Carbon Emissions

The TAG approach involves establishing the cost of greenhouse gas emissions to be taken into account over a 60 year period. Using the revised traffic flow characteristics for the local road network, the change in carbon emissions in the opening year of the bypass, 2009, is (rounded up to the nearest tonne), 385 tonnes.

The cost of this change in carbon emissions has been calculated for three different scenarios:

1) that presented in the Major Scheme Business Case as calculated using DMRB version 1.03c;

2) the same as 1) but assuming that carbon emissions per year remain constant between 2009 and 2068; and

3) the same as 2) but replacing the social cost of carbon with the shadow price of carbon.

The results of the calculations for each of these three scenarios and the associated DMRB spreadsheets are presented below.

The TAG approach is based on the social cost of carbon. In the Major Business Case scenario the change in tonnes of carbon emitted increases between 2009 and 2024, thereafter it remains constant. The social cost of carbon, estimated at £81.77 per tonne in 2009, increases year on year throughout the 60 year period.

In scenario 2) the change in tonnes of carbon emitted remains constant throughout the 60 year appraisal period. Using the social cost of carbon, this equates to a cost of £31,481 in 2009, rising to £54,989 in 2068 (rounded up to 385 tonnes). Based on discount rate of 3.5% for the first 30 years and 3.0% for the remainder of the period the net present value for this scenario would be £817,946.

In scenario 3) based on the shadow price of carbon, which is estimated at £97.17 per tonne in 2009, this difference in emissions equates to a cost of £37,410 in 2009, rising to £120,336 by 2068 (rounded up to 385 tonnes). On a similar basis, the net present value would be £1,219,769 over the 60 year period.

Calculation of Carbon Emissions

(Scenario 1 – Major Scheme Business Case)

Appraisal – Greenhouse Gases

Proposal Name:	Westbury Bypass
Current Year of Appraisal:	2007
Opening Year of Appraisal:	2009
Project (Road/Rail or Road and Rail)	Road

Overall Assessment Score:

Net Present Value of Carbon Emissions of Proposal (£): -924,476
(60 Year Period)

*positive value reflects a net benefit (i.e. carbon emissions reduction)

Quantitative Assessment:

Change in Carbon Emissions over 60 year appraisal period (tonnes) 26,424
(between with scheme and without scheme scenarios)

Change in Carbon Emissions in Opening Year (tonnes) 385
(between with scheme and without scheme scenarios)

Qualitative Comments:
None

Sensitivity Analysis:
Description:

Upper bound Net Present Value of Carbon Emissions of Proposal (£) -1,571,783

Lower bound Net Present Value of Carbon Emissions of Proposal (£) -600,823

Data Sources:

Carbon emitted in 2009, 2010 and 2024 from the local road network modelled calculated using DMRB version 1.03c.
Average speed of 48 km h^{-1} assumed on all minor roads.
Average speed of 96 km h^{-1} assumed on bypass.
Average speed of 30 km h^{-1} assumed on all junctions.

Road			Rail			Monetary calculation of total change resulting from scheme:			
	Tonnes of Carbon Emitted			Tonnes of Carbon Emitted					
Year	Without Scheme scenario	With Scheme scenario	Year	Without Scheme scenario	With Scheme scenario	Change in tonnes of carbon emitted	Social cost of carbon per tonne	Social cost of carbon for year change	NPV
2009	4031	4416	2009	0	0	384.808469	81.77	31463.86	-24730.31
2010	4060	4449	2010	0	0	389.0848586	82.80	32216.23	-24465.37
2011	4088	4482	2011	0	0	393.3612482	83.84	32977.44	-24196.57
2012	4117	4515	2012	0	0	397.6376377	84.87	33747.51	-23924.24
2013	4145	4547	2013	0	0	401.9140273	85.90	34526.42	-23648.73
2014	4174	4580	2014	0	0	406.1904169	86.94	35314.19	-23370.34
2015	4202	4613	2015	0	0	410.4668064	87.97	36110.82	-23089.41
2016	4231	4646	2016	0	0	414.743196	89.01	36916.29	-22806.21
2017	4259	4678	2017	0	0	419.0195856	90.04	37730.62	-22521.05
2018	4288	4711	2018	0	0	423.2959751	91.08	38553.80	-22234.20
2019	4316	4744	2019	0	0	427.5723647	92.11	39385.83	-21945.93
2020	4345	4777	2020	0	0	431.8487542	93.15	40226.71	-21656.50
2021	4373	4809	2021	0	0	436.1251438	94.18	41076.45	-21366.15
2022	4402	4842	2022	0	0	440.4015334	95.22	41935.03	-21075.12
2023	4430	4875	2023	0	0	444.6779229	96.25	42802.47	-20783.64
2024	4459	4908	2024	0	0	448.9543125	97.29	43678.77	-20491.92
2025	4459	4908	2025	0	0	448.9543125	98.32	44143.43	-20009.58
2026	4459	4908	2026	0	0	448.9543125	99.36	44608.10	-19536.44
2027	4459	4908	2027	0	0	448.9543125	100.40	45072.77	-19072.41
2028	4459	4908	2028	0	0	448.9543125	101.43	45537.44	-18617.42
2029	4459	4908	2029	0	0	448.9543125	102.47	46002.10	-18171.39
2030	4459	4908	2030	0	0	448.9543125	103.50	46466.77	-17734.24
2031	4459	4908	2031	0	0	448.9543125	104.54	46931.44	-17305.88

2032	4459	4908	2032	0	0	448.9543125	105.57	47396.11	-16886.21
2033	4459	4908	2033	0	0	448.9543125	106.61	47860.77	-16475.13
2034	4459	4908	2034	0	0	448.9543125	107.64	48325.44	-16072.54
2035	4459	4908	2035	0	0	448.9543125	108.68	48790.11	-15678.35
2036	4459	4908	2036	0	0	448.9543125	109.71	49254.78	-15292.43
2037	4459	4908	2037	0	0	448.9543125	110.75	49719.45	-14914.68
2038	4459	4908	2038	0	0	448.9543125	111.78	50184.11	-14615.60
2039	4459	4908	2039	0	0	448.9543125	112.82	50648.78	-14321.30
2040	4459	4908	2040	0	0	448.9543125	113.85	51113.45	-14031.73
2041	4459	4908	2041	0	0	448.9543125	114.89	51578.12	-13746.89
2042	4459	4908	2042	0	0	448.9543125	115.92	52042.78	-13466.73
2043	4459	4908	2043	0	0	448.9543125	116.96	52507.45	-13191.23
2044	4459	4908	2044	0	0	448.9543125	117.99	52972.12	-12920.36
2045	4459	4908	2045	0	0	448.9543125	119.03	53436.79	-12654.07
2046	4459	4908	2046	0	0	448.9543125	120.06	53901.45	-12392.34
2047	4459	4908	2047	0	0	448.9543125	121.10	54366.12	-12135.11
2048	4459	4908	2048	0	0	448.9543125	122.13	54830.79	-11882.36
2049	4459	4908	2049	0	0	448.9543125	123.17	55295.46	-11634.04
2050	4459	4908	2050	0	0	448.9543125	124.20	55760.13	-11390.10
2051	4459	4908	2051	0	0	448.9543125	125.24	56224.79	-11150.50
2052	4459	4908	2052	0	0	448.9543125	126.27	56689.46	-10915.20
2053	4459	4908	2053	0	0	448.9543125	127.31	57154.13	-10684.14
2054	4459	4908	2054	0	0	448.9543125	128.34	57618.80	-10457.29
2055	4459	4908	2055	0	0	448.9543125	129.38	58083.46	-10234.58
2056	4459	4908	2056	0	0	448.9543125	130.41	58548.13	-10015.98
2057	4459	4908	2057	0	0	448.9543125	131.45	59012.80	-9801.43
2058	4459	4908	2058	0	0	448.9543125	132.48	59477.47	-9590.88
2059	4459	4908	2059	0	0	448.9543125	133.52	59942.14	-9384.28
2060	4459	4908	2060	0	0	448.9543125	134.55	60406.80	-9181.58
2061	4459	4908	2061	0	0	448.9543125	135.59	60871.47	-8982.73
2062	4459	4908	2062	0	0	448.9543125	136.62	61336.14	-8787.67
2063	4459	4908	2063	0	0	448.9543125	137.66	61800.81	-8596.35
2064	4459	4908	2064	0	0	448.9543125	138.69	62265.47	-8408.72
2065	4459	4908	2065	0	0	448.9543125	139.73	62730.14	-8224.73
2066	4459	4908	2066	0	0	448.9543125	140.76	63194.81	-8044.33
2067	4459	4908	2067	0	0	448.9543125	141.80	63659.48	-7867.45
2068	4459	4908	2068	0	0	448.9543125	142.83	64124.14	-7694.06
				Net Present Value of Carbon Emissions of Proposal:					-924476.18

Calculation of Carbon Emissions (Scenario 2 – Constant tonnage per year)

Appraisal – Greenhouse Gases

Proposal Name: Westbury Bypass

Current Year of Appraisal: 2007

Opening Year of Appraisal: 2009

Project (Road/Rail or Road and Rail) Road

Overall Assessment Score:

Net Present Value of Carbon Emissions of Proposal (£): -817,946
(60 Year Period)

*positive value reflects a net benefit (i.e. carbon emissions reduction)

Quantitative Assessment:

Change in Carbon Emissions over 60 year appraisal period (tonnes) 23,089
(between with scheme and without scheme scenarios)

Change in Carbon Emissions in Opening Year (tonnes) 385
(between with scheme and without scheme scenarios)

Qualitative Comments:
None

Sensitivity Analysis using social cost:
Description:

Upper bound Net Present Value of Carbon Emissions of Proposal (£) -1,394,263

Lower bound Net Present Value of Carbon Emissions of Proposal (£) -529,788

Data Sources:

Carbon emitted in 2009, 2010 and 2024 from the local road network modelled calculated using DMRB version 1.03c.
Average speed of 48 km h^{-1} assumed on all minor roads.
Average speed of 96 km h^{-1} assumed on bypass.
Average speed of 30 km h^{-1} assumed on all junctions.

Road			Rail			Monetary calculation of total change resulting from scheme:			
	Tonnes of Carbon Emitted			Tonnes of Carbon Emitted					
Year	Without Scheme scenario	With Scheme scenario	Year	Without Scheme scenario	With Scheme scenario	Change in tonnes of carbon emitted	Social cost of carbon per tonne	Social cost of carbon for year change	NPV
2009	4031	4416	2009	0	0	384.808469	81.77	31463.86	-24730.31
2010	4031	4416	2010	0	0	384.808469	82.80	31862.14	-24196.48
2011	4031	4416	2011	0	0	384.808469	83.84	32260.42	-23670.47
2012	4031	4416	2012	0	0	384.808469	84.87	32658.69	-23152.36
2013	4031	4416	2013	0	0	384.808469	85.90	33056.97	-22642.23
2014	4031	4416	2014	0	0	384.808469	86.94	33455.25	-22140.12
2015	4031	4416	2015	0	0	384.808469	87.97	33853.53	-21646.08
2016	4031	4416	2016	0	0	384.808469	89.01	34251.80	-21160.14
2017	4031	4416	2017	0	0	384.808469	90.04	34650.08	-20682.31
2018	4031	4416	2018	0	0	384.808469	91.08	35048.36	-20212.59
2019	4031	4416	2019	0	0	384.808469	92.11	35446.63	-19751.00
2020	4031	4416	2020	0	0	384.808469	93.15	35844.91	-19297.51
2021	4031	4416	2021	0	0	384.808469	94.18	36243.19	-18852.10
2022	4031	4416	2022	0	0	384.808469	95.22	36641.46	-18414.75
2023	4031	4416	2023	0	0	384.808469	96.25	37039.74	-17985.42
2024	4031	4416	2024	0	0	384.808469	97.29	37438.02	-17564.07
2025	4031	4416	2025	0	0	384.808469	98.32	37836.29	-17150.65
2026	4031	4416	2026	0	0	384.808469	99.36	38234.57	-16745.10
2027	4031	4416	2027	0	0	384.808469	100.40	38632.85	-16347.37
2028	4031	4416	2028	0	0	384.808469	101.43	39031.12	-15957.39
2029	4031	4416	2029	0	0	384.808469	102.47	39429.40	-15575.10
2030	4031	4416	2030	0	0	384.808469	103.50	39827.68	-15200.41
2031	4031	4416	2031	0	0	384.808469	104.54	40225.95	-14833.25
2032	4031	4416	2032	0	0	384.808469	105.57	40624.23	-14473.54
2033	4031	4416	2033	0	0	384.808469	106.61	41022.51	-14121.19
2034	4031	4416	2034	0	0	384.808469	107.64	41420.78	-13776.13
2035	4031	4416	2035	0	0	384.808469	108.68	41819.06	-13438.25
2036	4031	4416	2036	0	0	384.808469	109.71	42217.34	-13107.47
2037	4031	4416	2037	0	0	384.808469	110.75	42615.61	-12783.70
2038	4031	4416	2038	0	0	384.808469	111.78	43013.89	-12527.35
2039	4031	4416	2039	0	0	384.808469	112.82	43412.17	-12275.09
2040	4031	4416	2040	0	0	384.808469	113.85	43810.44	-12026.90
2041	4031	4416	2041	0	0	384.808469	114.89	44208.72	-11782.75
2042	4031	4416	2042	0	0	384.808469	115.92	44607.00	-11542.63
2043	4031	4416	2043	0	0	384.808469	116.96	45005.27	-11306.49
2044	4031	4416	2044	0	0	384.808469	117.99	45403.55	-11074.32
2045	4031	4416	2045	0	0	384.808469	119.03	45801.83	-10846.08
2046	4031	4416	2046	0	0	384.808469	120.06	46200.10	-10621.74
2047	4031	4416	2047	0	0	384.808469	121.10	46598.38	-10401.27
2048	4031	4416	2048	0	0	384.808469	122.13	46996.66	-10184.63
2049	4031	4416	2049	0	0	384.808469	123.17	47394.94	-9971.79
2050	4031	4416	2050	0	0	384.808469	124.20	47793.21	-9762.70
2051	4031	4416	2051	0	0	384.808469	125.24	48191.49	-9557.34
2052	4031	4416	2052	0	0	384.808469	126.27	48589.77	-9355.65
2053	4031	4416	2053	0	0	384.808469	127.31	48988.04	-9157.61

2054	4031	4416	2054	0	0	384.808469	128.34	49386.32	-8963.17
2055	4031	4416	2055	0	0	384.808469	129.38	49784.60	-8772.28
2056	4031	4416	2056	0	0	384.808469	130.41	50182.87	-8584.92
2057	4031	4416	2057	0	0	384.808469	131.45	50581.15	-8401.02
2058	4031	4416	2058	0	0	384.808469	132.48	50979.43	-8220.55
2059	4031	4416	2059	0	0	384.808469	133.52	51377.70	-8043.47
2060	4031	4416	2060	0	0	384.808469	134.55	51775.98	-7869.73
2061	4031	4416	2061	0	0	384.808469	135.59	52174.26	-7699.29
2062	4031	4416	2062	0	0	384.808469	136.62	52572.53	-7532.10
2063	4031	4416	2063	0	0	384.808469	137.66	52970.81	-7368.12
2064	4031	4416	2064	0	0	384.808469	138.69	53369.09	-7207.30
2065	4031	4416	2065	0	0	384.808469	139.73	53767.36	-7049.60
2066	4031	4416	2066	0	0	384.808469	140.76	54165.64	-6894.97
2067	4031	4416	2067	0	0	384.808469	141.80	54563.92	-6743.36
2068	4031	4416	2068	0	0	384.808469	142.83	54962.19	-6594.74
				Net Present Value of Carbon Emissions of Proposal:					-817,946.44

Calculation of Carbon Emissions (Scenario 3 – Shadow Price of Carbon)

Appraisal – Greenhouse Gases

Proposal Name: Westbury Bypass

Current Year of Appraisal: 2007

Opening Year of Appraisal: 2009

Project (Road/Rail or Road and Rail) Road

Overall Assessment Score:

Net Present Value of Carbon Emissions of Proposal (£): -1,219,769
(60 Year Period)

*positive value reflects a net benefit (i.e. carbon emissions reduction)

Quantitative Assessment:

Change in Carbon Emissions over 60 year appraisal period (tonnes) 23,089
(between with scheme and without scheme scenarios)

Change in Carbon Emissions in Opening Year (tonnes) 385
(between with scheme and without scheme scenarios)

Qualitative Comments:
None

Sensitivity Analysis using social cost:
Description:

Upper bound Net Present Value of Carbon Emissions of Proposal (£) -1,394,263

Lower bound Net Present Value of Carbon Emissions of Proposal (£) -529,788

Data Sources:

Carbon emitted in 2009, 2010 and 2024 from the local road network modelled

calculated using DMRB version 1.03c.
Average speed of 48 km h^{-1} assumed on all minor roads.
Average speed of 96 km h^{-1} assumed on bypass.
Average speed of 30 km h^{-1} assumed on all junctions.

Road			**Rail**			**Monetary calculation of total change resulting from scheme:**			
	Tonnes of Carbon Emitted			**Tonnes of Carbon Emitted**					
Year	**Without Scheme scenario**	**With Scheme scenario**	**Year**	**Without Scheme scenario**	**With Scheme scenario**	**Change in tonnes of carbon emitted**	**Shadow price of carbon per tonne**	**Shadow price of carbon for year change**	**NPV**
2009	4031	4416	2009	0	0	384.808469	97.17	37390.56	29388.64
2010	4031	4416	2010	0	0	384.808469	99.11	38138.37	28962.72
2011	4031	4416	2011	0	0	384.808469	101.09	38901.13	28542.97
2012	4031	4416	2012	0	0	384.808469	103.11	39679.16	28129.30
2013	4031	4416	2013	0	0	384.808469	105.18	40472.74	27721.63
2014	4031	4416	2014	0	0	384.808469	107.28	41282.20	27319.87
2015	4031	4416	2015	0	0	384.808469	109.43	42107.84	26923.93
2016	4031	4416	2016	0	0	384.808469	111.61	42950.00	26533.73
2017	4031	4416	2017	0	0	384.808469	113.85	43809.00	26149.18
2018	4031	4416	2018	0	0	384.808469	116.12	44685.18	25770.21
2019	4031	4416	2019	0	0	384.808469	118.45	45578.88	25396.72
2020	4031	4416	2020	0	0	384.808469	120.81	46490.46	25028.66
2021	4031	4416	2021	0	0	384.808469	123.23	47420.27	24665.92
2022	4031	4416	2022	0	0	384.808469	125.70	48368.67	24308.44
2023	4031	4416	2023	0	0	384.808469	128.21	49336.04	23956.15
2024	4031	4416	2024	0	0	384.808469	130.77	50322.77	23608.96
2025	4031	4416	2025	0	0	384.808469	133.39	51329.22	23266.80
2026	4031	4416	2026	0	0	384.808469	136.06	52355.81	22929.60
2027	4031	4416	2027	0	0	384.808469	138.78	53402.92	22597.29
2028	4031	4416	2028	0	0	384.808469	141.55	54470.98	22269.79
2029	4031	4416	2029	0	0	384.808469	144.38	55560.40	21947.04
2030	4031	4416	2030	0	0	384.808469	147.27	56671.61	21628.97
2031	4031	4416	2031	0	0	384.808469	150.22	57805.04	21315.50
2032	4031	4416	2032	0	0	384.808469	153.22	58961.14	21006.58
2033	4031	4416	2033	0	0	384.808469	156.29	60140.36	20702.14
2034	4031	4416	2034	0	0	384.808469	159.41	61343.17	20402.11
2035	4031	4416	2035	0	0	384.808469	162.60	62570.03	20106.42
2036	4031	4416	2036	0	0	384.808469	165.85	63821.43	19815.03
2037	4031	4416	2037	0	0	384.808469	169.17	65097.86	19527.85
2038	4031	4416	2038	0	0	384.808469	172.55	66399.82	19338.26
2039	4031	4416	2039	0	0	384.808469	176.00	67727.82	19150.51
2040	4031	4416	2040	0	0	384.808469	179.52	69082.37	18964.58
2041	4031	4416	2041	0	0	384.808469	183.11	70464.02	18780.46
2042	4031	4416	2042	0	0	384.808469	186.78	71873.30	18598.13
2043	4031	4416	2043	0	0	384.808469	190.51	73310.77	18417.56
2044	4031	4416	2044	0	0	384.808469	194.32	74776.98	18238.75
2045	4031	4416	2045	0	0	384.808469	198.21	76272.52	18061.68
2046	4031	4416	2046	0	0	384.808469	202.17	77797.97	17886.32
2047	4031	4416	2047	0	0	384.808469	206.22	79353.93	17712.67
2048	4031	4416	2048	0	0	384.808469	210.34	80941.01	17540.70
2049	4031	4416	2049	0	0	384.808469	214.55	82559.83	17370.40
2050	4031	4416	2050	0	0	384.808469	218.84	84211.03	17201.76
2051	4031	4416	2051	0	0	384.808469	223.22	85895.25	17034.75
2052	4031	4416	2052	0	0	384.808469	227.68	87613.15	16869.36
2053	4031	4416	2053	0	0	384.808469	232.23	89365.42	16705.58
2054	4031	4416	2054	0	0	384.808469	236.88	91152.72	16543.39
2055	4031	4416	2055	0	0	384.808469	241.62	92975.78	16382.78
2056	4031	4416	2056	0	0	384.808469	246.45	94835.29	16223.72
2057	4031	4416	2057	0	0	384.808469	251.38	96732.00	16066.21
2058	4031	4416	2058	0	0	384.808469	256.40	98666.64	15910.23
2059	4031	4416	2059	0	0	384.808469	261.53	100639.97	15755.76
2060	4031	4416	2060	0	0	384.808469	266.76	102652.77	15602.79
2061	4031	4416	2061	0	0	384.808469	272.10	104705.83	15451.31
2062	4031	4416	2062	0	0	384.808469	277.54	106799.95	15301.29
2063	4031	4416	2063	0	0	384.808469	283.09	108935.94	15152.74
2064	4031	4416	2064	0	0	384.808469	288.75	111114.66	15005.62
2065	4031	4416	2065	0	0	384.808469	294.53	113336.96	14859.94
2066	4031	4416	2066	0	0	384.808469	300.42	115603.70	14715.67
2067	4031	4416	2067	0	0	384.808469	306.43	117915.77	14572.80
2068	4031	4416	2068	0	0	384.808469	312.56	120274.08	14431.31
								Net Present Value of Carbon Emissions of Proposal:	-1,219,769