Environmental Statement

Volume 2: Scheme-wide Assessment

Chapter 17: Effects on climate

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17. EFFECTS ON CLIMATE

Summary of principal findings

This chapter presents the assessment of the Huddersfield to Westtown section of the Transpennine Route Upgrade (TRU) Programme effects on climate during construction and operation. This chapter covers the assessment of the entirety of the Huddersfield to Westtown (Dewsbury) Route (herein referred to as the 'Scheme').

Greenhouse gas (GHG) emissions for the construction of the Scheme have been calculated, based on available design information, and have been considered in the context of the UK's national carbon budgets and overall Net Zero Carbon ambition.

The construction of the Scheme, plus operation of the Scheme in the first year, will contribute approximately 264,000 tCO_2e (tonnes of carbon dioxide equivalents) to the UK's fourth carbon budget (2023-2027), or 0.014%.

In operation, there will be a reduction in annual emissions of approximately 1,500 tCO_2e compared with baseline operations due to electrification of the line and a shift to bi-mode traction. The Scheme supports UK Government policy to encourage electrification of railways as a means of reducing carbon emissions from surface transport. Whilst it is not possible to quantify the future beneficial effects of this element of the Scheme, it is considered likely that the Scheme will provide an overall beneficial effect during its lifetime.

However, due to the small scale of emissions and emissions reductions (all rail travel is responsible for only 0.6% of total UK emissions), the Scheme is deemed to be unlikely to cause significant effects on climate either positively or negatively, or significantly affect the UK's ability to meet its emissions reduction targets.

Mitigation has been applied in line with carbon reduction hierarchy. Many elements of the principles 'build less' and 'build clever' have been embedded into the options selection and design. As the detailed design develops, more focus will be given to building clever, and construction mitigation which will be incorporated into Part B of the Code of Construction Practice (CoCP).

17.1 Introduction

17.1.1 This chapter presents the assessment of the effects on climate associated with the construction and operation of the Huddersfield to Westtown (Dewsbury) portion of the Transpennine Route Upgrade (TRU) Programme. This chapter covers the assessment of the entirety of the Huddersfield to Westtown (Dewsbury) Route (herein referred to as the 'Scheme').

17.1.2 This chapter is set out as follows:

- Legislative and policy context – relevant international, national and local policy requirements, legal requirements and guidance which have been used to define the assessment approach are outlined;
- Assessment methodology – the methodology the assessment follows is defined including the justification for the study area and the approach for determining significance of effects;
- Baseline – a summary of the climate baseline within the study area is provided;
- Potential effects – the potential impacts and effects (both beneficial and adverse) during construction and operation are characterised;
- Mitigation measures – agreed avoidance, mitigation, compensation and enhancement measures are described;
- Residual effects – the significance of residual effects (both beneficial and adverse) following the implementation of mitigation measures are assessed; and
- Cumulative effects - the potential likely significant cumulative effects of the Scheme are described.

17.1.3 A detailed description of the Scheme is provided in Chapter 2 (Scheme description) in Volume 2i of the ES and all appendices and figures referred to in this chapter are provided in Volumes 3 and 4 of this ES respectively.

17.1.4 No separate Route Section Assessments for climate effects are included within Volume 2ii of this ES.

17.1.5 Climate refers to the typical weather conditions experienced in a place over a period of time, conventionally expressed as average weather over a 30-year period. The Scheme has the potential to affect the earth's climate by the emission of Greenhouse Gases (GHGs) into the atmosphere, which will occur during construction and throughout its operational life.

17.2 Legislative and policy context

17.2.1 Human activities contribute to the emission of GHGs such as carbon dioxide (CO_2) to the atmosphere, primarily by the combustion of fossil fuels. GHGs trap heat in the atmosphere, with higher concentrations leading to increased global temperatures. Atmospheric CO_2 concentrations now exceed 400 parts per million for the first time in around 3 million years[1], and increased emissions have led to global average surface temperatures of 1°C higher than pre-industrial levels. There is a global consensus that emissions must be reduced dramatically. Relevant international, national and local policies described as follows.

International

Kyoto Protocol 1997

17.2.2 The first international agreement to mandate GHG emission reductions was the Kyoto Protocol. Under the United Nations Framework Convention on Climate Change (UNFCCC) treaty, industrialised nations pledged to cut their annual emissions by 5% on a 1990 baseline

[1] Atmospheric CO_2 concentrations in 2020

by 2012. Although the target was met successfully, it was insufficient to offset the increase in emissions from industrialising countries. Total global emissions continued to grow over the period, by 40% between 1990 and 2009.

Paris Agreement 2015

17.2.3 Strengthened negotiations at the Conference of the Parties (COP) 21 led to the 2015 Paris Agreement, the aim of which is to maintain the increase in global average temperature at 'well below' 2°C and 'pursue efforts' to limit the temperature increase even further to 1.5°C. A total of 160 parties, including the UK, made voluntary pledges to reduce emissions by 2030, however the cumulative effect of these would still lead to an estimated 3°C of warming or greater.

The Special Report on Global Warming of 1.5°C, International Panel on Climate Change (IPCC) 2018

17.2.4 The IPCC published a special report in response to the Paris Agreement, to present the impacts of the targeted 1.5°C temperature rise. The report highlighted that to achieve this, global emissions must decrease by 45% by 2030 (against a 1990 baseline), and that net zero global emissions (where emissions and removals from the atmosphere are balanced) must be achieved by 2050. This is noted to require rapid and far-reaching transitions of every sector on an unprecedented scale.

National

The Climate Change Act 2008 (as amended)

17.2.5 To support international efforts, the UK Climate Change Act set a legal GHG emission reduction target of 80% against 1990 levels by 2050. It also introduced a series of carbon 'budgets' for five-year periods, to act as stepping-stones to the overall reduction. There are budgets currently set up to 2032.

17.2.6 In response to the ambitions of the Paris Agreement, in June 2019 the Climate Change Act was amended to set the overall reduction target by 2050 to at least a 100% reduction in net emissions against 1990 levels, i.e. 'net zero carbon'.

17.2.7 The UK has so far outperformed its budgets, but progress is slowing, and the country is not on track to meet its future budgets or the overall reduction target, according to the most Recent Progress to Parliament by the Committee on Climate Change[2].

National Planning Policy Framework (NPPF)

17.2.8 The NPPF includes mitigating climate change as part of its overarching objectives and strategic policy. It provides that the planning system should support the transition to a low carbon future, shaping places in ways that contribute to radical reductions in GHGs. The Scheme itself supports the transition to lower-carbon transport through rail electrification and providing an alternative to road travel. In addition, a range of design embedded and suggested further mitigation measures are described in this chapter.

National Policy Statement for National Networks (NPS)

17.2.9 Although the Scheme is not a nationally significant infrastructure project, the NPS provides a helpful context of the UK Government's ambitions for transport. It is identified that transport will play an important part in meeting the Government's legally binding carbon targets, and the Government is committed to providing people with sustainable transport options. The policy

[2] Recent Progress to Parliament by the Committee on Climate Change

highlights that the modal shift from road and aviation to rail can help to reduce overall transport carbon emissions, and that the Government therefore seeks to accommodate an increase in rail travel and freight and encourage rail electrification. The Scheme supports ambitions to provide sustainable transport alternatives to road and aviation.

Local

Towards a zero-carbon Leeds City Region, Energy Delivery Plan 2018

17.2.10 Produced by the West Yorkshire Combined Authority (WYCA) and Leeds City Region Local Enterprise Partnership, the Energy Strategy and Delivery Plan (ESDP) sets out an ambition for the Leeds City Region to become a resilient, zero carbon energy economy. The Leeds City Region includes 10 local authority areas, including Kirklees District. Efficient and integrated transport is one of the five strategic priority areas within the ESDP, with increased use of public transport and electrification of railways, buses and cars being part of delivering this. The Scheme supports aims for an electrified transport system.

17.2.11 WYCA has declared a climate emergency[3].

Kirklees Council Climate Emergency Declaration

17.2.12 Kirklees Council declared a climate emergency in 2019, recognising that urgent action is required to improve and protect the environment. Kirklees' vision is to be carbon neutral or 'net zero carbon' by 2038. An action plan for achieving net zero carbon is due for release[4].

Technical guidance and standards

Publicly Available Standard (PAS) 2080:2016 'Construction Management in Infrastructure' (PAS 2080)

17.2.13 Commissioned by the Green Construction Board and facilitated by British Standards Institution (BSI), Standards Limited, PAS 2080 provides a framework for managing carbon within the infrastructure value chain. Section 7 details a framework for quantifying GHG emissions and is the industry standard methodology providing transparent and comparable carbon footprints. This assessment is based upon the methodological framework set out in PAS 2080.

17.3 Assessment methodology

Approach to the assessment

17.3.1 It is not possible to meaningfully link individual project emissions with indirect effects on global climate (for example temperature increase) in a quantitative manner. This, alongside the fact that the effect does not appreciably vary with the location or source of emissions, means that the assessment of the effects of the Scheme on climate is limited to quantification of the magnitude of GHG emissions and comparison of these to the baseline. This may be positive (leading to a reduction in emissions) or negative (leading to an increase in emissions).

17.3.2 The methodology used to calculate emissions has been developed with reference to PAS 2080. Whilst there are a number of GHGs with a range of different Global Warming Potentials (GWPs), all emissions are presented as their carbon dioxide equivalent (CO_2e) and when expressed in tonnes written as tCO_2e.

[3] https://www.westyorks-ca.gov.uk/all-news-and-blogs/combined-authority-declares-climate-emergency/ *Accessed: February 2021*
[4] Kirklees Council, Climate emergency. Available online at: https://www.kirklees.gov.uk/beta/climate-emergency/index.aspx *Accessed: February 2021*

17.3.3 The assessment calculates the emissions for two scenarios:

- The Do-Minimum scenario – This represents the emissions likely to occur should the Scheme not be implemented. Further detail on this is provided in the baseline section (Section 17.4) of this Chapter; and
- The Do-something scenario – This represents the emissions likely to occur should the Scheme be implemented. This scenario is covered by the operational assessment of the Scheme.

Study area

17.3.4 The scope of the assessment has taken into account the design detail available and has been set to include the elements set out in Table 17-1, in line with the lifecycle stages and source categories set out in PAS 2080. The scope boundaries incorporate direct and supply chain emissions for both construction and operational phases of the Scheme. The study area is not limited to the geographic extent of the Scheme itself, as emissions will also result from upstream and off-site activities such as materials production.

Table 17-1 Emission sources included in scope of assessment of effects on climate (adapted from PAS 2080)

Phase	Life cycle module	PAS 2080 reference	Assessment boundary
Construction	Product stage: • Raw material supply; • Transport; and • Manufacture.	A1-3	Emissions from the production of construction materials, including primary raw material extraction, manufacturing and intra-manufacturing transportation.
	Transport to works site	A4	Vehicle emissions from the transportation of construction materials from the primary site of manufacturing to site.
	Construction activities (incl. waste)	A5	Emissions relating to usage of plant during all clearance and construction activities. In addition, vehicle emissions from the transportation of waste materials from the site to a waste disposal facility, and emissions from the processing/ disposal of these wastes.
Operation	Users use of the infrastructure	B9	Emission associated with the operation of trains.

17.3.5 A detailed signalling design for utilities works is not available at this design stage, and these aspects are therefore not included within the product stage scope of the assessment.

17.3.6 Although operation phase emissions will be generated by maintenance activities and the operation of buildings and other stationary assets, by far the largest portion of rail's footprint[5] is traction, and the operation of trains is therefore the focus of this operational assessment. Baseline emissions from current diesel trains have been compared against future estimates for bi-modal trains on electrified line, accounting for forecast patronage increases.

Calculations

17.3.7 Emission calculations are carried out by multiplying activity data by an emission factor associated with the activity being measured. 'Activity data' is a quantitative measure of an activity that results in emissions for a defined range of an activity or activities (for example kilograms of materials produced, kilometres driven, kilowatt hours (kWh) of electricity consumed, or tonnes of waste sent to landfill). An 'emission factor' is a measure of the mass of emissions relative to a unit of activity.

17.3.8 Calculations have been undertaken in the RSSB Rail Carbon Tool (RCT) a copy of which has been included in Appendix 17-1. The RCT is a web-based tool that allows calculation and assessment of rail project carbon footprints using a verified, central database of carbon factors. The RCT is the standard tool in use across the rail industry.

17.3.9 Using the tool's 'Project Tree' functionality, each activity or item has been defined as a line item, in tiers according to the various project areas and lifecycle stages. The associated Scheme data has been entered, and calculations carried out automatically using the tool's predefined calculation formulae and carbon factors, both of which are provided in a library in the tool.

Data sources

17.3.10 Data for the assessment have been collected directly from the design and construction teams as well as other environmental disciplines. Where Scheme-specific data is not available, industry standards and proxy data from similar projects have been used. Table 17-2 summarises the data collected for each life cycle, and the emission factors used.

Table 17-2 Data collection

Life cycle module	Data source
Product stage	Temporary and permanent construction materials data have been provided based on the Scheme design. Where data is unavailable, information from similar Network Rail schemes was used in the first instance and assumptions were made by engineering specialists based on professional judgement. Key assumptions are listed below: • All reinforced concrete (unless otherwise stated) is made up of 96% concrete and 4% steel rebar; • All concrete, unless otherwise specified, uses the carbon factor for 'Concrete – General', which is based on a UK weighted average cement content of 12% by mass. All steel, unless otherwise specified, uses the carbon factor for 'Steel – General', which assumes material has EU 3 (UK, France and Germany) average recycled content of 59%. Cast iron used the factor 'Iron – General'; • For acrylic, the carbon factor 'Plastic – General' was used; and • For drainage and culvert design, a 100mm pipe thickness has been assumed where applicable.

[5] Rail Industry Decarbonisation Taskforce: Final Report to the Minister for Rail, 2019

Life cycle module	Data source
Transport	It is not presently known where all materials will be sourced from, or exactly how they will be transported. However, to give an idea of the order of magnitude of emissions from the transport of materials, estimations have been made based on the following high-level assumptions: • Materials will be transported by diesel-fuelled Heavy Goods Vehicles (HGV) using a >33tonne (t) Articulated HGV at 100% load; and • Materials will be sourced regionally, represented by a representative transport distance of 100km for a single-journey distance.
Construction activities (incl. waste)	Construction plant was provided by the Scheme Contractor. This included the types of plant which would be used, and the duration of use. To generate an estimate of fuel and electricity consumption, assumptions were made of the engine ratings for the plant. For generic construction plant, consumption data was taken from a reference set of construction activities on a major highways upgrade project, which required similar construction activities to the Scheme and much of the same plant. For activities and equipment relating specifically to rail construction, technical specifications were sourced and consulted to provide the energy rating. The quantity of fuel from plant required to construct the Scheme (including vehicle engines, generators, etc.) was calculated from the number of weeks those plant items are scheduled to be in use during construction, multiplied by their expected rate of utilisation, energy rating, and fuel-specific values. For construction activities, the following assumptions have been applied: • Where the number of weeks the scheduled activity is due to last is not specified, we have assumed it will last for one week, unless exactly similar activities have been defined in terms of duration, in which case it is matched to that; • Where the utilisation of plant is not specified, we have assumed 100% usage throughout the period; where given as a range, we have assumed the centre of the range; • Attachments to large vehicles, which are not themselves powered but operated by that vehicle, have been assumed as 15% of the energy of the vehicle to which it is attached; and • All plant is fuelled by 100% diesel or petrol, not biofuel blend; fuel-specific energy intensity values are consistent, i.e. there is no variation in the calorific value of any fuel used during construction. For the transportation of waste in construction, the following assumptions have been applied: • Wastes will be transported by diesel-fuelled HGV using a >33t Articulated HGV at 100% load; • Excavated material will be reused within the Scheme were possible. • Surplus wastes will be disposed of to a suitably licenced facility; and • Wastes will be disposed of locally, represented by a transport distance of 50km for a single journey.
Operation	Office for Rail Regulation (ORR) records show the total entries and exists for different stations for a given year. For the year 2019/20, the total numbers of passengers entering and exiting the Huddersfield, Deighton, Mirfield and Ravensthorpe stations was 5,332,308.

Life cycle module	Data source
	Patronage forecasting[6] using the Passenger Demand Forecasting Handbook for the year 2042/43 suggests that total trips will increase to 8,224,811. To provide a conservative estimate for passenger kilometres, the following has been assumed: • Every entry and exit is associated with a journey of the full scheme length (14km); and • 2042/43 patronage levels are representative of every year in the Do-Something scenario, with an abrupt increase to these levels rather than a gradual increase over time.

Carbon factors

17.3.11 Carbon factors integral to the RCT were used. Table 17-3 shows the carbon factors used for key materials and their original sources. Most factors are sourced either from the Bath Inventory of Carbon and Energy (ICE) or Defra. These are two well-respected, regularly updated and frequently used databases of carbon factors.

Table 17-3 Carbon factors

Material/component	Carbon factor ($kgCO_2e/kg$)	Carbon factor source
Brick	0.213	Bath ICE (3.0)
Gravel	0.0052	Bath ICE (2.0)
Iron	2.03	Bath ICE (2.0)
Polystyrene	3.46	Plastics Europe EPD 2008
Stone	0.079	Bath ICE (2.0)
Concrete	0.103	Bath ICE (3.0)
Steel Beam	1.55	Bath ICE (3.0)
Steel Rods	1.40	Bath ICE (2.0)
HDPE[7] Pipe	2.52	Bath ICE (2.0)
Glass Reinforced Plastic	8.59	Bath ICE (2.0)
Granite	0.70	Bath ICE (2.0)
Waste aggregate	1.3	Defra (2018)
Waste asphalt	1.3	Defra (2018)
Waste concrete and blockwork	1.3	Defra (2018)
Waste soil	18	Defra (2018)
Waste metal	1.3	Defra (2018)
Green waste	579	Defra (2018)
General construction waste	1.4	Defra (2018)
Diesel fuel	2.68779 (per litre)	Defra (2018)
Petrol fuel	2.30531 (per litre)	Defra (2018)
Electricity	0.35276 (per kWh)	Defra (2018)

17.3.12 For transport of materials and wastes, the carbon factor for 'Road Freight: Articulated HGV. >33t. 100% Load', sourced from the 2018 Defra Carbon Factors, has been used to translate emissions from estimated tonne-kilometres with a carbon factor of 0.07539 $kgCO_2e/tkm$.

[6] The Huddersfield Station Capacity – GRIP Stage 3 Option Selection Report
[7] High Density Polyethylene

17.3.13 For operational emissions calculations, data from the Rail Industry Decarbonisation Taskforce's 2019 Final Report to the Minister for Rail was used. Currently 43.8g CO_2e are released per passenger kilometre. The report also presents four pathways to reduce carbon by removing diesel-only passenger trains. These include options with and without additional electrification, and with reliance on diesel/electric bi-modes versus favouring alternative fuels such as hydrogen and biofuels. The pathway which represents additional electrification favouring bi-modes (P3) has been selected to represent the Scheme. This was shown to generate a 68% reduction in emissions compared with 2018 levels. Emissions for the Do-Something scenario are therefore assumed to be 14g CO_2e per passenger kilometre.

Comparison to UK carbon budgets

17.3.14 The UK has in place carbon budgets for five-year periods up to 2032[8]. The UK is currently in the third carbon budgetary period (2018-2022), the budget for which is 2,544 $MtCO_2e$. The UK cannot legally emit more GHGs than this within the budgetary period. The carbon budget for the 2023–2027 budgetary period is 1,950 $MtCO_2e$, and the budget for 2028-2032 is 1,725 $MtCO_2e$. Whilst budgets are not set beyond this, there is a legal requirement for the UK to reach 0 $MtCO_2e$ by 2050.

17.3.15 The results of emissions calculations are presented in terms of their percentage contribution to the relevant national carbon budget period. The construction stage and Scheme Opening Year are anticipated to fall within the fourth carbon budgetary period (2023-2027), the national budget for which is 1,950 $MtCO_2e$.

Assessment criteria

17.3.16 There is no specific accepted technical guidance for determining a level of significance (i.e. minor or major) of the effect of a development on climate, and there are no legal limits for emissions from any one development. For this reason, the general criteria presented in Chapter 4 (EIA methodology) in Volume 2i of the ES have been applied to assess the significance of the effect on climate. This generates a significance level based on the sensitivity of receptors and magnitude of the impact.

17.3.17 There is only one receptor, the atmosphere, and it has a consistent sensitivity (Very High); it is of very high importance and rarity, international in scale and there is no potential for substitution or replacement. There is also only one key impact; global warming, although this itself leads to myriad indirect effects on humans and the environment. The impact is global in scale, long-term in duration, and currently irreversible in nature. The impact is also certain, if emissions are released.

17.3.18 Given the consistency of receptor and impact regardless of the source, the level of significance of the impact is based solely upon the magnitude of emissions generated in the context of how the Scheme may help or hinder the UK's ability to meet its carbon budgets.

Residual impact assessment

17.3.19 If further mitigation (in addition to that which is embedded in the Scheme design) is required to reduce otherwise significant climate effects, this is identified in the mitigation section with a final assessment of the ultimate assessment detailed in the residual impact section.

[8] https://www.gov.uk/guidance/carbon-budgets

Embedded mitigation

17.3.20 This has been an iterative process throughout the Scheme's design to ensure that mitigation can be built into the design wherever possible with the objective of removing all significant residual risks at the design stage:

- Existing infrastructure is being reused and incorporated into the Scheme, to minimise the amount of new infrastructure being constructed;
- Elements of the Scheme have been removed during early design in order to 'build less';
- Excessive material use has been designed out early in the Scheme development process;
- Reused, reclaimed and recycled materials have been preferentially specified, where practicable; and
- The design has been prepared with buildability in mind, to allow efficient construction processes and reduced construction emissions.

Scoping and consultation

17.3.21 No specific consultation has been carried out in relation to the Scheme's effects on climate. One relevant comment on the Environmental Scoping Report was received from the WYCA, noting that the Leeds City Region has an ambition to become a resilient, zero carbon energy economy and has formally declared a climate emergency. WYCA has requested that measures should be incorporated to reduce the carbon footprint of the Scheme. Measures as to how this issue has been responded to are discussed in Section 17.6.

Assumptions and limitations

17.3.22 Where assumptions have been made, they have been selected to present either the most likely (when reasonably certain) or worst-case (when not reasonably certain) scenario for that particular item or factor. Actual data from previous Network Rail projects have been used as a proxy for some Scheme data which is not yet available. Data assumptions are highlighted in Table 17-2. The assessment of significance of the effect on climate has been based on consideration of the magnitude of emissions from the Scheme in comparison to the UK's carbon budgets. The nature of the assumptions made would not affect the order of magnitude of the calculated emissions, and these assumptions would therefore not impact the overall conclusions of this assessment.

17.4 Baseline

17.4.1 The baseline is defined as the Do-Minimum scenario, which is continued operation of the existing infrastructure, without the Scheme.

17.4.2 Passenger kilometres are estimated at approximately 75 million per year, with emissions of 35.1g CO_2e each. Estimated annual emissions for the operation of passenger trains are therefore 2,633 tCO_2e. As stated in Section 17.3, other operational emissions are likely to be minimal compared with emissions from passenger train traction, and this is therefore considered to be a suitable annual emissions baseline for the purposes of Environmental Impact Assessment (EIA).

17.5 Potential effects

17.5.1 The earth absorbs energy from the sun and re-emits it as thermal infrared radiation. GHGs such as CO_2 in the atmosphere absorb this radiation, preventing it from escaping into space. The higher the concentration of GHGs, the more heat is retained, and the higher global temperatures become. Due to human activities, the concentration of GHGs in the atmosphere has increased dramatically, leading to global warming.

17.5.2 The Scheme has the potential to affect climate by causing emissions of GHGs into the atmosphere during its construction and throughout its operational life.

17.5.3 This section presents the emissions calculated for the Do-Something scenario, a comparison against the Do-Minimum baseline, and an assessment against UK Government carbon budgets.

17.5.4 The calculations data have been split by route section for ease of reference however the assessment will consider the emissions across the Scheme.

Construction

17.5.5 This section presents the carbon emissions in kg CO_2e calculated in the RCT, as well as the raw data used in these calculations.

17.5.6 The production and transportation of materials for the construction of the Scheme will contribute a total of **249,808 tCO_2e** GHG emissions. Overhead Line Equipment (OLE) is likely to have the largest embodied carbon emissions accounting for 60%-72% of the total embodied material carbon emissions, while the transportation emissions are <1% of the total construction emissions.

Route Section 1 – Huddersfield

17.5.7 The total material and transport emissions for Route Section 1 is **28,138 tonnes CO_2e.**

Table 17-4 Material production and transport emissions – Route Section 1

Description of works	Component	Quantity	Unit	tonnes CO_2e
Permanent works	Ballast	3,653.64	m^3	6,744
	Drainage	4349.3	tonnes	187
OLE	OLE	1,530	M	18,910
Huddersfield Station	Footbridge (steel)	419	tonnes CO_2e	419
	Subway	361	tonnes CO_2e	361
Structure – Westgate Overbridge (MVL3/90)	Overbridge	35.4	M	2
Structure – Huddersfield Viaduct (Span 1) Underbridge (MVL3/92(1))	Steel	585	tonnes	854
	Reinforced concrete (RCC)	125	m^3	87
	Backfill	265	m^3	3
Structure – Huddersfield Viaduct (Span 29) Underbridge (MVL3/92(9))	Up deck	314.4	m^3	192
	Down deck	584.5	m^3	346
Retaining wall	King post wall	5.5	m^3	1
Fencing	Palisade fencing	90.9	m^3	32
Materials transportation	Road freight	1,868,626	tonne km	141
	Additional road transport			151
	Total			**28,138**

17.5.8 The total emissions from construction activities (excluding waste transport and processing) for Route Section 1 is **2,146 tonnes CO_2e.**

Table 17-5 Construction activity emissions – Route Section 1

Component	Quantity	Unit	tonnes CO_2e
Diesel	794,928	Litres	2,137
Petrol	3,588	Litres	8.3
Electricity	2,256	kWh	796

Route Section 2 – Hillhouse and Fartown

17.5.9 The total material and transport emissions for Route Section 2 are **39,344 tonnes CO_2e.**

Table 17-6 Material production and transport emissions – Route Section 2

Description of Works	Component	Quantity	Unit	tonnes CO_2e
Permanent works	Ballast	5,492	m^3	10,138
	Drainage	6,538	Tonnes	280
OLE	OLE	2,300	M	28,427
Structure – Red Doles Road Underbridge (MVL3/96)	Underbridge	2	Number	54
Structure – Field House Overbridge (MVL3/98)	Overbridge	1	Number	21
Structure – Ridings Underbridge (MVL3/99)	Concrete units	404	m^3	154
	Earth wing walls	2	Number	4
Structure – Peel's Pit Underbridge (MVL3/100)	Underbridge	130	m^3	12
Retaining walls	Gabion wall	150	m^3	30
Fencing	Palisade fencing	136.58	m^3	48
Materials transportation	Road freight	2,337,700	tonne km	176
	Total			**39,344**

17.5.10 The total emissions from construction activities (excluding waste transport and processing) for Route Section 2 is **409 tonnes CO_2e.**

Table 17-7 Construction activity emissions – Route Section 2

Component	Quantity	Unit	tonnes CO_2e
Diesel	150,959	Litres	405
Petrol	765	Litres	1.8
Electricity	5,176	kWh	1.8

Route Section 3 – Deighton and Bradley

17.5.11 The total material and transport emissions for Route Section 3 is **27,945 tonnes CO_2e.**

Table 17-8 Material production and transport emissions – Route Section 3

Description of works	Component	Quantity	Unit	tonnes CO_2e
Permanent works	Ballast	3,271.56	m^3	6,039
	Drainage	3,894.48	tonnes	167
OLE	OLE	1,370	m	16,933
Deighton Station	Station forecourt	2,500	m^3	29
	Footbridge (steel)	49	tonnes	72
	Footbridge (concrete)	80	m^3	19
	Compound-base	2,625	m^3	332

Description of works	Component	Quantity	Unit	tonnes CO_2e
	Access road	325	m^3	41
Structure – Whitacre Street Overbridge (MVL3/101)	Steel I beam girders	8	Number	917
	Concrete cill beams	2	Number	7
	RCC abutment	180	m^3	121
Structure – A62 Leeds Road Overbridge (MVL3/102)	Southern reinforced concrete pad foundations	130	m^3	88
	Northern reinforced concrete pad foundations	75	m^3	51
	Southern reinforced abutment wall	338	m^3	228
	Northern reinforced abutment wall	195	m^3	131
	RCC cill beam	112.5	m^3	76
	Superstructure: RCC filler beam deck	915.2	m^3	617
	Superstructure: steel beam	88	Number	15
	RCC parapets	132	m^3	89
	Parapets brickwork cladding	16	m^3	6
	Compound base	1,750	m^3	221
	Haul road	450	m^3	57
Structure – Wheatley's Overbridge (MVL3/103)	Weathering steel I Beams	2	Number	677
	Steel deck plate	3.75	m^3	45
	RCC cantilever units	2	Number	81
	Stone cladding	10	m^3	2
	Compound base	500	m^3	63
Structure – Bradley's No. 2 (BBW/1) Overbridge (MVL3/105)	Overbridge (parapet works)	4.97	m^3	21
Drainage and culverts	Precast concrete pipes (Bradley Culvert (MVL3/102A), Bradley Culvert (MVL3/106A))	2	Number	1
Retaining wall	Retaining wall (W4, W5, W6, W7, W8, W9)	554.95	m^3	497
Fencing	Palisade fencing	81.42	m^3	29
Materials transportation	Road freight	3,619,273	tonne km	273
	Total			**27,945**

17.5.12 The total emissions from construction activities (excluding waste transport and processing) for Route Section 3 is **2,078 tonnes CO_2e.**

Table 17-9 Construction activity emissions – Route Section 3

Component	Quantity	Unit	tonnes CO_2e
Diesel	753,005	Litres	2,024
Petrol	19,945	Litres	46
Electricity	21,984	kWh	8

Route Section 4 – Colne Bridge and Battyeford

17.5.13 The total material and transport emissions for Route Section 4 is **51,285 tonnes CO_2e.**

Table 17-10 Material production and transport emissions – Route Section 4

Description of Works	Component	Quantity	Unit	tonnes CO_2e
Permanent works	Ballast	6,089.4	m^3	11,240
	Drainage	7,248.84	tonnes	311
OLE	OLE	2,550	m	31,517
Structures – B6118 Bridge Road Overbridge (MVL3/107)	Fill	3,880	m^3	45
	Abutments and pad footings	320	m^3	216
	Superstructure (steel beams)	50	tonnes	76
	Superstructure (RCC)	200	m^3	135
	Compound base and haul road	1,200	m^3	152
	Crane platforms	200	m^3	25
	Piling platforms	2	Number	25
Structures – Huddersfield Broad Canal Underbridge (MVL3/108S)	Underbridge	2	Number	288
Structures – Colne Viaduct Underbridge (MVL3/109)	Underbridge	73	tonnes CO_2e	73
Structures – Parks Overbridge (MVL3/110) (MVL4/1)	Superstructure: Steel I beams	16	Number	558
	Substructure (RCC)	115	m^3	76
	Substructure (RCC) and cantilever abutments	2	Number	61
	Substructure (RCC) pier	50	m^3	34
Structures – Cooper Bridge Intersection (MVL4/2)	Underbridge	191	Number	653
Structures – Helm Lane Underbridge (MVN2/188)	Underbridge	215	m^3	100
Structures – Heaton Lodge Footbridge (MVL4/4)	Superstructure: weathering steel I Beams	2	Number	187
	Superstructure: S steel/FRP deck plate	1.3	m^3	16
	Substructure: steel access steps	4	Number	484
	Substructure: Pad footings	40	m^3	27

Description of Works	Component	Quantity	Unit	tonnes CO_2e
Structures – compounds	Compounds for structures	33,250	m^3	4,208
Drainage and culverts	Bradley Culvert (MVL3/106A), Colnebridge Culvert (MVL3/110A), Heaton Lodge Culvert (MVL4/4A), Heaton Lodge Junction, Mirfield Culvert (MVN2/190A)	5	Number	4
Retaining walls	Retaining wall W11	48	m^3	28
Fencing	Palisade fencing	151.4	m^3	54
Materials transportation	Road freight	9,150,222	tonne km	690
	Total			**51,285**

17.5.14 The total emissions from construction activities (excluding waste transport and processing) for Route Section 4 is **1,291 tonnes CO_2e.**

Table 17-11 Construction activity emissions – Route Section 4

Component	Quantity	Unit	tonnes CO_2e
Diesel	475,186	Litres	1,277
Petrol	1,100	Litres	3
Electricity	32,404	kWh	11

Route Section 5 – Mirfield and Lower Hopton

17.5.15 The total material and transport emissions for Route Section 5 is **43,624 tonnes CO_2e.**

Table 17-12 Material production and transport emissions – Route Section 5

Description of works	Component	Quantity	Unit	tonnes CO_2e
Permanent works	Ballast	6,089.4	m^3	11,240
	Drainage	7,248.84	tonnes	311
OLE	OLE	2,550	m	31,517
Mirfield Station	Footbridge (RCC)	1	Number	0.42
Structure – Woodend Road Overbridge (MVN2/191)	Underbridge	2	Number	3
		400	m^3	51
Structure – Mirfield Viaduct Underbridge (MVN2/192)	Reinforced Concrete	90	m^3	61
	Structural Steel	46	tonnes	71
Structure – Station Road Underbridge (MVN2/193)	Underbridge	46	tonnes	93
Structure – Sands Lane Overbridge (MVN2/199)	Overbridge	2.8	m^3	0.70
Fencing	Palisade fencing	151.4	m^3	54
Materials transportation	Road freight	2,461,940	tonne km	185
	Additional transport			37
	Total			**43,624**

17.5.16 The total emissions from construction activities (excluding waste transport and processing) for Route Section 5 is **1,514 tonnes CO_2e.**

Table 17-13 Construction activity emissions – Route Section 5

Component	Quantity	Unit	tonnes CO_2e
Diesel	535,177	Litres	1,438
Petrol	32,854	Litres	76
Electricity	400	kWh	0.1

Route Section 6 – Ravensthorpe and Westtown

17.5.17 The total material and transport emissions for Route Section 6 is **53,472 tonnes CO_2e.**

Table 17-14 Material production and transport emissions – Route Section 6

Description of works	Component	Quantity	Unit	tonnes CO_2e
Permanent works	Ballast	7,044	m^3	13,003
	Drainage	8,386	tonnes	360
OLE	OLE	2,950	M	36,460
Ravensthorpe Station	Footbridge (steel)	34	tonnes	50
	Footbridge (RCC)	56	m^3	38
	Waiting shelter	1	Number	6
	Refuge area	22.5	m^3	3
	Platform	1	Number	108
Structure – Hunger Hill Overbridge (MVN2/201)	Underbridge	15.34	m^3	136
Structure – Calder Road Overbridge (MVN2/202)	Concrete slab deck	239.4	m^3	60
	Retaining wall	37.63	m^3	22
	Steel beams	6	Number	174
Structure – Calder Road River Bridge Overbridge (MDL1/3)	Bridge	156	m^3	117
Structure – Lees Hall Farm Underbridge (MVN2/204)	Underbridge	191	m^3	34
Structure – Baker Intersection	Filler beam deck	1,274	m^3	315
	Vertical walls	2	Number	621
	Robust kerb	2,236	m^3	553
Structure – Occupation Underbridge (MDL1/10)	Underbridge	193.54	m^3	50
Structure – Toad Holes, Dewsbury Underbridge (MDL1/12)	Underbridge	450.80	m^3	139
Structure – Ming Hill Underbridge (MDL1/14)	Underbridge	244.55	m^3	66
Retaining walls	Gabion wall	1247	m^3	733
Access points	Fall Lane Road Rail Access Point (RRAP)	174	m^3	22
Fencing	Palisade fencing	175.12	m^3	62
Materials transportation	Road freight	4,509,700	tonne km	340
	Total			**53,472**

17.5.18 The total emissions from construction activities (excluding waste transport and processing) for Route Section 6 is **8,365 tonnes CO_2e.**

Table 17-15 Construction activity emissions – Route Section 6

Component	Quantity	Unit	tonnes CO_2e
Diesel	3,030,614	Litres	8,146
Petrol	63,190	Litres	146
Electricity	204,552	kWh	72

Construction waste

17.5.19 Emissions from the transport and processing of construction waste for the Scheme total **5,695 tonnes CO_2e.**

Table 17-16 Construction waste transport and processing

Waste	Quantity	Unit	tonnes CO_2e
Aggregate	56,388	Tonnes	72
Asphalt	124	Tonnes	0.2
Blockwork	2,100	Tonnes	3
Concrete	7,128	Tonnes	9
Soil	257,513	Tonnes	4,537
Metal	22,080	Tonnes	28
Green waste	1,594	Tonnes	923
General waste	22,894	Tonnes	31
Road freight	1,491,627	t km	91
Total			**5,695**

Operation

17.5.20 Passenger kilometres are forecasted at approximately 115 million per year[9], with emissions of 14g CO_2e each. Estimated annual emissions for the operation of passenger trains in the Do Something scenario are therefore 1,160 tCO_2e. This presents a reduction in emissions against the baseline of 1,473 tCO_2e per year.

17.5.21 As the carbon efficiency of the UK Grid electricity increases and diesel trains are phased out, contributions from the Scheme's operational carbon emissions would decrease further and may reduce the payback period. The Scheme has the potential to be Net Zero Carbon by 2050 in line with government targets.

17.5.22 Improvement of rail connections is an important part of the UK Government's strategy to reach Net Zero Carbon by 2050, due to the modal shift to sustainable transport it encourages. Although these wider benefits of the Scheme cannot presently be quantified, they are very likely to lead to an overall reduction in emissions against the present baseline.

[9] The Huddersfield Station Capacity – GRIP Stage 3 Option Selection Report

Comparison to UK carbon budgets

17.5.23 The construction of the Scheme will contribute 265,651 tCO_2e to the UK's fourth carbon budget of 1,950 Mt CO_2e (2023 – 2027). The Scheme will be operational for 1 year during this budgetary period, providing a carbon saving of 1,473 tCO_2e. The overall effect of the Scheme on the fourth budget will be the net emission of approximately 264,000 tCO_2e, or 0.014% of the budget. It is not considered that this represents a significant effect on climate, or that it will have a material impact on the UK's ability to meet its carbon budget.

17.5.24 Once operational, the Scheme will lead to annual savings of 1,473 tCO_2e, providing an ongoing positive effect on climate. The carbon reductions, although beneficial, are also not considered to be of sufficient magnitude to have a significant effect on the climate the UK's ability to meet its carbon budgets.

17.6 Mitigation measures

17.6.1 Mitigation has been applied in line with carbon reduction hierarchy:

- **Build nothing** – challenge the root cause of the need and explore alternative approaches to achieve the desired outcome;
- **Build less** – maximise the use of existing assets and optimise asset operation and management to reduce the extent of new construction required;
- **Build clever** – design for low carbon materials, streamline the delivery process, minimise resource consumption; and
- **Build efficiently** – embrace new construction technologies and eliminate waste.

17.6.2 Many elements of 'build less' and 'build clever' have been embedded into the options selection and design, examples of which are included in Chapter 3 (Consideration of alternatives) in Volume 2i of this ES. As the detailed design develops, more focus will be given to building clever, and construction mitigation which will be incorporated into Part B of the Code of Construction Practice (CoCP).

Additional mitigation

17.6.3 Further mitigation for the construction phase to 'build efficiently' are listed below, these measures are included within the Part A of the CoCP submitted as part of this application under Appendix 2-1:

- Targets will be set for waste recovery and recycling (e.g. a minimum of 90% non-hazardous waste to be reused or recycled by 2023/24 in line with Network Rail Key Performance Indicators (KPIs), and these will be communicated to those working on the Scheme;
- Fixed site plant and temporary offices will be powered by mains electrical sources wherever practicably possible, reducing reliance diesel and associated emissions;
- Machinery and vehicles which are not in use will be shut down rather than being allowed to idle;
- Energy efficiency of vehicles will be maximised, by full loading and efficient routing; and
- Use of local labour will be reflected within the main works contracts, to reduce emissions from worker travel.

17.6.4 Additionally, the following mitigation is also proposed for the construction phase:

- The Scheme will ensure that material resource management minimises wastage through application of the waste hierarchy. A Materials Management Plan (MMP) and Site Waste Management Plan (SWMP) will be prepared and included in Part B of the CoCP. These documents will be submitted pursuant to a condition to be attached to the deemed planning

permission[10] for approval by the local authority prior to work prior to construction works commencing. The SWMP will remain a live document which will be updated to reflect the ongoing effort to 'design out' waste;

- A Travel Plan for Construction Staff will be implemented for project staff, to encourage sustainable travel to and around the project site. Details of the travel plan will be detailed within the Construction Traffic Management Plan to be submitted to and agreed with the Local Planning Authority pursuant to a condition to be attached to the deemed planning permission.

17.7 Residual effects

17.7.1 At this stage of Scheme development, it is not possible to provide a quantitative assessment of the carbon emission reductions which would be generated by the additional mitigation items described in Section 17.6. Industry data[11] suggests that 15% savings can be made to emissions from construction activities by using efficient onsite construction practices.

17.7.2 As prior to this mitigation, the effects of the Scheme on climate were not considered to be significant, no residual significance effect is anticipated.

17.8 Cumulative effects

17.8.1 The atmosphere is equally affected by all emissions worldwide. It is therefore not appropriate to consider the effects of the Scheme cumulatively with other developments in the local area. However, it is noted that the effects of all GHG emissions are essentially cumulative, as it is their concentration in the atmosphere, rather than the level of emissions per time period, that determines the warming effect (i.e. it is the 'stock' rather than the 'flow' which is important). For this reason, the effects of the Scheme should be considered in the context of the global excess of emissions to which it contributes, however negligible the percentage contribution may be.

[10] On making an order under the Transport and Works Act 1992, the Secretary of State may direct that planning permission shall be deemed to be granted, subject to such conditions (if any) as may be specified in the direction.
[11] Strategic Forum for Construction & the Carbon Trust (2010): Reducing the footprint of the construction process