

APPENDIX C. OPTIMAL STRUCTURAL MAINTENANCE

This appendix contains a series of tables constructed by TRL to show the methods they have used to calculate optimal maintenance costs for different types of roads. These methods are referred to in detail in Section 3.3 of the report.

Table C.1 to Table C.7 show estimates for the trunk road network (see section 3.3.2.1 of the report).

Table C.8 to Table C.13 show estimates for the local authority network (see section 3.3.2.2. of the report).

Table C.1
Lengths of Trunk Road Pavements Within Traffic Flow and Condition Sub-Categories

		Data availability		Traffic Band Thresholds			Condition Data Thresholds			
		Network (km)	Data (km)	Motorway	Low/Average	Average/High	Residual Life (yrs)	Bad/Average	Average/Good	
Motorway		6861	2515	2500	249100	6000	5	5	18	
APTR-D		7344	2315	1400	35930	2800	13	13	4	
APTR-S		4777	1832	500	46590	1200	.05	.05	.15	
Motorways										
Long Life	Medium	984480	N/A	N/A	200	735180	200	200	569180	415100
Long Life	High	161810	N/A	N/A	200	125680	0	0	113100	48710
Long Life	Low	235850	N/A	N/A	13930	175330	0	0	108710	127140
Determinate life	Medium	696150	111600	298970	100	538640	800	800	324270	371080
Determinate life	High	147250	21490	52760	0	97220	200	200	66890	80160
Determinate life	Low	289970	23140	55850	780	221260	1900	1900	114300	173770
APTRs - dual										
Long Life	Average	267860	N/A	N/A	800	194300	270	270	193890	73700
Long Life	High	121420	N/A	N/A	0	69530	1400	1400	100730	19290
Long Life	Low	228140	N/A	N/A	4340	169830	1100	1100	146010	81030
Determinate life	Average	485570	75020	256020	3860	316320	1750	1750	339860	143960
Determinate life	High	316840	53480	145540	1600	237480	3350	3350	263910	49580
Determinate life	Low	895000	69090	258010	8290	679860	4110	4110	589360	301530
APTRs - Single										
Long Life	Average	165310	N/A	N/A	6410	110670	2750	2750	132010	30550
Long Life	High	87630	N/A	N/A	1000	38610	1790	1790	75740	10100
Long Life	Low	33830	N/A	N/A	0	8320	600	600	26830	6400
Determinate life	Average	822670	140520	460030	12200	345670	464800	17150	723780	81740
Determinate life	High	254740	52110	88020	3400	120710	7120	7120	227220	20400
Determinate life	Low	467860	44020	101130	7500	195260	11520	11520	373320	83020

NB: Lengths represent carriageway lengths

Table C.2
Maintenance Profile and Discounted WLC - Motorways

LL Status	Traffic level	Pavement Condition	Treatment Cost (£k/carrageway km)		Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£k)
			Overlay	Resurfacing		Works cost	User cost	
Long life	Good	Good	200	200	8 15 22 29	301.35	1593.60	22.17
	Average	Average	200	200	4 11 18 25	380.44	1428.70	27.99
	Poor	Poor	200	200	1 8 15 22 29	490.03	1798.50	36.06
	Good	Good	200	200	10 19 28	216.91	294.10	15.96
	Average	Average	200	200	5 14 23	290.27	244.00	21.36
	Poor	Poor	200	200	2 11 20 29	382.63	347.80	28.15
	Good	Good	200	200	12 23	151.75	56.70	11.17
	Average	Average	200	200	6 17 28	254.39	87.00	18.72
	Poor	Poor	200	200	2 13 25	318.37	86.20	23.43
Determinante life	Good	Good	430	200	8 15 22 29	321.03	1605.90	23.62
	Average	Average	430	200	3 12 19 26	432.55	1370.30	31.83
	Poor	Poor	514	200	2 9 16 23 30	578.16	1749.20	42.54
	Good	Good	340	200	10 21 29	216.28	286.80	15.91
	Average	Average	340	200	6 13 22	317.39	228.00	23.35
	Poor	Poor	438	200	3 12 21 30	427.32	337.80	31.44
	Good	Good	260	200	10 21	169.68	53.40	12.48
	Average	Average	260	200	3 12 25	330.44	72.60	24.31
	Poor	Poor	385	200	2 15 28	351.31	82.40	25.85

Key (Treatment type): **Surface dressing** *Overlay* Plain: Resurcing

Table C.3
Maintenance Profile and Discounted WLC - Motorways

Strategy: Do nothing

LL Status	Traffic level	Pavement Condition	Treatment Cost (£k/carrageaway.km)		Maintenance profile (Treatment Year)	Discounted WLC (£k)		Annual equivalent works cost (£k)
			Overlay	Resurfacing		Works cost	User cost	
Long life	High	Good		204	9 16 23 30	289.98	1643.40	21.34
		Average		204	5 12 19 26	366.09	1484.30	26.94
		Poor		204	2 9 16 23 30	471.54	1827.10	34.70
	Medium	Good		204	11 20 29	208.72	298.20	15.36
		Average		204	6 15 24	279.32	252.80	20.55
		Poor		204	3 12 21 30	368.19	354.60	27.09
	Low	Good		204	13 24	146.03	57.50	10.74
		Average		204	7 18 29	244.79	85.90	18.01
		Poor		204	3 14 26	306.35	86.90	22.54
Determinate life	High	Good	473	204	9 16 23 30	360.40	1798.90	26.52
		Average	473	204	4 13 20 27	489.26	1502.60	36.00
		Poor	565	204	3 10 17 24 31	748.28	1757.40	55.06
	Medium	Good	374	204	11 22 30	246.77	304.40	18.16
		Average	374	204	7 14 23	354.50	252.70	26.08
		Poor	482	204	4 13 22 31	567.39	354.50	41.75
	Low	Good	286	204	11 22	186.83	54.80	13.75
		Average	286	204	4 13 26	340.52	87.80	25.06
		Poor	424	204	3 16 29	473.53	85.40	34.84

Key (Treatment type):

Bold: Surface dressing *Italic: Overlay* Plain: Resurfacing

Table C.4
Maintenance Profile and Discounted WLC - All Purpose Trunk Roads (Dual)

LL Status	Traffic level	Pavement Condition	Treatment Cost (£k/carrageaway km)			Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£k)			
			Overlay	Resurfacing	Surface dressing		Works cost	User cost				
										Do something		
Long life	High	Good		100		10	20	30	104.43	398.90	7.68	
		Average		100		5	15	25	139.75	398.60	10.28	
		Poor		100		1	11	21	176.43	136.70	12.98	
	Medium	Good		100		25	10	19	28	51.90	161.90	3.82
		Average		100		25	4	15	26	67.02	170.30	4.93
		Poor		100		25	4	13	20	126.72	201.00	9.32
	Low	Good		100		25	12	24		18.60	30.60	1.37
		Average		100		25	6	18	30	30.74	46.80	2.26
		Poor		100		25	1	13	25	41.13	55.00	3.03
Determinate life	High	Good	250	100		10	21		129.38	262.50	9.52	
		Average	250	100		5	13	23	218.12	146.60	16.05	
		Poor	340	100		3	13	23	358.53	421.80	26.38	
	Medium	Good	210	100		25	10	18	22	107.27	176.70	7.89
		Average	210	100		25	4	13	24	142.96	144.30	10.52
		Poor	320	100		25	3	14	25	303.04	26.50	22.30
	Low	Good	170	100		25	12	22		54.11	22.80	3.98
		Average	170	100		25	6	15	26	94.05	36.50	6.92
		Poor	280	100		25	3	14	25	302.62	33.00	22.27

Key (Treatment type): **Bold: Surface dressing** *Italic: Overlay* Plain: Resurcing

**Table C.5
Maintenance Profile and Discounted WLC - All Purpose Trunk Roads (Dual)**

LL Status		Traffic level	Pavement Condition	Treatment Cost (£k/carriageway km)			Maintenance profile (Treatment Year)			Discounted WLC (£K)		Annual equivalent works cost (£k)
				Overlay	Resurfacing	Surface dressing	Works cost	User cost				
Long life	Good	High	Good	102			11	21	31	100.49	407.30	7.39
	Average		102			6	16	26	134.48	400.90	9.89	
	Poor		102			2	12	22	169.78	137.40	12.49	
	Good	Medium	Good	102		27.5	11	20	29	51.37	160.70	3.78
	Average		102		27.5	5	16	27	66.40	164.50	4.89	
	Poor		102		27.5	5	14	21	123.18	199.70	9.06	
	Good	Low	Good	102		27.5	13	25		19.30	36.80	1.42
	Average		102		27.5	7	19	31	31.90	56.10	2.35	
	Poor		102		27.5	2	14	26	42.68	69.30	3.14	
Determinate life	Good	High	Good	102	275		11	22		130.05	264.10	9.57
	Average		102	275		6	14	24	218.73	125.20	16.09	
	Poor		102	374		4	14	24	366.55	429.40	26.97	
	Good	Medium	Good	102	231		11	19	23	108.67	162.60	8.00
	Average		102	231		5	14	25	146.49	146.00	10.78	
	Poor		102	352		4	15	26	312.71	26.00	23.01	
	Good	Low	Good	102	0		13	23		56.16	22.80	4.13
	Average		102	187		7	16	27	97.60	35.70	7.18	
	Poor		102	308		4	15	26	261.48	32.10	19.24	

Key (Treatment type): **Surface dressing** *Overlay* Plain: Resurfacing

**Table C.6
Maintenance Profile and Discounted WLC - All Purpose Trunk Roads (Single)**

LL Status		Traffic level	Pavement Condition	Treatment Cost (£k/carrigeaway.km)			Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£k)	
				Overlay	Resurfacing	Surface dressing		Works cost	User cost		
Long life	High	Good		60	15	12	20	29	28.93	43.00	2.13
		Average		60	15	6	15	27	48.05	46.80	3.54
		Poor		60	15	2	11	23	27	61.33	61.50
	Medium	Good		60	15	12	24		11.16	15.90	0.82
		Average		60	15	7	19	29	26.01	22.80	1.91
		Poor		60	15	2	14	26	63.33	20.00	4.66
	Low	Good		60	15	12	24		11.16	6.50	0.82
		Average		60	15	7	19	30	14.93	7.90	1.10
		Poor		60	15	2	14	26	23.28	11.80	1.71
Determinate life	High	Good	<i>102</i>	60	15	12	20	29	42.03	48.00	3.09
		Average	<i>102</i>	60	15	4	<i>12</i>	26	75.76	43.40	5.57
		Poor	<i>204</i>	60	15	3	14	21	195.57	46.30	14.39
	Medium	Good	95	60	15	12	22		33.82	14.30	2.49
		Average	95	60	15	4	<i>12</i>	24	62.80	21.90	4.62
		Poor	<i>190</i>	60	15	3	15	27	168.90	21.30	12.43
	Low	Good	80	60	15	12	22		29.65	5.30	2.18
		Average	80	60	15	4	<i>14</i>	26	50.56	9.50	3.72
		Poor	<i>160</i>	60	15	3	15	27	143.71	8.40	10.57

Key (Treatment type): **Bold: Surface dressing** *Italic: Overlay* Plain: Resurcing

Table C.7
Maintenance Profile and Discounted WLC - All Purpose Trunk Roads (Single)

LL Status		Traffic level	Pavement Condition	Treatment Cost (£k/carrigeaway km)			Maintenance profile (Treatment Year)		Discounted WLC (£K)		Annual equivalent works cost (£k)
				Overlay	Resurfacing	Surface dressing			Works cost	User cost	
							Strategy: Do nothing				
Long life	Good	High	Good	61.2	16.5	13	21	30	28.61	41.90	2.11
	Average		Average	61.2	16.5	7	16	28	47.04	46.10	3.46
	Poor		Poor	61.2	16.5	3	12	24	60.32	60.60	4.44
	Good	Medium	Good	61.2	16.5	13	25		11.58	15.60	0.85
	Average		Average	61.2	16.5	8	20	30	26.15	22.20	1.92
	Poor		Poor	61.2	16.5	3	15	27	61.69	19.50	4.54
	Good	Low	Good	61.2	16.5	13	25		11.58	6.30	0.85
	Average		Average	61.2	16.5	8	20	31	15.50	7.70	1.14
	Poor		Poor	61.2	16.5	3	15	27	24.16	11.50	1.78
Determinante life	Good	High	Good	<i>112.2</i>	16.5	13	21	30	40.21	47.40	2.96
	Average		Average	<i>112.2</i>	16.5	5	13	27	74.72	43.50	5.50
	Poor		Poor	<i>224.4</i>	16.5	4	15	22	201.61	44.40	14.83
	Good	Medium	Good	<i>104.5</i>	16.5	13	23		31.89	14.20	2.35
	Average		Average	<i>104.5</i>	16.5	5	13	25	62.47	21.30	4.60
	Poor		Poor	<i>209</i>	16.5	4	16	28	173.17	20.40	12.74
	Good	Low	Good	88	16.5	13	23		28.07	5.20	2.07
	Average		Average	88	16.5	5	15	27	49.87	9.20	3.67
	Poor		Poor	<i>176</i>	16.5	4	16	28	147.03	7.90	10.82

Key (Treatment type): **Bold: Surface dressing** *Italic: Overlay* Plain: Resurcing

**Table C.8
Maintenance Profile and Discounted WLC - Principal (Rural)**

Road type	Traffic level	Pavement Condition	Treatment Cost (£/carriageway km)			Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£K)		
			Overlay	Surface dressing			Works cost	User cost			
				Resurfacing	Surface dressing						
Principal	High	Good	90	60	15	12	22	32.43	10.20	2.39	
		Average	90	60	15	6	11	24	61.69	16.50	4.54
		Poor	110	60	15	2	15	28	107.09	16.20	7.88
	Medium	Good	80	60	15	13	22		29.23	5.80	2.15
		Average	80	60	15	4	11	24	57.73	10.50	4.25
		Poor	100	60	15	3	16	29	92.63	8.90	6.82
	Low	Good	60	60	15	13	22		23.68	2.70	1.74
		Average	60	60	15	6	11	24	45.89	5.00	3.38
		Poor	80	60	15	2	15	28	80.39	4.60	5.92
Principal	High	Good	99	61.2	16.5	13	23	33.65	10.10	2.48	
		Average	99	61.2	16.5	7	12	25	64.02	15.90	4.71
		Poor	121	61.2	16.5	3	16	29	111.13	15.70	8.18
	Medium	Good	88	61.2	16.5	14	23		30.34	5.70	2.23
		Average	88	61.2	16.5	5	12	25	59.91	10.10	4.41
		Poor	110	61.2	16.5	4	17	30	96.13	8.60	7.07
	Low	Good	66	61.2	16.5	14	23		24.58	2.60	1.81
		Average	66	61.2	16.5	7	12	25	47.62	5.00	3.50
		Poor	88	61.2	16.5	3	16	29	83.43	4.50	6.14

Key (Treatment type): **Surface dressing** *Italic: Overlay* Plain: Resurfacing

**Table C.9
Maintenance Profile and Discounted WLC - Principal (Urban)**

Road type	Traffic level	Pavement Condition	Treatment Cost (£k/carrageway km)			Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£k)	
			Overlay	Resurfacing	Surface dressing		Works cost	User cost		
										Do something
Principal	High	Good	135	70	18	11	22	46.95	22.10	3.45
		Average	135	70	18	7	11	88.08	33.70	6.48
		Poor	135	70	18	3	14	125.50	35.20	9.23
	Medium	Good	120	70	18	11	22	42.78	10.30	3.15
		Average	120	70	18	6	11	80.90	16.80	5.95
		Poor	120	70	18	2	13	119.68	17.00	8.81
	Low	Good	90	70	18	11	22	34.46	6.10	2.54
		Average	90	70	18	4	11	66.66	10.90	4.91
		Poor	90	70	18	3	14	87.72	9.50	6.45
Principal	High	Good	149	71	19.8	12	23	48.72	22.30	4.13
		Average	149	71	19.8	8	12	91.41	33.40	6.73
		Poor	149	71	19.8	4	15	130.24	35.00	9.58
	Medium	Good	132	71	19.8	12	23	44.40	10.30	3.27
		Average	132	71	19.8	7	12	83.95	16.30	6.18
		Poor	132	71	19.8	3	14	124.20	16.70	9.14
	Low	Good	99	71	19.8	12	23	35.76	6.00	2.63
		Average	99	71	19.8	5	12	69.18	10.30	5.09
		Poor	99	71	19.8	4	15	91.03	9.20	6.70

Key (Treatment type): **Bold: Surface dressing** *Italic: Overlay* Plain: Resurfacing

**Table C.10
Maintenance Profile and Discounted WLC - Classified (Rural)**

Road type	Traffic level	Pavement Condition	Treatment Cost (£k/carrageaway km)			Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£k)	
			Overlay	Resurfacing	Surface dressing		Works cost	User cost		
Classified	High	Average	30	40	12	5	21	12.50	12.30	0.92
	Medium	Average	30	40	12	7	23	11.12	7.20	0.82
	Low	Average	30	40	12	9	25	9.90	1.60	0.73

Strategy: Do nothing

Classified	High	Average	33	40.8	13.2	6	22	12.97	11.90	0.95
	Medium	Average	33	40.8	13.2	8	24	11.54	7.00	0.85
	Low	Average	33	40.8	13.2	10	26	10.27	1.50	0.76

Key (Treatment type): **Bold: Surface dressing** *Italic: Overlay* Plain: Resurcing

**Table C.11
Maintenance Profile and Discounted WLC - Classified (Urban)**

Road type	Traffic level	Pavement Condition	Treatment Cost (£k/carriageway km)			Maintenance profile (Treatment Year)	Discounted WLC (£k)		Annual equivalent works cost (£k)	
			Overlay	Resurfacing	Surface dressing		Works cost	User cost		
										Do something
Classified	High	Average	15	40	15	5	20	15.89	29.40	1.17
	Medium	Average	15	40	15	7	22	14.14	6.90	1.04
	Low	Average	15	40	15	9	24	12.58	7.80	0.93

Strategy: Do nothing

Classified	High	Average	17	41	16.5	6	21	19.36	29.00	1.42
	Medium	Average	17	41	16.5	8	23	14.67	6.70	1.08
	Low	Average	17	41	16.5	10	25	13.06	7.60	0.96

Key (Treatment type): **Overlay** *Overlay* **Surface dressing** *Surface dressing* **Plain** *Plain* **Resurfacing** *Resurfacing*

Table C.12
Maintenance Profile and Discounted WLC - Unclassified (Rural)

Road type	Strategy: Do something		Pavement Condition	Treatment Cost (£k/carriageway km)		Maintenance profile (Treatment Year)	Discounted WLC (£K)		Annual equivalent works cost (£k)	
	Traffic level	Pavement Condition		Overlay	Resurfacing		Works cost	User cost		
	High	Average		30	40		11.60	-		
Unclassified	High	Average	30	40	12	5	26	11.60	-	0.85
	Medium	Average	30	40	12	7	28	10.33	-	0.76
	Low	Average	30	40	12	9	30	9.19	-	0.68

Unclassified (Rural)

Strategy: **Do nothing**

Unclassified	High	Average	33	40.8	13.2	6	27	12.04	-	0.89
	Medium	Average	33	40.8	13.2	8	29	10.72	-	0.79
	Low	Average	33	40.8	13.2	10	31	9.54	-	0.70

Key (Treatment type): **Bold: Surface dressing** *Italic: Overlay* Plain: Resurcing

Table C.13
Maintenance Profile and Discounted WLC - Unclassified (Urban)

Road type	Strategy: Do something		Pavement Condition	Treatment Cost (£k/carrageaway km)			Maintenance profile (Treatment Year)	Discounted WLC (£k)		Annual equivalent works cost (£k)
	Traffic level	Do something		Overlay	Resurfacing	Surface dressing		Works cost	User cost	
Unclassified	High	Average	30	40	15	5.0	25	14.70	-	1.08
	Medium	Average	30	40	15	7.0	27	13.09	-	0.96
	Low	Average	30	40	15	9.0	29	11.65	-	0.86

Unclassified (Urban)

Strategy: **Do nothing**

Unclassified	High	Average	33	41	16.5	6	26	15.26	-	1.12
	Medium	Average	33	41	16.5	8	28	13.58	-	1.00
	Low	Average	33	41	16.5	10	30	12.09	-	0.89

Key (Treatment type): **Surface dressing** *Overlay* Plain: Resurcing