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LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

Waste and material resources assessment (WM-001-000)

Waste and material resources

November 2013

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Appendix WM-001-000

Environmental topic:	Waste and material resources	WM
Appendix name:	Data appendix	001
Community forum area:	*Document includes all CFA*	000

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1   Introduction

1.1   Structure of the waste and material resources appendix

1.1.1   This waste and material resources appendix is divided on a community forum area (CFA) basis. Each section relates to a specific CFA and comprises:

- a description of the local assumptions and limitations;
- forecasted waste and material quantities from the construction phase; and
- forecasted waste and material quantities from operation.

1.1.2   A summary list of all publications referenced throughout this appendix is provided in Section 28. This is followed by two annexes, which are as follows:

- summary reporting tables for excavated material, demolition materials and waste, construction waste, worker accommodation site waste and operational waste; and
- BRE construction waste benchmarks for railway projects report

1.2   Purpose and scope

1.2.1   The purpose of this appendix is to provide more detailed information in relation to:

- the types and quantities of materials and waste that will be generated during construction and operation of the Proposed Scheme; and
- the estimated quantities of waste that will require off-site disposal to landfill during construction and operation of the Proposed Scheme.

1.2.2   The details contained within this appendix support the information provided within Section 2 of each CFA report within Volume 2. This is in relation to:

- construction waste and material resources (Section 2.3); and
- operational waste and material resources (Section 2.4).

1.2.3   An assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste generated during construction and operation of the Proposed Scheme has not been undertaken on a CFA basis, hence no such details have been provided within this appendix.

1.2.4   The likely significant environmental effects associated with the off-site disposal to landfill of solid waste generated during construction and operation of the Proposed Scheme have instead been considered on a route-wide basis (see Volume 3, Section 14).

2 Euston - Station and Approach (CFA 1)

2.1 Local assumptions and limitations

Assumptions

2.1.1 There are no local assumptions specific to the Euston - Station and Approach area.

Limitations

2.1.2 There are no local limitations specific to the Euston - Station and Approach area.

2.2 Construction

Forecast of material and waste quantities

Excavated material quantities

2.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,042,874 tonnes of excavated material within the Euston - Station and Approach area, as shown in Table 1.

Table 1: Forecast excavated material quantities

Excavated material types[1]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[2]
Selected fill	0	N/A
General engineering fill	0	N/A
Environmental mitigation earthworks fill	2,042,874	N/A
Topsoil	0	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**2,042,874**	**0**

2.2.2 The quantity of excavated material generated from the Euston area will require off-site disposal to permitted landfill sites. Due to the construction plan and specific geographical constraints, a proximate usage for this material within the Proposed Scheme cannot be found. The excavated material would need to have been moved large distances by road, which would have resulted in unacceptable road transport impacts.

2.2.3 Table 1 shows the quantity of excavated material to be disposed to landfill as zero, since this table only records contaminated excavated material that is chemically

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[1] 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] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is altogether reported on a route-wide basis in Volume 3, Section 14.

2.2.4   As shown in Table 1, it is forecast that no unacceptable class U1B or U2 material (contaminated excavated material), which is chemically unsuitable for reuse within the Proposed Scheme, will be generated in the Euston area.

2.2.5   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

Demolition material and waste quantities

2.2.6   Types of building demolitions required within the Euston - Station and Approach area are listed in Table 2 together with estimated demolition material quantities.

2.2.7   Demolition material quantities have been estimated using the Waste and Resources Action Plan (WRAP) 'Demolition bill of quantities estimator'[3], using the basic dimensions and typology of buildings.

2.2.8   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 2). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 2: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Industrial Units	0	0
Commercial Property	164,295	16,430
Residential Property	29,900	2,990
Community Amenities	18,400	1,840
Railways	94,330	9,433
Highways	0	0
TOTAL	**306,925**	**30,693**

Construction waste quantities

2.2.9   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[4]. The construction waste forecast for the Euston - Station and Approach area is given in Table 3.

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[3] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].
[4] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

2.2.10   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 3). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 3: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	50,146	5,015
Retaining walls	27,864	2,786
Bridges	12,413	1,241
Viaducts	0	0
Roadworks	1,727	173
Footpaths/tracks	0	0
Railworks	224,317	22,432
Watercourse diversions	0	0
Fencing	364	36
Drainage	0	0
Landscaping	17,364	1,736
Utilities	31,412	3,141
Construction compound	0	0
Tunnels	0	0
Ventilation shafts	0	0
Other structures	33,170	3,317
Railway systems	36,530	3,653
TOTAL	**465,520**	**46,552**

Worker accommodation site waste quantities

2.2.11   There will not be any worker accommodation sites in the Euston - Station and Approach area and therefore no waste will be generated from this source.

2.3   Operation

Forecast of waste quantities

2.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 4.

2.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[5].

2.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

2.3.4 The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[6]

Table 4: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	1,193	477
Rolling stock maintenance	0	0
Track maintenance	23	3
Ancillary infrastructure	2	1
TOTAL	1,218	481

2.3.5 Railway station and train waste has only been reported for areas along the route in which stations will be located. Euston station will be located in the Euston - Station and Approach area, hence railway station and train waste is reported in Table 4.

2.3.6 Rolling stock maintenance waste has not been reported in Table 4 as there will not be any rolling stock maintenance depots in the Euston - Station and Approach area.

2.3.7 Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Euston - Station and Approach area is shown in Table 4.

2.3.8 It has been estimated that the Proposed Scheme will generate a total quantity of 1,218 tonnes of operational waste annually in the Euston - Station and Approach area when it becomes fully operational in 2026, of which 737 tonnes (61%) will be diverted from landfill.

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[5] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[6] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

2.3.9   The Proposed Scheme in the Euston - Station and Approach area will generate an overall operational landfill disposal requirement of 481 tonnes per annum.

3 Camden Town and HS1 link (CFA 2)

3.1 Local assumptions and limitations

Assumptions

3.1.1 There are no local assumptions specific to the Camden Town and HS1 Link area.

Limitations

3.1.2 There are no local limitations specific to the Camden Town and HS1 Link area.

3.2 Construction

Forecast of material and waste quantities

Excavated material quantities

3.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 94,127 tonnes of excavated material within the Camden Town and HS1 Link area, as shown in Table 5.

3.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 5.

Table 5: Forecast excavated material quantities

Excavated material types[7]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[8]
Selected fill	0	N/A
General engineering fill	0	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	0	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	43,716	N/A
Unacceptable material Class U1B	17,219	617
Unacceptable material Class U2	33,192	33,192
TOTAL	**94,127**	**33,809**

3.2.3 The majority of excavated material that will be generated in Camden Town and HS1 Link area is expected to be suitable for beneficial reuse as engineering fill material or

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[7] 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.
[8] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for re-use with the Proposed Scheme.

in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[9] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

3.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

3.2.5   A small amount of excavated material from tunnelling will be generated in the Camden Town and HS1 Link area. However, due to the tunnelling process, the tunnelling materials will arise at the tunnel portal, located in the Kilburn (Brent) to Old Oak Common area.

3.2.6   A proportion of the excavated material in the Camden Town and HS1 Link area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[10]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

3.2.7   Types of building demolitions required within the Camden Town and HS1 Link area are listed in Table 2 together with estimated demolition material quantities.

3.2.8   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[11], using the basic dimensions and typology of buildings.

3.2.9   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 6). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 6: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	1,100	110
Industrial units	0	0
Commercial property	5,272	527
Residential property	1,179	118
Community amenities	0	0
Railways	0	0

[9] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[10] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[11] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Highways	4,507	451
TOTAL	**12,059**	**1,206**

Construction waste quantities

3.2.10   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[12]. The construction waste forecast for Camden Town and HS1 Link area is given in Table 7.

3.2.11   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 7). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 7: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	1,687	169
Retaining walls	0	0
Bridges	15,310	1,531
Viaducts	10,803	1,080
Roadworks	0	0
Footpaths/tracks	0	0
Railworks	0	0
Watercourse diversions	0	0
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	13,866	1,387
Ventilation shafts	0	0
Other structures	0	0
Railway systems	11,744	1,174

[12] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
TOTAL	53,410	5,341

Worker accommodation site waste quantities

3.2.12 There will not be any worker accommodation sites in the Camden Town and HS1 Link area and therefore no waste will be generated from this source.

3.3 Operation

Forecast of waste quantities

3.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 8.

3.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[13].

3.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

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

3.3.4 The rationale for each of these landfill diversion rates is provided in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[14].

Table 8: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	19	3
Ancillary infrastructure	2	1
TOTAL	21	4

3.3.5 Railway station and train waste has not been reported in Table 8 as there will not be any railway stations in the Camden Town and HS1 Link area. Although waste will be generated by passengers on trains travelling through Camden Town and HS1 Link

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[13] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[14] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 8.

3.3.6   Rolling stock maintenance waste has not been reported in Table 8 as there will not be any rolling stock maintenance depots in the Camden Town and HS1 Link area.

3.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Camden Town and HS1 Link area is shown in Table 8.

3.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 21 tonnes of operational waste annually in the Camden Town and HS1 Link area when it becomes fully operational in 2026, of which 17 tonnes (81%) will be diverted from landfill.

3.3.9   The Proposed Scheme in the Camden Town and HS1 Link area will generate an overall operational landfill disposal requirement of four tonnes per annum.

4 Primrose Hill to Kilburn (Camden) (CFA 3)

4.1 Local assumptions and limitations

Assumptions

4.1.1 There are no local assumptions specific to the Primrose Hill to Kilburn (Camden) community forum area.

Limitations

4.1.2 There are no local limitations specific to the Primrose Hill to Kilburn (Camden) area.

4.2 Construction

Forecast of materials and waste quantities

Excavated material quantities

4.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 1,855,281 tonnes of excavated material within the Primrose Hill to Kilburn (Camden) area, as shown in Table 9.

4.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 9.

Table 9: Forecast excavated material quantities

Excavated material types[15]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[16]
Selected fill	0	N/A
General engineering fill	0	N/A
Environmental mitigation earthworks fill	202,858	N/A
Topsoil	0	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	1,650,374	N/A
Unacceptable material Class U1B	2,049	2,049
Unacceptable material Class U2	0	0
TOTAL	**1,855,281**	**2,049**

4.2.3 The majority of excavated material that will be generated in the Primrose Hill to Kilburn (Camden) area is expected to be suitable for beneficial reuse as engineering fill

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[15] 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.
[16] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[17] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment

4.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

4.2.5   A proportion of the excavated material in the Primrose Hill to Kilburn (Camden) area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[18]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

4.2.6   Excavated materials from tunnelling are being generated in the Primrose Hill to Kilburn (Camden) area. However, due to the tunnelling process, the tunnelling materials will arise at the tunnel portal, located in the Kilburn to Old Oak Common area.

Demolition material and waste quantities

4.2.7   Types of building demolitions required within the Primrose Hill to Kilburn (Camden) area are listed in Table 10 together with estimated demolition material quantities.

4.2.8   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[19], using the basic dimensions and typology of buildings.

4.2.9   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 10). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 10: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Industrial Units	0	0
Commercial Property	3,129	313
Residential Property	0	0
Community Amenities	181	18
Railways	0	0

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[17] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[18] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[19] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Highways	0	0
TOTAL	**3,310**	**331**

Construction waste quantities

4.2.10   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[20]. The construction waste forecast for the Primrose Hill to Kilburn (Camden) area is given in Table 11.

4.2.11   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 11). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 11: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	0	0
Viaducts	0	0
Roadworks	0	0
Footpaths/tracks	0	0
Railworks	0	0
Watercourse diversions	0	0
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	52,082	5,208
Ventilation shafts	19,889	1,989
Other structures	0	0
Railway systems waste	120	12

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[20] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
TOTAL	72,091	7,209

4.2.12

Worker accommodation site waste quantities

4.2.13   There will not be any worker accommodation sites in the Primrose Hill to Kilburn (Camden) area and therefore no waste will be generated from this source.

4.3   Operation

Forecast of waste quantities

4.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see 12.

4.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[21].

4.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

4.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[22]

Table 12: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	83	12
Ancillary infrastructure	7	3
TOTAL	90	15

4.3.5   Railway station and train waste has not been reported in Table 12 as there will not be any railway stations in the Primrose Hill to Kilburn (Camden) area. Although waste will

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[21] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[22] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

be generated by passengers on trains travelling through the Primrose Hill to Kilburn (Camden) area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 12.

4.3.6   Rolling stock maintenance waste has not been reported in Table 12 as there will not be any rolling stock maintenance depots in the Primrose Hill to Kilburn (Camden) area.

4.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Primrose Hill to Kilburn (Camden) area is shown in Table 12.

4.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 90 tonnes of operational waste annually in the Primrose Hill to Kilburn (Camden) area when it becomes fully operational in 2026, of which 75 tonnes (83%) will be diverted from landfill.

4.3.9   The Proposed Scheme in the Primrose Hill to Kilburn (Camden) area will generate an overall operational landfill disposal requirement of 15 tonnes per annum.

5 Kilburn (Brent) to Old Oak Common (CFA 4)

5.1 Local assumptions and limitations

Assumptions

5.1.1 There are no local assumptions specific to the Kilburn (Brent) to Old Oak Common area.

Limitations

5.1.2 There are no local limitations specific to the Kilburn (Brent) to Old Oak Common area.

5.2 Construction

Forecast of material and waste quantities

Excavated material quantities

5.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 4,680,977 tonnes of excavated material within the Kilburn (Brent) to Old Oak Common area, as shown in Table 13.

5.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 13.

Table 13: Forecast excavated material quantities

Excavated material types[23]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[24]
Selected fill	0	N/A
General engineering fill	0	N/A
Environmental mitigation earthworks fill	3,028,910	N/A
Topsoil	0	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	848,820	N/A
Unacceptable material Class U1B	803,247	117,446
Unacceptable material Class U2	0	0
TOTAL	**4,680,977**	**117,446**

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[23] 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.
[24] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

5.2.3   The majority of excavated material that will be generated in Kilburn (Brent) to Old Oak Common area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[25] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

5.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

5.2.5   Excavated material from the whole of the Euston and HS1-HS2 Link Tunnels and a portion of the Northolt Tunnel will come to the surface in the Kilburn (Brent) to Old Oak Common area. This excavated material originates in the Primrose Hill to Kilburn (Camden) and Northolt Corridor areas where it is reported. The amount of excavated material that will be generated in these adjacent areas can be found in the respective sections of this waste and material resources appendix, and constitutes a larger quantity than that generated in the Kilburn (Brent) to Old Oak Common area alone. The environmental effects of the total excavated material arising and its management in the Kilburn (Brent) to Old Oak Common area are reported in Volume 2: CFA Report 4, Section 4 (air quality assessment), Section 12 (sound, noise and vibration assessment) and Section 13 (traffic and transport assessment) and the corresponding appendices (Volume 5: Appendices AQ-001-004, SV-003-004 and TR-001-000). Excavated materials arising in the Kilburn (Brent) to Old Oak Common area will be removed by conveyor to the Euroterminal railhead and transported by rail to the Calvert railhead in the Calvert, Twyford, Steeple Clayton and Chetwode area, where the majority of it will be beneficially reused.

5.2.6   A proportion of the excavated material in the Kilburn (Brent) to Old Oak Common area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[26]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

5.2.7   Types of building demolitions required within the Kilburn (Brent) to Old Oak Common area are listed in Table 14 together with estimated demolition material quantities.

5.2.8   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[27], using the basic dimensions and typology of buildings.

5.2.9   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 14). The landfill diversion rate has been selected based on a

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[25] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[26] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[27] Waste & Resources Action Programme. Net Waste Tool. Available at: http://nwtool.wrap.org.uk [Accessed 5 November 2012].

review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 14: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	6,728	673
Industrial units	127,924	12,792
Commercial property	26,703	2,670
Residential property	1,072	107
Community amenities	28	3
Railways	81,890	8,189
Highways	0	0
TOTAL	**244,345**	**24,434**

Construction waste quantities

5.2.10 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[28]. The construction waste forecast for Kilburn (Brent) to Old Oak Common area is given in Table 15.

5.2.11 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 15). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 15: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	8,731	873
Viaducts	0	0
Roadworks	0	0
Footpaths/tracks	0	0
Railworks	0	0
Watercourse diversions	0	0

[28] BRE Ltd, (February 2013), *Construction waste benchmarks for railway projects.*

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	102,082	10,208
Ventilation shafts	7,173	717
Stations	215,328	21,533
Other structures	32,029	3,203
Railway systems waste	73,370	7,337
TOTAL	**438,713**	**43,871**

Worker accommodation site waste quantities

5.2.12   There will not be any worker accommodation sites in the Kilburn (Brent) to Old Oak Common area and therefore no waste will be generated from this source.

5.3   Operation

Forecast of waste quantities

5.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see 16.

5.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[29].

5.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

5.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology technical note which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[30].

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[29] British Standards Institution, (December 2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

Table 16: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	595	238
Rolling stock maintenance	0	0
Track maintenance	118	18
Ancillary infrastructure	10	4
TOTAL	**723**	**260**

5.3.5   Railway station and train waste has only been reported for areas along the route in which stations will be located. Old Oak Common Station will be located in the Kilburn (Brent) to Old Oak Common area, hence railway station and train waste is reported in Table 16.

5.3.6   Rolling stock maintenance waste has not been reported in Table 4 as there will not be any rolling stock maintenance depots in the Kilburn (Brent) to Old Oak Common area.

5.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Kilburn (Brent) to Old Oak Common area is shown in Table 16.

5.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 723 tonnes of operational waste annually in the Kilburn (Brent) to Old Oak Common area when it becomes fully operational in 2026, of which 463 tonnes (64%) will be diverted from landfill.

5.3.9   The Proposed Scheme in the Kilburn (Brent) to Old Oak Common area will generate an overall operational landfill disposal requirement of 260 tonnes per annum.

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[30] ARUP/URS, (2013), *HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.*

6 Northolt Corridor (CFA 5)

6.1 Local assumptions and limitations

Assumptions

6.1.1   There are no local assumptions specific to the Northolt Corridor area.

Limitations

6.1.2   There are no local limitations specific to the Northolt Corridor area.

6.2 Construction

Forecast of material and waste quantities

Excavated material quantities

6.2.1   Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,979,550 tonnes of excavated material within the Northolt Corridor area, as shown in Table 17.

6.2.2   The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 17.

Table 17: Forecast excavated material quantities

Excavated material types[31]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[32]
Selected fill	0	N/A
General engineering fill	0	N/A
Environmental mitigation earthworks fill	1,827,313	N/A
Topsoil	0	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	1,088,787	N/A
Unacceptable material Class U1B	63,450	56,500
Unacceptable material Class U2	0	0
TOTAL	**2,979,550**	**56,500**

6.2.3   The majority of excavated material that will be generated in the Northolt Corridor area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme either within this area

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[31] 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.
[32] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[33] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

6.2.4 Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

6.2.5 A proportion of the excavated material in the Northolt Corridor area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[34]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

6.2.6 Excavated materials from tunnelling are being generated in the Northolt Corridor area. However, due to the tunnelling process, the tunnelling materials will arise at the tunnel portals, located in the Kilburn to Old Oak Common and South Ruislip to Ickenham areas.

Demolition material and waste quantities

6.2.7 Types of building demolitions required within the Northolt Corridor area are listed in Table 18 together with estimated demolition material quantities.

6.2.8 Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[35], using the basic dimensions and typology of buildings.

6.2.9 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 18). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 18: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Industrial Units	13,986	1,399
Commercial Property	0	0
Residential Property	0	0
Community Amenities	0	0
Railways	0	0
Highways	0	0

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[33] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[34] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[35] Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
TOTAL	13,986	1,399

Construction waste quantities

6.2.10 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[36]. The construction waste forecast for the Northolt Corridor area is given in Table 19.

6.2.11 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 19). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 19: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	0	0
Viaducts	0	0
Roadworks	0	0
Footpaths/tracks	0	0
Railworks	0	0
Watercourse diversions	0	0
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	96,088	9,609
Ventilation shafts	24,594	2,459
Other structures	0	0
Railway systems waste	220	22
TOTAL	**120,902**	**12,090**

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[36] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Worker accommodation site waste quantities

6.2.12   There will not be any worker accommodation sites in the Northolt Corridor area and therefore no waste will be generated from this source.

6.3   Operation

Forecast of waste quantities

6.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 20.

6.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005.[37]

6.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

6.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[38]

Table 20: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	143	21
Ancillary infrastructure	12	5
TOTAL	155	26

6.3.5   Railway station and train waste has not been reported in Table 20 as there will not be any railway stations in the Northolt Corridor area. Although waste will be generated by passengers on trains travelling through the Northolt Corridor area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 20.

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[37] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[38] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

6.3.6   Rolling stock maintenance waste has not been reported in Table 20 as there will not be any rolling stock maintenance depots in the Northolt Corridor area.

6.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Northolt Corridor area is shown in Table 20.

6.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 155 tonnes of operational waste annually in the Northolt Corridor area when it becomes fully operational in 2026, of which 129 tonnes (83%) will be diverted from landfill.

6.3.9   The Proposed Scheme in the Northolt Corridor area will generate an overall operational landfill disposal requirement of 26 tonnes per annum.

7 South Ruislip to Ickenham (CFA 6)

7.1 Local assumptions and limitations

Assumptions

7.1.1 There are no local assumptions specific to the South Ruislip to Ickenham area.

Limitations

7.1.2 There are no local limitations specific to the South Ruislip to Ickenham area.

7.2 Construction

Forecast of material and waste quantities

Excavated material quantities

7.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 5,319,182 tonnes of excavated material within the South Ruislip to Ickenham area, as shown in Table 21.

7.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 21.

Table 21: Forecast excavated material quantities

Excavated material types[39]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[40]
Selected fill	0	N/A
General engineering fill	0	N/A
Environmental mitigation earthworks fill	38,280	N/A
Topsoil	185,220	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	5,077,424	N/A
Unacceptable material Class U1B	18,258	16,617
Unacceptable material Class U2	0	0
TOTAL	**5,319,182**	**16,617**

7.2.3 The majority of excavated material that will be generated in South Ruislip to Ickenham area is expected to be suitable for beneficial re-use as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme

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[39] 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.
[40] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

either within this area or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[41] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

7.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

7.2.5   The construction of the Proposed Scheme within the South Ruislip to Ickenham area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

7.2.6   Excavated material from a portion of the Northolt Tunnel will come to the surface in the South Ruislip to Ickenham area. A proportion of this excavated material originates in the Northolt Corridor area where it is reported. The amount of excavated material that will be generated in this adjacent area can be found in the respective section of this waste and material resources appendix, and constitutes a larger quantity than that generated in the South Ruislip to Ickenham area alone. The environmental effects of the total excavated material arising and its management in the South Ruislip to Ickenham area are reported in Volume 2: CFA Report 6, Section 4 (air quality assessment), Section 12 (sound, noise and vibration assessment) and Section 13 (traffic and transport assessment) and the corresponding appendices (Volume 5: Appendices AQ-001-006, SV-003-006 and TR-001-000).

7.2.7   Sustainable placement of inert surplus excavated material will be used where the material cannot be reused beneficially along or locally beyond the route and where it cannot be removed by either rail or along the construction corridor. Three areas of sustainable placement will be used within the South Ruislip to Ickenham area to permanently dispose of surplus excavated material generated in this area from the Proposed Scheme to avoid causing significant environmental effects associated with the road transport of that material. The sustainable placement areas of surplus excavated material are located at an area north of Newyears Green Lane and at two areas between Breakspear Road and Harvil Road. Further information can be found in Volume 3, Section 14.

7.2.8   A proportion of the excavated material in the South Ruislip to Ickenham area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[42]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

7.2.9   Types of building demolitions required within the South Ruislip to Ickenham area are listed in Table 22 together with estimated demolition material quantities.

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[41] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[42] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).

7.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[43], using the basic dimensions and typology of buildings.

7.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 22). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 22: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Industrial Units	0	0
Commercial Property	12,833	1,283
Residential Property	709	71
Community Amenities	0	0
Highways	2,226	223
Railways	0	0
TOTAL	**15,768**	**1,577**

Construction waste quantities

7.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[44]. The construction waste forecast for South Ruislip to Ickenham area is given in Table 23.

7.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 23). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 23: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	26,029	2,603
Retaining walls	0	0
Bridges	12,257	1,226
Viaducts	0	0

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[43] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].
[44] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Roadworks	0	0
Footpaths/tracks	0	0
Railworks	0	0
Watercourse diversions	0	0
Fencing	0	0
Drainage	124	12
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	66,823	6,682
Ventilation shafts	7,257	726
Stations	0	0
Other structures	20,448	2,045
Railway systems waste	3,728	373
TOTAL	**136,666**	**13,667**

Worker accommodation site waste quantities

7.2.14   There will not be any worker accommodation sites in the South Ruislip to Ickenham area and therefore no waste will be generated from this source.

7.3   Operation

Forecast of waste quantities

7.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 24.

7.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[45].

7.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

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[45] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

- ancillary infrastructure: 60%.

7.3.4 The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[46].

Table 24: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	110	17
Ancillary infrastructure	9	4
TOTAL	**119**	**21**

7.3.5 Railway station and train waste has not been reported in Table 24 as there will not be any railway stations in the South Ruislip to Ickenham area. Although waste will be generated by passengers on trains travelling through the South Ruislip to Ickenham area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 24.

7.3.6 Rolling stock maintenance waste has not been reported in Table 24 as there will not be any rolling stock maintenance depots in the South Ruislip to Ickenham area.

7.3.7 Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the South Ruislip to Ickenham area is shown in Table 24.

7.3.8 It has been estimated that the Proposed Scheme will generate a total quantity of 119 tonnes of operational waste annually in the South Ruislip to Ickenham area when it becomes fully operational in 2026, of which 98 tonnes (82%) will be diverted from landfill.

7.3.9 The Proposed Scheme in the South Ruislip to Ickenham area will generate an overall operational landfill disposal requirement of 21 tonnes per annum.

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[46] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

8 Colne Valley (CFA 7)

8.1 Local assumptions and limitations

Assumptions

8.1.1 There are no local assumptions specific to the Colne Valley area.

Limitations

8.1.2 There are no local limitations specific to the Colne Valley area.

8.2 Construction

Forecast of material and waste quantities

Excavated material quantities

8.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,746,951 tonnes of excavated material within the Colne Valley area, as shown in Table 25.

8.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3 along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 25.

Table 25: Forecast excavated material quantities

Excavated material types[47]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[48]
Selected fill	182,234	N/A
General engineering fill	1,710,434	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	376,116	N/A
Agricultural subsoil	424,660	N/A
Unacceptable material Class U1A	53,508	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**2,746,951**	**0**

8.2.3 The majority of excavated material that will be generated in the Colne Valley area is expected to be suitable for beneficial reuse as engineering fill material or in the

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[47] 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.
[48] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

8.2.4 Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

8.2.5 Excavated material from the whole of the Chilterns Tunnel will come to the surface in the Colne Valley area. This excavated material originates in the Chalfonts and Amersham and Central Chilterns areas where it is reported. The amount of excavated material that will be generated in these adjacent areas can be found in the respective sections of this waste and material resources appendix, and constitutes a larger quantity than that generated in the Colne Valley area alone. The environmental effects of the total excavated material arising and its management in the Colne Valley area are reported in Volume 2: CFA Report 7, Section 4 (air quality assessment), Section 12 (sound, noise and vibration assessment) and Section 13 (traffic and transport assessment)and the corresponding appendices (Volume 5: Appendices AQ-001-007, SV-003-007 and TR-001-000). As there is a shortfall of excavated material in the Colne Valley area, the Chilterns Tunnel arisings are reused within the Colne Valley area.

8.2.6 Sustainable placement of inert surplus excavated material will be used where the material cannot be reused beneficially along or locally beyond the route and where it cannot be removed by either rail or along the construction corridor. An area of sustainable placement will be used within the Colne Valley area to permanently dispose of surplus excavated material generated in this area from the Proposed Scheme to avoid causing significant environmental effects associated with the road transport of that material. The sustainable placement area is located at Harvil Road. Further detail can be found in Volume 3, Section 14.

Demolition material and waste quantities

8.2.7 Types of building demolitions required within the Colne Valley area are listed in Table 26 together with estimated demolition material quantities.

8.2.8 Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[49], using the basic dimensions and typology of buildings.

8.2.9 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 26). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 26: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	6,441	644

[49] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Industrial units	0	0
Commercial property	296	30
Residential property	2,009	201
Community amenities	342	34
Railways	0	0
Highways	0	0
TOTAL	**9,088**	**909**

Construction waste quantities

8.2.10 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[50]. The construction waste forecast for the Colne Valley area is given in Table 27.

8.2.11 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 27). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 27: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	6,718	672
Retaining walls	2,128	213
Bridges	1,469	147
Viaducts	35,893	3,589
Roadworks	3,624	362
Footpaths/tracks	230	23
Railworks	0	0
Watercourse diversions	146	15
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0

[50] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Tunnels	4,521	452
Ventilation shafts	0	0
Other structures	0	0
Railway systems	410	41
TOTAL	55,140	5,514

Worker accommodation site waste quantities

8.2.12 Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

8.2.13 Forecast waste quantities over the duration of the construction period are shown in Table 28.

8.2.14 A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 28). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 28: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Colne Valley Viaduct Main Compound (Average no. of workers)	51	60	95	48
Chiltern Tunnel Main Compound (Average no. of workers)	84	65	164	82
TOTAL	-	-	259	130

8.3   Operation

Forecast of waste quantities

8.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 29.

8.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[51].

8.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

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

8.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[52].

Table 29: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	92	14
Ancillary infrastructure	8	3
TOTAL	**100**	**17**

8.3.5   Railway station and train waste has not been reported in Table 29 as there will not be any railway stations in the Colne Valley area. Although waste will be generated by passengers on trains travelling through the Colne Valley area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 29.

8.3.6   Rolling stock maintenance waste has not been reported in Table 29 as there will not be any rolling stock maintenance depots in the Colne Valley area.

8.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Colne Valley area is shown in Table 29.

8.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 100 tonnes of operational waste annually in Colne Valley area when it becomes fully operational in 2026, of which 83 tonnes (83%) will be diverted from landfill.

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[51] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[52] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

8.3.9   The Proposed Scheme in the Colne Valley area will generate an overall operational landfill disposal requirement of 17 tonnes per annum.

9   The Chalfonts and Amersham (CFA 8)

9.1   Local assumptions and limitations

Assumptions

9.1.1   There are no local assumptions specific to the Chalfonts and Amersham area.

Limitations

9.1.2   There are no local limitations specific to the Chalfonts and Amersham area.

9.2   Construction

Forecast of material and waste quantities

Excavated material quantities

9.2.1   Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 3,942,531 tonnes of excavated material within the Chalfonts and Amersham area, as shown in Table 30.

9.2.2   The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 30.

Table 30: Forecast excavated material quantities

Excavated material types[53]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[54]
Selected fill	0	N/A
General engineering fill	222,245	N/A
Environmental mitigation earthworks fill	16,758	N/A
Topsoil	0	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	3,703,527	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**3,942,531**	**0**

9.2.3   The majority of excavated material that will be generated in the Chalfonts and Amersham area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme

[53] 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.
[54] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

either within this area or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[55] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

9.2.4   The construction of the Proposed Scheme within the Chalfonts and Amersham area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

9.2.5   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

9.2.6   A proportion of the excavated material in the Chalfonts and Amersham area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[56]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

9.2.7   Excavated materials from tunnelling are being generated in the Chalfonts and Amersham area. However, due to the tunnelling process, the tunnelling materials will arise at the tunnel portals, located in the Colne Valley area.

Demolition material and waste quantities

9.2.8   Types of building demolitions required within the Chalfonts and Amersham area are listed in 31 together with estimated demolition material quantities.

9.2.9   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[57], using the basic dimensions and typology of buildings.

9.2.10   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 31). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 31: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Industrial Units	0	0
Commercial Property	335	34
Residential Property	0	0
Community Amenities	0	0

[55] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[56] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[57] Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Railways	0	0
Highways	0	0
TOTAL	335	34

Construction waste quantities

9.2.11 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[58]. The construction waste forecast for the Chalfonts and Amersham area is given in Table 32.

9.2.12 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 32). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 32: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	0	0
Viaducts	0	0
Roadworks	0	0
Footpaths/tracks	0	0
Railworks	0	0
Watercourse diversions	0	0
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	163,905	16,391
Ventilation shafts	9,552	955
Other structures	0	0

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[58] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Railway systems waste	190	19
TOTAL	**173,647**	**17,365**

Worker accommodation site waste quantities

9.2.13 There will not be any worker accommodation sites in the Chalfonts and Amersham area and therefore no waste will be generated from this source.

9.3 Operation

Forecast of waste quantities

9.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 33.

9.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[59].

9.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancilliary infrastructure: 60%.

9.3.4 The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[60]

Table 33: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	185	28
Ancillary infrastructure	16	6
TOTAL	**201**	**34**

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[59] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[60] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

9.3.5   Railway station and train waste has not been reported in Table 33 as there will not be any railway stations in the Chalfonts and Amersham area. Although waste will be generated by passengers on trains travelling through the Chalfonts and Amersham area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 33.

9.3.6   Rolling stock maintenance waste has not been reported in Table 33 as there will not be any rolling stock maintenance depots in the Chalfonts and Amersham area.

9.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Chalfonts and Amersham area is shown in Table 33.

9.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 201 tonne of operational waste annually in the Chalfonts and Amersham area when it becomes fully operational in 2026, of which 167 tonnes (83%) will be diverted from landfill.

9.3.9   The Proposed Scheme in the Chalfonts and Amersham area will generate an overall operational landfill disposal requirement of 34 tonnes per annum.

10 Central Chilterns (CFA 9)

10.1 Local assumptions and limitations

Assumptions

10.1.1 There are no local assumptions specific to the Central Chilterns area.

Limitations

10.1.2 There are no local limitations specific to the Central Chilterns area.

10.2 Construction

Forecast of material and waste quantities

Excavated material quantities

10.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 6,976,960 tonnes of excavated material within the Central Chilterns area, as shown in Table 34.

10.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 34.

Table 34: Forecast excavated material quantities

Excavated material types[61]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[62]
Selected fill	0	N/A
General engineering fill	5,747,298	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	334,240	N/A
Agricultural subsoil	282,341	N/A
Unacceptable material Class U1A	613,081	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**6,976,960**	**0**

10.2.3 The majority of excavated material that will be generated in the Central Chilterns area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme either within this area

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[61] 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.
[62] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

or elsewhere along the route. Excavated material falling into the unacceptable material classes U1A and U1B[63] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

10.2.4   The construction of the Proposed Scheme within the Central Chilterns area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

10.2.5   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

10.2.6   Excavated materials from tunnelling are being generated in the Central Chilterns area. However, due to the tunnelling process, the tunnelling materials will arise at the southern tunnel portal, located in the Colne Valley area.

10.2.7   A proportion of the excess excavated material generated within the Central Chilterns area will be transferred northwards along the trace to meet requirements for landscape fill south of the A413. The balance will be taken along the trace to the sustainable placement area at Hunts Green Farm.

10.2.8   Sustainable placement of inert surplus excavated material will be used where the material cannot be reused beneficially along or locally beyond the route and where it cannot be removed by either rail or along the construction corridor. An area of sustainable placement will be used within the adjacent Dunsmore, Wendover and Halton area to permanently dispose of surplus excavated material generated in the Central Chilterns area to avoid causing significant environmental effects associated with the road transport of that material. The sustainable placement area is located at Hunt's Green Farm. Further detail can be found in Volume 3, Section 14.

Demolition material and waste quantities

10.2.9   Types of building demolitions required within the Central Chilterns area are listed in Table 35 together with estimated demolition material quantities.

10.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[64], using the basic dimensions and typology of buildings.

10.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 35). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

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[63] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[64] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Table 35: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	2272	227
Industrial Units	0	0
Commercial Property	3,507	351
Residential Property	3,467	347
Community Amenities	0	0
Railways	0	0
Highways	0	0
TOTAL	**9,246**	**925**

Construction waste quantities

10.2.12 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[65]. The construction waste forecast for the Central Chilterns area is given in Table 36.

10.2.13 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 36). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 36: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	8,711	871
Retaining walls	0	0
Bridges	3,072	307
Viaducts	0	0
Roadworks	1,047	105
Footpaths/tracks	24	2
Railworks	0	0
Watercourse diversions	124	12
Fencing	0	0
Drainage	0	0
Landscaping	0	0

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[65] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Utilities	0	0
Construction compound	0	0
Tunnels	22,350	2,235
Ventilation shafts	3,182	318
Other structures	0	0
Railway systems waste	370	37
TOTAL	38,880	3,888

Worker accommodation site waste quantities

10.2.14   There will not be any worker accommodation sites in the Central Chilterns area and therefore no waste will be generated from this source.

10.3   Operation

Forecast of waste quantities

10.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see 37.

10.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005.[66]

10.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancilliary infrastructure: 60%.

10.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[67]

Table 37: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0

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[66] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[67] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Rolling stock maintenance	0	0
Track maintenance	99	15
Ancillary infrastructure	8	3
TOTAL	107	18

10.3.5   Railway station and train waste has not been reported in Table 37 as there will not be any railway stations in the Central Chilterns area. Although waste will be generated by passengers on trains travelling through the Central Chilterns area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 37.

10.3.6   Rolling stock maintenance waste has not been reported in Table 37 as there will not be any rolling stock maintenance depots in the Central Chilterns area.

10.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Central Chilterns area is shown in Table 37.

10.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 107 tonnes of operational waste annually in the Central Chilterns area when it becomes fully operational in 2026, of which 89 tonnes (83%) will be diverted from landfill.

10.3.9   The Proposed Scheme in the Central Chilterns area will generate an overall operational landfill disposal requirement of 18 tonnes per annum.

11 Dunsmore, Wendover and Halton (CFA 10)

11.1 Local assumptions and limitations

Assumptions

11.1.1 There are no local assumptions specific to the Dunsmore, Wendover and Halton area.

Limitations

11.1.2 There are no local limitations specific to the Dunsmore, Wendover and Halton area.

11.2 Construction

Forecast of materials and waste quantities

Excavated material quantities

11.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4 the construction of the Proposed Scheme is forecast to generate a total of 5,105,809 tonnes of excavated material within the Dunsmore, Wendover and Halton area, as shown in Table 38.

11.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14 along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in 38.

Table 38: Forecast excavated material quantities

Excavated material types[68]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[69]
Selected fill	0	N/A
General engineering fill	4,329,030	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	431,712	N/A
Agricultural subsoil	345,067	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**5,105,809**	**0**

[68] 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.
[69] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

11.2.3   The majority of excavated material that will be generated in the Dunsmore, Wendover and Halton area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

11.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

11.2.5   The construction of the Proposed Scheme within the Dunsmore, Wendover and Halton area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

11.2.6   Excess excavated materials are anticipated to be transported from the Stoke Mandeville and Aylesbury and the Waddesdon and Quainton areas southwards to the Dunsmore, Wendover and Halton area along the construction corridor.

11.2.7   Sustainable placement of inert surplus excavated material will be used where the material cannot be reused beneficially along or locally beyond the route and where it cannot be removed by either rail or along the construction corridor. An area of sustainable placement, near Hunt's Green Farm, will be used within the Dunsmore, Wendover and Halton area to permanently dispose of surplus excavated material generated in the Central Chilterns area from the Proposed Scheme to avoid causing significant environmental effects associated with the road transport of that material. Further detail can be found in Volume 3, Section 14.

Demolition material and waste quantities

11.2.8   Types of building demolitions required within the Dunsmore, Wendover and Halton area are listed in Table 39 together with estimated demolition material quantities.

11.2.9   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[70], using the basic dimensions and typology of buildings.

11.2.10   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 39). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 39: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	4,386	439
Industrial Units	0	0
Commercial Property	4,691	469
Residential Property	1,880	188
Community Amenities	225	22

[70] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Railways	455	46
Highways	0	0
TOTAL	**11,637**	**1,164**

Construction waste quantities

11.2.11 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[71]. The construction waste forecast for the Dunsmore, Wendover and Halton area is given in Table 40.

11.2.12 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 40). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 40: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	7,353	735
Retaining walls	0	0
Bridges	4,195	420
Viaducts	10,596	1,060
Roadworks	839	84
Footpaths/tracks	515	52
Railworks	0	0
Watercourse diversions	117	12
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	17,771	1,777
Ventilation shafts	0	0

[71] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Other structures	0	0
Railway systems waste	220	22
TOTAL	41,606	4,161

Worker accommodation site waste quantities

11.2.13　Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

11.2.14　Forecast waste quantities over the duration of the construction period are shown in Table 411.

11.2.15　A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 411). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 41: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Small Dean Viaduct Main Compound (Average no. of workers)	168	51	266	133
TOTAL	-	-	266	133

11.3　Operation

Forecast of waste quantities

11.3.1　Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 42.

11.3.2　Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[72].

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[72] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

11.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

11.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[73].

Table 42: Operational waste forecast for the Proposed Scheme

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

11.3.5   Railway station and train waste has not been reported in Table 42 as there will not be any railway stations in the Dunsmore, Wendover and Halton area. Although waste will be generated by passengers on trains travelling through the Dunsmore, Wendover and Halton area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 42.

11.3.6   Rolling stock maintenance waste has not been reported in Table 42 as there will not be any rolling stock maintenance depots in the Dunsmore, Wendover and Halton area.

11.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Dunsmore, Wendover and Halton area is shown in Table 42.

11.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 142 tonnes of operational waste annually in the Dunsmore, Wendover and Halton area when it becomes fully operational in 2026, of which 118 tonnes (83%) will be diverted from landfill.

11.3.9   The Proposed Scheme in the Dunsmore, Wendover and Halton area will generate an overall operational landfill disposal requirement of 24 tonnes per annum.

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[73] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

12 Stoke Mandeville and Aylesbury (CFA 11)

12.1 Local assumptions and limitations

Assumptions

12.1.1 There are no local assumptions specific to the Stoke Mandeville and Aylesbury area.

Limitations

12.1.2 There are no local limitations specific to the Stoke Mandeville and Aylesbury area.

12.2 Construction

Forecast of material and waste quantities

Excavated material quantities

12.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,841,551 tonnes of excavated material within the Stoke Mandeville and Aylesbury area, as shown in Table 43.

12.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14 along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 43.

Table 43: Forecast excavated material quantities

Excavated material types[74]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[75]
Selected fill	156,366	N/A
General engineering fill	1,787,998	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	539,873	N/A
Agricultural subsoil	335,151	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	22,163	22,163
TOTAL	**2,841,551**	**22,163**

12.2.3 The majority of excavated material that will be generated in Stoke Mandeville and Aylesbury area is expected to be suitable for beneficial reuse as engineering fill

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[74] 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.
[75] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

12.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

12.2.5   The construction of the Proposed Scheme within the Stoke Mandeville and Aylesbury area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

12.2.6   No overall excess or shortfall is anticipated for this part of the route, fill materials are anticipated to be transported from the Dunsmore, Wendover and Halton area northwards along the construction corridor and southwards from the Waddesdon and Quainton area along the construction corridor.

12.2.7   A proportion of the excavated material in the Stoke Mandeville and Aylesbury area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[76]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

12.2.8   Types of building demolitions required within the Stoke Mandeville and Aylesbury area are listed in Table 44 together with estimated demolition material quantities.

12.2.9   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[77], using the basic dimensions and typology of buildings.

12.2.10   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 44). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 44: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	1,253	125
Industrial Units	0	0
Commercial Property	489	49
Residential Property	1,509	151
Community Amenities	0	0
Railways	0	0

[76] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[77] Waste & Resources Action Programme. Net Waste Tool. Available at: http://nwtool.wrap.org.uk/ [Accessed 5 November 2012].

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Highways	0	0
TOTAL	**3,251**	**325**

Construction waste quantities

12.2.11 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[78]. The construction waste forecast for Stoke Mandeville and Aylesbury area is given in Table 45.

12.2.12 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 45). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 45: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	12,742	1,274
Retaining walls	0	0
Bridges	7,633	763
Viaducts	7,191	719
Roadworks	300	30
Footpaths/tracks	181	18
Railworks	0	0
Watercourse diversions	317	32
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	0	0
Ventilation shafts	0	0
Other structures	1,252	125
Railway systems waste	150	15

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[78] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
TOTAL	29,766	2,977

Worker accommodation site waste quantities

12.2.13 Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

12.2.14 Forecast waste quantities over the duration of the construction period are shown in Table 416.

12.2.15 A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 416). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 46: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
A41 Bicester Road Embankment Main Compound (Average no. of workers)	62	42	78	39
TOTAL	-	-	78	39

12.3 Operation

Forecast of waste quantities

12.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 47.

12.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[79].

12.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

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[79] British Standards Institution, (December 2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

12.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[80].

Table 47: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	173	26
Ancillary infrastructure	15	6
TOTAL	**188**	**32**

12.3.5   Railway station and train waste has not been reported in Table 47 as there will not be any railway stations in the Stoke Mandeville and Aylesbury area. Although waste will be generated by passengers on trains travelling through the Stoke Mandeville and Aylesbury area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 47.

12.3.6   Rolling stock maintenance waste has not been reported in Table 47 as there will not be any rolling stock maintenance depots in the Stoke Mandeville and Aylesbury area.

12.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Stoke Mandeville and Aylesbury area is shown in Table 47.

12.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 188 tonnes of operational waste annually in the Stoke Mandeville and Aylesbury area when it becomes fully operational in 2026, of which 156 tonnes (83%) will be diverted from landfill.

12.3.9   The Proposed Scheme in the Stoke Mandeville and Aylesbury area will generate an overall operational landfill disposal requirement of 32 tonnes per annum.

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[80] ARUP/URS, (2013), *HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.*

13 Waddesdon and Quainton (CFA 12)

13.1 Local assumptions and limitations

Assumptions

13.1.1 There are no local assumptions specific to the Waddesdon and Quainton area.

Limitations

13.1.2 There are no local limitations specific to the Waddesdon and Quainton area.

13.2 Construction

Forecast of material and waste quantities

Excavated material quantities

13.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,844,890 tonnes of excavated material within the Waddesdon and Quainton area, as shown in Table 48.

13.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 48.

Table 48: Forecast excavated material quantities

Excavated material types[81]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[82]
Selected fill	0	N/A
General engineering fill	2,398,426	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	446,464	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**2,844,890**	**0**

13.2.3 The majority of excavated material that will be generated in Waddesdon and Quainton area is expected to be suitable for beneficial reuse as engineering fill

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[81] 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.
[82] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for re-use with the Proposed Scheme.

material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

13.2.4   The construction of the Proposed Scheme within the Waddesdon and Quainton area will also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

13.2.5   Excess excavation materials from areas to the north of the Waddesdon and Quainton area are anticipated to be transported southwards along the construction corridor. Excess excavation materials from Waddesdon and Quainton will be transported southward in the same fashion. No overall excess or shortfall is anticipated for this part of the route.

13.2.6   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

Demolition material and waste quantities

13.2.7   Types of building demolitions required within the Waddesdon and Quainton area are listed in Table 49 together with estimated demolition material quantities.

13.2.8   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[83], using the basic dimensions and typology of buildings.

13.2.9   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 49). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 49: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	8,121	812
Industrial Units	0	0
Commercial Property	1,887	189
Residential Property	316	32
Community Amenities	0	0
Railways	0	0
Highways	1,365	136
TOTAL	**11,689**	**1,169**

Construction waste quantities

13.2.10   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment

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[83] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Ltd[84]. The construction waste forecast for Waddesdon and Quainton area is given in Table 50.

13.2.11   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 50). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 50: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	31,281	3,128
Retaining walls	0	0
Bridges	9,709	971
Viaducts	0	0
Roadworks	4,847	485
Footpaths/tracks	51	5
Railworks	0	0
Watercourse diversions	546	55
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	0	0
Ventilation shafts	0	0
Other structures	0	0
Railway systems waste	250	25
TOTAL	**46,684**	**4,669**

Worker accommodation site waste quantities

13.2.12   There will not be any worker accommodation sites in the Waddesdon and Quainton area and therefore no waste will be generated from this source.

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[84] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

13.3   Operation

Forecast of waste quantities

13.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 51.

13.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[85].

13.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

13.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[86].

Table 51: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	166	25
Ancillary infrastructure	14	6
TOTAL	180	31

13.3.5   Railway station and train waste has not been reported in Table 51 as there will not be any railway stations in the Waddesdon and Quainton area. Although waste will be generated by passengers on trains travelling through Waddesdon and Quainton area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 51.

13.3.6   Rolling stock maintenance waste has not been reported in Table 51 as there will not be any rolling stock maintenance depots in the Waddesdon and Quainton area.

13.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary

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[85] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[86] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

infrastructure waste generation for the Waddesdon and Quainton area is shown in Table 51.

13.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 180 tonnes of operational waste annually in the Waddesdon and Quainton area when it becomes fully operational in 2026, of which 149 tonnes (83%) will be diverted from landfill.

13.3.9   The Proposed Scheme in the Waddesdon and Quainton area will generate an overall operational landfill disposal requirement of 31 tonnes per annum.

14 Calvert, Steeple Clayton, Tywford and Chetwode (CFA 13)

14.1 Local assumptions and limitations

Assumptions

14.1.1   There are no local assumptions specific to the Calvert, Steeple Clayton, Twyford and Chetwode area.

Limitations

14.1.2   There are no local limitations specific to the Calvert, Steeple Clayton, Twyford and Chetwode area.

14.2 Construction

Forecast of material and waste quantities

Excavated material quantities

14.2.1   Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 6,372,406 tonnes of excavated material within the Calvert, Steeple Clayton, Twyford and Chetwode area, as shown in Table 52.

14.2.2   The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for re-use within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 52.

Table 52: Forecast excavated material quantities

Excavated material types[87]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[88]
Selected fill	132,964	N/A
General engineering fill	5,047, 230	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	939,897	N/A
Agricultural subsoil	237,543	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	14,772	14,772

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[87] 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.
[88] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for re-use with the Proposed Scheme.

Excavated material types[87]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[88]
TOTAL	6,372,406	14,772

14.2.3   The majority of excavated material that will be generated in Calvert, Steeple Clayton, Twyford and Chetwode area is expected to be suitable for beneficial re-use as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

14.2.4   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

14.2.5   The construction of the Proposed Scheme within the Calvert, Steeple Clayton, Twyford and Chetwode area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route

14.2.6   Excess excavated material from areas to the north are anticipated to be transported southwards to this area along the construction corridor. Shortfalls will be met by importing material into Calvert rail-head from the London Metropolitan section for subsequent haulage either northwards or southwards along the construction corridor or southwards via the road network to Calvert Sustainable Placement Area.

14.2.7   A proportion of the excavated material in the Calvert, Steeple Clayton, Twyford and Chetwode area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[89]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

14.2.8   An area of sustainable placement will be used within the Calvert, Steeple Clayton, Twyford and Chetwode area to permanently dispose of surplus excavated material generated from bored tunnels in the London Metropolitan area. This material will be moved off-site by rail as the location at which this surplus excavated material arises and the volumes generated make road transportation impracticable. It will therefore be most efficient to take this material to a rail-connected disposal site. The continuous (i.e. 24 hour, 7 day per week) bored tunnelling activities in the London Metropolitan area require that any disposal site must provide certainty that the quantity of surplus excavated material generated can be moved at the rate at which it is produced. A sustainable placement area within the Calvert, Steeple Claydon, Twyford and Chetwode area can provide this certainty, and capture the environmental benefits associated with the sustainable placement of surplus excavated material moved by rail. Further detail can be found in Volume 3, Section 14.

Demolition material and waste quantities

14.2.9   Types of building demolitions required within the Calvert, Steeple Clayton, Twyford and Chetwode area are listed in Table 53 together with estimated demolition material quantities.

[89] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).

14.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[90], using the basic dimensions and typology of buildings.

14.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 53). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 53: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	597	60
Industrial Units	0	0
Commercial Property	14,545	1,454
Residential Property	3,220	322
Community Amenities	4,270	427
Highways	1,820	182
Railways	910	91
TOTAL	**25,363**	**2,536**

Construction waste quantities

14.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[91]. The construction waste forecast for Calvert, Steeple Clayton, Twyford and Chetwode area is given in Table 54.

14.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 54). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 54: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	13,982	1,398
Retaining walls	869	87
Bridges	15,248	1,525
Viaducts	3,060	306

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[90] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].
[91] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Roadworks	39,203	3,920
Footpaths/tracks	213	21
Railworks	0	0
Watercourse diversions	229	23
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	0	0
Ventilation shafts	0	0
Stations	0	0
Other structures	4,306	431
Railway systems	21,101	2,110
TOTAL	**98,211**	**9,821**

Worker accommodation site waste quantities

14.2.14   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

14.2.15   Forecast waste quantities over the duration of the construction period are shown in Table 55.

14.2.16   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 55). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 55: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
West Street Overbridge Main Compound (Average no. of workers)	65	81	163	82

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Total	-	-	163	82

14.3 Operation

Forecast of waste quantities

14.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 56.

14.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005.[92]

14.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

14.3.4 The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[93]

Table 56: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	167	25
Ancillary infrastructure	14	6
TOTAL	181	31

14.3.5 Railway station and train waste has not been reported in Table 56 as there will not be any railway stations in the Calvert, Steeple Clayton, Twyford and Chetwode area. Although waste will be generated by passengers on trains travelling through the Calvert, Steeple Clayton, Twyford and Chetwode area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 56.

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[92] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.
[93] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

14.3.6   Rolling stock maintenance waste has not been reported in Table 56 as there will not be any rolling stock maintenance depots in the Calvert, Steeple Clayton, Twyford and Chetwode area.

14.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Calvert, Steeple Clayton, Twyford and Chetwode area is shown in Table 56.

14.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 181 tonnes of operational waste annually in the Calvert, Steeple Clayton, Twyford and Chetwode area when it becomes fully operational in 2026, of which 150 tonnes (83%) will be diverted from landfill.

14.3.9   The Proposed Scheme in the Calvert, Steeple Clayton, Twyford and Chetwode area will generate an overall operational landfill disposal requirement of 31 tonnes per annum.

15 Newton Purcell to Brackley (CFA 14)

15.1 Local assumptions and limitations

Assumptions

15.1.1 There are no local assumptions specific to the Newton Purcell to Brackley area.

Limitations

15.1.2 There are no local limitations specific to the Newton Purcell to Brackley area.

15.2 Construction

Forecast of material and waste quantities

Excavated material quantities

15.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 9,913,441 tonnes of excavated material within the Newton Purcell to Brackley area, as shown in Table 57.

15.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 57.

Table 57: Forecast excavated material quantities

Excavated material types[94]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[95]
Selected fill	6,174,723	N/A
General engineering fill	2,410,833	N/A
Environmental mitigation earthworks fill	0	N/A
Topsoil	718,648	N/A
Agricultural subsoil	456,609	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	152,628	152,628
TOTAL	**9,913,441**	**152,628**

15.2.3 The majority of excavated material that will be generated in Newton Purcell to Brackley area is expected to be suitable for beneficial reuse as engineering fill material

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[94] 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.
[95] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

15.2.4   The construction of the Proposed Scheme within the Newton Purcell to Brackley area will also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

15.2.5   Excess excavated material from areas to the north are anticipated to be transported southwards to the Newton Purcell to Brackley area along the construction corridor. Selected types of excess excavated material from the Newton Purcell to Brackley area will be transported southwards along the construction corridor for use in other areas or for transfer via the closest suitable roadhead for onward transport.

15.2.6   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

15.2.7   A proportion of the excavated material in the Newton Purcell to Brackley area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2).[96] As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

15.2.8   Types of building demolitions required within the Newton Purcell to Brackley area are listed in Table 58 together with estimated demolition material quantities.

15.2.9   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[97], using the basic dimensions and typology of buildings.

15.2.10   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 58). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 58: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	4,010	401
Industrial Units	0	0
Commercial Property	10,408	1,041
Residential Property	860	86
Community Amenities	0	0
Railways	0	0

[96] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[97] Waste & Resources Action Programme. Net Waste Tool. Available at: <http://nwtool.wrap.org.uk/> [Accessed 5 November 2012].

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Highways	910	91
TOTAL	**16,188**	**1,619**

Construction waste quantities

15.2.11 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[98]. The construction waste forecast for the Newton Purcell to Brackley area is given in Table 59.

15.2.12 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 59). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 59: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	19,430	1,943
Retaining walls	0	0
Bridges	18,485	1,849
Viaducts	5,320	532
Roadworks	0	0
Footpaths/tracks	93	9
Railworks	0	0
Watercourse diversions	118	12
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	0	0
Ventilation shafts	0	0
Other structures	0	0
Railway systems	90	9

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[98] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
TOTAL	43,536	4,354

Worker accommodation site waste quantities

15.2.13   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

15.2.14   Forecast waste quantities over the duration of the construction period are shown in Table 60.

15.2.15   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 60). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 60: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Brackley South Cutting Main Compound (Average no. of workers)	105	66	215	108
TOTAL	-	-	215	108

15.3   Operation

Forecast of waste quantities

15.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see 61.

15.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[99].

15.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

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[99] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

15.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecasting and assessment methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2)[100].

Table 61: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	195	29
Ancillary infrastructure	16	7
TOTAL	**211**	**36**

15.3.5   Railway station and train waste has not been reported in Table 61 as there will not be any railway stations in the Newton Purcell to Brackley area. Although waste will be generated by passengers on trains travelling through Newton Purcell to Brackley area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 61.

15.3.6   Rolling stock maintenance waste has not been reported in Table 61**Error! Reference source not found.** as there will not be any rolling stock maintenance depots in the Newton Purcell to Brackley area.

15.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Newton Purcell to Brackley area is shown in Table 61.

15.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 211 tonnes of operational waste annually in the Newton Purcell to Brackley area when it becomes fully operational in 2026, of which 175 tonnes (83%) will be diverted from landfill.

15.3.9   The Proposed Scheme in the Newton Purcell to Brackley area will generate an overall operational landfill disposal requirement of 36 tonnes per annum.

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[100] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

16 Greatworth to Lower Boddington (CFA 15)

16.1 Local assumptions and limitations

Assumptions

16.1.1 There are no local assumptions specific to the Greatworth to Lower Boddington area.

Limitations

16.1.2 There are no local limitations specific to the Greatworth to Lower Boddington area.

16.2 Construction

Forecast of material and waste quantities

Excavated material quantities

16.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 16,200,444 tonnes of excavated material within the Greatworth to Lower Boddington area, as shown in 62.

16.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2 which is unsuitable for reuse, within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14 along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 62.

Table 62: Forecast excavated material quantities

Excavated material types[101]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[102]
Selected fill	3,820,098	N/A
General engineering fill	9,136,230	N/A
Environmental mitigation earthworks fill	1,110,679	N/A
Topsoil	1,169,874	N/A
Agricultural subsoil	963,564	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**16,200,445**	**0**

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[101] 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.
[102] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

16.2.3   The majority of excavated material that will be generated in the Greatworth to Lower Boddington area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme either within this area or elsewhere along the route.

16.2.4   The construction of the Proposed Scheme within the Greatworth to Lower Boddington area will also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

16.2.5   No overall excess or shortfall is anticipated for this part of the route, fill materials from the northern end of the Greatworth to Lower Boddington area are anticipated to be transported southwards along the construction corridor in this area. Excess excavation materials from the south of the Greatworth to Lower Boddington area are anticipated to be transported northwards. No overall excess or shortfall is anticipated for this part of the route.

16.2.6   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

Demolition material and waste quantities

16.2.7   Types of building demolitions required within the Greatworth to Lower Boddington area are listed in Table 63 together with estimated demolition material quantities.

16.2.8   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[103], using the basic dimensions and typology of buildings.

16.2.9   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 63). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 63: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Industrial Units	0	0
Commercial Property	32,832	3,283
Residential Property	6,386	639
Community Amenities	0	0
Railways	0	0
Highways	0	0
TOTAL	**39,218**	**3,922**

[103] Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed: 5 November 2012.

Construction waste quantities

16.2.10 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[104]. The construction waste forecast for the Greatworth to Lower Boddington area is given in Table 64.

16.2.11 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 64). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 64: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	21,149	2,115
Retaining walls	2,965	296
Bridges	5,089	509
Viaducts	7,966	797
Roadworks	947	95
Footpaths/tracks	369	37
Railworks	0	0
Watercourse diversions	634	63
Fencing	0	0
Drainage	0	0
Landscaping	0	0
Utilities	0	0
Construction compound	0	0
Tunnels	73,075	7,307
Ventilation shafts	0	0
Other structures	0	0
Railway systems waste	410	41
TOTAL	**112,604**	**11,260**

Worker accommodation site waste quantities

16.2.12 Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per month, according to the number of workers to be accommodated and the duration of occupation. This waste generation rate was

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[104] BRE Ltd, February 2013. Construction waste benchmarks for railway projects.

derived from the average annual household waste generation in the UK of 466kg/person in 2009/10, and has been adjusted assuming an average working week of five and a half days.

16.2.13   Forecast waste quantities over the duration of the construction period are shown in Table 65.

16.2.14   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 65). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 65: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Chipping Warden Green Tunnel Main Compound (Average no. of workers)	109	63	213	107
Total	-	-	213	107

16.3   Operation

Forecast of waste quantities

16.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 66.

16.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[105].

16.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

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

16.3.4   The rationale for each of these landfill diversion rates is provided in the Technical Note - Waste Forecasting and Assessment Methodology which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).[106]

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[105] British Standards Institution (December 2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

Table 66: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	279	42
Ancillary infrastructure	23	9
TOTAL	302	51

16.3.5   Railway station and train waste has not been reported in Table 66 as there will not be any railway stations in the Greatworth to Lower Boddington area. Although waste will be generated by passengers on trains travelling through the Greatworth to Lower Boddington area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 66.

16.3.6   Rolling stock maintenance waste has not been reported in Table 66**Error! Reference source not found.** as there will not be any rolling stock maintenance depots in the Greatworth to Lower Boddington area.

16.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Greatworth to Lower Boddington area is shown in Table 66.

16.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 302 tonnes of operational waste annually in the Greatworth to Lower Boddington area when it becomes fully operational in 2026, of which 251 tonnes (83%) will be diverted from landfill.

16.3.9   The Proposed Scheme in the Greatworth to Lower Boddington area will generate an overall operational landfill disposal requirement of 51 tonnes per annum.

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[106] ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

17   Ladbroke and Southam (CFA 16)

17.1   Local assumptions and limitations

Assumptions

17.1.1   There are no local assumptions specific to the Ladbroke and Southam area.

Limitations

17.1.2   There are no local limitations specific to the Ladbroke and Southam area.

17.2   Construction

Forecast of materials and waste quantities

Excavated material quantities

17.2.1   Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 9,037,559 tonnes of excavated material within the Ladbroke and Southam area, as shown in Table 67.

17.2.2   The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 67.

Table 67: Forecast excavated material quantities

Excavated material types[107]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[108]
Selected fill	0	N/A
General engineering fill	2,046,500	N/A
Environmental mitigation earthworks fill	5,430,492	N/A
Topsoil	922,031	N/A
Agricultural subsoil	562,995	N/A
Unacceptable material Class U1A	33,830	N/A
Unacceptable material Class U1B	41,711	0
Unacceptable material Class U2	0	0
TOTAL	**9,037,559**	**0**

17.2.3   The majority of excavated material that will be generated in the Ladbroke and Southam area is expected to be suitable for beneficial reuse as engineering fill material or in the

[107] 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.
[108] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for re-use with the Proposed Scheme.

environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

17.2.4   The construction of the Proposed Scheme within the Ladbroke and Southam area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

17.2.5   Within the Ladbroke and Southam area there is an excess of selected types of excavated material, which are expected to be used in the Offchurch and Cubbington area, Stoneleigh, Kenilworth and Burton Green area. There is also a shortfall of selected types of excavated material in the Ladbroke and Southam area, which will be balanced with excess excavated material from, for example, the Offchurch and Cubbington area, and Greatworth to Lower Boddington area.

17.2.6   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

17.2.7   Excavated material falling into the unacceptable material classes U1A and U1B[109] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

17.2.8   Types of building demolitions required within the Ladbroke and Southam area are listed in Table 68 together with estimated demolition material quantities.

17.2.9   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[110], using the basic dimensions and typology of buildings.

17.2.10   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 68). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 68: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Non-residential property (industrial units and commercial property)	16,304	1,630
Residential property	588	59
Community amenities	0	0
Highways	0	0
TOTAL	**16,892**	**1,689**

[109] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[110] Waste and Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Construction waste quantities

17.2.11   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[111]. The construction waste forecast for the Ladbroke and Southam area is given in Table 69.

17.2.12   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 69). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 69: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	2,834	283
Viaducts	5,402	540
Roadworks	1,242	124
River diversions	112	11
Fencing	0	0
Drainage	2,835	284
Landscaping	0	0
Depots	0	0
Utilities	280	28
Tunnels	26,918	2,692
Ancillaries	898	90
TOTAL	**40,521**	**4,052**

Worker accommodation site waste quantities

17.2.13   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

17.2.14   Forecast waste quantities over the duration of the construction period are shown in Table 70.

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[111] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

17.2.15   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 70). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 70: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Lower Radbourne Compound	33	59	60	30
Long Itchington Wood Compound	30	49	46	23
TOTAL	**63**	**108**	**106**	53

17.3   Operation

Forecast of waste quantities

17.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 71.

17.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[112].

17.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

17.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 71: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0

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[112] British Standards Institution (2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Rolling stock maintenance	0	0
Track maintenance	259	39
Ancillary infrastructure	22	9
TOTAL	**281**	**48**

17.3.5   Railway station and train waste has not been reported in Table 71 as there will not be any railway stations in the Ladbroke and Southam area. Although waste will be generated by passengers on trains travelling through the Ladbroke and Southam area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 71.

17.3.6   Rolling stock maintenance waste has not been reported in Table 71 as there will not be any rolling stock maintenance depots in the Ladbroke and Southam area.

17.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Ladbroke and Southam area is shown in Table 71.

17.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 281 tonnes of operational waste annually in the Ladbroke and Southam area when it becomes fully operational in 2026, of which 233 tonnes (83%) will be diverted from landfill.

17.3.9   The Proposed Scheme in the Ladbroke and Southam area will generate an overall operational landfill disposal requirement of 48 tonnes per annum.

18 Offchurch and Cubbington (CFA 17)

18.1 Local assumptions and limitations

Assumptions

18.1.1 There are no local assumptions specific to the Offchurch and Cubbington area.

Limitations

18.1.2 There are no local limitations specific to the Offchurch and Cubbington area.

18.2 Construction

Forecast of material and waste quantities

Excavated material quantities

18.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 6,497,354tonnes of excavated material within the Offchurch and Cubbington area, as shown in Table 72.

18.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 72.

Table 72: Forecast excavated material quantities

Excavated material types[113]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[114]
Selected fill	799,508	N/A
General engineering fill	4,388,470	N/A
Environmental mitigation earthworks fill	192,639	N/A
Topsoil	589,162	N/A
Agricultural subsoil	331,839	N/A
Unacceptable material Class U1A	129,102	N/A
Unacceptable material Class U1B	66,634	0
Unacceptable material Class U2	0	0
TOTAL	**6,497,354**	**0**

18.2.3 The majority of excavated material that will be generated in the Offchurch and Cubbington area is expected to be suitable for beneficial reuse as engineering fill

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[113] 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.
[114] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

18.2.4   The construction of the Proposed Scheme within the Offchurch and Cubbington area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

18.2.5   An excess of selected types of excavated material will be generated in the Offchurch and Cubbington area. This is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme within the Ladbroke and Southam area, and Stoneleigh, Kenilworth and Burton Green area.

18.2.6   The construction of the Proposed Scheme within the Offchurch and Cubbington area may also be able to beneficially incorporate selected types of excess excavated material from the Ladbroke and Southam area, and Stoneleigh, Kenilworth and Burton Green area.

18.2.7   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

18.2.8   Excavated material falling into the unacceptable material classes U1A and U1B[115] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

18.2.9   Building demolition material quantities have not been reported as there will not be any demolition works in the Offchurch and Cubbington area.

Construction waste quantities

18.2.10   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[116]. The construction waste forecast for the Offchurch and Cubbington area is given in Table 73.

18.2.11   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 73). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 73: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0

[115] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[116] British Standards Institution (2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Retaining walls	10,482	1,048
Bridges	2,345	235
Viaducts	1,224	122
Roadworks	1,321	132
River diversions	28	3
Fencing	0	0
Drainage	1,460	146
Landscaping	0	0
Depots	0	0
Utilities	40	4
Tunnels	0	0
Ancillaries	216	22
TOTAL	**17,116**	**1,712**

Worker accommodation site waste quantities

18.2.12 Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

18.2.13 Forecast waste quantities over the duration of the construction period are shown in Table 74.

18.2.14 A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 74). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 74: Forecast waste quantities from worker accommodation site

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Fosse Way Compound	23	62	44	22
TOTAL	**23**	**62**	**44**	**22**

18.3   Operation

Forecast of waste quantities

18.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 75.

18.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[117].

18.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

18.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 75: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	123	18
Ancillary infrastructure	10	4
TOTAL	**133**	**22**

18.3.5   Railway station and train waste has not been reported in Table 75 as there will not be any railway stations in the Offchurch and Cubbington area. Although waste will be generated by passengers on trains travelling through the Offchurch and Cubbington area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 75.

18.3.6   Rolling stock maintenance waste has not been reported in Table 75 as there will not be any rolling stock maintenance depots in the Offchurch and Cubbington area.

18.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been

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[117] British Standards Institution (2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Offchurch and Cubbington area is shown in Table 75.

18.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 133 tonnes of operational waste annually in the Offchurch and Cubbington area when it becomes fully operational in 2026, of which 111 tonnes (83%) will be diverted from landfill.

18.3.9   The Proposed Scheme in the Offchurch and Cubbington area will generate an overall operational landfill disposal requirement of 22 tonnes per annum.

19 Stoneleigh, Kenilworth and Burton Green (CFA 18)

19.1 Local assumptions and limitations

Assumptions

19.1.1 There are no local assumptions specific to the Stoneleigh, Kenilworth and Burton Green area.

Limitations

19.1.2 There are no local limitations specific to the Stoneleigh, Kenilworth and Burton Green area.

19.2 Construction

Forecast of material and waste quantities

Excavated material quantities

19.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 7,187,325 tonnes of excavated material within the Stoneleigh, Kenilworth and Burton Green area, as shown in Table 76.

19.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 76.

Table 76: Forecast excavated material quantities

Excavated material types[118]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[119]
Selected fill	614,374	N/A
General engineering fill	5,577,318	N/A
Environmental mitigation earthworks fill	70,871	N/A
Topsoil	698,900	N/A
Agricultural subsoil	117,102	N/A
Unacceptable material Class U1A	39,910	N/A
Unacceptable material Class U1B	68,850	0
Unacceptable material Class U2	0	0
TOTAL	**7,187,325**	**0**

[118] 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.
[119] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

19.2.3   The majority of excavated material that will be generated in the Stoneleigh, Kenilworth and Burton Green area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

19.2.4   The construction of the Proposed Scheme within the Stoneleigh, Kenilworth and Burton Green area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

19.2.5   An excess of selected types of excavated material will be generated in the Stoneleigh, Kenilworth and Burton Green area. This is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme within the Offchurch and Cubbington area, Balsall Common and Hampton in Arden, and Washwood Heath to Curzon Street area.

19.2.6   The construction of the Proposed Scheme within the Stoneleigh, Kenilworth and Burton Green area may also be able to beneficially incorporate selected types of excess excavated material from the Ladbroke and Southam area, Offchurch and Cubbington area, and Washwood Heath to Curzon Street area.

19.2.7   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

19.2.8   Excavated material falling into the unacceptable material classes U1A and U1B[120] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

19.2.9   Types of building demolitions required within the Stoneleigh, Kenilworth and Burton Green area are listed in Table 77 together with estimated demolition material quantities.

19.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[121], using the basic dimensions and typology of buildings.

19.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 77). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 77: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0

[120] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[121] Waste and Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Non-residential property (industrial units and commercial property)	10,067	1,007
Residential property	8,078	808
Community amenities	1,254	125
Highways	460	46
TOTAL	**19,859**	**1,986**

Construction waste quantities

19.2.12 Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[122]. The construction waste forecast for the Stoneleigh, Kenilworth and Burton Green area is given in Table 78.

19.2.13 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 78). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 78: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	21,398	2,140
Bridges	4,871	487
Viaducts	2,775	277
Roadworks	2,058	206
River diversions	95	10
Fencing	0	0
Drainage	2,462	246
Landscaping	0	0
Depots	0	0
Utilities	320	32
Tunnels	7,631	763
Track equipment	612	61
Ancillaries	2,621	262

[122] Building Research Establishment Ltd (2013), Construction Waste Benchmarks for Railway Projects.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
TOTAL	44,843	4,484

Worker accommodation site waste quantities

19.2.14 Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

19.2.15 Forecast waste quantities over the duration of the construction period are shown in Table 79.

19.2.16 A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 79). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 79: Forecast waste quantities from worker accommodation site

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Coventry Road Compound	26	63	51	26
TOTAL	26	63	51	26

19.3 Operation

Forecast of waste quantities

19.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 80.

19.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[123].

19.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

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[123] British Standards Institution (2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

- ancillary infrastructure: 60%.

19.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 80: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	183	27
Ancillary infrastructure	15	6
TOTAL	**198**	33

19.3.5   Railway station and train waste has not been reported in Table 80 as there will not be any railway stations in the Stoneleigh, Kenilworth and Burton Green area. Although waste will be generated by passengers on trains travelling through the Stoneleigh, Kenilworth and Burton Green area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 80.

19.3.6   Rolling stock maintenance waste has not been reported in Table 80 as there will not be any rolling stock maintenance depots in the Stoneleigh, Kenilworth and Burton Green area.

19.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Stoneleigh, Kenilworth and Burton Green area is shown in Table 80.

19.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 198 tonnes of operational waste annually in the Stoneleigh, Kenilworth and Burton Green area when it becomes fully operational in 2026, of which 165 tonnes (83%) will be diverted from landfill.

19.3.9   The Proposed Scheme in the Stoneleigh, Kenilworth and Burton Green area will generate an overall operational landfill disposal requirement of 33 tonnes per annum.

20 Coleshill Junction (CFA 19)

20.1 Local assumptions and limitations

Assumptions

20.1.1 There are no local assumptions specific to the Coleshill Junction area.

Limitations

20.1.2 There are no local limitations specific to the Coleshill Junction area.

20.2 Construction

Forecast of material and waste quantities

Excavated material quantities

20.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 9,149,821 tonnes of excavated material within the Coleshill Junction area, as shown in Table 81.

20.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 81.

Table 81: Forecast excavated material quantities

Excavated material types[124]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[125]
Selected fill	377,809	N/A
General engineering fill	6,380,462	N/A
Environmental mitigation earthworks fill	1,341,560	N/A
Topsoil	904,877	N/A
Agricultural subsoil	46,651	N/A
Unacceptable material Class U1A	98,462	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**9,149,821**	**0**

20.2.3 The majority of excavated material that will be generated in the Coleshill Junction area is expected to be suitable for beneficial reuse as engineering fill material or in the

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[124] 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.
[125] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

20.2.4 The construction of the Proposed Scheme within the Coleshill Junction area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

20.2.5 Within the Coleshill Junction area there is an excess of selected types of excavated material, which are expected to be used in the Coleshill Junction area. There is also a shortfall of selected types of excavated material in the Coleshill Junction area, which will be balanced with excess excavated material from, for example, the Curdworth to Middleton area.

20.2.6 Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

20.2.7 Excavated material falling into the unacceptable material classes U1A and U1B[126] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

20.2.8 Types of building demolitions required within the Coleshill Junction area are listed in Table 82 together with estimated demolition material quantities.

20.2.9 Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[127], using the basic dimensions and typology of buildings.

20.2.10 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 82). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 82: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Non-residential property (industrial units and commercial property)	37,731	3,773
Residential property	5,668	567
Community amenities	0	0
Highways	0	0
TOTAL	**43,399**	**4,340**

[126] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[127] Waste and Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Construction waste quantities

20.2.11   Construction waste has been forecasted based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from Building Research Establishment Ltd[128]. The construction waste forecast for the Coleshill Junction area is given in Table 83.

20.2.12   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 83). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 83: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	3,354	335
Bridges	6,827	683
Viaducts	50,978	5,098
Roadworks	4,078	408
River diversions	533	53
Fencing	0	0
Drainage	3,124	312
Landscaping	0	0
Depots	0	0
Box structures	13,108	1,311
Rail line	2,905	291
Utilities	60	6
Tunnels	0	0
Ancillaries	2,099	210
TOTAL	**87,066**	**8,707**

Worker accommodation site waste quantities

20.2.13   Worker accommodation site waste has been forecasted based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

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[128] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

20.2.14   Forecasted waste quantities over the duration of the construction period are shown in Table 84.

20.2.15   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 84). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 84: Forecast waste quantities from worker accommodation site

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Coleshill Heath Road Compound	40	61	76	38
TOTAL	40	61	76	38

20.3   Operation

Forecast of waste quantities

20.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 85.

20.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[129].

20.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

20.3.4   The rationale for each of these landfill diversion rates is provided in the Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 85: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0

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[129] British Standards Institution (2005), *BS5906:2006 Waste Management in Buildings – Code of Practice*.

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Rolling stock maintenance	0	0
Track maintenance	305	46
Ancillary infrastructure	26	10
TOTAL	**331**	**56**

20.3.5   Railway station and train waste has not been reported in Table 85 as there will not be any railway stations in the Coleshill Junction area. Although waste will be generated by passengers on trains travelling through the Coleshill Junction area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 85.

20.3.6   Rolling stock maintenance waste has not been reported in Table 85 as there will not be any rolling stock maintenance depots in the Coleshill Junction area.

20.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Coleshill Junction area is shown in Table 85.

20.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 331 tonnes of operational waste annually in the Coleshill Junction area when it becomes fully operational in 2026, of which 275 tonnes (83%) will be diverted from landfill.

20.3.9   The Proposed Scheme in the Coleshill Junction area will generate an overall operational landfill disposal requirement of 56 tonnes per annum.

21 Curdworth to Middleton (CFA 20)

21.1 Local assumptions and limitations

Assumptions

21.1.1 There are no local assumptions specific to the Curdworth to Middleton area.

Limitations

21.1.2 There are no local limitations specific to the Curdworth to Middleton area.

21.2 Construction

Forecast of material and waste quantities

Excavated material quantities

21.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,975,404 tonnes of excavated material within the Curdworth to Middleton area, as shown in Table 86.

21.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 86.

Table 86: Forecast excavated material quantities

Excavated material types[130]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[131]
Selected fill	1,139,496	N/A
General engineering fill	973,254	N/A
Environmental mitigation earthworks fill	27,306	N/A
Topsoil	678,323	N/A
Agricultural subsoil	111,780	N/A
Unacceptable material Class U1A	45,245	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**2,975,404**	**0**

21.2.3 The majority of excavated material that will be generated in the Curdworth to Middleton area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

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[130] 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.
[131] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

21.2.4   The construction of the Proposed Scheme within the Curdworth to Middleton area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

21.2.5   An excess of selected types of excavated material will be generated in the Curdworth to Middleton area. This is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme within the Drayton Bassett, Hints and Weeford area, and Coleshill Junction area.

21.2.6   The construction of the Proposed Scheme within the Curdworth to Middleton area may also be able to beneficially incorporate selected types of excess excavated material from the Drayton Bassett, Hints and Weeford area, Coleshill Junction area, Kilburn (Brent) to Old Oak Common area, and South Ruislip to Ickenham area.

21.2.7   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

21.2.8   Excavated material falling into the unacceptable material classes U1A and U1B[132] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

21.2.9   Types of building demolitions required within the Curdworth to Middleton area are listed in Table 87 together with estimated demolition material quantities.

21.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[133], using the basic dimensions and typology of buildings.

21.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 87). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 87: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Non-residential property (industrial units and commercial property)	18,574	1,857
Residential property	12,240	1,224
Community amenities	0	0
Highways	404	41
TOTAL	**31,218**	**3,122**

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[132] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[133] Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Construction waste quantities

21.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[134]. The construction waste forecast for the Curdworth to Middleton area is given in Table 88.

21.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 88). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 88: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	11,587	1,159
Viaducts	2,734	273
Roadworks	1,579	158
River diversions	24	2
Fencing	0	0
Drainage	2,142	214
Landscaping	0	0
Depots	0	0
Train line	2,905	291
Utilities	310	31
Box structures	2,589	259
Tunnels	0	0
Ancillaries	564	56
TOTAL	**24,434**	**2,443**

Worker accommodation site waste quantities

21.2.14   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

21.2.15   Forecast waste quantities over the duration of the construction period are shown in Table 89.

[134] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

21.2.16   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 89). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 89: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Kingsbury Road Compound	36	57	64	32
TOTAL	36	57	64	32

21.3   Operation

Forecast of waste quantities

21.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 90.

21.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[135].

21.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

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

21.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 90: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0

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[135] British Standards Institution (2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Track maintenance	179	27
Ancillary infrastructure	15	6
TOTAL	**194**	**33**

21.3.5   Railway station and train waste has not been reported in Table 90 as there will not be any railway stations in the Curdworth to Middleton area. Although waste will be generated by passengers on trains travelling through the Curdworth to Middleton area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 90.

21.3.6   Rolling stock maintenance waste has not been reported in Table 90 as there will not be any rolling stock maintenance depots in the Curdworth to Middleton area.

21.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Curdworth to Middleton area is shown in Table 90.

21.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 194 tonnes of operational waste annually in the Curdworth to Middleton area when it becomes fully operational in 2026, of which 161 tonnes (83%) will be diverted from landfill.

21.3.9   The Proposed Scheme in the Curdworth to Middleton area will generate an overall operational landfill disposal requirement of 33 tonnes per annum.

22 Drayton Bassett, Hints and Weeford (CFA 21)

22.1 Local assumptions and limitations

Assumptions

22.1.1 There are no local assumptions specific to the Drayton Bassett, Hints and Weeford area.

Limitations

22.1.2 There are no local limitations specific to the Drayton Bassett, Hints and Weeford area.

22.2 Construction

Forecast of material and waste quantities

Excavated material quantities

22.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 6,610,208 tonnes of excavated material within the Drayton Bassett, Hints and Weeford area, as shown in Table 91.

22.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 91.

Table 91: Forecast excavated material quantities

Excavated material types[136]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[137]
Selected fill	609,463	N/A
General engineering fill	5,252,371	N/A
Environmental mitigation earthworks fill	124,494	N/A
Topsoil	537,571	N/A
Agricultural subsoil	84,391	N/A
Unacceptable material Class U1A	1,918	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**6,610,208**	**0**

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[136] 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.
[137] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

22.2.3   The majority of excavated material that will be generated in the Drayton Bassett, Hints and Weeford area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

22.2.4   The construction of the Proposed Scheme within the Drayton Bassett, Hints and Weeford area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

22.2.5   An excess of selected types of excavated material will be generated in the Drayton Bassett, Hints and Weeford area. This is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme within the Curdworth to Middleton area, and Whittington to Handsacre area.

22.2.6   The construction of the Proposed Scheme within the Drayton Bassett, Hints and Weeford area may also be able to beneficially incorporate selected types of excess excavated material from the Curdworth to Middleton area, and Whittington to Handsacre area.

22.2.7   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

22.2.8   Excavated material falling into the unacceptable material classes U1A and U1B[138] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

22.2.9   Types of building demolitions required within the Drayton Bassett, Hints and Weeford area are listed in Table 92 together with estimated demolition material quantities.

22.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[139], using the basic dimensions and typology of buildings.

22.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 92). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 92: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Non-residential property (industrial units and commercial property)	1,565	157
Residential property	44,193	4,419
Community amenities	0	0

[138] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
[139] Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Highways	0	0
TOTAL	**45,758**	**4,576**

Construction waste quantities

22.2.12　Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[140]. The construction waste forecast for the Drayton Bassett, Hints and Weeford area is given in Table 93.

22.2.13　A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 93). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 93: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	0	0
Bridges	3,070	307
Viaducts	2,684	268
Roadworks	2,034	203
River diversions	297	30
Fencing	0	0
Drainage	1,977	198
Landscaping	0	0
Depots	0	0
Utilities	80	8
Tunnels	54	5
Ancillaries	1,178	118
TOTAL	**11,374**	**1,137**

Worker accommodation site waste quantities

22.2.14　There will not be any worker accommodation sites in the Drayton Bassett Hints and Weeford area and therefore no waste will be generated from this source.

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[140] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

22.3   Operation

Forecast of waste quantities

22.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 94.

22.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[141].

22.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

22.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 94: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	144	22
Ancillary infrastructure	12	5
TOTAL	**156**	**27**

22.3.5   Railway station and train waste has not been reported in Table 94 as there will not be any railway stations in the Drayton Bassett, Hints and Weeford area. Although waste will be generated by passengers on trains travelling through the Drayton Bassett, Hints and Weeford area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 94.

22.3.6   Rolling stock maintenance waste has not been reported in Table 94 as there will not be any rolling stock maintenance depots in the Drayton Bassett, Hints and Weeford area.

22.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported

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[141] British Standards Institution (2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Drayton Bassett, Hints and Weeford area is shown in Table 94.

22.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 156 tonnes of operational waste annually in the Drayton Bassett, Hints and Weeford area when it becomes fully operational in 2026, of which 129 tonnes (83%) will be diverted from landfill.

22.3.9   The Proposed Scheme in the Drayton Bassett, Hints and Weeford area will generate an overall operational landfill disposal requirement of 27 tonnes per annum.

23 Whittington to Handsacre (CFA 22)

23.1 Local assumptions and limitations

Assumptions

23.1.1 There are no local assumptions specific to the Whittington to Handsacre area.

Limitations

23.1.2 There are no local limitations specific to the Whittington to Handsacre area.

23.2 Construction

Forecast of material and waste quantities

Excavated material quantities

23.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,026,575 of excavated material within the Whittington to Handsacre area, as shown in Table 95.

23.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 95.

Table 95: Forecast excavated material quantities

Excavated material types[142]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[143]
Selected fill	311,991	N/A
General engineering fill	988,987	N/A
Environmental mitigation earthworks fill	13,149	N/A
Topsoil	650,727	N/A
Agricultural subsoil	32,612	N/A
Unacceptable material Class U1A	29,109	N/A
Unacceptable material Class U1B	0	0
Unacceptable material Class U2	0	0
TOTAL	**2,026,575**	**0**

23.2.3 The majority of excavated material that will be generated in the Whittington to Handsacre area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

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[142] 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.
[143] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

23.2.4   The construction of the Proposed Scheme within the Whittington to Handsacre area may also be able to beneficially incorporate selected types of excess excavated material from other areas along the route.

23.2.5   An excess of selected types of excavated material will be generated in the Whittington to Handsacre area. This is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme within the Whittington to Handsacre area, and Drayton Bassett, Hints and Weeford area.

23.2.6   The construction of the Proposed Scheme within the Whittington to Handsacre area may also be able to beneficially incorporate selected types of excess excavated material from the Drayton Bassett, Hints and Weeford area, Newton Purcell to Brackley area, Kilburn (Brent) to Old Oak Common area and Calvert, and Steeple Claydon, Twyford and Chetwode area.

23.2.7   Selected fill is a good quality granular material (e.g. limestone), which is suitable for engineering works as well as the environmental mitigation earthworks.

23.2.8   Excavated material falling into the unacceptable material classes U1A and U1B[144] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

Demolition material and waste quantities

23.2.9   Types of building demolitions required within the Whittington to Handsacre area are listed in Table 96 together with estimated demolition material quantities.

23.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[145], using the basic dimensions and typology of buildings.

23.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 96). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 96: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Non-residential property (industrial units and commercial property)	7,952	795
Residential property	8,761	876
Community amenities	0	0
Highways	507	51

[144] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials Sub-Clause 2(ii)(a).
[145] Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
TOTAL	17,220	1,722

Construction waste quantities

23.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[146]. The construction waste forecast for the Whittington to Handsacre area is given in Table 97.

23.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 97). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 97: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	0	0
Retaining walls	671	67
Bridges	1,534	153
Viaducts	11,524	1,152
Roadworks	4,157	416
River diversions	154	15
Fencing	0	0
Drainage	2,438	244
Landscaping	0	0
Depots	0	0
Utilities	230	23
Train line	47,086	4,709
Tunnels	259	26
Ancillaries	1,475	148
TOTAL	69,528	6,953

Worker accommodation site waste quantities

23.2.14   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

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[146] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

23.2.15 Forecast waste quantities over the duration of the construction period are shown in Table 98.

23.2.16 A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 98). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 98: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Cappers Lane Main Compound	29	70	63	32
A515 Lichfield Road underbridge main Compound	30	64	60	30
TOTAL	59	134	123	62

23.3 Operation

Forecast of waste quantities

23.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 99.

23.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[147].

23.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

23.3.4 The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

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[147] British Standards Institution (2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

Table 99: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	244	37
Ancillary infrastructure	20	8
TOTAL	**264**	**45**

23.3.5   Railway station and train waste has not been reported in Table 99 as there will not be any railway stations in the Whittington to Handsacre area. Although waste will be generated by passengers on trains travelling through the Whittington to Handsacre area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 99.

23.3.6   Rolling stock maintenance waste has not been reported in Table 99 as there will not be any rolling stock maintenance depots in the Whittington to Handsacre area.

23.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Whittington to Handsacre area is shown in Table 99.

23.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 264 tonnes of operational waste annually in the Whittington to Handsacre area when it becomes fully operational in 2026, of which 219 tonnes (83%) will be diverted from landfill.

23.3.9   The Proposed Scheme in the Whittington to Handsacre area will generate an overall operational landfill disposal requirement of 45 tonnes per annum.

24 Balsall Common and Hampton in Arden (CFA 23)

24.1 Local assumptions and limitations

Assumptions

24.1.1   There are no local assumptions specific to the Balsall Common and Hampton-in-Arden area.

Limitations

24.1.2   There are no local limitations specific to the Balsall Common and Hampton-in-Arden area.

24.2 Construction

Forecast of material and waste quantities

Excavated material quantities

24.2.1   Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,328,456 tonnes of excavated material within the Balsall Common and Hampton-in-Arden area, as shown in Table 100.

24.2.2   The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14 along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 10000.

Table 100: Forecast excavated material quantities

Excavated material types[148]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[149]
Selected fill	338,089	N/A
General engineering fill	781,132	N/A
Environmental mitigation earthworks fill	504,659	N/A
Topsoil	499,440	N/A
Agricultural subsoil	105,197	N/A
Unacceptable material Class U1A	62,556	N/A
Unacceptable material Class U1B	35,789	0
Unacceptable material Class U2	1,593	1,593

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148 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.
149 Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

Excavated material types[148]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[149]
TOTAL	2,328,455	1,593

24.2.3   The majority of excavated material that will be generated in the Balsall Common and Hampton-in-Arden area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

24.2.4   The construction of the Proposed Scheme within the Balsall Common and Hampton-in-Arden area may be able to beneficially incorporate selected types of excess excavated material from the Offchurch and Cubbington area, the Stoneleigh, Kenilworth and Burton Green area, Birmingham Interchange and Chelmsley Wood area, and the Washwood Heath to Curzon Street area.

24.2.5   There may also be opportunities for selected types of excess excavated material within the Balsall Common and Hampton-in-Arden area to be used within the Coleshill Junction area and the Birmingham Interchange and Chelmsley Wood area.

24.2.6   Selected fill is a good quality granular material (e.g. limestone), which is primarily intended for engineering works.

24.2.7   Excavated material falling into the unacceptable material classes U1A and U1B[150] may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

24.2.8   A proportion of the excavated material in the Balsall Common and Hampton-in-Arden area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2) [151]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

24.2.9   Types of building demolitions required within the Balsall Common and Hampton-in-Arden area are listed in Table 101 together with estimated demolition material quantities.

24.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[152], using the basic dimensions and typology of buildings.

24.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 101). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

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150 Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
151 Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
152 Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Table 101: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	0	0
Non-residential property (industrial units and commercial property)	4,345	435
Residential property	0	0
Community amenities	0	0
Highways	0	0
Railway systems	0	0
TOTAL	**4,345**	**435**

Construction waste quantities

24.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[153]. The construction waste forecast for the Balsall Common and Hampton-in-Arden area is given in Table 102.

24.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 102). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 102: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	9,175	917
Retaining walls	303	30
Bridges	3,540	354
Structures to be incorporated into the works	146	15
Viaducts	4,207	421
Roadworks	3,195	320
River diversions	14	1
Fencing	563	56
Drainage	1,189	119
Landscaping	227	23

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153 Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects, BRE.*

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Depots	0	0
Utilities	8,388	839
Tunnels	0	0
Ancillaries	0	0
Railway systems	60	6
TOTAL	**31,007**	**3,101**

Worker accommodation site waste quantities

24.2.14   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

24.2.15   Forecast waste quantities over the duration of the construction period are shown in Table 103.

24.2.16   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 103). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 103: Forecast waste quantities from worker accommodation sites

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Park Lane Main Office	42	36	47	24
A452 Kenilworth Road Satellite Office	26	50	40	20
TOTAL	-	-	**87**	**44**

24.3   Operation

Forecast of waste quantities

24.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 104.

24.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[154].

24.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

24.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 104: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and train	0	0
Rolling stock maintenance	0	0
Track maintenance	128	19
Ancillary infrastructure	11	4
TOTAL	139	23

24.3.5   Railway station and train waste has not been reported in Table 104 as there will not be any railway stations in the Balsall Common and Hampton-in-Arden area. Although waste will be generated by passengers on trains travelling through the Balsall Common and Hampton-in-Arden area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 104.

24.3.6   Rolling stock maintenance waste has not been reported in Table 104 as there will not be any rolling stock maintenance depots in the Balsall Common and Hampton-in-Arden area.

24.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Balsall Common and Hampton-in-Arden area is shown in Table 104.

24.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 139 tonnes of operational waste annually in the Balsall Common and Hampton-in-Arden area when it becomes fully operational in 2026, of which 116 tonnes (83%) will be diverted from landfill.

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[154] British Standards Institution (2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

24.3.9   The Proposed Scheme in the Balsall Common and Hampton-in-Arden area will generate an overall operational landfill disposal requirement of 23 tonnes per annum.

25 Birmingham Interchange and Chelmsley Wood (CFA 24)

25.1 Local assumptions and limitations

Assumptions

25.1.1 The following assumptions apply to the Birmingham Interchange and Chelmsley Wood area:

- it is assumed that the quantity of waste generated from passengers on the people mover will be insignificant, and any waste generated will be collected and managed along with station waste from the proposed Birmingham Interchange station or Birmingham International railway station; and

- it is assumed that the waste generation rate for a people mover depot will be similar to that for a rolling stock maintenance depot, and as such the methodology for calculating rolling stock maintenance waste has been applied.

Limitations

25.1.2 There are no local limitations specific to the Birmingham Interchange and Chelmsley Wood area.

25.2 Construction

Forecast of material and waste quantities

Excavated material quantities

25.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 2,563,695 tonnes of excavated material within the Birmingham Interchange and Chelmsley Wood area, as shown in Table 105.

25.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2[155], which is unsuitable for re-use within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 105.

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[155] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).

Table 105: Forecast excavated material quantities

Excavated material types[156]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[157]
Selected fill	361,294	N/A
General engineering fill	821,221	N/A
Environmental mitigation earthworks fill	466,607	N/A
Topsoil	658,899	N/A
Agricultural subsoil	1,852	N/A
Unacceptable material Class U1A	34,343	N/A
Unacceptable material Class U1B	217,107	133,503
Unacceptable material Class U2	2,372	2,372
TOTAL	**2,563,695**	**135,875**

25.2.3   The majority of excavated material that will be generated in the Birmingham Interchange and Chelmsley Wood area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

25.2.4   The construction of the Proposed Scheme within the Birmingham Interchange and Chelmsley Wood area may be able to beneficially incorporate selected types of excess excavated material from the Stoneleigh, Kenilworth and Burton Green area, Coleshill Junction area, Balsall Common and Hampton-in-Arden area, the Castle Bromwich and Bromford area and the Washwood Heath to Curzon Street area.

25.2.5   There may also be opportunities for selected types of excess excavated material within the Birmingham Interchange and Chelmsley Wood area to be used within the Coleshill Junction area and the Balsall Common and Hampton-in-Arden area.

25.2.6   Selected fill is a good quality granular material (e.g. limestone), which is primarily intended for engineering works.

25.2.7   Excavated material falling into the unacceptable material classes U1A and U1B may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

25.2.8   A proportion of the excavated material in the Birmingham Interchange and Chelmsley Wood area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2).[158] As a worst case scenario it has been assumed that this material will be disposed of to landfill.

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[156] Department for Transport & Highways Agency (2013). *Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks* [online]. Available at: http://www.dft.gov.uk/ha/standards/mchw/vol1/; [Accessed 26 June 2013].

[157] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for re-use with the Proposed Scheme.

[158] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).

Demolition material and waste quantities

25.2.9   Types of building demolitions required within the Birmingham Interchange and Chelmsley Wood area are listed in Table 106 together with estimated demolition material quantities.

25.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[159], using the basic dimensions and typology of buildings.

25.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 106). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed One).

Table 106: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	1,800	180
Non-residential property (industrial units and commercial property)	6,849	685
Residential property	381	38
Community amenities	0	0
Highways	4,330	433
TOTAL	**13,360**	**1,336**

Construction waste quantities

25.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd.[160] The construction waste forecast for the Birmingham Interchange and Chelmsley Wood area is given in Table 107.

25.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 107). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed One).

Table 107: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	9,175	917

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[159] Waste & Resources Action Programme (2013). *Net Waste Tool* [online]. Available at: http://nwtool.wrap.org.uk/; [Accessed 5 November 2012].
[160] Building Research Establishment Ltd (BRE) (2013). *Construction Waste Benchmarks for Railway Projects*. Watford, BRE.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Retaining walls	656	66
Bridges	13,723	1,372
Structures incorporated into the works	146	15
Viaducts	0	0
Roadworks	13,716	1,372
People mover	28,262	2,826
River diversions	69	7
Fencing	563	56
Drainage	1,212	121
Landscaping	227	23
Stations	50,350	5,035
Depots	0	0
Utilities	8,378	838
Tunnels	0	0
Railway systems	110	11
Ancillaries	0	0
TOTAL	**126,587**	**12,659**

Worker accommodation site waste quantities

25.2.14   Worker accommodation site waste has been forecast based on a waste generation rate of 0.031 tonnes per worker per 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 in 2009/10, and has been adjusted assuming an average working week of five and a half days.

25.2.15   Forecast waste quantities over the duration of the construction period are shown in Table 108.

25.2.16   A landfill diversion rate of 50% has been applied to worker accommodation site waste (see Table 108). Waste generated by occupants of a worker accommodation site will be similar in composition to household waste. As such, the landfill diversion rate is based on a review of national waste targets for England and Wales and takes into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).

Table 108: Forecast waste quantities from worker accommodation site

Location	Worker numbers in accommodation	Duration (months)	Estimated worker waste quantity (tonnes)	Estimated worker waste for disposal to landfill (tonnes)
Birmingham Interchange temporary worker accommodation, Middle Bickenhill Lane	109	50	169	85
TOTAL	-	-	169	85

25.3 Operation

Forecast of waste quantities

25.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 109.

25.3.2 Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005.[161]

25.3.3 The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

25.3.4 The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 109: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	660	264
Rolling stock maintenance	675	135
Track maintenance	72	11
Ancillary infrastructure	6	2

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[161] British Standards Institution (BSI) (2005). *BS5906:2006 Waste Management in Buildings – Code of Practice*. London, BSI.

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
TOTAL	1,413	412

25.3.5   Railway station and train waste has only been reported for areas along the route in which stations will be located. Birmingham Interchange station will be located in the Birmingham Interchange and Chelmsley Wood area, hence railway station and train waste is reported in Table 109.

25.3.6   Rolling stock maintenance waste has only been reported for areas along the route in which these facilities will be located. The people mover depot will be located in the Birmingham Interchange and Chelmsley Wood area, hence rolling stock maintenance waste is reported in Table 109.

25.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Birmingham Interchange and Chelmsley Wood area is shown in Table 109.

25.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 1,413 tonnes of operational waste annually in the Birmingham Interchange and Chelmsley Wood area when it becomes fully operational in 2026, of which 1,001 tonnes (71%) will be diverted from landfill.

25.3.9   The Proposed Scheme in the Birmingham Interchange and Chelmsley Wood area will generate an overall operational landfill disposal requirement of 412 tonnes per annum.

26 Castle Bromwich and Bromford (CFA 25)

26.1 Local assumptions and limitations

Assumptions

26.1.1 There are no local assumptions specific to the Castle Bromwich and Bromford area.

Limitations

26.1.2 There are no local limitations specific to the Castle Bromwich and Bromford area.

26.2 Construction

Forecast of material and waste quantities

Excavated material quantities

26.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 4.5, the construction of the Proposed Scheme is forecast to generate a total of 1,907,860 tonnes of excavated material within the Castle Bromwich and Bromford area, as shown in Table 110.

26.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 110.

Table 110: Forecast excavated material quantities

Excavated material types[162]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[163]
Selected fill	0	N/A
General engineering fill	167,602	N/A
Environmental mitigation earthworks fill	648,435	N/A
Topsoil	143,283	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	818,089	N/A
Unacceptable material Class U1B	128,326	39,343
Unacceptable material Class U2	2,126	2,126
TOTAL	**1,907,860**	**41,469**

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162. 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.
163. Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

26.2.3   The majority of excavated material that will be generated in the Castle Bromwich and Bromford area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

26.2.4   The construction of the Proposed Scheme within the Castle Bromwich and Bromford area may be able to beneficially incorporate selected types of excess excavated material from the Stoneleigh, Kenilworth and Burton Green area.

26.2.5   There may also be opportunities for selected types of excess excavated material within the Castle Bromwich and Bromford area to be used within the Coleshill Junction area, and the Birmingham Interchange and Chelmsley Wood area.

26.2.6   Selected fill is a good quality granular material (e.g. limestone), which is primarily intended for engineering works.

26.2.7   Excavated material falling into the unacceptable material classes U1A and U1B may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment[164].

26.2.8   A proportion of the excavated material in the Castle Bromwich and Bromford area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2) [165]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

26.2.9   Types of building demolitions required within the Castle Bromwich and Bromford area are listed in Table 111 together with estimated demolition material quantities.

26.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator', using the basic dimensions and typology of buildings[166].

26.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 111). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 111: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	1,200	120
Non-residential property (industrial units and commercial property)	66,352	6,635

164. Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).
165. Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
166. Waste & Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Residential property	0	0
Community amenities	0	0
Highways	0	0
TOTAL	**67,552**	**6,755**

Construction waste quantities

26.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[167]. The construction waste forecast for the Castle Bromwich and Bromford area is given in Table 112.

26.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 112). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

167. Building Research Establishment Ltd (2013), Construction Waste Benchmarks for Railway Projects.

Table 112: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	9,175	917
Retaining walls	330	33
Bridges	421	42
Viaducts	4,467	447
Roadworks	494	49
River diversions	2,072	207
Fencing	63	6
Drainage	3,288	329
Landscaping	227	23
Depots	0	0
Utilities	8,378	838
Tunnels	29,351	2,935
Ancillaries	0	0
Railway systems	80	8
TOTAL	**58,345**	**5,834**

Worker accommodation site waste quantities

26.2.14   There will not be any worker accommodation sites in the Castle Bromwich and Bromford area and therefore no waste will be generated from this source.

26.3   Operation

Forecast of waste quantities

26.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 113.

26.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[168].

26.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

- railway station and trains: 60%;

- rolling stock maintenance: 80%;

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168. British Standards Institution (2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

- track maintenance: 85%; and

- ancillary infrastructure: 60%.

26.3.4   The rationale for each of these landfill diversion rates is provided in the Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 113: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	84	13
Ancillary infrastructure	7	3
TOTAL	**91**	**16**

26.3.5   Railway station and train waste has not been reported in Table 113 as there will not be any railway stations in the Castle Bromwich and Bromford area (CFA 25). Although waste will be generated by passengers on trains travelling through the Castle Bromwich and Bromford area, this will not be removed until each train has reached its terminating railway station hence it is not reported in Table 113.

26.3.6   Rolling stock maintenance waste has not been reported in Table 113 as there will not be any rolling stock maintenance depots in the Castle Bromwich and Bromford area.

26.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Castle Bromwich and Bromford area is shown in Table 113.

26.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 91 tonnes of operational waste annually in the Castle Bromwich and Bromford area when it becomes fully operational in 2026, of which 75 tonnes (82%) will be diverted from landfill.

26.3.9   The Proposed Scheme in the Castle Bromwich and Bromford area will generate an overall operational landfill disposal requirement of 16 tonnes per annum.

27 Washwood Heath to Curzon Street (CFA 26)

27.1 Local assumptions and limitations

Assumptions

27.1.1 There are no local assumptions specific to the Washwood Heath to Curzon Street area.

Limitations

27.1.2 There are no local limitations specific to the Washwood Heath to Curzon Street area.

27.2 Construction

Forecast of material and waste quantities

Excavated material quantities

27.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 6.3, the construction of the Proposed Scheme is forecast to generate a total of 3,797,864 tonnes of excavated material within the Washwood Heath to Curzon Street area, as shown in Table 114.

27.2.2 The estimated quantity of surplus excavated material for disposal only includes the quantity of unacceptable material classes U1B and U2[169], which is unsuitable for reuse within the Proposed Scheme. The overall balance of excavated material is presented in Volume 3, Section 14, along with the total quantity of surplus excavated material requiring disposal and therefore it is not included in Table 114.

Table 114: Forecast excavated material quantities

Excavated material types[170]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[171]
Selected fill	0	N/A
General engineering fill	849,986	N/A
Environmental mitigation earthworks fill	780,724	N/A
Topsoil	31,889	N/A
Agricultural subsoil	0	N/A
Unacceptable material Class U1A	192,985	N/A
Unacceptable material Class U1B	1,833,835	28,254
Unacceptable material Class U2	108,445	108,445

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[169] Unacceptable material Class U1A is 'physically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clauses 2(i)(a) and 2(i)(b). Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a).

[170] 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.

[171] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme.

Excavated material types[170]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[171]
TOTAL	3,797,864	136,699

27.2.3   The majority of excavated material that will be generated in the Washwood Heath to Curzon Street area is expected to be suitable for beneficial reuse as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route.

27.2.4   The construction of the Proposed Scheme within the Washwood Heath to Curzon Street area may be able to beneficially incorporate selected types of excess excavated material from the Stoneleigh, Kenilworth and Burton Green area.

27.2.5   There may also be opportunities for selected types of excess excavated material within the Washwood Heath to Curzon Street area to be used within the Coleshill Junction area, the Curdworth to Middleton area, Balsall Common and Hampton-in-Arden area and the Birmingham Interchange and Chelmsley Wood area.

27.2.6   Selected fill is a good quality granular material (e.g. limestone), which is primarily intended for engineering works.

27.2.7   Excavated material falling into the unacceptable material classes U1A and U1B may be suitable for engineering and/or environmental mitigation earthworks fill, either with or without treatment.

27.2.8   A proportion of the excavated material in the Washwood Heath to Curzon Street area is likely to be unacceptable for use within the engineering works due to the presence of contaminated materials (i.e. unacceptable material Class U1B) or the hazardous properties of the material (i.e. unacceptable material Class U2)[172]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

27.2.9   Types of building demolitions required within the Washwood Heath to Curzon Street area are listed in Table 115 together with estimated demolition material quantities.

27.2.10   Demolition material quantities have been estimated using the WRAP 'Demolition bill of quantities estimator'[173], using the basic dimensions and typology of buildings.

27.2.11   A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 115). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

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[172] Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i).
[173] Waste & Resources Action Programme; *Net Waste Tool*; http://nwtool.wrap.org.uk/; Accessed 5 November 2012.

Table 115: Forecast demolition waste quantities to landfill

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Utilities	3,858	386
Non-residential property (industrial units and commercial property)	558,367	55,837
Residential property	30,608	3,061
Community amenities	2,438	244
Highways	24,460	2,446
TOTAL	**619,730**	**61,973**

Construction waste quantities

27.2.12   Construction waste has been forecast based on a waste generation rate of 26.4 tonnes per £100,000 of construction spend. This rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment Ltd[174]. The construction waste forecast for the Washwood Heath to Curzon Street is given in Table 116.

27.2.13   A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 116). The landfill diversion rate has been selected based on a review of industry good practice landfill diversion rates of other large-scale infrastructure projects in the UK (e.g. Crossrail, London 2012 Olympics and High Speed 1).

Table 116: Forecast construction waste quantities to landfill

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Earthworks	9,175	917
Retaining walls	1,619	162
Bridges	1,456	146
Structures to be incorporated into the works	0	0
Viaducts	20,813	2,081
Roadworks	2,869	287
River diversions	386	39
Fencing	63	6
Drainage	5,480	548
Landscaping	227	23
Stations	87,960	8,796
Depots	94,440	9,444

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[174] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.

Type of construction	Estimated construction waste quantities (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Utilities	8,378	838
Tunnels	22,437	2,244
Ancillaries	0	0
Railway systems	34,316	3,432
TOTAL	**289,620**	**28,962**

Worker accommodation site waste quantities

27.2.14   There will not be any worker accommodation sites in the Washwood Heath to Curzon Street area and therefore no waste will be generated from this source.

27.3   Operation

Forecast of waste quantities

27.3.1   Operational waste quantities for the Proposed Scheme have been forecast on an annual basis and are based upon maximum capacity in the first year of operation (2026), see Table 117.

27.3.2   Operational waste has been forecast based on waste generation data received from Network Rail and standard waste generation rates provided in British Standard BS5906:2005[175].

27.3.3   The following landfill diversion rates have been applied to the estimated operational waste quantities:

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

27.3.4   The rationale for each of these landfill diversion rates is provided in Waste forecast and assessment methodology technical note, which can be found in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Table 117: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Railway station and trains	836	334
Rolling stock maintenance	10,023	2,005
Track maintenance	94	14

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[175] British Standards Institution (2005), *BS5906:2006 Waste Management in Buildings – Code of Practice.*

Waste source	Estimated quantity of waste per annum (tonnes)	Estimated quantity of waste for off-site disposal to landfill per annum (tonnes)
Ancillary infrastructure	8	3
TOTAL	10,961	2,356

27.3.5   Railway station and train waste has only been reported for areas along the route in which stations will be located. Curzon Street station will be located in the Washwood Heath to Curzon Street area; hence railway station and train waste is reported in Table 117.

27.3.6   Rolling stock maintenance depot waste has only been reported for areas along the route in which these facilities will be located. Washwood Heath depot will be located in the Washwood Heath to Curzon Street area; hence rolling stock maintenance waste is reported in Table 117.

27.3.7   Track maintenance waste and ancillary infrastructure waste has been estimated using an average waste generation rate per kilometre length of total track and has been reported for each area along the route. Track maintenance waste and ancillary infrastructure waste generation for the Washwood Heath to Curzon Street area is shown in Table 117.

27.3.8   It has been estimated that the Proposed Scheme will generate a total quantity of 10,961 tonnes of operational waste annually in the Washwood Heath to Curzon Street area when it becomes fully operational in 2026, of which 8,605 tonnes (79%) will be diverted from landfill.

27.3.9   The Proposed Scheme in the Washwood Heath to Curzon Street area will generate an overall operational landfill disposal requirement of 2,356 tonnes per annum.

28   References

ARUP/URS (2012), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report.

ARUP/URS (2013), HS2 London to West Midlands Environmental Impact Assessment Scope and Methodology Report Addendum.

British Standard Institution (2005), BS5906:2006 Waste Management in Buildings – Code of Practice.

Building Research Establishment Ltd (2013), Construction Waste Benchmarks for Railway Projects.

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.

Waste and Resources Action Programme; Net Waste Tool; http://nwtool.wrap.org.uk/; Accessed: 5 November 2012.

Volume 5 Annex 1 - CFA and regional waste and material resources reporting tables

Annex 1 Table 1 - CFA waste and material resources

Table 1a: Forecast excavated material quantities (CFAs 1 to 26), 2017 to 2025

Community forum area		Forecast quantities of excavated material available before use (tonnes)								
No	Name	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4)	Unacceptable material (U1A)	Unacceptable material (U1B)	Unacceptable material (U1B) for disposal as non-hazardous waste	Unacceptable material (U2) for disposal as hazardous waste	Total
1	Euston – Station and Approach	0	0	0	0	2,042,874	0	0	0	0	2,042,874
2	Camden and HS1 Link	0	0	0	0	0	43,716	16,602	617	33,192	94,127
3	Primrose Hill to Kilburn (Camden)	0	0	0	0	202,858	1,650,374	0	2,049	0	1,855,281
4	Kilburn (Brent) to Old Oak Common	0	0	0	0	3,028,910	848,820	685,801	117,446	0	4,680,977
5	Northolt Corridor	0	0	0	0	1,827,313	1,088,787	6,950	56,500	0	2,979,550
6	South Ruislip to Ickenham	0	0	0	0	38,280	5,077,424	1,641	16,617	0	5,133,962
7	Colne Valley	182,234	1,002,718	0	707,716	0	53,508	0	0	0	1,946,175
8	The Chalfonts and Amersham	0	222,245	0	0	16,758	3,703,527	0	0	0	3,942,531
9	Central Chilterns	0	3,191,292	0	2,556,006	0	613,081	0	0	0	6,360,379
10	Dunsmore, Wendover and Halton	0	2,457,703	0	1,871,327	0	0	0	0	0	4,329,030

No	Name	Forecast quantities of excavated material available before use (tonnes)									
		Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4)	Unacceptable material (U1A)	Unacceptable material (U1B)	Unacceptable material (U1B) for disposal as non-hazardous waste	Unacceptable material (U2) for disposal as hazardous waste	Total
11	Stoke Mandeville and Aylesbury	156,366	0	0	1,787,998	0	0	0	0	22,163	1,966,527
12	Waddesdon and Quainton	0	0	0	2,398,426	0	0	0	0	0	2,398,426
13	Calvert, Steeple Claydon, Twyford and Chetwode	132,964	0	0	5,047,230	0	0	0	0	14,772	5,194,966
14	Newton Purcell to Brackley	6,174,723	0	0	2,410,833	0	0	0	0	152,628	8,738,184
15	Greatworth to Lower Boddington	3,820,098	0	0	9,136,230	1,110,679	0	0	0	0	14,067,007
16	Ladbroke and Southam	0	49,914	1,300,282	696,304	5,430,492	33,830	41,711	0	0	7,552,533
17	Offchurch and Cubbington	799,508	58,931	2,582,913	1,746,626	192,639	129,102	66,634	0	0	5,576,353
18	Stoneleigh, Kenilworth and Burton Green	614,374	3,674,715	1,596,426	306,177	70,871	39,910	68,850	0	0	6,371,323
19	Coleshill Junction	377,809	0	3,943,604	2,436,858	1,341,560	98,462	0	0	0	8,198,293
20	Curdworth to Middleton	1,139,496	0	785,310	187,944	27,306	45,245	0	0	0	2,185,301

No	Name	Forecast quantities of excavated material available before use (tonnes)									
	Community forum area	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4)	Unacceptable material (U1A)	Unacceptable material (U1B)	Unacceptable material (U1B) for disposal as non-hazardous waste	Unacceptable material (U2) for disposal as hazardous waste	Total
21	Drayton Bassett, Hints and Weeford	609,463	2,597,983	1,798,699	855,689	124,494	1,918	0	0	0	5,988,246
22	Whittington to Handsacre	311,991	824,204	110,072	54,711	13,149	29,109	0	0	0	1,343,236
23	Balsall Common and Hampton-in-Arden	338,089	226,288	542,320	12,524	504,659	62,556	35,789	0	1,593	1,723,818
24	Birmingham Interchange and Chelmsley Wood	361,294	544,213	124,278	152,730	466,607	34,343	83,604	133,503	2,372	1,902,944
25	Castle Bromwich and Bromford	0	0	0	167,602	648,435	818,089	88,983	39,343	2,126	1,764,578
26	Washwood Heath to Curzon Street	0	0	0	849,986	780,724	192,985	1,805,581	28,254	108,445	3,765,975
	Total	15,018,409	14,850,206	12,783,904	33,382,917	17,868,608	14,564,786	2,902,146	394,329	337,291	112,102,596

Table 1b: Forecast engineering and environmental mitigation earthworks fill requirements (CFAs 1 to 26), 2017 to 2025

Community forum area		Forecast quantities of fill required (tonnes)[1]							
No	Name	Backfill (CL1/3/6)	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation bund fill (CL2)	Environmental mitigation earthworks fill (CL4)	Total
1	Euston – Station and Approach	0	0	0	0	0	0	0	0
2	Camden and HS1 Link	0	0	0	0	0	0	0	0
3	Primrose Hill to Kilburn (Camden)	0	0	0	0	0	0	0	0
4	Kilburn (Brent) to Old Oak Common	0	0	0	0	0	0	0	0
5	Northolt Corridor	0	0	0	0	0	0	0	0
6	South Ruislip to Ickenham	0	0	563,892	0	8,232	0	0	572,124
7	Colne Valley	0	73,995	676,995	132,171	19,598	0	4,972,210	5,874,969
8	The Chalfonts and Amersham	0	0	0	0	5,343	0	130,119	135,462

[1] The abbreviations for excavated material refer to soil classifications outlined in the Department for Transport 'Manual of Contract Documents for Highway Works, Volume 1 - Specification for Highway Works' (http://www.dft.gov.uk/ha/standards/mchw/vol1/pdfs/series_0600.pdf).

CL1   Class 1
CL2   Class 2
CL3   Class 3
CL4   Class 4
CL5   Class 5
CL6   Class 6
U1A   Unacceptable Material Class U1A
U1B   Unacceptable Material Class U1B
U2   Unacceptable Material Class U2

Community forum area		Forecast quantities of fill required (tonnes)[1]							
No	Name	Backfill (CL1/3/6)	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation bund fill (CL2)	Environmental mitigation earthworks fill (CL4)	Total
9	Central Chilterns	0	367,890	8,407	0	41,419	623,555	1,233,436	2,274,707
10	Dunsmore, Wendover and Halton	23,338	577,473	498,639	249,849	209,050	189,280	3,580,737	5,328,366
11	Stoke Mandeville and Aylesbury	192,536	225,355	632,098	0	556,514	838,557	1,882,496	4,327,556
12	Waddesdon and Quainton	211,984	372,043	288,079	0	861,545	1,134,940	491,395	3,359,986
13	Calvert, Steeple Claydon, Twyford and Chetwode	255,377	256,200	513,687	0	2,384,504	386,846	1,578,506	5,375,120
14	Newton Purcell to Brackley	16,312	243,760	346,502	74,777	549,593	0	2,305,415	3,536,359
15	Greatworth to Lower Boddington	285,737	2,195,291	738,594	103,970	422,477	4,260,181	8,089,111	16,095,361
16	Ladbroke and Southam	889,583	130,758	723,565	228,088	281,695	0	4,952,907	7,206,596
17	Offchurch and Cubbington	319,334	75,899	455,101	120,451	278,755	0	2,219,142	3,468,682
18	Stoneleigh, Kenilworth and Burton Green	132,562	189,643	244,310	481,657	799,110	0	2,307,793	4,155,075
19	Coleshill Junction	560,291	137,116	2,505,306	3,134,435	61,291	0	3,042,084	9,440,523
20	Curdworth to Middleton	862,286	51,022	1,052,680	410,664	3,099,922	0	2,531,375	8,007,949
21	Drayton Bassett, Hints and Weeford	110,276	125,677	229,868	3,721	505,198	0	1,142,999	2,117,739
22	Whittington to Handsacre	136,250	85,765	2,900,822	2,974,693	1,207,202	514,500	2,142,416	9,961,648

Community forum area		Forecast quantities of fill required (tonnes)[1]							
No	Name	Backfill (CL1/3/6)	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation bund fill (CL2)	Environmental mitigation earthworks fill (CL4)	Total
23	Balsall Common and Hampton-in-Arden	134,517	193,408	719,172	383,033	1,243,746	476,357	939,803	4,090,036
24	Birmingham Interchange and Chelmsley Wood	222,213	288,541	782,312	374,242	1,992,051	0	647,151	4,306,510
25	Castle Bromwich and Bromford	42,527	27,139	93,557	0	74,909	0	0	238,132
26	Washwood Heath to Curzon Street	134,630	114,038	9,821	76,099	759,336	0	0	1,093,924
	Total	4,529,753	5,731,013	13,983,407	8,747,850	15,361,490	8,424,216	44,189,095	100,966,824

Table 1c: Forecast topsoil and agricultural subsoil quantities available and required (CFAs 1 to 26), 2017 to 2025

Community forum area		Topsoil and agricultural subsoil available (tonnes)			Topsoil and agricultural subsoil required (tonnes)		
No	Name	Topsoil for engineering	Topsoil for environmental mitigation	Agricultural subsoil for environmental mitigation	Topsoil for engineering	Topsoil for environmental mitigation	Agricultural subsoil for environmental mitigation
1	Euston – Station and Approach	0	0	0	0	0	0
2	Camden and HS1 Link	0	0	0	0	0	0
3	Primrose Hill to Kilburn (Camden)	0	0	0	0	0	0
4	Kilburn (Brent) to Old Oak Common	0	0	0	0	0	0
5	Northolt Corridor	0	0	0	0	0	0
6	South Ruislip to Ickenham	185,220	0	0	0	0	0
7	Colne Valley	89,470	286,646	424,660	18,396	357,719	424,660
8	The Chalfonts and Amersham	0	0	0	0	0	0
9	Central Chilterns	157,410	176,830	282,341	47,663	286,577	282,341
10	Dunsmore, Wendover and Halton	214,793	216,919	345,067	87,251	344,460	345,067
11	Stoke Mandeville and Aylesbury	230,107	309,766	335,151	57,515	482,364	335,151
12	Waddesdon and Quainton	206,845	239,619	0	63,555	382,909	0
13	Calvert, Steeple Claydon, Twyford and Chetwode	649,569	290,328	237,543	403,216	536,681	237,543
14	Newton Purcell to Brackley	402,231	316,417	456,609	135,884	582,766	456,609
15	Greatworth to Lower Boddington	476,272	693,602	963,564	220,756	881,909	963,564
16	Ladbroke and Southam	476,979	445,052	562,995	142,304	421,686	511,478
17	Offchurch and Cubbington	300,123	289,039	331,839	95,680	274,822	301,187

No	Name	Topsoil and agricultural subsoil available (tonnes)			Topsoil and agricultural subsoil required (tonnes)		
		Topsoil for engineering	Topsoil for environmental mitigation	Agricultural subsoil for environmental mitigation	Topsoil for engineering	Topsoil for environmental mitigation	Agricultural subsoil for environmental mitigation
18	Stoneleigh, Kenilworth and Burton Green	388,668	310,232	117,102	113,279	292,666	102,236
19	Coleshill Junction	702,352	202,525	46,651	247,071	160,123	54,737
20	Curdworth to Middleton	402,357	275,966	111,780	109,211	140,354	96,969
21	Drayton Bassett, Hints and Weeford	347,028	190,543	84,391	117,221	93,147	75,502
22	Whittington to Handsacre	423,602	227,125	32,612	71,149	131,478	50,801
23	Balsall Common and Hampton-in-Arden	382,863	116,577	105,197	132,447	127,732	105,197
24	Birmingham Interchange and Chelmsley Wood	624,609	34,290	1,852	191,207	29,243	1,852
25	Castle Bromwich and Bromford	143,283	0	0	140,576	0	0
26	Washwood Heath to Curzon Street	31,889	0	0	33,943	0	0
	Total	6,835,670	4,621,476	4,439,354	2,428,324	5,526,636	4,344,894

Table 1d: Balance of excavated material (CFAs 1 to 26), 2017 to 2025

No	Name	Balance of excavated material[2] (tonnes)							
		Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4) including 15% bulking	Topsoil	Agricultural subsoil	Total
1	Euston – Station and Approach	0	0	0	0	2,042,874	0	0	2,042,874
2	Camden and HS1 Link	0	0	0	0	60,318	0	0	60,318
3	Primrose Hill to Kilburn (Camden)	0	0	0	0	1,853,232	0	0	1,853,232
4	Kilburn (Brent) to Old Oak Common	0	0	0	0	4,563,531	0	0	4,563,531
5	Northolt Corridor	0	0	0	0	2,923,050	0	0	2,923,050
6	South Ruislip to Ickenham	0	-563,892	0	-8,232	5,117,344	185,220	0	4,730,440
7	Colne Valley	108,238	325,722	-132,171	688,118	-4,918,702	0	0	-3,928,795
8	The Chalfonts and Amersham	0	222,245	0	-5,343	3,590,166	0	0	3,807,068
9	Central Chilterns	-367,890	3,182,885	0	1,891,032	-620,356	0	0	4,085,671
10	Dunsmore, Wendover and Halton	-600,810	1,959,064	-249,849	1,472,997	-3,580,737	2	0	-999,333
11	Stoke Mandeville and Aylesbury	-261,525	-632,098	0	392,927	-1,882,496	-6	0	-2,383,198

[2] Positive numbers indicate a local excess of excavated material and negative numbers indicate a local shortfall of excavated material in a given community forum area.

Community forum area		Balance of excavated material[2] (tonnes)							
No	Name	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4) including 15% bulking	Topsoil	Agricultural subsoil	Total
12	Waddesdon and Quainton	-584,027	-288,079	0	401,942	-491,395	0	0	-961,559
13	Calvert, Steeple Claydon, Twyford and Chetwode	-378,613	-513,687	0	2,275,880	-1,578,506	0	0	-194,926
14	Newton Purcell to Brackley	5,914,652	-346,502	-74,777	1,861,240	-2,305,415	0	0	5,049,198
15	Greatworth to Lower Boddington	1,339,071	-738,594	-103,970	4,453,572	-6,978,432	67,209	0	-1,961,144
16	Ladbroke and Southam	-1,020,341	-673,650	1,072,194	414,609	553,126	358,040	51,517	755,495
17	Offchurch and Cubbington	404,276	-396,170	2,462,461	1,467,872	-1,830,767	218,660	30,652	2,356,984
18	Stoneleigh, Kenilworth and Burton Green	292,169	3,430,404	1,114,769	-492,933	-2,128,162	292,954	14,866	2,524,067
19	Coleshill Junction	-319,598	-2,505,306	809,169	2,375,566	-1,602,061	497,684	-8,086	-752,632
20	Curdworth to Middleton	226,188	-1,052,680	374,646	-2,911,978	-2,458,824	428,757	14,811	-5,379,080
21	Drayton Bassett, Hints and Weeford	373,510	2,368,115	1,794,978	350,491	-1,016,587	327,202	8,889	4,206,598
22	Whittington to Handsacre	89,976	-2,076,618	-2,864,621	-1,666,991	-2,100,159	448,101	-18,189	-8,188,501
23	Balsall Common and Hampton-in-Arden	10,164	-492,884	159,287	-1,707,579	-336,800	239,262	0	-2,128,550
24	Birmingham Interchange and Chelmsley Wood	-149,460	-238,099	-249,964	-1,839,321	-62,597	438,450	0	-2,100,991
25	Castle Bromwich and	-69,666	-93,557	0	92,692	1,555,507	2,707	0	1,487,683

Community forum area		Balance of excavated material[2] (tonnes)							
No	Name	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4) including 15% bulking	Topsoil	Agricultural subsoil	Total
	Bromford								
26	Washwood Heath to Curzon Street	-248,668	-9,821	-76,099	90,650	2,779,290	-2,054	0	2,533,298
	Total	4,757,646	866,798	4,036,053	9,597,211	-8,853,558	3,502,188	94,460	14,000,798

Table 1e: Forecast demolition and construction material and waste quantities (CFAs 1 to 26), 2017 to 2025

Community forum area		Demolition			Construction		
No	Name	Estimated demolition material quantities (tonnes)	Estimated demolition waste for off-site disposal to landfill (tonnes)	Estimated demolition waste diverted from landfill (tonnes)	Estimated construction waste quantities (tonnes)	Estimated construction waste for off-site disposal to landfill (tonnes)	Estimated construction waste diverted from landfill (tonnes)
1	Euston – Station and Approach	306,925	30,693	276,232	465,520	46,552	418,968
2	Camden and HS1 Link	12,059	1,206	10,853	53,410	5,341	48,069
3	Primrose Hill to Kilburn (Camden)	3,310	331	2,979	72,091	7,209	64,882
4	Kilburn (Brent) to Old Oak Common	244,345	24,434	219,911	438,713	43,871	394,842
5	Northolt Corridor	13,986	1,399	12,587	120,902	12,090	108,812
6	South Ruislip to Ickenham	15,768	1,577	14,191	136,666	13,667	122,999
7	Colne Valley	9,088	909	8,179	55,140	5,514	49,626
8	The Chalfonts and Amersham	335	34	301	173,647	17,365	156,282
9	Central Chilterns	9,246	925	8,321	38,880	3,888	34,992
10	Dunsmore, Wendover and Halton	11,637	1,164	10,473	41,606	4,161	37,445
11	Stoke Mandeville and Aylesbury	3,251	325	2,926	29,766	2,977	26,789
12	Waddesdon and Quainton	11,689	1,169	10,520	46,684	4,669	42,015
13	Calvert, Steeple Claydon, Twyford and Chetwode	25,363	2,536	22,827	98,211	9,821	88,390
14	Newton Purcell to Brackley	16,188	1,619	14,569	43,536	4,354	39,182
15	Greatworth to Lower Boddington	39,218	3,922	35,296	112,604	11,260	101,344
16	Ladbroke and Southam	16,892	1,689	15,203	40,521	4,052	36,469

Community forum area		Demolition			Construction		
No	Name	Estimated demolition material quantities (tonnes)	Estimated demolition waste for off-site disposal to landfill (tonnes)	Estimated demolition waste diverted from landfill (tonnes)	Estimated construction waste quantities (tonnes)	Estimated construction waste for off-site disposal to landfill (tonnes)	Estimated construction waste diverted from landfill (tonnes)
17	Offchurch and Cubbington	0	0	0	17,116	1,712	15,404
18	Stoneleigh, Kenilworth and Burton Green	19,859	1,986	17,873	44,843	4,484	40,359
19	Coleshill Junction	43,399	4,340	39,059	87,066	8,707	78,359
20	Curdworth to Middleton	31,218	3,122	28,096	24,434	2,443	21,991
21	Drayton Bassett, Hints and Weeford	45,758	4,576	41,182	11,374	1,137	10,237
22	Whittington to Handsacre	17,220	1,722	15,498	69,528	6,953	62,575
23	Balsall Common and Hampton-in-Arden	4,345	435	3,910	31,007	3,101	27,906
24	Birmingham Interchange and Chelmsley Wood	13,360	1,336	12,024	126,587	12,659	113,928
25	Castle Bromwich and Bromford	67,552	6,755	60,797	58,345	5,835	52,510
26	Washwood Heath to Curzon Street	619,730	61,973	557,757	289,620	28,962	260,658
	Total	1,601,741	160,177	1,441,564	2,727,818	272,783	2,455,035

Table 1f: Worker accommodation site waste quantities (CFAs 1 to 26), 2017 to 2025

Community forum area		Worker accommodation site waste				
No	Name	Average No of workers in accommodation site	Duration of accommodation site (months)[3]	Estimated worker accommodation site waste quantity (tonnes)	Estimated worker accommodation site waste for off-site disposal to landfill (tonnes)	Estimated worker accommodation site waste diverted from landfill (tonnes)
1	Euston – Station and Approach	0	0	0	0	0
2	Camden and HS1 Link	0	0	0	0	0
3	Primrose Hill to Kilburn (Camden)	0	0	0	0	0
4	Kilburn (Brent) to Old Oak Common	0	0	0	0	0
5	Northolt Corridor	0	0	0	0	0
6	South Ruislip to Ickenham	0	0	0	0	0
7	Colne Valley	135	125	259	130	129
8	The Chalfonts and Amersham	0	0	0	0	0
9	Central Chilterns	0	0	0	0	0
10	Dunsmore, Wendover and Halton	168	21	266	133	133
11	Stoke Mandeville and Aylesbury	62	42	78	39	39
12	Waddesdon and Quainton	0	0	0	0	0
13	Calvert, Steeple Claydon, Twyford and Chetwode	65	81	163	82	81
14	Newton Purcell to Brackley	105	66	215	108	107

[3] Where there is more than one worker accommodation site in a CFA the durations have been summed. For a detailed breakdown of the duration for each site see individual Volume 5 CFA reports.

Community forum area		Worker accommodation site waste				
No	Name	Average No of workers in accommodation site	Duration of accommodation site (months)[3]	Estimated worker accommodation site waste quantity (tonnes)	Estimated worker accommodation site waste for off-site disposal to landfill (tonnes)	Estimated worker accommodation site waste diverted from landfill (tonnes)
15	Greatworth to Lower Boddington	109	63	213	107	106
16	Ladbroke and Southam	63	108	106	53	53
17	Offchurch and Cubbington	23	62	44	22	22
18	Stoneleigh, Kenilworth and Burton Green	26	63	51	26	25
19	Coleshill Junction	40	61	76	38	38
20	Curdworth to Middleton	36	57	64	32	32
21	Drayton Bassett, Hints and Weeford	0	0	0	0	0
22	Whittington to Handsacre	59	134	123	62	61
23	Balsall Common and Hampton-in-Arden	68	51	90	45	45
24	Birmingham Interchange and Chelmsley Wood	109	50	169	84	85
25	Castle Bromwich and Bromford	0	0	0	0	0
26	Washwood Heath to Curzon Street	0	0	0	0	0
	Total	1,068	1,014	1,917	961	956

Table 1g: Railway station and train, and rolling stock maintenance waste (CFAs 1 to 26), 2026

Community forum area		Railway stations and trains			Rolling stock maintenance		
No	Name	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)
1	Euston – Station and Approach	1,193	477	716	0	0	0
2	Camden and HS1 Link	0	0	0	0	0	0
3	Primrose Hill to Kilburn (Camden)	0	0	0	0	0	0
4	Kilburn (Brent) to Old Oak Common	595	238	357	0	0	0
5	Northolt Corridor	0	0	0	0	0	0
6	South Ruislip to Ickenham	0	0	0	0	0	0
7	Colne Valley	0	0	0	0	0	0
8	The Chalfonts and Amersham	0	0	0	0	0	0
9	Central Chilterns	0	0	0	0	0	0
10	Dunsmore, Wendover and Halton	0	0	0	0	0	0
11	Stoke Mandeville and Aylesbury	0	0	0	0	0	0
12	Waddesdon and Quainton	0	0	0	0	0	0
13	Calvert, Steeple Claydon, Twyford and Chetwode	0	0	0	0	0	0
14	Newton Purcell to Brackley	0	0	0	0	0	0
15	Greatworth to Lower Boddington	0	0	0	0	0	0
16	Ladbroke and Southam	0	0	0	0	0	0
17	Offchurch and Cubbington	0	0	0	0	0	0

Community forum area		Railway stations and trains			Rolling stock maintenance		
No	Name	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)
18	Stoneleigh, Kenilworth and Burton Green	0	0	0	0	0	0
19	Coleshill Junction	0	0	0	0	0	0
20	Curdworth to Middleton	0	0	0	0	0	0
21	Drayton Bassett, Hints and Weeford	0	0	0	0	0	0
22	Whittington to Handsacre	0	0	0	0	0	0
23	Balsall Common and Hampton-in-Arden	0	0	0	0	0	0
24	Birmingham Interchange and Chelmsley Wood	660	264	396	675	135	540
25	Castle Bromwich and Bromford	0	0	0	0	0	0
26	Washwood Heath to Curzon Street	836	334	502	10,023	2,005	8,018
	Total	3,284	1,313	1,971	10,698	2,140	8,558

Table 1h: Track maintenance and ancillary infrastructure waste quantities (CFAs 1 to 26), 2026

Community forum area		Track maintenance			Ancillary infrastructure		
No	Name	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)
1	Euston – Station and Approach	23	3	20	2	1	1
2	Camden and HS1 Link	19	3	16	2	1	1
3	Primrose Hill to Kilburn (Camden)	83	12	71	7	3	4
4	Kilburn (Brent) to Old Oak Common	118	18	100	10	4	6
5	Northolt Corridor	143	21	122	12	5	7
6	South Ruislip to Ickenham	110	17	94	9	4	5
7	Colne Valley	92	14	78	8	3	5
8	The Chalfonts and Amersham	185	28	158	16	6	10
9	Central Chilterns	99	15	84	8	3	5
10	Dunsmore, Wendover and Halton	131	20	111	11	4	7
11	Stoke Mandeville and Aylesbury	173	26	147	15	6	9
12	Waddesdon and Quainton	166	25	141	14	6	8
13	Calvert, Steeple Claydon, Twyford and Chetwode	167	25	142	14	6	8
14	Newton Purcell to Brackley	195	29	166	16	7	9
15	Greatworth to Lower Boddington	279	42	238	23	9	14
16	Ladbroke and Southam	259	39	220	22	9	13
17	Offchurch and Cubbington	123	18	105	10	4	6

Community forum area		Track maintenance			Ancillary infrastructure		
No	Name	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste diverted from landfill per annum (tonnes)
18	Stoneleigh, Kenilworth and Burton Green	183	27	156	15	6	9
19	Coleshill Junction	305	46	259	26	10	16
20	Curdworth to Middleton	179	27	152	15	6	9
21	Drayton Bassett, Hints and Weeford	144	22	122	12	5	7
22	Whittington to Handsacre	244	37	207	20	8	12
23	Balsall Common and Hampton-in-Arden	128	19	109	11	4	7
24	Birmingham Interchange and Chelmsley Wood	72	11	61	6	2	4
25	Castle Bromwich and Bromford	84	13	71	7	3	4
26	Washwood Heath to Curzon Street	94	14	80	8	3	5
	Total	3,798	570	3,230	319	128	191

Annex 1 Table 2 - Regional waste and material resources

Table 2a: Forecast excavated material quantities (by region), 2017 to 2025

Former English planning regions	Forecast quantities of excavated material available before use (tonnes)									
Name	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4)	Unacceptable material (U1A)	Unacceptable material (U1B)	Unacceptable material (U1B) for disposal as non-hazardous waste	Unacceptable material (U2) for disposal as hazardous waste	Total
Greater London	94,615	520,605	0	367,442	7,140,235	8,736,902	710,994	193,229	33,192	17,797,214
South East	4,560,582	6,079,951	0	15,461,135	16,758	4,327,745	0	0	141,575	30,587,746
East England	49,688	273,402	0	192,966	0	14,590	0	0	0	530,646
East Midlands	5,761,500	0	0	9,894,223	1,110,679	0	0	0	47,988	16,814,390
West Midlands	4,552,024	7,976,248	12,783,904	7,467,151	9,600,936	1,485,549	2,191,152	201,100	114,536	46,372,600
Total	15,018,409	14,850,206	12,783,904	33,382,917	17,868,608	14,564,786	2,902,146	394,329	337,291	112,102,596

Table 2b: Forecast engineering and environmental mitigation earthworks fill requirements (by region), 2017 to 2025

Former English planning regions	Forecast quantities of fill required (tonnes)[4]							
Name	Backfill (CL1/3/6)	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation bund fill (CL2)	Environmental mitigation earthworks fill (CL4)	Total
Greater London	0	38,418	915,384	68,622	18,407	0	2,581,543	3,622,374
South East	694,418	1,981,481	2,319,381	328,626	4,439,249	3,173,178	11,512,196	24,448,529
East England	0	20,176	184,590	36,038	5,344	0	1,355,727	1,601,875
East Midlands	290,866	2,271,932	847,538	127,481	595,275	4,260,181	8,813,959	17,207,232
West Midlands	3,544,469	1,419,006	9,716,514	8,187,083	10,303,215	990,857	19,925,670	54,086,814
Total	4,529,753	5,731,013	13,983,407	8,747,850	15,361,490	8,424,216	44,189,095	100,966,824

[4] The abbreviations for excavated material refer to soil classifications outlined in the Department for Transport 'Manual of Contract Documents for Highway Works, Volume 1 - Specification for Highway Works' (http://www.dft.gov.uk/ha/standards/mchw/vol1/pdfs/series_0600.pdf).
CL1   Class 1
CL2   Class 2
CL3   Class 3
CL4   Class 4
CL5   Class 5
CL6   Class 6
U1A   Unacceptable Material Class U1A
U1B   Unacceptable Material Class U1B
U2   Unacceptable Material Class U2
Details of the former planning regions can be found at the Local Government Boundary Commission (see www.lgbce.org.uk).

Table 2c: Forecast topsoil and agricultural subsoil quantities available and required (by region), 2017 to 2025

Former English planning regions	Topsoil and agricultural subsoil available (tonnes)			Topsoil and agricultural subsoil required (tonnes)		
Name	Topsoil for engineering	Topsoil for environmental mitigation	Agricultural subsoil for environmental mitigation	Topsoil for engineering	Topsoil for environmental mitigation	Agricultural subsoil for environmental mitigation
Greater London	231,672	148,825	220,481	9,551	185,726	220,481
South East	1,753,112	1,510,058	1,601,539	756,190	2,506,986	1,601,539
East England	24,395	78,157	115,788	5,016	97,536	115,788
East Midlands	602,738	793,087	1,107,127	263,479	1,065,137	1,107,127
West Midlands	4,223,753	2,091,349	1,394,419	1,394,088	1,671,251	1,299,959
Total	6,835,670	4,621,476	4,439,354	2,428,324	5,526,636	4,344,894

Table 2d: Balance of excavated material (by region), 2017 to 2025

Former English planning regions	Balance of excavated material (tonnes)[5]							
Name	Selected fill (CL6)	General railway fill (CL1/3)	General railway fill (CL2)	General highway fill (CL2)	Environmental mitigation earthworks fill (CL4) including 15% bulking	Topsoil	Agricultural subsoil	Total
Greater London	56,197	-394,779	-68,622	349,035	14,006,587	185,220	0	14,133,638
South East	1,884,683	3,760,569	-328,626	7,848,708	-7,167,693	-4	0	5,997,637
East England	29,512	88,812	-36,038	187,623	-1,341,138	0	0	-1,071,229
East Midlands	3,198,704	-847,538	-127,481	5,038,767	-7,703,280	67,209	0	-373,619
West Midlands	-411,450	-1,740,266	4,596,820	-3,826,922	-6,648,034	3,249,763	94,460	-4,685,629
Total	4,757,646	866,798	4,036,053	9,597,211	-8,853,558	3,502,188	94,460	14,000,798

[5] Positive numbers indicate a local excess of excavated material and negative numbers indicate a local shortfall of excavated material.
The abbreviations for excavated material refer to soil classifications outlined in the Department for Transport 'Manual of Contract Documents for Highway Works, Volume 1 - Specification for Highway Works' (http://www.dft.gov.uk/ha/standards/mchw/vol1/pdfs/series_0600.pdf).
CL1   Class 1
CL2   Class 2
CL3   Class 3
CL4   Class 4
CL5   Class 5
CL6   Class 6
U1A   Unacceptable Material Class U1A
U1B   Unacceptable Material Class U1B
U2   Unacceptable Material Class U2
Details of the former planning regions can be found at the Local Government Boundary Commission (see www.lgbce.org.uk).

Table 2e: Forecast demolition and construction (by region), 2017 to 2025

Former English planning regions	Demolition waste			Construction waste		
Name	Estimated demolition material quantities (tonnes)	Estimated demolition waste for off-site disposal to landfill (tonnes)	Estimated demolition waste diverted from landfill (tonnes)	Estimated construction waste quantities (tonnes)	Estimated construction waste for off-site disposal to landfill (tonnes)	Estimated construction waste diverted from landfill (tonnes)
Greater London	601,112	60,111	541,001	1,315,930	131,593	1,184,337
South East	74,510	7,451	67,059	470,119	47,012	423,107
East England	2,478	248	2,230	15,035	1,504	13,531
East Midlands	44,308	4,431	39,877	126,292	12,629	113,663
West Midlands	879,333	87,934	791,399	800,442	80,044	720,398
Total	1,601,741	160,175	1,441,566	2,727,818	272,782	2,455,036

Table 2f: Forecast worker accommodation site waste (by region), 2017 to 2025

Former English planning regions	Worker accommodation site waste		
Name	Estimated worker accommodation site waste quantity (tonnes)	Estimated worker accommodation site waste for off-site disposal to landfill (tonnes)	Estimated worker accommodation site waste diverted from landfill (tonnes)
Greater London	134	67	67
South East	708	354	354
East England	71	35	36
East Midlands	281	141	140
West Midlands	723	362	361
Total	1,917	959	958

Table 2g: Forecast railway station, train and rolling stock maintenance waste quantities (by region), 2026

Former English planning regions	Railway stations and trains			Rolling stock maintenance		
Name	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste quantity diverted from landfill per annum (tonnes)	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste quantity diverted from landfill per annum (tonnes)
Greater London	1,788	715	1,073	0	0	0
South East	0	0	0	0	0	0
East England	0	0	0	0	0	0
East Midlands	0	0	0	0	0	0
West Midlands	1,496	598	898	10,698	2,140	8,558
Total	3,284	1,313	1,971	10,698	2,140	8,558

Table 2h: Forecast track maintenance and ancillary infrastructure waste quantities (by region), 2026

Former English planning regions	Track maintenance			Ancillary infrastructure		
Name	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste quantity diverted from landfill per annum (tonnes)	Estimated quantity of waste per annum (tonnes)	Estimated waste for off-site disposal to landfill per annum (tonnes)	Estimated waste quantity diverted from landfill per annum (tonnes)
Greater London	544	81	463	46	19	27
South East	1,074	162	912	91	36	55
East England	25	4	21	2	1	1
East Midlands	340	51	289	28	11	17
West Midlands	1,815	272	1,543	152	60	92
Total	3,798	570	3,228	319	127	192

Volume 5 Annex 2 - Construction waste benchmarks for railway projects

bre

Construction waste benchmarks for railway projects

Prepared for: ████████
██████████
Arup

15th February 2013

Client report number 284-945
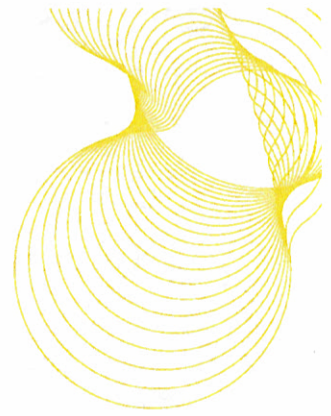
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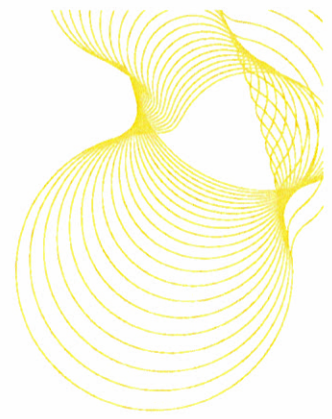
Executive Summary

Arup require information on construction waste arisings and waste management methods for railway projects. This is to assist in the proposed HS2 railway project. BRE's SMARTWaste database contains data on over 8000 completed construction projects (including approximately 300 completed railway projects) and these can be used to produce benchmarks of waste arisings and waste management methods.

Average performance indicators for waste arisings (tonnes)/£100K project value have been produced for railway projects both overall and by waste type. In addition, benchmarks for standard, good and best practice have been produced. Similarly, for waste management routes, the average reused, recycled and recovered has been calculated together with benchmarks for diversion of waste from landfill.

Contents

Introduction

Arup requires information on construction waste arisings and waste management methods for railway projects. BRE's SMARTWaste database contains data on over 8000 completed construction projects and these can be used to produce benchmarks of waste arisings and waste management methods.

SMARTWaste is a web-based tool to help users prepare, implement and review site waste management plans. It also allows users to measure waste arisings and waste management routes. It can be accessed at www.smartwaste.co.uk. The tool was developed in 2008 to coincide with the introduction of the Site Waste Management Plan legislation and since that time data on over 13,000 projects (including over 8,000 completed projects) has been collected. For each project a large amount of data is collected including:

- Project value

- Project floor area

- Location (by region)

- Project type (e.g. new build, refurbishment, fit-out, demolition)

- Client type

- Construction type (e.g. frame type)

- Project classification (e.g. residential, education, healthcare, commercial office, commercial retail etc.)

- Waste arisings by waste product type

- Waste management methods used
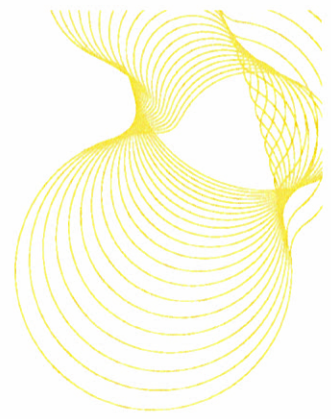
Description of the project

Data is available in the SMARTWaste database for 300 completed railway projects. Of these, approximately half of the projects have reported waste arisings in tonnes and these have been used to produce the benchmarks.. For some railway projects, it can be difficult to assign floor areas to the projects so the performance indicators are based on project value, i.e. tonnes/£100K. Aggregated data obtained from completed SMARTWaste projects was subject to a number of logical and statistical tests, to ensure that the data used to produce the performance indicator (tonnes/£100K) is valid.

Initially all projects that meet the following criteria were selected.

- The waste arising must be more than 1 tonne.
- The project value must be greater than £1.

Performance indicators of tonnes waste (based on construction phase waste excluding soils) per £100K project value were calculated for these projects and further statistical analysis carried out to remove any potential outliers. It has been assumed that projects with performances indicators below the 5th percentile and above the 95th percentile are potential outliers and these so only projects with performance indicators that fall between the 5th percentile and the 95th percentile were used for further analysis.

For projects that passed these logical tests, a count of the number of plausible results, the average, standard deviation and median of the results was obtained for the tonnes waste/£100K project value. In addition, benchmarks for Standard, Good and Best practice were produced as follows:

- Best practice is results in the lowest quartile of the performance indicator
- Good practice is the second quartile of the performance indicator (i.e. between the median and the lowest quartile)
- Standard practice is results between the average and the median.
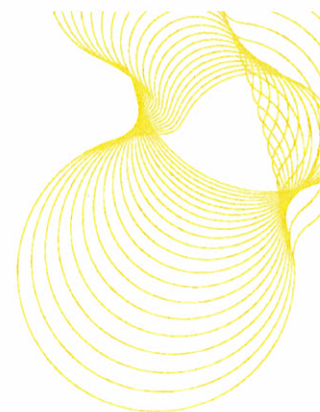
Findings

Waste arising/£100K project value

Railway projects that were completed by 31/12/12 that passed the above statistical criteria were used to produce the figures for waste arisings/£100K. These were broken down into different project types as shown in the Table 1 below.

	Number of completed SMARTWaste Plan Railway projects
All projects	114
Railways	71
Stations	32
Bridges	8
Tunnels	3

Table 1: Number of projects used in determination of performance indicators

The mean of the performance indicators for completed railway projects are shown in Table 2.

|	Average Tonnes waste/£100K project value			
	Construction tonnes/£100K	Excavation tonnes/£100K	Demolition tonnes/£100K	Total tonnes/£100K
All projects	26.4	1.9	17.3	45.7
Railways	34.4	2.0	14.8	51.2
Stations	14.1	0.8	28.2	43.1
Bridges	6.0	6.8	1.5	14.3
Tunnels	24.5	0.0	0.0	24.5

Table 2: Mean tonnes/£100K project value for completed railway projects
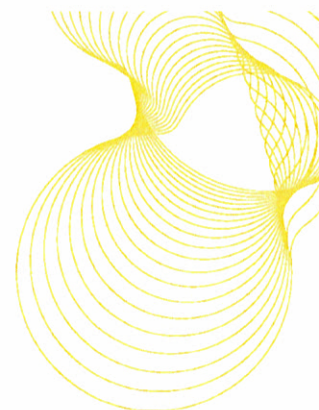
The performance indicators for all railway projects have been used to produce figures for Standard, Good and Best practice. Standard practice is performance between the median and the average, good practice is between the median and the upper quartile and best practice is performance in the upper quartile.

	Tonnes waste/£100K project value		
	Standard	**Good**	**Best**
Construction phase	6.1 - 26.4	2.5 - 6.1	<2.5
Excavation phase	1.9 – 6.4	0.7 – 1.9	<0.7
Demolition phase	4.6 – 17.3	1.7 – 4.6	<1.7
Overall	8.9 – 45.7	4.4 – 8.9	<4.4

Table 3: Standard, good and best performance indicators for waste arisings from all rail projects
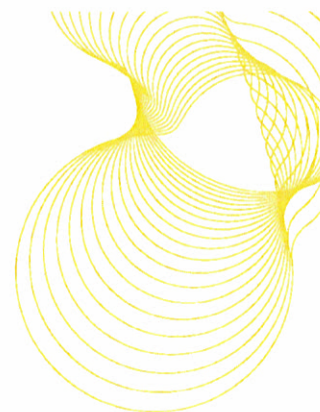
Waste arisings by waste product

The waste arisings were analysed in more detail to give overall performance indicators for specific waste products. These are show in Table 4.

Waste product	Average tonnes/£100K
Soils (17 05 04)	17.1
Concrete (17 01 01)	16.0
Mixed (17 09 04)	4.6
Other (20 03 01)	2.9
Inert (17 01 07)	2.2
Metals (17 04 07)	1.0
Timber (17 02 01)	0.7
Asphalt and tar (17 03 02)	0.3
Bricks (17 01 02)	0.2
Insulation (17 06 04)	0.2
Canteen/office/adhoc waste (20 03 01)	0.1
Gypsum (17 08 02)	0.1
Packaging (15 01 06)	0.1
Electrical and electronic equipment (20 01 36)	0.0
Plastics (17 02 03)	0.0
Hazardous (17 09 03*)	0.0
Binders (17 01 01)	0.0
Tiles and Ceramics (17 01 03)	0.0
Furniture (20 03 07)	0.0
Liquids (16 10 02)	0.0
Oils (13 01 13*)	0.0

Table 4: Performance indicators for individual waste products from rail projects

Waste product breakdown for rail projects

Mixed (17 09 04), 4.6

Other (20 03 01), 2.9

Concrete (17 01 01), 16.0

Inert (17 01 07), 2.2

Metals (17 04 07), 1.0

Other, 1.5

Soils (17 05 04), 17.1

Timber (17 02 01), 0.7

Asphalt and tar (17 03 02), 0.3
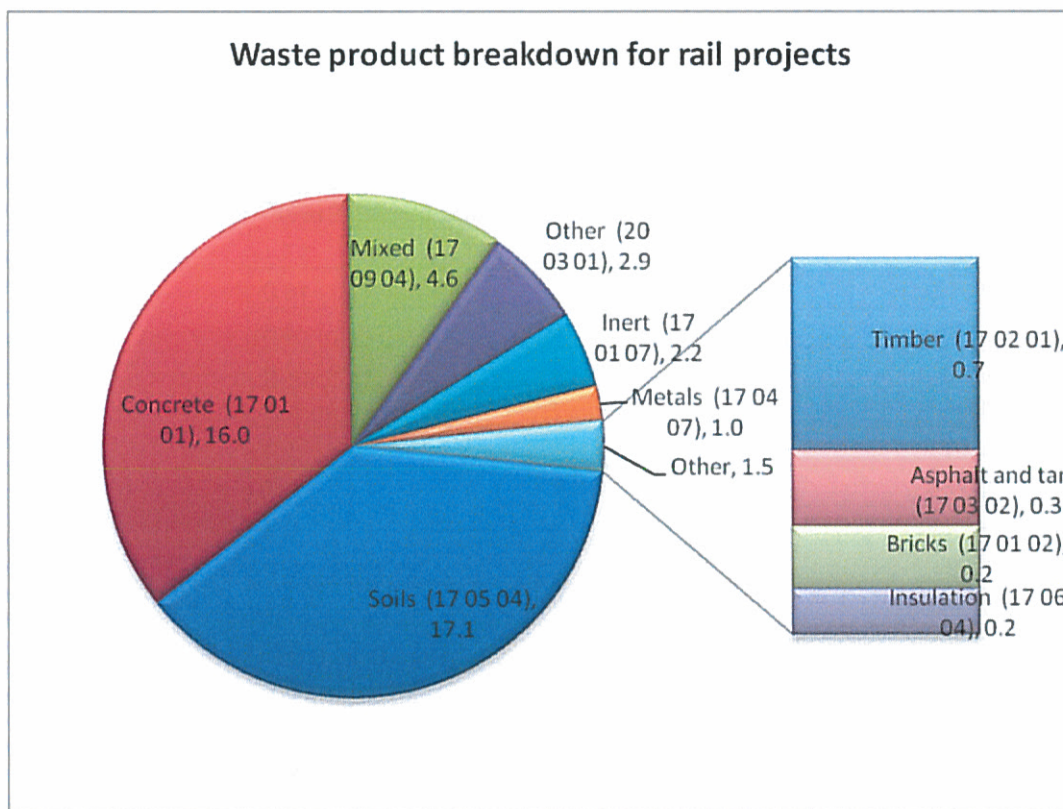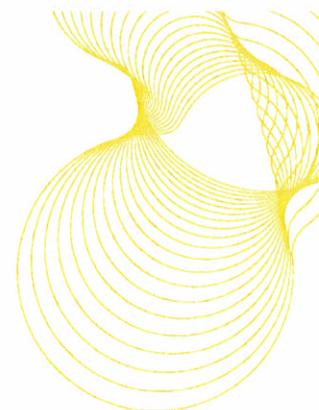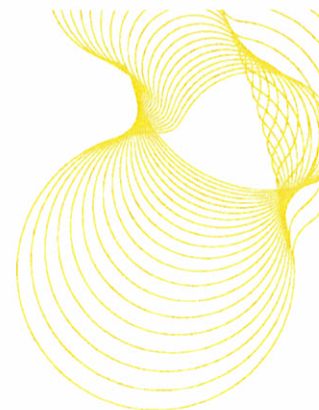
Bricks (17 01 02), 0.2

Insulation (17 06 04), 0.2

Chart 1: Summary of top 10 waste products for rail projects

Waste management routes

These projects were analysed to determine the waste management methods used. The overall percentages reused, recycled, recovered and diverted from landfill for all waste arisings were calculated.

Waste management route	Average %
Reused	1.4
Recycled	32.1
Recovered	27.0
Landfilled	39.5
Diverted from landfill	60.5

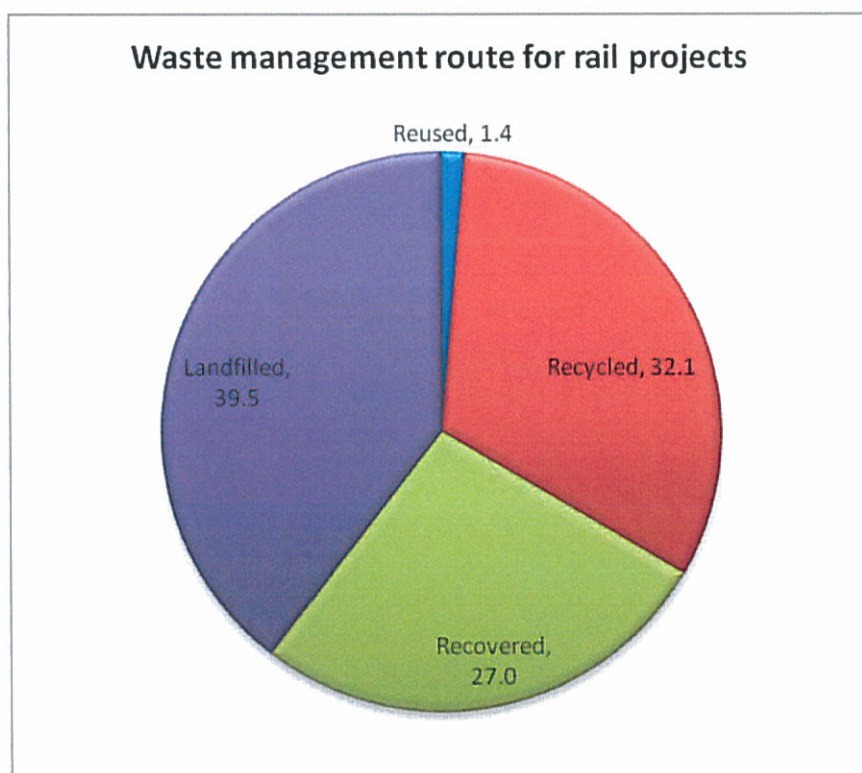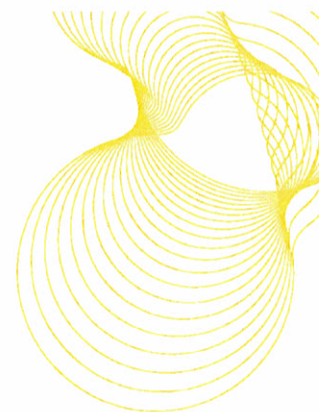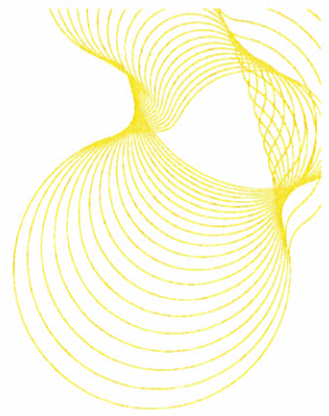Table 5: Waste management routes for waste arisings from rail projects

Chart 2: Waste management routes for waste from rail projects

Benchmarks for diversion of waste from landfill for rail projects were also calculated with performance in the top quartile being best practice, the next quartile good practice and between the average and the median is standard practice.

	Standard	Good	Best
Diversion of waste from landfill (as a percentage)	60.5 - 61.7	61.7 – 97.1	>97.1

Table 6: Benchmarks for diversion of waste from landfill for rail projects

Conclusion

Performance indicators for waste arisings (tonnes)/£100K project value have been calculated for completed railway projects both overall and for specific waste types. These can be used to help forecast waste arisings and set targets for similar projects.

In addition, details of waste management routes used for waste arising from railway projects have been calculated and these can also be used to inform waste management decisions on future projects. The benchmarks for diversion of waste from landfill can be used to help set targets for waste management.