M3 Junction 9 Improvement

Scheme Number: TR010055

6.3 Environmental Statement Appendix 14.1 - Construction Greenhouse Gas Assessment Calculations

APFP Regulation 5(2)(a)

Planning Act 2008

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

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M3 Junction 9 Improvement
Development Consent Order 202[x]

6.3 ENVIRONMENTAL STATEMENT - APPENDIX 14.1: CONSTRUCTION GREENHOUSE GAS EMISSIONS CALCULATIONS

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Author:	M3 Junction 9 Improvement Project Team, National Highways

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Table 14.1.1: A1-A3 Embodied Carbon Calculations Summary

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Drainage Items	Pipework - including material selection	Plastic	150mm diameter plastic pipework (HDPE)	m	3360.19	2.52	N/A	0.0024	20.32
Drainage Items	Pipework - including material selection	Plastic	225mm diameter plastic pipework (HDPE)	m	3078.28	2.52	N/A	0.0042	32.58
Drainage Items	Pipework - including material selection	Plastic	300mm diameter plastic pipework (HDPE)	m	2320.65	2.52	N/A	0.0075	43.86
Drainage Items	Pipework - including material selection	Plastic	450mm diameter plastic pipework (HDPE)	m	1665.33	2.52	N/A	0.0112	47.00
Drainage Items	Manholes and inspection chambers - including material selection	Concrete	1200mm diameter, up to 3m depth Precast concrete manholes	nr	814.79	0.2384	N/A	3.22	625.47

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Drainage Items	Manholes and inspection chambers - including material selection	Concrete	1200mm diameter, 3m - 6m depth Precast concrete manholes	nr	3	0.2107	N/A	5.95	3.76
Drainage Items	Manholes and inspection chambers - including material selection	Concrete	1500mm diameter, up to 3m depth Precast concrete manholes	nr	50	0.2176	N/A	4.91	53.42
Drainage Items	Manholes and inspection chambers - including material selection	Concrete	1500mm diameter, 3m - 6m depth Precast concrete manholes	nr	4	0.1998	N/A	8.9	7.11
Drainage Items	Manholes and inspection chambers - including material selection	Concrete	1800mm diameter, up to 3m depth Precast concrete manholes	nr	4	0.2074	N/A	6.62	5.49
Drainage Items	Gullies	Plastic	Plastic gully pots - PVC Gullies	nr	482	2.5953	N/A	0.0212	26.52

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Fence Items	Fences (including type)	Timber	Timber rail fence (all types, includes posts)	m	1760	0.263	N/A	0.0143	6.62
Fence Items	Fences (including type)	Steel	Steel/wire/chain fence (includes posts)	m	6380	2.76	N/A	0.0038	66.91
Fence Items	Road restraint system/safety barrier	Steel	Steel RRS barrier single sided Road Restraint System/ Safety Barrier	m	12458	2.76	N/A	0.0223	766.76
Fence Items	Road restraint system/safety barrier	Concrete	Pre-cast concrete step barrier Road Restraint System/ Safety Barrier	m	2029	0.249	N/A	1.2	606.27
Road Pavement Item Options	Kerb	Concrete	Pre-cast concrete 125x255mm Kerb	m	5400	0.132	N/A	0.0733	52.25
Street Furniture Options	Traffic Signs	Aluminium		m2	500	6.67	N/A	0.05	166.75

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Street Furniture Options	Cable	Electrical Equipment	Armoured cable / Power cable Cable	m	7000	1.86	N/A	0.0007	9.11
Street Furniture Options	MS4 Signs	Electrical Equipment	Electronically operated MS4 signs	nr	8	4.323	N/A	0.725	25.07
Road Pavement Item Options	Bitumen surface treatment	Asphalt and bitumen	Bitumen emulsion	m2	233480	0.050	500	1	23.35
Bulk Materials	Ready Mix concrete	Concrete	100% CEM I - C6/8 (Gen 0, ST1) Ready mix concrete	m3	1550	0.070437227	N/A	2.4	262.03
Bulk Materials	Ready Mix concrete	Concrete	100% CEM I - C8/10 (Gen 1, ST 2) Ready mix concrete	m3	134	0.097192891	N/A	2.4	31.26
Bulk Materials	Ready Mix concrete	Concrete	100% CEM I - C16/20 (Gen 3, ST 4) Ready mix concrete	m3	3190	0.112663883	N/A	2.4	862.55

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Bulk Materials	Ready Mix concrete	Concrete	100% CEM I - C20/25 (ST 5) Ready mix concrete	m3	120	0.120928209	N/A	2.4	34.83
Bulk Materials	Ready Mix concrete	Concrete	100% CEM I - C32/40 Ready mix concrete	m3	3977	0.149482537	N/A	2.4	1426.78
Bulk Materials	Ready Mix concrete	Concrete	100% CEM I - C40/50 Ready mix concrete	m3	9556	0.172289283	N/A	2.4	3951.35
Bulk Materials	Reinforcement steel	Steel bar and rod	Steel	tonnes	2662	1.99	N/A	1	5297.38
Civil Structures (including foundations)	Piling	Steel piles	Steel	tonnes	1675	2.76	N/A	1	4623.08
Civil Structures (including foundations)	Pre-cast concrete	Concrete	High strength concrete	tonnes	840	0.191	N/A	1	160.44

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Earthworks Items	Site won soil/ muck shift	Inert	General soil	tonnes	800,000	0	N/A	1	0.00
Earthworks Items	Geotextiles	Plastic	Polypropylene geotextile / matting Ground stabilisation	m2	38617	2.54	N/A	0.00946	927.90
Bulk Materials	Fill, aggregate and sand	Inert	General mixture	tonnes	275080	0.007	N/A	1	1925.56
Fence Items	Road Restraint System/ Safety Barrier	Steel	Steel RRS barrier single sided	tonnes	450	2.760	N/A	0.02229	27.68
Plastic Pipework	Drainage	Plastic	HDPE 225mm	metres	239.00	2.52	N/A	0.00422362	2.54
Precast concrete inspection	Drainage	Concrete	Precast concrete inspection chambers	nr	6.00	0.2	N/A	1.753	2.10
Earthworks	Site won soil/muck shift	Inert	Muck shift	tonnes	1747.00	0	N/A	1	0.00
Road Pavements	Bitumen surface treatment	Asphalt and bitumen	Bitumen emulsion	tonnes	250.00	0.222	N/A	1	55.50

Item	Category	Material Type	Description	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Carbon Conversion Factor[1]	Estimated GHG emissions (tCO_2e)
Street Furniture & Electrical Equipment	Traffic signs	Aluminium	Traffic signs	no	2.00	6.67	N/A	0.05	0.67
Bulk Materials	Ready mix concrete	Concrete	14m ADS Tubular Cantilever	m3	10.00	2.76	N/A	11.5	317.40
Bulk materials	Ready mix concrete	Concrete	Gantry base	m3	23.00	0.172	N/A	2.4	9.49
Civils Structures & Retaining Walls	Retaining walls	Inert	Gabion walls (stone and wire mesh)	tonnes	600.00	3.1	N/A	1	1860.00
Civils Structures & Retaining Walls	Gantries	Steel	45m to 57m Portal	no	1	2.76	N/A	40	110.40
Bulk Materials	Ready mix concrete	Concrete	CEM 1 C40/C50 foundation bases	m3	48	0..172	N/A	2.4	19.81
								TOTAL	**25,535.85**

NOTE 1 – The Highways England Carbon Conversion Factors require specific units (e.g. m2, tonnes) to calculate estimated GHG emissions. Where the unit of the item is not available in the appropriate unit for the Carbon Conversion Factor, a unit conversion factor has been applied. For example, drainage pipe work was provided in m, which was converted to tonnes by using the HE Carbon unit conversion factor of 0.0024 tonnes/m3 for 150mm diameter plastic pipework.

Table 14.1.2: A4 Transport to Works Site Calculations Summary

Defra Outputs – annual Construction Traffic Emissions (tCO_2e/yr)	Total Construction Traffic Emissions over 3 year construction period (tCO_2e)
280.97	**842.92**

NOTE 1 – Construction vehicle movement information was provided by VolkerFitzpatrick. The following notes are provided in relation to the calculation of vehicle movements: it is approximated that there would be approx 200,000m3 of spoil generated from the development, to be transported in 8m3 loads, equating to approximately 25,000 movements over the construction period. These movements would be to/from the deposition areas, it is thought approximately one third of these loads will be routed on the highway network (8,300 movements). In addition, it is anticipated there would be 20,000m3 of concrete being delivered to the site from external sources (with 7.5m3 concrete wagons, this equates to 2,600 concrete wagons across the construction phase), 80,000m3 of imported aggregate from external sources (with 8.5m3 wagons, this equates to 9,411 movements over the 3 years), 25 additional misc. HGV deliveries per day. Avg of 100 cars to site per day. Approximately 50,000 cu.m of spoil arising from the works should be assumed to be unacceptable to be re-used in the landscaping proposals and thus will need transporting off site to landfill. The likely landfill location is 32km away at Rookery Farm Landfill (SO13 1BL), with a likely route of traveling south on the M3 then east on the M27. Taking the same vehicle assumptions as above, (8m3) and with an advised bulking factor of 30%, this should be assumed to require approximately 6,250 two-way vehicle movements.

NOTE 2 – GHG emissions calculated using Defra EFT Toolkit Defra, 2020. 'Emissions Factors Toolkit v10.1, Department for Environment Food & Rural Affairs [online]: [redacted]

Table 14.1.3: A5 Construction Waste Calculations Summary

Item	Waste Disposal Category	Unit	Quantity	Carbon Factor (tCO2e/t)	Unit conversion factor (to HE unit)	Estimated GHG Emissions (tCO2e)
Mixed construction & demolition waste	Recycled	m3	380	0.006	2.4	5.472
	Landfill	m3	20	0.093	2.4	4.464
	TOTAL		400			
Concrete	Recycled	m3	2,375	0.001	2.45	5.81875
	Landfill	m3	125	0.001	2.45	0.30625
	TOTAL		2,500			
Inert	Recycled	m3	97,850	0.001	2.08	203.528
	Landfill	m3	70,150	0.001	2.08	145.912
	TOTAL		168,000			
					TOTAL	**365**

NOTE 1 – Input data is in line with 95% diversion from landfill

Table 14.1.4: A5 Construction Energy Use – Cabins Calculations Summary

Site Compound	Total kW	Scenario	Construction Timescale (weeks)	Construction timescale (annual hours)*	kWh (electric scenario)	Carbon factor	Carbon Factor Unit	Carbon Conversion Factor	Total kgCO2e	Total tCO2e
General Arrangement Office	134	Electric	174	14,964	2,005,176	0.212	$kgCO_2e/kWh$	0.001	425,097	425
General Arrangement Operatives	81.6	Electric	174	14964	1,221,062	0.212	$kgCO_2e/kWh$	0.001	258,865	259
								Total	683962	**684**

** Note 1 – Annual hours are based on a worst-case scenario of an 86 hour work week (6:00 to 22:00 Monday to Friday, 7:30 to 13:30 Saturday) however a typically week is anticipated to be 56 hours (7:30 to 17:30 Monday to Friday and 7:30 to 13:30 Saturday).*
Carbon factors from The Highways England Carbon Tool V2.2-2018 have been used to calculate the amount of CO2e.

Table 14.1.5: A5 Construction Plant – summary of totals from plant assignment programme and calculations

Activity Name and Equipment Type	Resource ID Name	Quant	Output/hr	Assumed Fuel Consumption (hourly)- litres	Fuel consumed (hourly fuel consumption x total fuel consumption)	Carbon Factor (kg CO2e / litre)	Carbon Emissions
Earthworks - ADT	Item 9.38 M3 Junction 9 Diesel Usage Calculations	400000m3	15m3	20	533333	3.122	1665065.63
Earthworks – 360 Exc	Item 9.38 M3 Junction 9 Diesel Usage Calculations	400000m3	60m3	17	113333	3.122	353825.63
Earthworks - Roller	Item 9.38 M3 Junction 9 Diesel Usage Calculations	10800	hr	9	97200	3.122	303458.40
Earthworks - Lorries	Item 9.38 M3 Junction 9 Diesel Usage Calculations	10000	hr	10	100000	3.122	312200.00
Earthworks - Scraper	Item 9.38 M3 Junction 9 Diesel Usage Calculations	10800	hr	34	367200	3.122	1146398.40
Structures – Access Platform	Item 9.38 M3 Junction 9 Diesel Usage Calculations	9600	hr	7	67200	3.122	209798.40
Structures – Crane Lorry Mounted	Item 9.38 M3 Junction 9 Diesel Usage Calculations	9600	hr	34	326400	3.122	1019020.80
Structures – Crane Tracker	Item 9.38 M3 Junction 9 Diesel Usage Calculations	9600	hr	17	163200	3.122	509510.40
Surfacing - Paver	Item 9.38 M3 Junction 9 Diesel Usage Calculations	200	10 hr shift	25	50000	3.122	156100.00

Activity Name and Equipment Type	Resource ID Name	Quant	Output/hr	Assumed Fuel Consumption (hourly)- litres	Fuel consumed (hourly fuel consumption x total fuel consumption)	Carbon Factor (kg CO2e / litre)	Carbon Emissions
Surfacing - Roller	Item 9.38 M3 Junction 9 Diesel Usage Calculations	200	10 hr shift	14	28800	3.122	89913.60
Surfacing – Small Roller	Item 9.38 M3 Junction 9 Diesel Usage Calculations	200	10 hr shift	5	10000	3.122	31220.00
Surfacing - Lorries	Item 9.38 M3 Junction 9 Diesel Usage Calculations	800	10 hr shift	10	80000	3.122	249760.00
Lighting / Air – Generating Sets	Item 9.38 M3 Junction 9 Diesel Usage Calculations	21600	hr	12	259200	3.122	809222.40
Material Movement – Small Dumper	Item 9.38 M3 Junction 9 Diesel Usage Calculations	17280	hr	4.9	84672	3.122	264345.98
Material Movement – Loader Back Hoe	Item 9.38 M3 Junction 9 Diesel Usage Calculations	17280	hr	10.9	188352	3.122	588034.94
						Total kgCO2e Emissions	**7707874.58**
						Total tCO2e Emissions	**7,707.87**

Note 1 – *Assumed fuel consumption (litres/hour) is based on assumptions of typical plant gangs from previous schemes and 1995 Fuel Consumption Rates, provided by the contractors for the Scheme. Efficiency in fuel management over past 26 years likely mean this results in overestimating fuel consumption.*

Table 14.1.6: A5 Land Use Change

Habitat group	ha / length of hedgerow			t CO2 ha-1	
	Existing area	Proposed area	Combined change	Carbon stock in soils & vegetation	Construction Emissions (over 3 years)
Cropland	33.96	13.18	-20.78	88.20	1832.61
Grassland	14.10	23.49	9.38	69.00	0.00
Heathland and shrub	3.02	6.56	3.54	100.00	0.00
Lakes	0.00	1.00	1.00	n/a	0.00
Sparsely vegetated land	0.28	0.28	0.00	n/a	0.00
Urban	32.28	34.29	2.01	0.00	0.00
Woodland and forest	28.80	30.18	1.38	169.00	0.00
Native Species Rich Hedgerow with trees	0.86	1.76	0.90	144.50	0.00
Native Species Rich Hedgerow	0.19	0.19	0.00	144.50	0.00
Native Hedgerow	2.51	1.81	-0.70	144.50	101.44
				Total (t CO2 ha-1)	**1,934.05**