A358 Taunton to Southfields Dualling Scheme

Preliminary Environmental Information Report - Appendix 14.1 Greenhouse Gas Assessment Assumptions, Methodology and Emissions Factors

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1 Greenhouse gas (GHG) assessment assumptions, methodology and emissions factors

1.1 GHG emissions assessment supporting information

1.1.1 Table 1-1 of this appendix presents all assumptions made in the quantification of the capital carbon assessment, presented in Chapter 14 Climate of the Preliminary Environmental Information (PEI) Report.

Table 1-1 GHG assessment assumptions

Item category	Location	Description	Quantity	Units	Assumptions
Pavements	Mainline	Pavements - Surface course - Close graded macadam - Thin - in carriageway, hard shoulder and hard strip	12,971	m^3 (cubic metre)	1. Assume the density of close bitumen macadam is 1,700Kg/m^3 (kilograms per cubic metre). 2. Assume that close graded macadam has the same conversion factor as Asphalt. 3. 0.04m (metre) thickness = 22,050 tonnes.
Pavements	Mainline	Pavements - Binder course - Dense bitumen macadam (DBM50) in carriageway hard shoulder and hard strip	16,213	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion factor as Asphalt. 3. 0.05m thickness = 27,563 tonnes.
Pavements	Mainline	Pavements - Base - Dense bitumen macadam (DBM50): In carriageway hard shoulder and hard strip	74,581	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion factor as Asphalt. 3. 0.23m thickness = 126,788 tonnes.
Pavements	Mainline	Pavements - Sub-base type 1 unbound mixture: in carriageway, hard shoulder and hard strip	74,581	m^3	1. Assume the subbase type 1 is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000Kg/m^3. 3. 0.23m thickness = 149,163 tonnes.
Pavements	Mainline	Pavements - Capping layer - unbound mixture: in carriageway, hard shoulder and hard strip	139,435	m^3	1. Assume the capping layer is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000Kg/m^3. 3. 0.43m thickness = 278,869 tonnes.
Pavements	Mainline Overlay	Pavements - Surface course - Close graded macadam - Thin - in carriageway, hard shoulder and hard strip	3,072	m^3	1. Assume the density of close bitumen macadam is 1,700Kg/m^3. 2. Assume that close graded macadam has the same conversion factor as Asphalt. 3. 0.04m thickness = 5,222 tonnes.
Pavements	Mainline Overlay	Pavements - Binder course - Dense bitumen macadam (DBM50) in carriageway hard shoulder and hard strip	3,839	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion factor as Asphalt. 3. 0.05m thickness = 6,527 tonnes.
Pavements	Mainline Overlay	Pavements - Base - Dense bitumen macadam (DBM50): In	12,286	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion

Item category	Location	Description	Quantity	Units	Assumptions
		carriageway hard shoulder and hard strip			factor as Asphalt. 3. 0.16m thickness = 20,886 tonnes.
Pavements	Side roads and slips	Pavements - Surface course - Close graded macadam - Thin - in carriageway, hard shoulder and hard strip	3,904	m^3	1. Assume the density of close bitumen macadam is 1,700Kg/m^3. 2. Assume that close graded macadam has the same conversion factor as Asphalt. 3. 0.04m thickness = 6,637 tonnes.
Pavements	Side roads and slips	Pavements - Binder course - Dense bitumen macadam (DBM50) in carriageway hard shoulder and hard strip	4,880	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion factor as Asphalt. 3. 0.05m thickness = 8,296 tonnes.
Pavements	Side roads and slips	Pavements - Base - Dense bitumen macadam (DBM50): In carriageway hard shoulder and hard strip	15,617	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion factor as Asphalt. 3. 0.16m thickness = 26,548 tonnes.
Pavements	Side roads and slips	Pavements - Sub-base type 1 unbound mixture: in carriageway, hard shoulder and hard strip	24,401	m^3	1. Assume the subbase type 1 is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000Kg/m^3. 3. 0.25m thickness = 48,802 tonnes.
Pavements	Side roads and slips	Pavements - Capping layer - unbound mixture: in carriageway, hard shoulder and hard strip	41,482	m^3	1. Assume the capping layer is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000Kg/m^3. 3. 0.425m thickness = 82,964 tonnes.
Pavements	Type 1 Access Track	Pavements - Sub-base type 1 unbound mixture: in carriageway, hard shoulder and hard strip	6,810	m^3	1. Assume the subbase type 1 is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000Kg/m^3. 3. 0.23m thickness = 13,620 tonnes.
Pavements	Type 1 Access Track	Pavements - Capping layer - unbound mixture: in carriageway, hard shoulder and hard strip	11,843	m^3	1. Assume the capping layer is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000 Kg/m^3. 3. 0.4m thickness = 23,686 tonnes.
Barriers	Central reserve	Concrete step barrier	14,500	m	1. Steel N2 has been specified within verges, where required. A rigid concrete step barrier (CSB) has been specified along the length of the proposed scheme within the majority of the central reserve. A working width for all barriers has been assumed to be

Item category	Location	Description	Quantity	Units	Assumptions
					W2. This will result in a steel post at 2m spacings. Transition and terminal lengths have been included within the total lengths for each option. A 0.4mx0.4mx0.6m concrete foundation would be required for 20% of VRS posts. The remaining would be driven posts. 2. Carbon conversion factor taken from the Highways England carbon tool. 1.2 tonnes per metre = 17,400 tonnes.
Barriers	Central reserve	Steel barrier N2	13,653	m	1. Steel N2 has been specified within verges, where required. A rigid concrete step barrier (CSB) has been specified along the length of the proposed scheme within the majority of the central reserve. A working width for all barriers has been assumed to be W2. This will result in a steel post at 2m spacings. Transition and terminal lengths have been included within the total lengths for each option. A 0.4mx0.4mx0.6m concrete foundation would be required for 20% of Vehicle Restraint Systems (VRS) posts. The remaining would be driven posts. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.04 tonnes per metre = 485 tonnes.
Pavements	Combined footway/cycleway	Pavements - Surface course - Close graded macadam - Thin - in carriageway, hard shoulder and hard strip	177	m^3	1. Assume the density of close bitumen macadam is 1,700Kg/m^3. 2. Assume that close graded macadam has the same conversion factor as Asphalt. 3. 0.02m thickness = 301 tonnes. 4. Footways have been calculated from length of footpath multiplied by the average width of 3.5m. Splitter islands have been included on three of the arms (North, South, West) of the Nexus 25 roundabout. Build up based on light vehicle overrun specification in accordance with CD 239.
Pavements	Combined footway/cycleway	Pavements - Binder course - Dense bitumen macadam (DBM50) in carriageway hard shoulder and hard strip	443	m^3	1. Assume the density of dense bitumen macadam is 1,700Kg/m^3. 2. Assume the dense bitumen macadam has the same conversion factor as Asphalt. 3. 0.05m thickness = 753 tonnes. 4. Footways have been calculated from length of footpath multiplied by the average width of 3.5m. Splitter islands have been included on three of the arms (North, South, West) of the Nexus 25 roundabout. Build up based on light vehicle overrun specification in accordance with CD 239.

Item category	Location	Description	Quantity	Units	Assumptions
Pavements	Combined footway/cycleway	Pavements - Sub-base type 1 unbound mixture: in carriageway, hard shoulder and hard strip	1,994	m^3	1. Assume the subbase type 1 is equivalent to natural aggregate. 2. Assume the density of subbase type 1 is 2,000Kg/m^3 3. 0.225m thickness = 3,988 tonnes. 4. Footways have been calculated from length of footpath multiplied by the average width of 3.5m. Splitter islands have been included on three of the arms (North, South, West) of the Nexus 25 roundabout. Build up based on light vehicle overrun specification in accordance with CD 239.
Pavements	Fencing	Fencing - Timber post and rail	294,652	m	1. Assume one access gate per access track and that existing fencing is degraded and needs replacement. 2. Assume timber post and rail to be used for all fencing. 3. Ecology mitigation will be required at numerous locations without the proposed scheme, e.g. otter proofing around watercourses, however this information is not available at present. 4. Carbon conversion factor taken from the Highways England carbon tool. 0.01 tonnes per metre = 4,209 tonnes.
Pavements	Kerb lengths	Pavements - Kerb lengths - Edging	2,532	m	1. The back of the combined footway/cycleway is to use edging kerb. Kerbing has also been included at roundabouts and entries/exits. Kerbing has been included with the assumed splitter islands on the Nexus 25 roundabout. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.09 tonnes per metre = 222 tonnes.
Pavements	Kerb lengths	Pavements - Kerb lengths - HB2	3,032	m	1. The back of the combined footway/cycleway is to use edging kerb. Kerbing has also been included at roundabouts and entries/exits. Kerbing has been included with the assumed splitter islands on the Nexus 25 roundabout. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.09 tonnes per metre = 266 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Pipe 150-300mm diameter - length (m)	31,600	m	1. Plastic, High-density polyethylene (HDPE). 2. Carbon conversion factor taken from the Highways England carbon tool. 0.97 tonnes per metre = 30,652 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Pipe 375-600mm diameter - length (m)	12,150	m	1. Plastic, HDPE. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.97 tonnes per metre = 11,786 tonnes.

Item category	Location	Description	Quantity	Units	Assumptions
Drainage	Mainline and Local Roads Sections 1 & 2	Pipe 675-900mm diameter - length (m)	700	m	1. Concrete. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.89 tonnes per metre = 622 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Surface Water Channel - length (m)	27,350	m	1. Concrete. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.15 tonnes per metre = 410 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Linear Channel - length (m)	450	m	1. Concrete. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.15 tonnes per metre = 68 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Kerb Drain - length (m)	780	m	1. Concrete, pre-cast. 2. Carbon conversion factor taken from the Highways England carbon tool. 0.09 tonnes per metre = 68 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Manhole Chamber 1200mm diameter - number	885	no. (number)	1. Concrete, pre-cast. 2. Carbon conversion factor taken from the Highways England carbon tool. 5.95 tonnes per metre = 5,266 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Headwall - number	250	no.	1. Concrete, pre-cast. 2. Worst-case scenario was assumed from the selection of headwalls that accommodated 900mm (millimetre) diameter pipes. Link: https://www.althon.co.uk/products/h10c-f-headwall/detail/. 3. As per the assumption above, each headwall assumed to be 3.375 tonnes per unit = 844 tonnes total. 4. Emissions factor assumed to be the same as precast concrete.
Drainage	Mainline and Local Roads Sections 1 & 2	Fill - Filter Drain - Volume (m3)	5,050	m^3	1. Type 1 aggregate. 2. Carbon conversion factor taken from the Highways England carbon tool. 2.00 tonnes per metre = 10,100 tonnes.
Drainage	Mainline and Local Roads Sections 1 & 2	Fill - Carrier Drain - Volume m3	33,600	m^3	1. If as-dug material is of good quality, this will be used for carrier drain bedding and fill. Assume material is of sufficient quality. 2. Carbon conversion factor taken from the Highways England carbon tool. 2.00 tonnes per metre = 67,200 tonnes.
Earthworks	Across proposed scheme	Fill material	58,705	m^3	1. Additional fill material required is assumed to be new material (natural aggregate). 2. Assume the density of fill material is 2,000Kg/m^3 = 117,410 tonnes.

Item category	Location	Description	Quantity	Units	Assumptions
Labour and Plant	Across proposed scheme	Labour and plant emissions	n/a	n/a	1. No information is available at this stage to calculate labour and plant for the proposed scheme. As such, an average has been calculated using the respective labour and plant footprints (normalised by km) of the schemes listed in Table 14-18 of Chapter 14 Climate of this PEI Report.
Maintenance	Across proposed scheme	Maintenance emissions	n/a	n/a	1. No information is available at this stage to calculate maintenance for the proposed scheme. As such, an average has been calculated using the respective maintenance footprints (normalised by kilometre (km)) of the schemes listed in Table 14-18 of Chapter 14 Climate of this PEI Report. 2. Assume surface course is replaced once every 15 years and that pavements are replaced every 40 years.
Structures	Across proposed scheme	Structures - Fill material	36,156	m^3	1. Carbon conversion factor taken from the Highways England carbon tool. 2.00 tonnes per m^3 = 72,312 tonnes.
Structures	Across proposed scheme	Structures - *In situ* concrete	7,658	m^3	1. Carbon conversion factor taken from the Highways England carbon tool. 2.4 tonnes per m^3 = 18,379 tonnes.
Structures	Across proposed scheme	Structures - Precast concrete	6,628	m^3	1. Carbon conversion factor taken from the Highways England carbon tool. 2.4 tonnes per m^3 = 15,906 tonnes.
Structures	Across proposed scheme	Structures - Steel	377	m^3	1. Carbon conversion factor taken from the Highways England carbon tool. 8.00 tonnes per m^3 = 3,018 tonnes.
Transport	Across proposed scheme	Emissions from traffic during operation and construction	n/a	n/a	1. Assumptions are detailed in Tag traffic model.
Water	Across proposed scheme	Water use from operation	n/a	n/a	1. Carbon emissions resulting from the consumption of water required by the proposed scheme to enable it to operate and deliver its service are assumed to be insignificant.