off-route effects that will be dealt with in Volume 4 of the formal Environmental Statement.

3.8 Climate change impacts

- 3.8.1 Whilst there are some potential climate change impacts on waste and material resources (detailed in Scope and Methodology Report Addendum, Volume 5: Appendix CT-001-000/2), these are not considered to have any significant direct impact and hence will not be considered further within the assessment.

3.9 Mitigation, enhancement and off-setting

- 3.9.1 Mitigation of construction and operation effects will be considered in line with key principles of waste and material resources management including the waste

hierarchy, proximity principle and product (or development) lifecycle. Mitigation will also have regard to relevant legislation, policy and guidance.

3.9.2 Residual environmental effects will be identified, subsequent to the application of any mitigation measures.

Annex K: Water resources and flood risk– technical notes

1.1.1 The following technical notes are appended to this document:

- Surface water quality assessment
- Ground water assessment method
- Spillage risk assessment



HS2 London-West Midlands

**Water resources and flood risk
Technical note – Surface water
quality assessment**

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This technical note has been prepared as guidance for the assessment of the effects of the project on the quality of surface waters. It should be read in conjunction with the Scope and Methodology Report (SMR see Volume 5; Appendix CT-001-000/1). Mitigation of these effects and reporting of residual effects should be carried out as stated in the SMR.
- 1.1.2 The note is intended as a guide to ensure a consistent approach across the project, not an exhaustive and prescriptive methodology.
- 1.1.3 This note should not be used to assess the following:
- effects from construction of the project (see code of construction practice);
 - effects on groundwater (see Water resources and flood risk technical note – groundwater assessment method in Annex K of the SMR addendum); and
 - effects from accidental spillages (see Water resources and flood risk technical note – Spillage risk assessment in Annex K of the SMR addendum).

2 Baseline assessment

2.1 Baseline definition

- 2.1.1 Where there is a defined impact pathway for the operation of the railway to have an effect on the quality of surface water receptors, the baseline condition of those water body receptors shall be defined.
- 2.1.2 The baseline assessment for each water body shall be recorded using the Water Framework Directive¹ (WFD) status classification system for surface waters covering watercourses, lakes and artificial or heavily modified water bodies.
- 2.1.3 Within the context of the water resources and flood risk topic, the following elements of a water body's WFD status will be considered within the surface water quality baseline:
- physico-chemical and specific pollutants components of the watercourse's 'ecological status'; and,
 - where appropriate, the priority substances components of the watercourse's 'surface water chemical status'.
- 2.1.4 Other WFD elements, such as biological quality, are covered by other technical disciplines.
- 2.1.5 The baseline assessment will also consider other potential quality elements not specifically used in determining WFD status where a scheme impact may affect this element e.g. suspended solids, or nitrate concentrations for fluvial systems in Nitrate Vulnerable Zones.

¹ European Commission (EC), 2000, *Water Framework Directive (2000/60/EC)*, EC.

2.1.6 A report assessing the extent to which the Proposed Scheme complies with the Water Framework Directive will be included in the Environmental Statement.

2.2 Data from the Environment Agency and others

2.2.1 The assessment of the baseline conditions will generally utilise water quality data received from the Environment Agency, water companies or local authorities. This data is expected to be sufficient for the vast majority of locations where a baseline assessment is required. All such received data should meet the criteria set out in paragraph 2.2.3.

2.2.2 The baseline assessment shall be recorded using the existing WFD status class of the watercourse.

2.2.3 Where a baseline assessment is required, but no data is available at the point of impact, the next downstream location where data is available will be used. The data is considered appropriate for use in an assessment if:

- the location is within 5km;
- there is no significant change in land use, which could result in the introduction of different diffuse pollutants, between the impact point and sample point; and
- there is no discharge entering the downstream length of the watercourse that results in, or has the potential to effect a change in, the physico-chemical or specific pollutant standards of a watercourse's WFD ecological status or the watercourse's WFD chemical status.

2.2.4 If no data is available from a downstream location, the Environment Agency will be approached, as they may hold unpublished data that would be appropriate.

2.2.5 A potential impact source resulting in water quality effects could be:

- pollution from a new station;
- pollution from a new depot
- pollution from other railway infrastructure;
- pollution from a public road; or
- physical changes to water body morphology (e.g. channel diversion or river crossings).

2.2.6 If a potential impact pathway is identified from any of these impact sources to a receptor where no baseline data (that meets the criteria in this section) is available then targeted water sampling should be considered.

2.3 Water sampling protocol

2.3.1 The Environment Agency should be consulted prior to any water sampling, because:

- they may be able to carry out the sampling as part of their own work; or

- if they cannot carry out the work, the frequency and method of sampling should be discussed.

2.3.2 At least four samples should be obtained, at least one month apart, over a six month period. Analysis of the samples should be carried out at a certified laboratory.

3 Scope of impact assessment

3.1.1 The method in this Section should be used to assess the effects on surface water quality for all locations on the project with the exception of:

- roads where the annual average daily traffic of Heavy Goods Vehicles is forecast to exceed 500, where the HAWRAT method in Design Manual for Roads and Bridges 11.3.10 (HD45)² should be used; and
- locations where all the drainage will be discharged to a foul sewer.

3.1.2 When assessing the effects on the quality of surface watercourses, the following will be used: details of the receiving water course and an estimate, based on a combination of expert judgement and analysis, for the quantity of pollution that could be released during routine operations. Estimates will be conservative and assume little or no dispersion.

3.1.3 Where flow information for a watercourse is not available from a suitable monitoring location, flow estimates will be derived for that location using Low Flows³ software or an appropriate alternative. Estimates will be conservative, assuming no or low dispersion.

3.1.4 Similar to highway drainage, release quantities should be derived from typical annual loading measured in track drainage elsewhere (if these have been quantified).

3.1.5 The method shall consider the effects of the operation of the railway, including minor maintenance such as treatment with herbicides or pesticides, and treatment with de-icing materials. These are addressed in the draft Operation and Maintenance Plan for Water Resources and Flood Risk (refer to Volume 5: Appendix WR-001-000).

² DMRB (2006), Volume 11 Section 3 Part 10: HD45: Road Drainage and the Water Environment.

³ Gustard, A et al, Low flow estimation in the UK: Institute of Hydrology Report no 108 (1992).



HS2 London-West Midlands

**Water resources and flood risk
Technical note – Groundwater
assessment method**

A report to HS2 Ltd by Arup/URS

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1 Introduction

- 1.1.1 This technical note has been prepared to provide guidance for in the assessment of the effects of the project on groundwater quantity and quality. It should be read in conjunction with the Scope and Methodology Report (SMR) (see Volume 5:Appendix CT-001-000/1)
- 1.1.2 The note is intended as a guide to ensure a consistent approach across the project, not an exhaustive and prescriptive methodology
- 1.1.3 This note should not be used to assess the following:
- effects from construction of the project (see draft code of construction practice (CoCP) - Volume 5; Appendix CT-003-000);
 - effects on surface water (see Water resources and flood risk technical note – surface water assessment - see Annex K of the SMR addendum); or
 - effects from accidental spillages (see Water resources and flood risk technical note – spillage risk assessment see Annex K of the SMR addendum).
- 1.1.4 This technical note is set out in four sections covering baseline, impact assessment, mitigation and residual effects.
- 1.1.5 There is overlap between groundwater and other topics including surface water, flood risk, ecology, land quality and geotechnics. These are referred to as necessary in the following sections to provide guidance on areas of responsibility.

2 Baseline

2.1 Baseline data

- 2.1.1 Where recent (since 2010) groundwater quality data is available, this can be used to define baseline groundwater quality. In the absence of such data, the status of groundwater bodies can be used, if available.
- 2.1.2 Water quality standards (WQS) are used to indicate baseline groundwater quality. Two forms of WQS are available: drinking water standards (DWS) and environmental quality standards (EQS). DWS are defined to protect human health (i.e. are suitable for potable supply); whereas, EQS are defined to protect sensitive aquatic ecology from any surface water receiving groundwater via baseflow. The appropriate WQS should be chosen based upon site conditions; where both are applicable, the more stringent WQSs should be applied. Reference should be made to the conditions of each WQS, for instance, whether the standard applies to an annual average concentration or the maximum admissible concentration, and a consistent and appropriate approach should be taken, based upon WQS conditions and data availability.
- 2.1.3 Groundwater level data should extend back as far as possible so that seasonal and long term fluctuations can be identified. Peak wet years and extended drought periods should be used to determine maximum and minimum groundwater ranges where possible. Future variations as a result of climate change are to be considered, in

addition to these historical variations, using the process set out in the ES (refer to SMR Addendum Section 17, Water resources and flood risk assessment).

- 2.1.4 Project specific groundwater data should be collected if the opportunity arises in sensitive areas and where boreholes are to be drilled for geotechnical, design or land quality reasons.

2.2 Baseline conditions

- 2.2.1 The base case to be adopted will depend on data availability but ideally should extend to 2011 for variables such as water quality and groundwater levels.
- 2.2.2 The cut off date for data such as Environment Agency levels and licensed abstractions should be clearly stated.
- 2.2.3 Aquifer parameter data and information such as groundwater/surface water interactions is unlikely to be time sensitive so all published data may be relevant.
- 2.2.4 The main mapping scale to be used is 1:50,000, with detail at 1:10,000 in selected areas if needed.
- 2.2.5 Baseline contamination data will be collected by the land quality teams. The geology baseline description will be based on that prepared by the land quality teams to ensure consistency. Baseline ecology and identification of groundwater dependent ecosystems should be collected by the ecology teams.

3 Impact assessment

3.1 Groundwater quantity and flow

- 3.1.1 Dewatering and mounding effects will be assessed qualitatively unless the design assumption of 1m below track bed can be used to quantify effects in combination with accepted hydrogeological solutions, for example Theis well theory or Darcy's Law.
- 3.1.2 Greater emphasis and attempts to quantify impacts should be focussed on areas of high risk.
- 3.1.3 Dewatering calculations will give an indication of magnitude of impact based on selected hydraulic conditions. The aim is to estimate the potential effect and thus identify mitigation rather than make accurate predictions. Once site specific data is available the estimates may change.
- 3.1.4 Dewatering impacts (flow rates and drawdown) as a result of temporary shafts or portal dewatering will be quantified for the purpose of the EIA using site data where available or using data from existing groundwater models. In the absence of such data, 25 and 75 percentile hydraulic values from the British Geological Survey (BGS) Aquifer Properties Manual¹ should be used. To be conservative a higher permeability and lower storativity are recommended. Professional judgement may also be used.
- 3.1.5 Drawdowns will be based on measured groundwater levels where available, or on water strikes from borehole logs where applicable.

¹ BGS, 1997. The Aquifer Properties of Major Aquifers in England and Wales.

3.1.6 For shaft dewatering, if the highest groundwater level in the aquifer is below the base of the excavation at the time of casting, then it will be assumed that dewatering is not required.

3.1.7 Initial estimates of the flow rates required for dewatering shafts can be made using the Thiem and Sichardt equations. These equations apply to an idealised aquifer which is horizontal, confined above and below between impermeable formations, infinite in horizontal extent, of constant thickness and homogeneous and isotropic with respect to its hydrogeological parameters.

$$Q = \frac{2\pi k D (H - h)}{\ln(R_o / R_e)} \quad \text{Thiem equation for confined conditions}$$

$$R_o = C(H - h)\sqrt{k} \quad \text{Sichardt formula}$$

Where;

Q = flow rate (m³/d)

Q_{pp} = flow rate adjusted for partial penetrating wells

k = permeability (m/d)

D = thickness of the confined aquifer (m)

d = depth well penetrates into aquifer (m)

H = initial piezometric level in the aquifer (m)

h = target drawdown level in the equivalent well (m)

R_o = radius of influence (m)

R_e = effective radius of dewatering (m) (taken as 5m more than the shaft radius)

C = empirical calculation factor (assumed to be 3000 when k is in m/s)

3.1.8 Where the dewatering wells are partially penetrating the flow rate will be adjusted to Q_{pp} as follows:

$$Q_{pp} = Q \times \frac{d}{D}$$

3.1.9 The equations represent steady state conditions and are therefore appropriate if dewatering is likely to occur over a number of months to a point where groundwater level changes stabilise. For shorter scale works, such as manholes, transient, non steady state methods will be applied, where appropriate, to determine the dewatering requirements.

3.1.10 Impacts of temporary dewatering in shallow aquifers where a steady state is not reached will be based on the Cooper Jacob equation for non-steady conditions where appropriate. The drawdown, *s*, at a distance, *r*, from the dewatering borehole assuming semi-confined aquifer conditions, is given by:

$$s = \frac{2.303Q \log_{10}(2.25kDt / (r^2 S))}{4\pi kD}$$

Where

Q	=	flow rate from well (m ³ /s)
r	=	radius of interest (m)
s	=	drawdown (m)
S	=	specific yield of aquifer

- 3.1.11 The impact of dewatering on Sites of Special Scientific Interest (SSSI) and other sensitive receptors will be estimated, where appropriate, using the following mathematical equations:

For plane flow (to a cutting):

$$L_0 = \sqrt{\frac{12Tt}{S}}$$

Or radial flow:

$$R_0 = \sqrt{\frac{2.25Tt}{S}}$$

Where

Lo or Ro are the distance of influence (m)

T is the transmissivity in (m²/d)

t is time (days)

S is the confined or unconfined storage depending on aquifer conditions

- 3.1.12 Further details are provided in the CIRIA Publication on Groundwater control – design and practice².
- 3.1.13 Dewatering impacts on surface watercourses and wetland hydrology (where these are known to be not perched) will be covered by the groundwater section, based on the baseline conditions provided by these topics.
- 3.1.14 The effects of dewatering or mounding may extend beyond the construction period and beyond the standard 1km groundwater assessment distance, and will be considered as exceptions, as set out in the SMR.
- 3.1.15 To quantify seepages into the tunnels, guidance such as the specification for tunnelling³ can be used as appropriate.

3.2 Groundwater quality

- 3.2.1 Effects on groundwater quality will be assessed qualitatively. No significant effects during construction or operation are expected.

² Preene, M., Roberts, T.O.L., Powrie, W. and Dyer, M.R., (2000) Groundwater control – design and practice. CIRIA Publication C515.

³ British Tunnelling Society and The Institution of Civil Engineers (2010) Specification for Tunnelling.

- 3.2.2 The groundwater section will assess pollution as a result of the groundwater pathway. The land quality topic will assess these effects as well as pathways other than groundwater and receptors other than groundwater.

3.3 Assessment methodology

- 3.3.1 The operational impacts will be assessed as per the SMR. The maximum and minimum groundwater condition may be more relevant in some circumstances.
- 3.3.2 The effects are to be assessed for receptors in the catchment or area under consideration; sources may fall within another catchment or area.

4 Mitigation

- 4.1.1 The general approach to mitigation is set out in Volume 1. Other avoidance and mitigation measures such as minimising dewatering, groundwater cut-off or re-routing of groundwater flows, water recirculation, re-injection and pollution control are discussed in the water resources and flood risk assessments. Note that water discharges during operation will be covered by permitting where necessary.

5 Reporting residual effects

- 5.1.1 The Environmental Statement will report the residual effects including mitigation measures.
- 5.1.2 Measures to mitigate residual effects may include compensation for derogation of licensed abstractions or other effects where monitoring confirms that the effect is significant.



HS2 London-West Midlands

**Water resources and flood risk
Technical note – Spillage risk
assessment**

A report to HS2 Ltd by Arup/URS

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1 Introduction

1.1.1 This technical note has been prepared to give further guidance on the assessment of the risk of spillages and the possible environmental effects on the quality of the water environment. It should be read in conjunction with the Scope and Methodology Report (see Volume 5 Appendix CT-001-000/1).

1.1.2 The note is intended as a guide to ensure a consistent approach across the project, not an exhaustive or prescriptive methodology.

1.2 Scope of technical note

1.2.1 The note covers the assessment of the risks from accidents, spillages and the like during the operation of the railway.

1.2.2 The note covers all parts of the project constructed within the land required for the Proposed Scheme. It covers three main categories of asset as a source of spillage risk:

- the railway and associated infrastructure such as tunnels, embankments and viaducts;
- new or modified roads; and
- stations and depots.

1.2.3 The note does not cover the assessment of risks during the construction phase of the project.

1.2.4 The note does not cover the assessment of risks that occur during routine maintenance work. These are addressed in the draft Operation and Maintenance Plan for Water Resources and Flood Risk – (see Volume 5: Appendix WR-001-000).

1.2.5 The note does not cover the assessment of risks in locations where drainage is discharged to a foul sewer.

2 Baseline assessment

2.1.1 The baseline assessment should consider the risk of spillages and their consequences for the water environment from those parts of the lands required for the Proposed Scheme that are planned to be developed. These will include existing roads, existing stations, or those parts of existing stations due to be redeveloped, and other land required for the Proposed Scheme.

2.1.2 At many locations, for example existing agricultural land, the existing spillage risks are negligible. In other locations, for example existing roads, the baseline risks may exceed the future risks, due to improvement in the layout or pollution control measures in the roads.

3 Spillage risk methodology

3.1 Railway and associated infrastructure

- 3.1.1 The risk of pollution of the water environment from spillages from the operational railway and its maintenance is considered very low, as it is planned that only electric and totally sealed trains will use the route for the vast majority of the time. Spillages on the route are therefore only likely following derailments, collisions, or major on-board incidents, all of which are considered highly improbable.
- 3.1.2 Even if a spillage of a pollutant does occur, it will not necessarily lead to a pollution incident, as the pollutant may not reach a receiving water body, either because of prompt action by emergency personnel or as a result of pollution control measures, such as shut-off valves, balancing ponds, and silt traps, or because the pollutant is absorbed by ballast, soil or vegetation.
- 3.1.3 The risk at a discharge outfall will be a function of the generic risk, the length of the catchment draining to that outfall and the sensitivity of the receptor.
- 3.1.4 As local conditions are not likely to make a significant difference to these risks, these spillage risks will be assessed on a route wide basis.

3.2 Roads

- 3.2.1 The spillage risks for all roads (as per Section 1.1.2), should be assessed using the methodology set out in the Design Manual for Roads and Bridges (DMRB) 11.3.10¹ (HD45) Annex I Method D.
- 3.2.2 Roads where the annual average daily traffic of Heavy Goods Vehicles is less than 500 are unlikely to pose a significant spillage risk. Assessment of such roads is not required unless there are local conditions that warrant it. Examples of such conditions could include the use of a road to convey highly polluting materials, or the close proximity of a water-sensitive SSSI to the road.

3.3 Stations and depots

- 3.3.1 Roof drainage discharging directly to a drain or water body may be considered not to pose a spillage risk. Areas draining to a foul sewer do not need to be assessed for risk of spillages. Remaining areas, such as those used for the storage of potential contaminants, should be assessed using an appropriate combination of expert judgment and analysis.

4 Mitigation measures

- 4.1.1 Mitigation measures will be identified to avoid, reduce or offset significant spillages risks. These will be described in the Environmental Statement. These may include physical measures, such as spillage basins or control valves, or may include operating procedures, such as spillage kits, contingency plans and drainage layouts showing which section of the project drains to which outfall.

¹ DMRB (2006), Volume 11 Section 3 Part 10: HD45: Road Drainage and the Water Environment. Her Majesty's Stationery Office, London..

4.1.2 For roads, reference should be made to Design Manual for Roads and Bridges (DMRB) 4.2.1² (HA 103) and DMRB 4.2.3³ (HD33). Both documents give examples of suitable measures to reduce spillage risk from roads.

4.1.3 For stations and depots, reference, where necessary, should be made to the Pollution Prevention Guidelines (PPG) published by the Environment Agency:

www.environment-agency.gov.uk/business/topics/pollution/39083.aspx

4.1.4 Of particular relevance are the following PPGs:

- PPG 18: Managing fire water and major spillages;
- PPG 21: Pollution incident response planning; and
- PPG 22: Dealing with spills.

5 Reporting residual effects

5.1.1 The Environmental Statement will report the residual effects following the implementation of mitigation measures.

² Highways Agency (2009) *DMRB Volume 4, Section 2, Part 1 (HA103)*, Her Majesty's Stationery Office, London.

³ Highways Agency (2009) *DMRB Volume 4, Section 2, Part 3 (HD33)*, Her Majesty's Stationery Office, London.

