E64

High Speed Rail (West Midlands - Crewe)

Environmental Statement

Volume 5: Technical appendices

Waste and material resources

Route-wide waste and material resources assessment (WM-001-000)

July 2017

ES 3.5.0.17

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Department for Transport

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

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1 Introduction

1.1 Structure of the waste and material resources appendix

1.1.1 This Appendix presents waste and material resources data for High Speed Rail (West Midlands - Crewe). The Proposed Scheme will pass through the following community areas (CA):

- CA1: Fradley to Colton;
- CA2: Colwich to Yarlet;
- CA3: Stone and Swynnerton;
- CA4: Whitmore Heath to Madeley; and
- CA5: South Cheshire.

1.1.2 The following sections of this Appendix relate to the above areas in sequence and comprise:

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

1.1.3 These are followed by two annexes:

- Annex A - CA waste and material resources reporting tables; and
- Annex B - Construction waste benchmarks for railway projects.

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

1.2.2 The assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste generated during the construction and operation of the Proposed Scheme has been undertaken on a route-wide and not a community area basis, as detailed within Volume 3, Route-wide effects, Section 15.

1.3 Waste infrastructure capacity

Current baseline

1.3.1 Table 1 provides baseline waste infrastructure capacity for the counties through which the Proposed Scheme will pass.

Table 1: Baseline (2015) Waste infrastructure capacity by county

County	Landfill (tonnes)	Incineration (tonnes)	Waste treatment and transfer (tonnes)	Total[1]
Staffordshire	14,842,034	670,000	2,014,850	17,526,883
Cheshire	16,701,064	1,050,000	2,442,953	20,194,017

1.3.2 The baseline information presented is based on permitted capacity for all types of waste treatment and disposal facilities for the year 2015, published by the Environment Agency[2].

Future baseline

1.3.3 Table 2 provides projected landfill capacity for inert, non-hazardous and hazardous landfill for the counties through which the Proposed Scheme will pass.

1.3.4 As the future baseline provides the basis for the assessment and the assessment relates to loss of finite waste management capacity only landfill capacity is reported in Table 2, as incineration and waste treatment and transfer are processes rather than repositories.

1.3.5 Landfill capacity is reported by type as the assessment uses different significance criteria for each type of landfill.

Table 2: Future baseline (2020 to 2026) landfill capacity by county

Landfill type and county		2020	2026	2027
Inert landfill (tonnes)	Staffordshire	5,852,637	5,755,255	5,739,183
	Cheshire	289,072	84,165	68,520
Non-hazardous landfill (tonnes)	Staffordshire	7,106,256	5,419,171	5,179,822
	Cheshire	9,464,721	6,171,102	5,746,524
Hazardous landfill (tonnes)	Staffordshire	0	0	0
	Cheshire	2,041,234	1,701,770	1,650,956

1.3.6 Projected landfill capacity is based on the average percentage change in permitted landfill capacity for the years 2000 to 2015 (for inert and non-hazardous waste landfills) and for the years 2006 to 2015 (for hazardous waste landfill) as reported by the Environment Agency. The average percentage change has then been applied to the reported 2015 permitted landfill capacity and projected forward to 2027.

[1] Numbers do not sum to total due to rounding
[2] Environment Agency (2015), *Waste Management Information 2015*, https://www.gov.uk/government/statistics/waste-management-for-england-2015

1.3.7 This method assumes that the average percentage change in permitted capacity for each class of landfill remains constant. Use of an average value taken from historical data also provides a reasonable allowance for potential future increases in permitted capacity for each class of landfill.

1.4 Committed development

1.4.1 Committed developments are defined as: developments with planning permission; or sites allocated in adopted development plans.

1.4.2 The impact of committed development on the Proposed Scheme is assessed as cumulative effects in Volume 3, Route-wide effects.

Phase 2a and Phase One

1.4.3 The construction waste arisings considered in the assessment of cumulative effects from Phase 2a and Phase One as committed development relate to those construction waste arisings which will require off-site disposal to landfill in the West Midlands region. This being the only region through which both Phase 2a and Phase One pass. The cumulative effects of these construction waste arisings are considered in Volume 3: Route-wide effects.

1.4.4 The operational waste arisings considered in the assessment of cumulative effects from Phase 2a and Phase One as committed development are set out in Table 3. The cumulative effects of these operational waste arisings are considered in Volume 3: Route-wide effects.

Table 3: Phase 2a and Phase One operational waste arisings (cumulative effect)

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	3,284	1,313
Rolling stock maintenance	10,698	2,140
Track maintenance	4,151	570
Ancillary infrastructure	385	154
Total	18,518	4,177

Phase 2a and other committed developments

1.4.5 The methodology used to develop the future baseline landfill capacities during the proposed construction period, takes account of waste generation trends driven by developments in the respective regional areas. It is considered that none of the committed developments are of sufficient scale to disrupt these trends, they are therefore considered to comprise part of the future baseline.

2 Fradley to Colton (CA1)

2.1 Local assumptions and limitations

2.1.1 There are no local assumptions or limitations specific to the Fradley to Colton 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 6, the construction of the Proposed Scheme is forecast to generate a total of 8,357,046 tonnes of excavated material within the Fradley to Colton area, as shown in Table 4.

Table 4: Forecast excavated material quantities in the Fradley to Colton area

Excavated material types[3]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[4]
Selected fill	3,177,175	N/A
General engineering fill	2,906,767	N/A
Environmental mitigation earthworks fill	822,493	N/A
Topsoil	773,333	N/A
Agricultural subsoil	572,928	N/A
Unacceptable material Class U1A	88,236	N/A
Unacceptable material Class U1B	15,358	0
Unacceptable material Class U2	756	756
Total	8,357,046	756

2.2.2 The majority of excavated material that will be generated in the Fradley to Colton area is expected to be suitable for beneficial reuse as engineering fill material, in the environmental mitigation earthworks, or in backfilling borrow pits of the Proposed Scheme.

2.2.3 Approximately 57% of the excavated material generated in the Fradley to Colton area is expected to arise from the five borrow pits proposed in the area. There is a need for high quality aggregate to construct rail embankments in the Fradley to Colton area. The import of the construction aggregate is likely to result in significant adverse transport effects during the construction period of the Proposed Scheme on minor

[3] Department for Transport, Highways Agency, *Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*, http://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/600.pdf

[4] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme. All other material reused within the Proposed Scheme so no surplus for disposal to landfill, indicated by N/A (Not Applicable)

roads used by local communities. To minimise the transport movements of construction aggregate, the use of borrow pits in close proximity to the route of the Proposed Scheme is proposed.

2.2.4 A proportion of the excavated material in the Fradley to Colton 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)[5] or the hazardous properties of the material (i.e. unacceptable material Class U2)[6]. As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

2.2.5 Types of building demolitions required within the Fradley to Colton area are listed in Table 5 together with estimated demolition material quantities.

2.2.6 Demolition material quantities have been estimated using the Waste and Resources Action Programme (WRAP) 'Demolition bill of quantities estimator'[7], using the basic dimensions and typology of buildings.

2.2.7 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 5). 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 5: Forecast demolition waste quantities to landfill in the Fradley to Colton area

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Non-residential property (industrial units and commercial property)	5,481	548
Residential property	1,872	187
Bridges	0	0
Miscellaneous	0	0
Total	7,353	735

Construction waste quantities

2.2.8 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 performance benchmark data procured from the Building Research Establishment Ltd[8] (BRE). The construction waste forecast for the Fradley to Colton area is given in Table 6.

[5] Unacceptable material Class U1B 'contaminated materials', as described in the *Specification for Highway Works, Series 601 Classification and Uses of Earthworks Materials sub-clause 2(ii)*
[6] 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] Waste and Resources Action Programme, *Net Waste Tool*, http://nwtool.wrap.org.uk/
[8] Building Research Establishment (February 2013), *Construction waste benchmarks for railway projects*

2.2.9 A landfill diversion rate of 90% has been applied to the estimated construction waste 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 One).

Table 6: Forecast construction waste quantities to landfill in the Fradley to Colton area

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Pyford Brook viaduct satellite compound	2,218	222
Pyford North embankment satellite compound	5,446	544
Bourne embankment satellite compound	10,753	1,075
River Trent viaduct satellite compound	16,134	1,613
Pipe Ridware embankment satellite compound incorporating Pipe Ridware auto-transformer station satellite compound	6,531 114	653 11
Blithbury Central cutting satellite compound	7,003	700
Blithbury North cutting satellite compound	15,604	1,560
Stockwell Heath cutting satellite compound	6,449	645
Moreton Brook viaduct satellite compound	1,160	116
Bourne Brook auto-transformer station railway systems compound	114	11
Blithbury crossovers satellite compound	15	1
Newlands Lane auto-transformer feeder station satellite compound	405	40
Total	71,946	7,191

Worker accommodation site waste quantities

2.2.10 There will not be any worker accommodation sites in the Fradley to Colton 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 assuming a full year of operation (2027), see Table 7.

2.3.2 Operational waste has been forecast based on waste generation data received from Network Rail, standard waste generation rates provided in British Standard BS5906:2005[9] and rail length.

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%;
- ballast track maintenance: 85%;
- slab track maintenance: 100%; and
- ancillary infrastructure: 60%.

2.3.4 The rationale for each of these landfill diversion rates is provided in the Waste forecasting and assessment methodology, which can be found in the Environmental Impact Assessment Scope and Methodology Report (SMR) and its Addendum in Volume 5: Appendices CT-001-001 and CT-001-002.

2.3.5 Slab track will be used in the Fradley to Colton area.

Table 7: Operational waste forecast for the Proposed Scheme in the Fradley to Colton area

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	17	0
Ancillary infrastructure	2	1
Total	19	1

2.3.6 Railway station and train waste has not been reported in Table 7 as there will not be any stations in the Fradley to Colton area.

2.3.7 Rolling stock maintenance waste has not been reported in Table 7 as there will not be any rolling stock maintenance depots in the Fradley to Colton area.

2.3.8 Slab track maintenance waste has been estimated using a weight per metre length of rail, and has been reported for each area along the route. Track maintenance waste generation for the Fradley to Colton area is shown in Table 7.

2.3.9 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. Ancillary infrastructure waste generation for the Fradley to Colton area is shown in Table 7.

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

2.3.10 It has been estimated that the Proposed Scheme will generate a total quantity of 19 tonnes of operational waste annually in the Fradley to Colton area when it becomes fully operational in 2027, of which 18 tonnes (95%) will be diverted from landfill.

2.3.11 The Proposed Scheme in the Fradley to Colton area will generate an overall operational landfill disposal requirement of one tonne per annum.

3 Colwich to Yarlet (CA2)

3.1 Local assumptions and limitations

3.1.1 There are no local assumptions or limitations specific to the Colwich to Yarlet 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 6, the construction of the Proposed Scheme is forecast to generate a total of 5,945,404 tonnes of excavated material within the Colwich to Yarlet area, as shown in Table 8.

Table 8: Forecast excavated material quantities in the Colwich to Yarlet area

Excavated material types[10]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[11]
Selected fill	573,918	N/A
General engineering fill	3,904,216	N/A
Environmental mitigation earthworks fill	619,934	N/A
Topsoil	737,761	N/A
Agricultural subsoil	43,581	N/A
Unacceptable material Class U1A	0	N/A
Unacceptable material Class U1B	65,047	0
Unacceptable material Class U2	947	947
Total	5,945,404	947

3.2.2 The majority of excavated material that will be generated in the Colwich to Yarlet area is expected to be suitable for beneficial reuse as engineering fill material, in the environmental mitigation earthworks, or in backfilling borrow pits as part of the Proposed Scheme.

3.2.3 A proportion of the excavated material in the Colwich to Yarlet 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). As a worst case scenario it has been assumed that this material will be disposed of to landfill.

[10] Department for Transport, Highways Agency, *Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*, http://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/600.pdf

[11] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme. All other material reused within the Proposed Scheme so no surplus for disposal to landfill, indicated by N/A (Not Applicable)

Demolition material and waste quantities

3.2.4 Types of building demolitions required within the Colwich to Yarlet area are listed in Table 9 together with estimated demolition material quantities.

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

3.2.6 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 9). 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 9: Forecast demolition waste quantities to landfill in the Colwich to Yarlet area

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Non-residential property (industrial units and commercial property)	44,181	4,418
Residential property	10,698	1,070
Bridges	0	0
Miscellaneous	6,717	672
Total	61,596	6,160

Construction waste quantities

3.2.7 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 performance benchmark data procured from BRE. The construction waste forecast for the Colwich to Yarlet area is given in Table 10.

3.2.8 A landfill diversion rate of 90% has been applied to the estimated construction waste 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 One).

Table 10: Forecast construction waste quantities to landfill in the Colwich to Yarlet area

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)[12]
Trent South embankment main compound	24,617	2,462
Trent North embankment satellite compound	5,683	568
Brancote South cutting satellite compound	7,239	724

[12] Numbers do not sum to total due to rounding

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)[12]
Hopton South cutting satellite compound	8,360	836
Hopton North cutting satellite compound	6,952	695
Marston South embankment satellite compound	4,344	434
Marston North embankment satellite compound	2,441	244
Yarlet South cutting satellite compound	4,462	446
Moreton auto-transformer station satellite compound	114	11
Mill Lane auto-transformer station compound	114	11
Sandon Road auto-transformer station satellite compound	114	11
Yarlet express feeder auto-transformer station satellite compound	114	11
Total	64,554	6,455

Worker accommodation site waste quantities

3.2.9 Worker accommodation site waste has been forecast based on a waste generation rate of 0.027 tonnes per person per month. This rate has been derived from the average annual household waste generation in the UK of 407kg/person in 2015[13] and has been adjusted assuming an average 5.5-day working week[14].

3.2.10 There is one worker accommodation site proposed in the Colwich to Yarlet area, located at the Trent South embankment main compound. The worker accommodation site is expected to generate 330 tonnes of waste, of which 165 tonnes is forecast to require off-site disposal to landfill.

3.2.11 A landfill diversion rate of 50% has been applied to the estimated worker accommodation site waste quantities. The landfill diversion rate has been selected based on local authority household waste recycling rates.

3.3 Operation

Forecast of waste quantities

3.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis assuming a full year of operation (2027), see Table 11.

3.3.2 Operational waste has been forecast based on waste generation data received from Network Rail, ~~a~~ standard waste generation rates provided in British Standard BS5906:2005 and rail length.

[13] Department for Environment Food and Rural Affairs (2017), *Digest of Waste and Resource Statistics – 2017 Edition (revised),* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/607416/Digest_of_Waste_and_Resource_Statistics__2017_rev.pdf

[14] Department for Environment, Food and Rural Affairs, *Waste and Recycling Statistics*, https://www.gov.uk/government/collections/waste-and-recycling-statistics

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%;
- ballast track maintenance: 85%;
- slab track maintenance: 100%; and
- ancillary infrastructure: 60%.

3.3.4 The rationale for each of these landfill diversion rates is provided in the Waste forecasting and assessment methodology, which can be found in the SMR and its Addendum in Volume 5: Appendices CT-001-001 and CT-001-002.

3.3.5 Slab track will be used in the Colwich to Yarlet area.

Table 11: Operational waste forecast for the Proposed Scheme in the Colwich to Yarlet area

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	220	0
Ancillary infrastructure	21	8
Total	241	8

3.3.6 Railway station and train waste has not been reported in Table 11 as there will not be any stations in the Colwich to Yarlet area.

3.3.7 Rolling stock maintenance waste has not been reported in Table 11 as there will not be any rolling stock maintenance depots in the Colwich to Yarlet area.

3.3.8 Slab track maintenance waste has been estimated using a weight per metre length of rail and has been reported for each area along the route. Track maintenance waste generation for the Colwich to Yarlet area is shown in Table 11.

3.3.9 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. Ancillary infrastructure waste generation for the Colwich to Yarlet area is shown in Table 11.

3.3.10 It has been estimated that the Proposed Scheme will generate a total quantity of 241 tonnes of operational waste annually in the Colwich to Yarlet area when it becomes fully operation in 2027, of which 233 tonnes (97%) will be diverted from landfill.

3.3.11 The Proposed Scheme in the Colwich to Yarlet area will generate an overall operational landfill disposal requirement of eight tonnes per annum.

4 Stone and Swynnerton (CA3)

4.1 Local assumptions and limitations

4.1.1 There are no local assumptions or limitations specific to the Stone and Swynnerton area.

4.2 Construction

Forecast of material and waste quantities

Excavated material quantities

4.2.1 Based on the integrated engineering earthworks design approach, described in Volume 1, Section 6 the construction of the Proposed Scheme is forecast to generate a total of 11,181,296 tonnes of excavated material within the Stone and Swynnerton area, as shown in Table 12.

Table 12: Forecast excavated material quantities in the Stone and Swynnerton area

Excavated material types[15]	Estimated quantity of excavated material (tonnes)[16]	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[17]
Selected fill	850,239	0
General engineering fill	6,608,931	0
Environmental mitigation earthworks fill	1,813,546	0
Topsoil	1,070,102	0
Agricultural subsoil	114,944	0
Unacceptable material Class U1A	631,051	0
Unacceptable material Class U1B	88,630	0
Unacceptable material Class U2	3,854	3,854
Total	11,181,296	3,854

4.2.2 The majority of excavated material that will be generated in the Stone and Swynnerton area is expected to be suitable for beneficial reuse as engineering fill material, in the environmental mitigation earthworks, or in backfilling borrow pits as part of the Proposed Scheme.

4.2.3 A proportion of the excavated material in the Stone and Swynnerton 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

[15] Department for Transport, Highways Agency, *Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*, http://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/600.pdf
[16] Numbers do not sum to total due to rounding
[17] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme. All other material reused within the Proposed Scheme so no surplus for disposal to landfill, indicated by N/A (Not Applicable)

properties of the material (i.e. unacceptable material Class U2). As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

4.2.4 Types of building demolitions required within the Stone and Swynnerton area are listed in Table 13 together with estimated demolition material quantities.

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

4.2.6 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 13). 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 13: Forecast demolition waste quantities to landfill in the Stone and Swynnerton area

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Non-residential property (industrial units and commercial property)	9,430	943
Residential property	6,267	627
Bridges	6,000	600
Miscellaneous	9,388	939
Total	31,085	3,109

Construction waste quantities

4.2.7 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 performance benchmark data procured from BRE. The construction waste forecast for the Stone and Swynnerton area is given in Table 14.

4.2.8 A landfill diversion rate of 90% has been applied to the estimated construction waste quantities (see Table 14). 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 14: Forecast construction waste quantities to landfill in the Stone and Swynnerton area

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Yarlet embankment satellite compound	7,971	797
Yarlet North cutting satellite compound	22,067	2,207
Yarnfield North embankment satellite compound	44,472	4,447

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
M6 Meaford viaduct satellite compound	3,858	386
Meaford North embankment satellite compound	12,675	1,268
Swynnerton embankment satellite compound	3,359	335
Swynnerton North cutting main compound	10,160	1,016
Hatton South cutting satellite compound	8,883	888
Hatton North cutting satellite compound	3,947	395
Stone connection satellite compound	19	2
Stone railhead main compound	1,355	136
Stableford auto-transformer station satellite compound	114	11
Total	118,880	11,888

Worker accommodation site waste quantities

4.2.9 Worker accommodation site waste has been forecast based on a waste generation rate of 0.027 tonnes per person per month. This rate has been derived from the average annual household waste generation in the UK of 407kg/person in 2015[18] and has been adjusted assuming an average 5.5-day working week[19].

4.2.10 There is one worker accommodation site proposed in the Stone and Swynnerton area, located at the Yarnfield North Embankment satellite compound. The worker accommodation site is expected to generate 330 tonnes of waste, of which 165 tonnes is forecast to require off-site disposal to landfill.

4.2.11 A landfill diversion rate of 50% has been applied to the estimated worker accommodation site waste quantities. The landfill diversion rate has been selected based on local authority household waste recycling rates.

4.3 Operation

Forecast of waste quantities

4.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis assuming a full year of operation (2027), see Table 15.

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

[18] Department for Environment Food and Rural Affairs (2017), *Digest of Waste and Resource Statistics – 2017 Edition (revised)*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/607416/Digest_of_Waste_and_Resource_Statistics__2017_rev.pdf

[19] Department for Environment, Food and Rural Affairs, *Waste and Recycling Statistics*, https://www.gov.uk/government/collections/waste-and-recycling-statistics

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%;
- ballast track maintenance: 85%;
- slab track maintenance: 100%; and
- ancillary infrastructure: 60%.

4.3.4 The rationale for each of these landfill diversion rates is provided in the Waste forecasting and assessment methodology, which can be found in the SMR and its Addendum in Volume 5: Appendices CT-001-001 and CT-001-002.

4.3.5 Slab track will be used in the Stone and Swynnerton area.

Table 15: Operational waste forecast for the Proposed Scheme in the Stone and Swynnerton area

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	205	0
Ancillary infrastructure	19	8
Total	225	8

4.3.6 Railway station and train waste has not been reported in Table 15 as there will not be any stations in the Stone and Swynnerton area.

4.3.7 Rolling stock maintenance waste has not been reported in Table 15 as there will not be any rolling stock maintenance depots in the Stone and Swynnerton area.

4.3.8 Slab track maintenance waste has been estimated using a weight per metre length of rail and has been reported for each area along the route. Track maintenance waste generation for the Stone and Swynnerton area is shown in Table 15.

4.3.9 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. Ancillary infrastructure waste generation for the Stone and Swynnerton area is shown in Table 15.

4.3.10 It has been estimated that the Proposed Scheme will generate a total quantity of 225 tonnes of operational waste annually in the Stone and Swynnerton area when it becomes fully operation in 2027, of which 217 tonnes (96%) will be diverted from landfill.

4.3.11 The Proposed Scheme in the Stone and Swynnerton area will generate an overall operational landfill disposal requirement of eight tonnes per annum.

5 Whitmore Heath to Madeley (CA4)

5.1 Local assumptions and limitations

5.1.1 There are no local assumptions or limitations specific to the Whitmore Heath to Madeley 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 6, the construction of the Proposed Scheme is forecast to generate a total of 7,173,909 tonnes of excavated material within the Whitmore Heath to Madeley area, as shown in Table 16.

Table 16: Forecast excavated material quantities in the Whitmore Heath to Madeley area

Excavated material types[20]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[21]
Selected fill	806,902	0
General engineering fill	4,408,915	0
Environmental mitigation earthworks fill	673,852	0
Topsoil	660,038	0
Agricultural subsoil	374,087	0
Unacceptable material Class U1A	250,023	0
Unacceptable material Class U1B	92	0
Unacceptable material Class U2	0	0
Total	7,173,909	0

5.2.2 The majority of excavated material that will be generated in the Whitmore Heath to Madeley area is expected to be suitable for beneficial reuse as engineering fill material, in the environmental mitigation earthworks, or in backfilling borrow pits as part of the Proposed Scheme.

5.2.3 Approximately 18% of the excavated material generated in the Whitmore Heath to Madeley area is expected to arise from the borrow pit proposed in the area. There is a need for high quality aggregate to construct rail embankments in the Whitmore Heath to Madeley area. The import of the construction aggregate is likely to result in

[20] Department for Transport, Highways Agency, *Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*, http://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/600.pdf

[21] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme. All other material reused within the Proposed Scheme so no surplus for disposal to landfill, indicated by N/A (Not Applicable)

significant adverse transport effects during the construction period of the Proposed Scheme on minor roads used by local communities. To minimise the transport movements of construction aggregate, the use of borrow pits in close proximity to the route of the Proposed Scheme is proposed.

Demolition material and waste quantities

5.2.4 Types of building demolitions required within the Whitmore Heath to Madeley area are listed in Table 17 together with estimated demolition material quantities.

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

5.2.6 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 17). 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 17: Forecast demolition waste quantities to landfill in the Whitmore Heath to Madeley area

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Non-residential property (industrial units and commercial property)	0	0
Residential property	5,088	509
Bridges	0	0
Miscellaneous	2,300	230
Total	7,388	739

Construction waste quantities

5.2.7 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 performance benchmark data procured from BRE. The construction waste forecast for the Whitmore Heath to Madeley area is given in Table 18.

5.2.8 A landfill diversion rate of 90% has been applied to the estimated construction waste 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 One).

Table 18: Forecast construction waste quantities to landfill in the Whitmore Heath to Madeley area

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)[22]
Stableford North embankment satellite compound	8,099	810
Whitmore Heath tunnel satellite compound	26,943	2,694
Whitmore North cutting satellite compound	9,407	941
River Lea viaduct satellite compound	14,016	1,402
Madeley cutting satellite compound	4,480	448
Madeley tunnel (south) satellite compound	23,097	2,310
Madeley tunnel (north) satellite compound	203	20
Checkley South embankment satellite compound	8,939	894
Whitmore Heath tunnel south portal satellite compound	62	6
Whitmore Heath tunnel north portal satellite compound	136	14
Whitmore North auto-transformer station satellite compound	114	11
Madeley Tunnel north portal satellite compound	285	29
Total	95,781	9,578

Worker accommodation site waste quantities

5.2.9 There will not be any worker accommodation sites in the Whitmore Heath to Madeley 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 assuming a full year of operation (2027), see Table 19.

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

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%;
- ballast track maintenance: 85%;

[22] Numbers do not sum to total due to rounding

- slab track maintenance: 100%; and
- ancillary infrastructure: 60%.

5.3.4 The rationale for each of these landfill diversion rates is provided in the Waste forecasting and assessment methodology, which can be found in the SMR and its Addendum in Volume 5: Appendices CT-001-001 and CT-001-002.

5.3.5 Slab track will be used in the Whitmore Heath to Madeley area.

Table 19: Operational waste forecast for the Proposed Scheme in the Whitmore Heath to Madeley area

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	132	0
Ancillary infrastructure	12	5
Total	144	5

5.3.6 Railway station and train waste has not been reported in Table 19 as there will not be any stations in the Whitmore Heath to Madeley area.

5.3.7 Rolling stock maintenance has not been reported in Table 19 as there will not be any rolling stock maintenance depots in the Whitmore Heath to Madeley area.

5.3.8 Slab track maintenance waste has been estimated using a weight per metre length of rail and has been reported for each area along the route. Track maintenance waste generation for the Whitmore Heath to Madeley area is shown in Table 19.

5.3.9 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. Ancillary infrastructure waste generation for the Whitmore Heath to Madeley area is shown in Table 19.

5.3.10 It has been estimated that the Proposed Scheme will generate a total quantity of 144 tonnes of operational waste annually in the Whitmore Heath to Madeley area when it becomes fully operation in 2027, of which 139 tonnes (97%) will be diverted from landfill.

5.3.11 The Proposed Scheme in the Whitmore Heath to Madeley area will generate an overall operational landfill disposal requirement of five tonnes per annum.

6 South Cheshire (CA5)

6.1 Local assumptions and limitations

6.1.1 There are no local assumptions or limitations specific to the South Cheshire 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 6, the construction of the Proposed Scheme is forecast to generate a total of 6,656,875 tonnes of excavated material within the South Cheshire area, as shown in Table 20.

Table 20: Forecast excavated material quantities in the South Cheshire area

Excavated material types[23]	Estimated quantity of excavated material (tonnes)	Estimated quantity of surplus excavated material for disposal to landfill (tonnes)[24]
Selected fill	513,591	0
General engineering fill	3,922,580	0
Environmental mitigation earthworks fill	764,817	0
Topsoil	921,910	0
Agricultural subsoil	507,586	0
Unacceptable material Class U1A	7,810	0
Unacceptable material Class U1B	17,832	0
Unacceptable material Class U2	749	749
Total	6,656,875	749

6.2.2 The majority of excavated material that will be generated in the South Cheshire area is expected to be suitable for beneficial reuse as engineering fill material, in the environmental mitigation earthworks, or in backfilling borrow pits of the Proposed Scheme.

6.2.3 Approximately 35% of the excavated material generated in the South Cheshire area is expected to arise from the borrow pit proposed in the area. There is a need for high quality aggregate to construct rail embankments in the South Cheshire area. The import of the construction aggregate is likely to result in significant adverse transport effects during the construction period of the Proposed Scheme on minor roads used

[23] Department for Transport, Highways Agency, *Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*, http://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/600.pdf

[24] Only includes the quantity of unacceptable material classes U1B and U2, which is unsuitable for reuse with the Proposed Scheme. All other material reused within the Proposed Scheme so no surplus for disposal to landfill, indicated by N/A (Not Applicable)

by local communities. To minimise the transport movements of construction aggregate, the use of borrow pits in close proximity to the route of the Proposed Scheme is proposed.

6.2.4 A proportion of the excavated material in the South Cheshire 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). As a worst case scenario it has been assumed that this material will be disposed of to landfill.

Demolition material and waste quantities

6.2.5 Types of building demolitions required within the South Cheshire area are listed in Table 21 together with estimated demolition material quantities.

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

6.2.7 A landfill diversion rate of 90% has been applied to the estimated demolition material quantities (see Table 21). 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 21: Forecast demolition waste quantities to landfill in the South Cheshire area

Type of structure	Estimated demolition material quantities (tonnes)	Estimated demolition waste for disposal to landfill (tonnes)
Non-residential property (industrial units and commercial property)	9,922	992
Residential property	0	0
Bridges	12,045	1,205
Miscellaneous	287	29
Total[25]	22,253	2,225

Construction waste quantities

6.2.8 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 performance benchmark data procured from BRE. The construction waste forecast for the South Cheshire area is given in Table 22.

6.2.9 A landfill diversion rate of 90% has been applied to the estimated construction waste 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 One).

[25] Numbers do not sum to total due to rounding

Table 22: Forecast construction waste quantities to landfill in the South Cheshire area

Construction compound	Estimated construction waste quantity (tonnes)	Estimated construction waste for disposal to landfill (tonnes)
Checkley North embankment satellite compound and Checkley Lane East main compound	5,246	525
Blakenhall Northbound Spur embankment satellite compound	22,010	2,201
Blakenhall cutting satellite compound (WCML)	6,124	612
Crewe South cutting satellite compound	21,811	2,181
Chorlton cutting satellite compound	3,719	372
Crewe South portal satellite compound	4,415	442
Basford cutting main compound	3,511	351
Checkley Lane West satellite compound	73	7
Den Lane Welfare satellite compound	56	6
Den Lane East satellite compound	65	7
Den Lane West satellite compound	112	11
Delta Junction satellite compound	48	5
Waybutt Lane satellite compound	79	8
Swill Brook satellite compound	15	2
Heath Farm satellite compound	28	3
Creamery Bridge satellite compound	246	25
Casey Lane East satellite compound	43	4
Basford Hall Southbound satellite compound	103	10
Crewe South Crossovers satellite compound	176	18
Motorail Terminal main compound	14,753	1,475
Alexandra Stadium satellite compound	127	13
Total[26]	82,755	8,276

Worker accommodation site waste quantities

6.2.10 Worker accommodation site waste has been forecast based on a waste generation rate of 0.027 tonnes per person per month. This rate has been derived from the

[26] Numbers do not sum to total due to rounding

average annual household waste generation in the UK of 407kg/person in 2015[27] and has been adjusted assuming an average 5.5-day working week[28].

6.2.11 There is one worker accommodation site proposed in the South Cheshire area, located at the Basford Cutting Main Compound. The worker accommodation site is expected to generate 428 tonnes of waste, of which 214 tonnes is forecast to require off-site disposal to landfill.

6.2.12 A landfill diversion rate of 50% has been applied to the estimated worker accommodation site waste quantities. The landfill diversion rate has been selected based on local authority household waste recycling rates.

6.3 Operation

Forecast of waste quantities

6.3.1 Operational waste quantities for the Proposed Scheme have been forecast on an annual basis assuming a full year of operation (2027), see Table 23.

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

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%;
- ballast track maintenance: 85%;
- slab track maintenance: 100%; and
- ancillary infrastructure: 60%.

6.3.4 The rationale for each of these landfill diversion rates is provided in the Waste forecasting and assessment methodology, which can be found in the SMR and its Addendum in Volume 5: Appendices CT-001-001 and CT-001-002.

6.3.5 Slab track will be used in the South Cheshire area.

[27] Department for Environment Food and Rural Affairs (2017,) *Digest of Waste and Resource Statistics – 2017 Edition (revised),* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/607416/Digest_of_Waste_and_Resource_Statistics__2017_rev.pdf

[28] Department for Environment, Food and Rural Affairs, *Waste and Recycling Statistics*, https://www.gov.uk/government/collections/waste-and-recycling-statistics

Table 23: Operational waste forecast for the Proposed Scheme in the South Cheshire area

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	132	0
Ancillary infrastructure	12	5
Total	144	5

6.3.6 Railway station and train waste has not been reported in Table 23 as there will not be any stations in the South Cheshire area.

6.3.7 Rolling stock maintenance waste has not been reported in Table 23 as there will not be any rolling stock maintenance depots in the South Cheshire area.

6.3.8 Slab track maintenance waste has been estimated using a weight per metre length of rail and has been reported for each area along the route. Track maintenance waste generation for the South Cheshire area is shown in Table 23.

6.3.9 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. Ancillary infrastructure waste generation for the South Cheshire area is shown in Table 23.

6.3.10 It has been estimated that the Proposed Scheme will generate a total quantity of 144 tonnes of operational waste annually in the South Cheshire area when it becomes fully operation in 2027, of which 139 tonnes (97%) will be diverted from landfill.

6.3.11 The Proposed Scheme in the South Cheshire area will generate an overall operational landfill disposal requirement of five tonnes per annum.

7 References

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Annex A – CA waste and material resources reporting tables

Table 1a: Forecast excavated material quantities, 2020 to 2026

Community area		Forecast quantities of excavated material available before use (tonnes)									
Number	**Name**	**Selected fill (CL6)**	**General railway fill (CL1/3)**	**General railway fill (CL2)**	**General highway fill (CL2)**	**Landscape fill (CL4)**	**Geotechnically unacceptable material (U1A)**	**Chemically unacceptable material (U1B)**	**Chemically unacceptable material (U1B) for disposal as non-hazardous waste**	**Chemically unacceptable material (U2)for disposal as hazardous waste**	**Total**
CA1	Fradley to Colton	3,177,175	5,050	2,245,636	656,081	822,493	88,236	15,358	0	756	7,010,785
CA2	Colwich to Yarlet	573,918	509,779	2,060,389	1,334,048	619,934	0	65,047	0	947	5,164,062
CA3	Stone and Swynnerton	850,239	2,200,157	2,775,258	1,633,516	1,813,546	631,051	88,630	0	3,854	9,996,251
CA4	Whitmore Heath to Madeley	806,902	2,922,774	916,200	569,941	673,852	250,023	92	0	0	6,139,784
CA5	South Cheshire	513,591	1,688,834	1,080,432	1,153,314	764,817	7,810	17,832	0	749	5,227,379
Total[1]		5,921,825	7,326,594	9,077,915	5,346,900	4,694,641	977,120	186,959	0	6,306	33,538,261

[1] Numbers do not sum to total due to rounding

Table 1b: Forecast engineering and environmental mitigation earthworks fill requirements, 2020 to 2026

Community area		Forecast quantities of fill required (tonnes)[2]							
Number	**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 landscape fill (CL4)**	**Total**
CA1	Fradley to Colton	66,731	497,667	0	1,370,453	231,137	310,788	5,387,300	7,864,076
CA2	Colwich to Yarlet	62,823	554,071	0	1,621,012	409,234	397,863	838,578	3,883,582
CA3	Stone and Swynnerton	407,234	913,375	0	2,254,383	2,392,174	37,667	1,912,113	7,916,946
CA4	Whitmore Heath to Madeley	162,229	737,761	0	2,856,524	867,714	647,806	2,382,548	7,654,581
CA5	South Cheshire	18,713	822,186	0	1,908,908	476,449	442,718	3,410,402	7,079,375
Total[3]		717,730	3,525,061	0	10,011,280	4,376,707	1,836,842	13,930,940	34,398,560

[2]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.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/MCHW%20600.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

[3] Numbers do not sum to total due to rounding

Table 1c: Forecast topsoil and agricultural subsoil quantities available and required, 2020 to 2026

Community area		Topsoil and agricultural subsoil available (tonnes)			Topsoil and agricultural subsoil required (tonnes)		
Number	**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**
CA1	Fradley to Colton	650,850	122,483	572,928	415,523	253,555	572,928
CA2	Colwich to Yarlet	614,306	123,456	43,581	224,675	176,516	43,581
CA3	Stone and Swynnerton	950,580	119,522	114,944	246,638	172,044	114,944
CA4	Whitmore Heath to Madeley	580,071	79,967	374,087	308,069	137,925	374,087
CA5	South Cheshire	788,333	133,577	507,586	412,774	168,296	507,586
Total[4]		3,584,139	579,005	1,613,124	1,607,679	908,337	1,613,125

[4] Numbers do not sum to total due to rounding

Table 1d: Forecast demolition and construction material and waste quantities, 2020 to 2026

Community area		Demolition			Construction		
Number	**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)**
CA1	Fradley to Colton	7,353	735	6,618	71,946	7,191	64,755
CA2	Colwich to Yarlet	61,596	6,160	55,437	64,554	6,455	58,098
CA3	Stone and Swynnerton	31,085	3,109	27,977	118,880	11,888	106,992
CA4	Whitmore Heath to Madeley	7,388	739	6,649	95,781	9,578	86,203
CA5	South Cheshire	22,253	2,225	20,028	82,755	8,276	74,480
Total[5]		129,676	12,968	116,709	433,916	43,388	390,528

[5] Numbers do not sum to total due to rounding

Table 1e: Worker accommodation site waste quantities, 2020 to 2026

Community area		Worker accommodation site waste		
Number	**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)**
CA1	Fradley to Colton	0	0	0
CA2	Colwich to Yarlet	330	165	165
CA3	Stone and Swynnerton	330	165	165
CA4	Whitmore Heath to Madeley	0	0	0
CA5	South Cheshire	428	214	214
Total[6]		1,089	544	544

[6] Numbers do not sum to total due to rounding

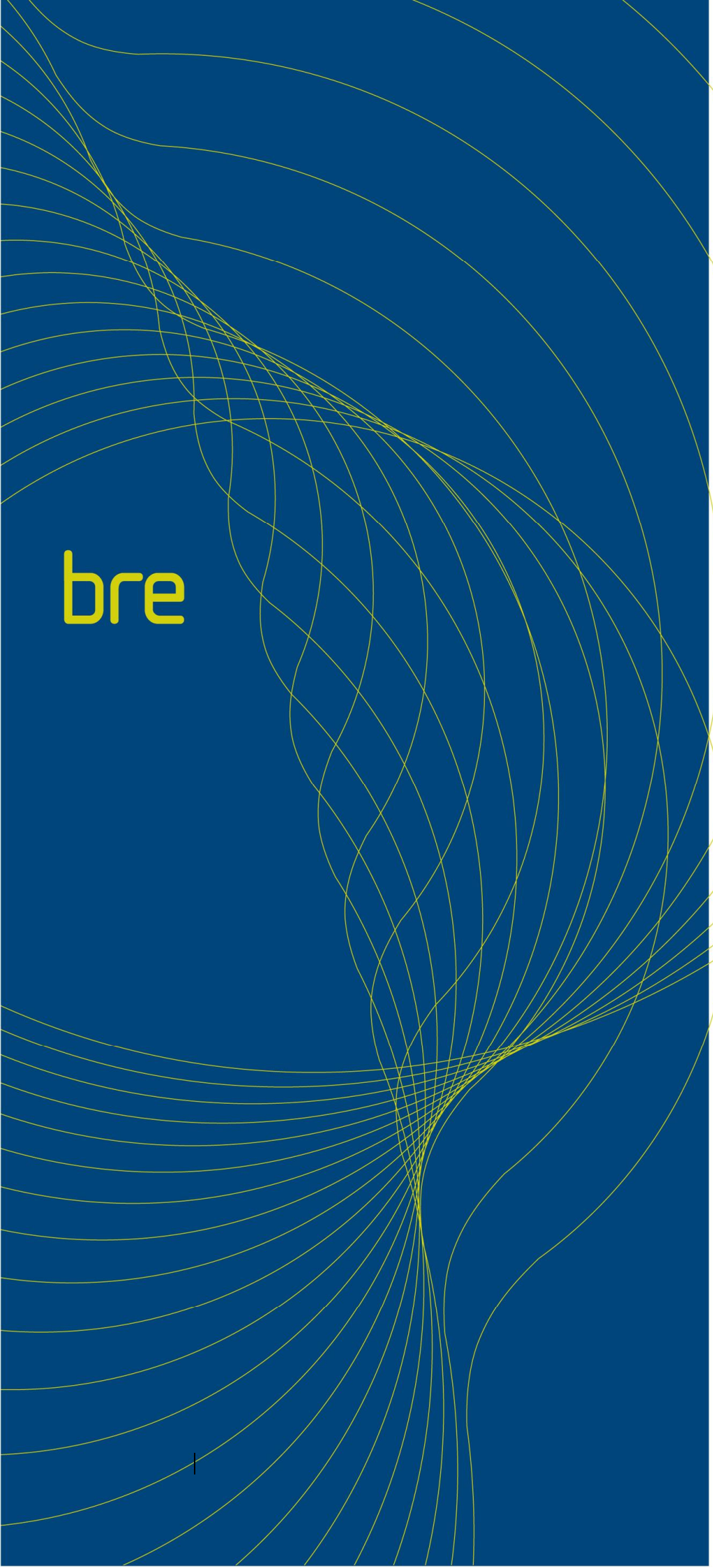
Table 1f: Railway station and train, and rolling stock maintenance waste, 2027

Community area		Station and train waste		
Number	**Name**	**Estimated station and train waste quantity (tonnes)**	**Estimated station and train waste for off-site disposal to landfill (tonnes)**	**Estimated station and train waste diverted from landfill (tonnes)**
CA1	Fradley to Colton	0	0	0
CA2	Colwich to Yarlet	0	0	0
CA3	Stone and Swynnerton	0	0	0
CA4	Whitmore Heath to Madeley	0	0	0
CA5	South Cheshire	0	0	0
Total		0	0	0
Community area		**Rolling stock maintenance waste**		
Number	**Name**	**Estimated rolling stock maintenance waste quantity (tonnes)**	**Estimated rolling stock maintenance waste for off-site disposal to landfill (tonnes)**	**Estimated rolling stock maintenance waste diverted from landfill (tonnes)**
CA1	Fradley to Colton	0	0	0
CA2	Colwich to Yarlet	0	0	0
CA3	Stone and Swynnerton	0	0	0
CA4	Whitmore Heath to Madeley	0	0	0
CA5	South Cheshire	0	0	0
Total		0	0	0

Table 19: Track maintenance and ancillary infrastructure waste quantities, 2027

Community area		Track maintenance waste		
Number	**Name**	**Estimated track maintenance waste quantity (tonnes)**	**Estimated track maintenance waste for off-site disposal to landfill (tonnes)**	**Estimated track maintenance waste diverted from landfill (tonnes)**
CA1	Fradley to Colton	17	0	17
CA2	Colwich to Yarlet	220	0	220
CA3	Stone and Swynnerton	205	0	205
CA4	Whitmore Heath to Madeley	132	0	132
CA5	South Cheshire	132	0	132
Total		706	0	706
Community area		**Ancillary infrastructure waste**		
Number	**Name**	**Estimated ancillary infrastructure waste quantity (tonnes)**	**Estimated ancillary infrastructure waste for off-site disposal to landfill (tonnes)**	**Estimated ancillary infrastructure waste diverted from landfill (tonnes)**
CA1	Fradley to Colton	2	1	1
CA2	Colwich to Yarlet	21	8	13
CA3	Stone and Swynnerton	19	8	11
CA4	Whitmore Heath to Madeley	12	5	7
CA5	South Cheshire	12	5	7
Total		66	27	39

Annex B – Construction waste benchmarks for railway projects



Construction waste benchmarks for railway projects

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

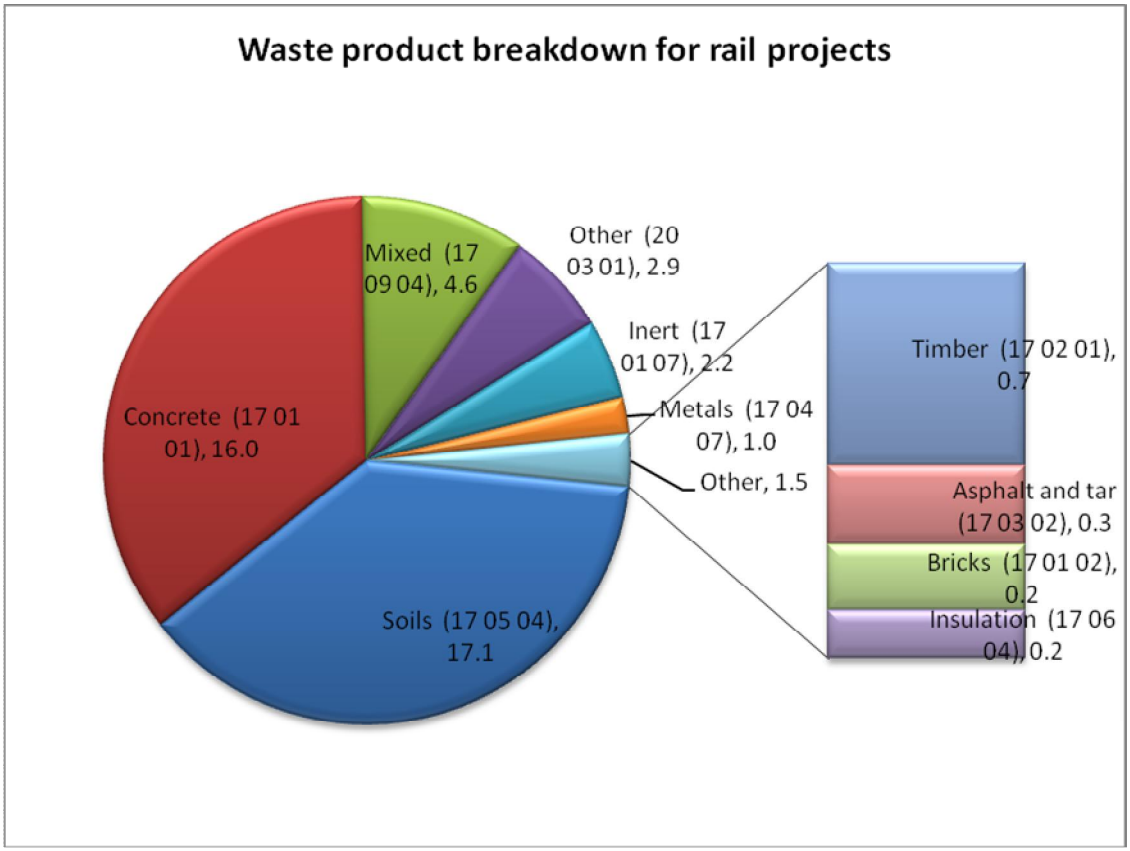


Chart 1: Summary of top 10 waste products for rail projects

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

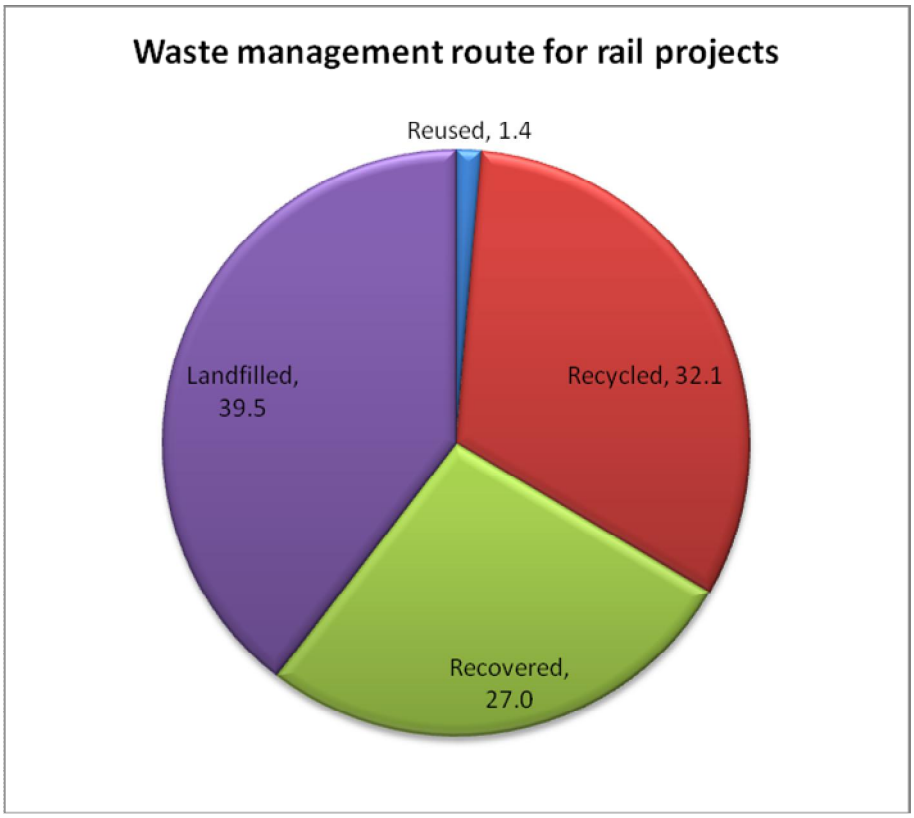


Chart 2: Waste management routes for waste from rail projects

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.

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