

A47 North Tuddenham to Easton Dualling

Scheme Number: TR010038

Volume 6

6.3 Environmental Statement Appendices **Appendix 14.1 - Embodied carbon assessment**

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

March 2021

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms and
Procedure) Regulations 2009**

The A47 North Tuddenham to Easton
Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT APPENDICES
Appendix 14.1 – Embodied carbon assessment

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1. Introduction

- 1.1.1 This report sets out the methodology for calculating the embodied greenhouse gas (GHG) emissions associated with the A47 North Tuddenham to Easton dualling scheme (hereafter referred to as the Proposed Scheme) and culminates in a total embodied carbon value which can be used as a baseline for further carbon reductions and future reference.
- 1.1.2 This report details the greenhouse gas (GHG) emissions associated with the construction of the Proposed Scheme. An assessment of the significance of these emissions is contained within Chapter 14: Climate of the Environmental Statement (**TR010038/APP/6.1**).
- 1.1.3 Embodied carbon is the term used for the GHG emissions associated with the creation of an asset, including the production and transportation of materials to site. It is referred to within this report as 'carbon' and is measured in tonnes of carbon dioxide equivalent (tCO_{2e}). The quantification and assessment of embodied carbon is a key stage in the carbon management process.
- 1.1.4 Carbon emissions associated with the Proposed Scheme have been quantified using the Highways England (HE) Carbon Tool (version 2.3). This assessment has been undertaken based on the information available at Project Control Framework (PCF) Stage 3 of design development with assumptions and interpretation where necessary.

2. Methodology

2.1.1 This methodology was followed for calculating carbon emissions associated with preliminary design (PCF Stage 3) of the Proposed Scheme.

2.2 Materials

2.2.1 The calculation of carbon emissions associated with the Proposed Scheme was undertaken using the HE Carbon Tool (version 2.3). This tool uses the UK Government GHG Conversion Factors (2020) as well as density conversions from the Inventory of Carbon and Energy (ICE) database (version 3, 2019).

2.2.2 This assessment uses the methodology described within the HE Carbon Tool Guidance (Highways England, 2020). The data used within the Highways England Carbon Tool comprised estimates of Proposed Scheme construction material types and quantities, based on information provided by the Design Team in the form of a Bill of Quantities (BoQ).

2.2.3 Carbon emissions have been calculated based on categories as defined by the HE Carbon Tool:

- bulk materials
- earthworks
- fencing, barriers and road restraint systems
- drainage
- road pavements
- street furniture and electrical equipment
- civil works and retaining walls
- fuel, energy and water
- waste

2.2.4 The HE Carbon Tool requires specific units for all line items. In some instances, it was possible to enter the same value from the BoQ as the units were the same, however in other instances it was necessary to use a density conversion factor (eg a 2.3kg/m³ density factor needed to be applied to convert m³ to tonnes of asphalt).

2.3 Construction

2.3.1 Emissions associated with on-site construction processes have been calculated using a methodology based on the SPONS Civil Engineering and Highway Works Price Book (2017). Site activities in SPONS have an associated Plant Cost which is the sum of all costs incurred through renting the plant, labour costs and fuel costs etc. In order to isolate the fuel costs, a Fuel Cost Percentage was calculated

through comparing the fuel consumption rates of relevant plant and the total hourly plant cost. Through a detailed analysis, it was found that 20% was an appropriate estimate for the Fuel Cost Percentage for all site activities. Therefore, using the Total Plant Cost, the Fuel Cost Percentage and the cost of plant fuel (diesel), a value for plant fuel in litres was able to be calculated for each item. This value was then entered into the HE Carbon Tool to calculate carbon emissions in tCO_{2e}.

2.3.2 In some cases, the HE Carbon Tool does not include factors for some potentially sizeable items, e.g. earthworks. In these cases, the construction methodology to calculate fuel use described above has been used to account for these emissions.

2.3.3 For this calculation at Stage 3, plant fuel has been estimated for site clearance, earthworks and drainage. More detail will be included for the carbon calculations at Stage 5 but, based on professional judgement, will not materially influence the carbon estimation.

2.4 Transportation

2.4.1 It was assumed that imported materials will be transported a nominal distance of 60km by HGV. This is due to the approximate distance between the most easterly and westerly of the A47 schemes (120km), and the location of a provider of larger items such as concrete or steel within this distance. This distance is halved due to the likelihood of a provider based in Norwich for the eastern schemes and Peterborough for the western schemes. Where more detailed transport assumptions were available, transport distances and vehicles were refined, (eg site won material had an associated distance of 5km). This was entered for each item within the HE Carbon Tool to calculate the carbon associated using UK Government carbon factors for transportation vehicles (eg van, HGV, etc).

2.5 Assumptions

2.5.1 Attempts have been made to calculate the carbon emissions for every construction item. However, in some instances, either carbon factors do not currently exist (and therefore carbon cannot be estimated with a suitable degree of accuracy) or suitable information does not exist on which to base carbon assumptions, e.g. a drainage attenuation structure, drainage connections or a road bollard. In these instances, their impact is not considered to be material to the scheme's carbon estimate.

2.5.2 In cases where an appropriate carbon factor in the HE Tool was not available; a suitable alternative was used (eg a steel or wire or chain fence option instead of a 'Steel Field Gate' with a suitable conversion factor).

2.5.3 It is expected that the road construction will require maintenance and replacement during its design life. The carbon emissions associated with these future activities have been excluded from this assessment due to the inherent uncertainty in their frequency and extent. However, an initial estimate of the carbon emissions resulting from the replacement of the surface asphalt courses due to the design

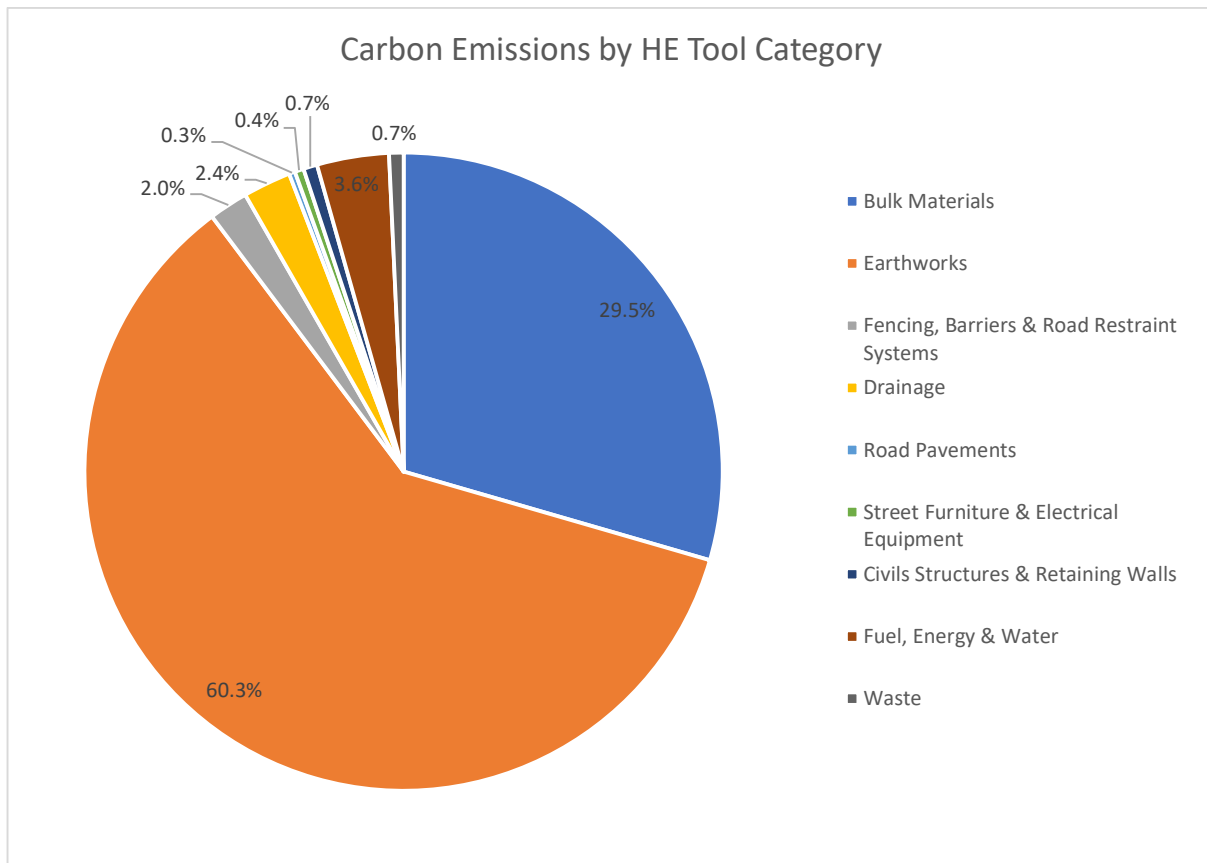
life of the materials (five times for the surface course and once for the binder course over a 60 year appraisal period) as a reasonable worst-case replacement scenario, based on professional judgement. This accounts for approximately 8,112 tCO_{2e}.

3. Results

3.1.1 The following key results have been obtained using the HE Carbon Tool:

- Embodied carbon emissions associated with Proposed Scheme construction are estimated to be 87,727 tCO₂e.
- The greatest sources of carbon emissions are associated with the earthworks category estimated to be 52,873 tCO₂e (60% of the total GHG emissions).
- The second most significant source of carbon emissions is calculated to be bulk materials (the HE Tool category associated with all large quantities of materials such as asphalt, fill and aggregate and concrete) category estimated to be 25,865 tCO₂e (30% of the total carbon emissions).

Figure 1: Highways England Carbon Tool Output



Source: HE Carbon Tool

3.1.2 When carbon emissions are categorised by the Design Manual for Roads and Bridges (DMRB) series as shown in Figure 2, it can be seen that Earthworks

(57,295tCO₂e) is the greatest source of carbon emissions, followed by Pavement (19,041 tCO₂e).

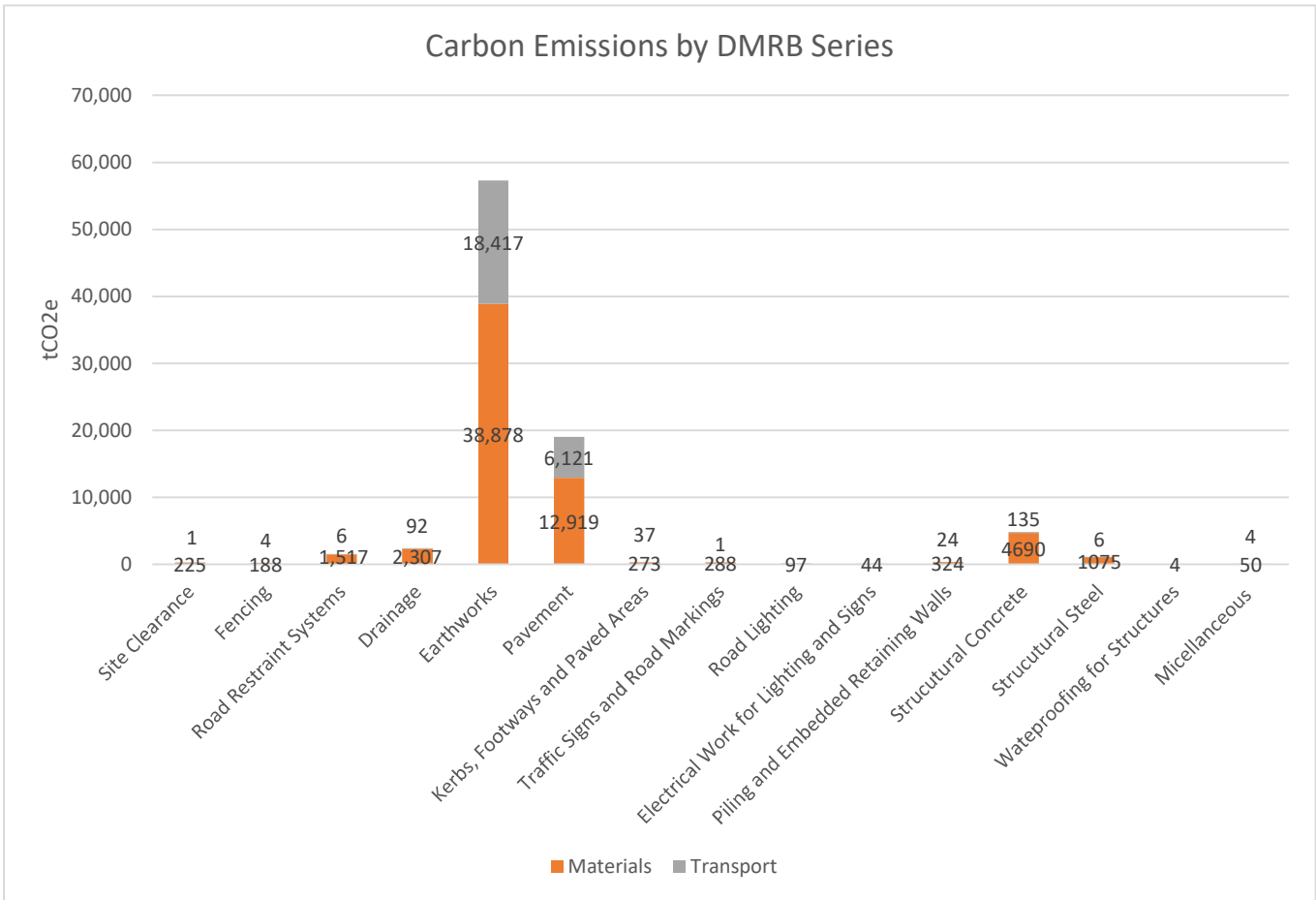


Figure 2: Carbon Emissions by DMRB Series

3.1.3 This estimate of carbon emissions associated with the Proposed Scheme will be recalculated during the detailed design stage (PCF Stage 5).

References

- Aecom (2017) *Spon's Civil Engineering and Highways Works Price Book*. 31st ed. Oxon: CRC Press, Taylor & Francis Group.
- *Highways England Carbon Tool* [online] available at <https://www.gov.uk/government/publications/carbon-tool> (last accessed August 2020)
- Highways England (2020) *Highways England Carbon Tool Guidance* [online] available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/453177/Task_446_Guidance_Document.pdf (last accessed August 2020)