

A5 Vehicle operating costs

A5.1 Introduction

Introduction This appendix provides values for vehicle operating costs (VOC) categorised into running costs, road surface related costs, speed change cycle costs, congestion costs, and costs while at a stop. Values are provided by vehicle classes and for standard traffic compositions on four different road categories.

Vehicle classes The vehicle classes are defined in appendix A2.2. The VOC for each vehicle class are based on the weighted average costs of the vehicles of different types within each class.

Standard traffic compositions The VOC are given for the standard traffic compositions using the four road categories defined in appendix A2.2, namely: urban arterial, urban other, rural strategic and rural other. The road category costs contained in the tables in this appendix are for the 'all time periods' traffic mix.

Nature of costs in this appendix The VOC in this appendix are provided as resource costs, ie, exclusive of duties and indirect taxation, such as excise and other taxes on fuel, import duties, and GST on all cost inputs.

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A5.1 Introduction, continued

Regression equations

To assist analysts, regression equations are provided which can be used to predict the VOC when using spreadsheets or other applications. Note: The regression coefficients vary between vehicle classes and road categories.

The regression equations were used to generate the corresponding VOC tables so the results will be consistent, irrespective of which approach is used.

Minor differences will arise when calculating road category costs from individual vehicle class costs due to the regression equations being developed from the road category data. Where high precision is required, the vehicle class equations should be summed and used in preference to the road category equations.

Components of VOC

The total VOC are calculated by adding the following components:

VOC = base running costs by speed and gradient
+ road roughness costs (if appropriate)
+ road surface texture costs (if appropriate)
+ pavement elastic deflection costs (if appropriate)
+ congestion costs (if appropriate)
+ bottleneck costs (if appropriate)
+ speed change cycle costs (if appropriate).

All components except the base running costs are marginal costs that reflect the additional cost due to that component.

A5.2 Base VOC and VOC by speed and gradient

Base vehicle operating costs

The base vehicle operating costs (base VOC) comprise fuel, tyres, repairs and maintenance, oil, and the proportion of depreciation related to vehicle use. Standing charges, i.e. those incurred irrespective of use, are excluded from these costs. Such charges are included in the travel time costs for vehicle types (table A4.2) and the composite travel time values (table A4.3).

The breakdown of the base VOC by component is given in table A5.0(a) below.

Table A5.0(a) Breakdown of base VOC by component

Vehicle class	Percentage of total base VOC by component			
	Fuel and oil	Tyres	Maintenance and repairs	Depreciation
PC	30.0	7.0	29.3	33.7
LCV	32.3	8.3	27.3	32.1
MCV	30.4	7.2	45.4	17.0
HCVI	34.7	10.5	44.3	10.5
HCVII	31.3	13.5	43.4	11.8
BUS	29.9	6.3	45.5	18.3
Road type				
Urban arterial	30.3	7.2	29.9	32.5
Urban other	30.3	7.2	30.1	32.4
Rural strategic	30.5	7.5	30.9	31.1
Rural other	30.4	7.5	30.6	31.5

A5.2 Base VOC and VOC by speed and gradient, *continued*

VOC by speed and gradient

Tables for VOC by speed (between 10 and 120 km/h) and gradients (between 0 and 12 percent) are provided in tables A5.1 to A5.10. The regression coefficients for running costs by speed and gradient are provided in table A5.11. Each table is accompanied by a graph. The tables give calculated values for each 5 km/h and percentage gradient.

The values are the average of the uphill and downhill gradient costs. While VOC are provided for all vehicle classes over the speed and gradient ranges, certain combinations of vehicle class, speed and gradient do not occur in practice, eg, sustained operation of laden heavy vehicles at high speed on steep gradients. VOC estimates at these extremes are less reliable than those in the range of normal operation.

Intermediate values should be interpolated or predicted using the regression equation. To use the graphs, the line of average traffic speed on the X-axis shall be read upwards to where it intersects with the appropriate gradient curve and then the running costs read off the Y-axis.

For all vehicle classes and road categories, the graph curves slope steeply upwards at low speeds. This arises because as vehicle speeds decrease the fuel consumption is governed by the minimum fuel consumption of the vehicle. As vehicle speeds increase above 60-70 km/h the graph curves start to rise due to the effects of increasing aerodynamic drag.

Tables A5.1 to A5.6 provide VOC for individual vehicle classes for use when an evaluation requires costs for a particular vehicle class or road category and where the traffic composition does not fall into one of the four standard road categories. One set of tables is provided for each vehicle class and these combine the VOC for both urban and rural road categories.

Where a non-standard traffic composition is considered, the combined VOC are estimated from the costs of the individual vehicle classes, and the mean speed of each vehicle class shall be used rather than the mean speed of the traffic stream as a whole.

Tables A5.7 to A5.10 provide the VOC for standard traffic compositions in the four road categories.

Buses

Buses are not included in these standard traffic compositions. If buses form a significant component of the traffic stream they shall be included in proportion to their representation.

A5.3 Additional VOC due to road surface conditions

Road roughness

For some projects, road surface roughness is an important contributor to VOC. Projects for which roughness measurements are necessary include shape correction, seal extension and any other work in which the riding characteristic of the road surface is changed by the project. The base VOC and VOC by speed and gradient outlined in appendix A5.2 are calculated assuming zero road roughness (as measured on the IRI m/km scale) and shall be supplemented for the additional costs caused by road roughness when relevant to the project evaluation.

Roughness costs are made up of two components: vehicle costs and values for vehicle occupants' willingness to pay (WTP) to avoid rough road conditions. The WTP values reflect the preference of road users for driving on smooth roads and are based on New Zealand research. The WTP values indicate that road users on rural roads have a higher WTP value for a given roughness than urban users because of their higher average speeds. However, at very high roughness levels the WTP values are the same for both urban and rural road users. These two components are combined in tables A5.12 to A5.15.

Tables A5.12 and A5.13 provide the additional costs due to road roughness for individual vehicle classes for urban and rural conditions. Table A5.14 provides the costs for the standard traffic composition on the four road categories and table A5.15 provides the regression coefficients for predicting the roughness costs.

Measurement of road roughness

To use the VOC tables for road roughness requires the measurement of road roughness. Previously, NAASRA counts/km were the primary measure but with the increased use of profilometers the International Roughness Index (IRI) has been adopted as the primary measure. The NAASRA roughness can be estimated from the IRI using the conversion $1 \text{ NAASRA counts/km} = 26.49 \times \text{IRI m/km} - 1.27$.

Road surface texture

A vehicle's rolling resistance is influenced by the macrotexture of the road surface and impacts on fuel and tyre consumption. The base VOC and VOC by speed and gradient provided in appendix A5.2 are calculated on the basis of 0 texture.

The effect of surface texture on VOC is as follows:

1 mm increase in surface macrotexture = 0.15 cents/ km / vehicle (all vehicle classes combined)

Macrotexture is expressed in mm either as a mean profile depth (MPD) or a sand circle (SS). The conversion between the two measures is:

$$SS = 0.2 + 0.8 \text{ MPD}$$

The additional VOC due to road surface texture is added to the VOC in tables A5.2 to A5.11 and is applied to the total traffic volume using the road.

A5.3 Additional VOC due to road surface conditions, continued

Pavement elastic deflection

Most road pavements in New Zealand are of a bituminous flexible construction. Pavement elastic deformation under heavy wheel loads depends on the type and strength of the pavement layers and sub-grade. It influences rolling resistance and therefore fuel and tyre consumption.

The pavement elastic deformation costs from table A5.0(b) are added to the VOC in tables A5.3 to A5.11 for MCV, HCVI, HCVII and buses and the four road categories.

Use of these costs should be accompanied by an adequate statistical sample of Benkelman beam test results for existing pavements, or Benkelman beam equivalent values from another recognised non-destructive test method.

Table A5.0(b) Increase in vehicle operating costs per vehicle-kilometre per 1 mm increase in Benkelman beam deflection (July 2002)

Vehicle class	Cents/veh/km
MCV	1.9
HCVI	3.0
HCVII	4.0
Bus	3.0
Road category	
Urban arterial	0.15
Urban other	0.16
Rural strategic	0.35
Rural other	0.29

A5.4 Additional VOC due to congestion

Congestion costs

The congestion costs are the additional VOCs due to vehicle accelerations and decelerations arising from traffic congestion. At low volume-to-capacity ratios (VC ratio) there are few accelerations or decelerations so the congestion values are relatively low, but they increase with increasing VC ratio, eventually becoming asymptotic as traffic flows approach capacity (VC ratio = 1.0).

The congestion costs by vehicle class are supplied in tables A5.16 to A5.18 for three different types of operating conditions:

- urban arterial and urban otherroads.
- rural strategic and rural other roads.
- motorways.

Motorway costs are based on the rural strategic traffic composition.

Road category costs (all vehicle classes combined) are also provided in table A5.19, while table A5.20 provides regression coefficients for predicting the congestion costs by vehicle class and table A5.21 by road category.

When considering congestion costs, the analyst must take into account the amount of time over the year when traffic is at different levels of congestion (ie, different VC ratio) must be accounted for. A minimum of 5 different one-hourly flow periods should be adopted, reflecting low to high flows, and the number of hours per year the traffic is at each flow level calculated (summing to 8760 h/year). The procedure for using the costs is as follows:

- Determine the capacity of the road (see appendix A3.8)
 - For each of the hourly flow periods, determine the traffic flow in pcu/hr and the corresponding VC ratio (see appendix A3.17).
 - From appendix A3, determine the speed for each of the hourly flow periods.
 - Using the VOC tables, determine the unadjusted VOC (including roughness, texture and deflection) for each of the hourly flow period speeds.
 - For each of the hourly flow periods, determine the congestion cost corresponding to the VC ratio from tables A5.16 to A5.19.
 - Determine the total VOC for each flow period as the sum of the unadjusted VOC and the congestion costs.
 - Determine the total annual VOC by weighting the costs for each flow period by the percentage of the year that flow is experienced.
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A5.5 Additional VOC due to bottleneck delay

Additional VOC during bottleneck delay

Tables A5.22 and A5.23 show the additional VOC by vehicle class and road category for a vehicle while experiencing bottleneck delay (ie, VC ratio ≥ 1.0). They are calculated from the fuel consumption while idling and are in cents/minute.

A5.6 Additional VOC due to speed change cycles

Additional VOC due to speed change cycle

When a vehicle travelling at its cruise speed has this speed interrupted due to road geometry or other road features (eg, one-lane bridges or intersections), it decelerates to a minimum speed (which may be a complete stop) before accelerating back to its original cruise speed. The speed change cycle values are the difference in travel time and VOC for travelling the distance of the speed cycle at the original cruise speed versus through the speed cycle.

Additional VOC due to speed change cycles are only to be used for specific situations where traffic follows a speed cycle comprised of a single deceleration from an initial cruise speed to a minimum speed before returning to the original cruise speed. These situations typically consist of:

- curves
- traffic signals
- one-lane bridges
- intersections
- work zones.

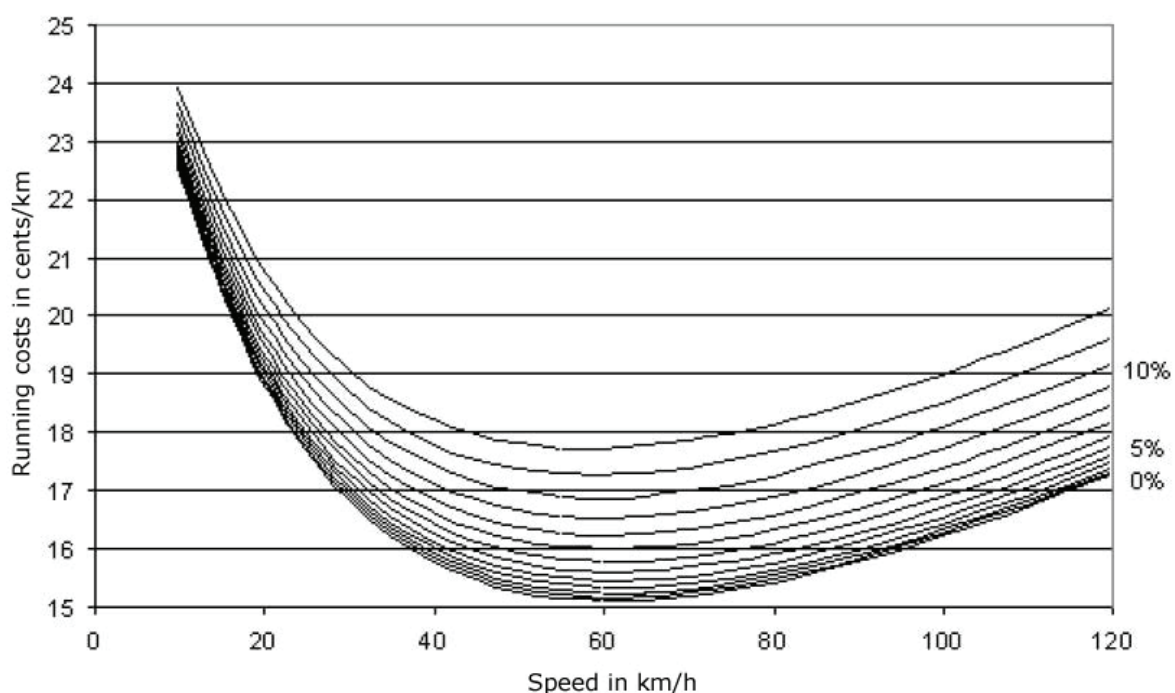
Tables A5.24 to A5.43 provide additional travel time (in seconds per speed cycle) and additional VOC (in cents per speed cycle) due to a speed change cycle for (1) the individual vehicle classes and (2) the standard traffic compositions in the four road categories.

Since the speed change cycle costs are additional VOC, care must be taken to ensure that there is no double counting of travel time benefits. For example, when considering traffic signals, the average speed excluding delays at traffic signals would be used to calculate the travel time and VOC. For those vehicles delayed by traffic signals, the additional time and additional VOC associated with the speed change would then be added. In the case of one-lane bridges, the average speed excluding the delay at the bridge would be used to calculate the travel time and VOC. The additional time and additional VOC due to the bridge would then be added.

A5.7 Vehicle operating cost tables

Table A5.1 Passenger car VOC by speed and gradient (cents/km – July 2002)

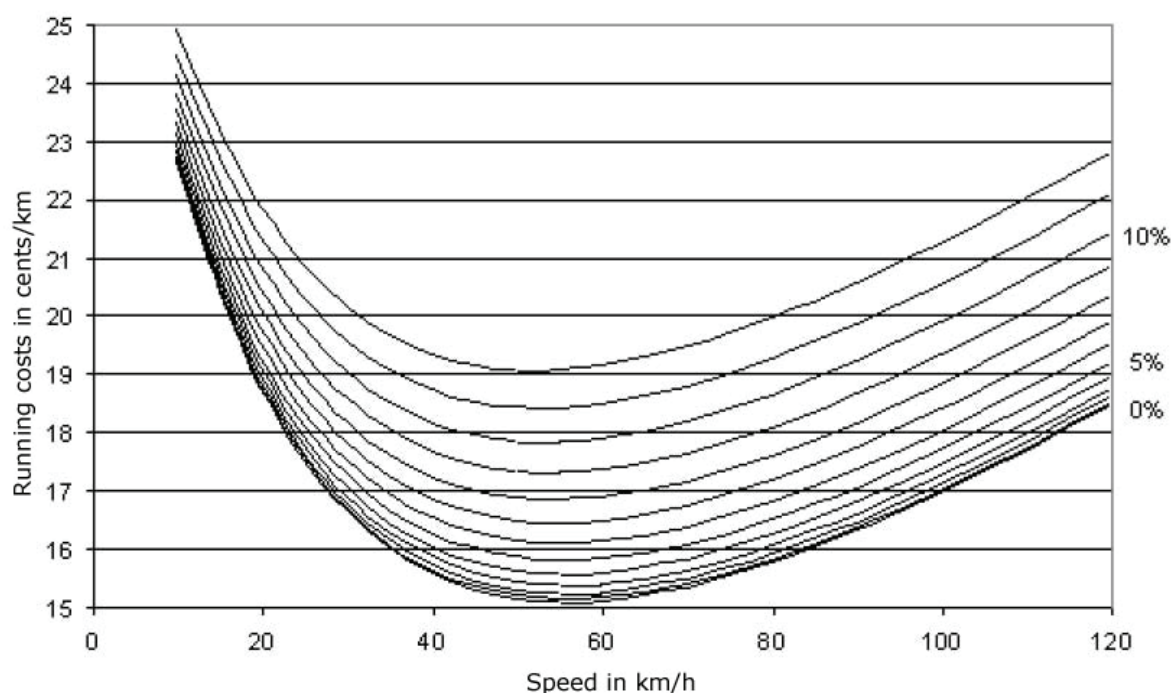
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	22.5	22.6	22.6	22.7	22.7	22.8	22.9	23.0	23.1	23.3	23.4	23.6	23.9
15	20.4	20.5	20.5	20.6	20.7	20.8	20.9	21.0	21.2	21.4	21.6	21.8	22.1
20	18.8	18.9	19.0	19.0	19.1	19.2	19.4	19.5	19.7	19.9	20.2	20.5	20.8
25	17.7	17.7	17.8	17.9	18.0	18.1	18.3	18.4	18.6	18.9	19.1	19.4	19.8
30	16.8	16.9	17.0	17.1	17.2	17.3	17.4	17.6	17.8	18.1	18.4	18.7	19.1
35	16.2	16.3	16.4	16.4	16.6	16.7	16.8	17.0	17.2	17.5	17.8	18.2	18.6
40	15.8	15.8	15.9	16.0	16.1	16.2	16.4	16.6	16.8	17.1	17.4	17.8	18.2
45	15.4	15.5	15.6	15.7	15.8	15.9	16.1	16.3	16.5	16.8	17.1	17.5	17.9
50	15.2	15.3	15.4	15.5	15.6	15.7	15.9	16.1	16.4	16.6	17.0	17.3	17.8
55	15.1	15.2	15.3	15.4	15.5	15.6	15.8	16.0	16.3	16.5	16.9	17.3	17.7
60	15.1	15.1	15.2	15.3	15.4	15.6	15.8	16.0	16.2	16.5	16.9	17.2	17.7
65	15.1	15.1	15.2	15.3	15.4	15.6	15.8	16.0	16.2	16.5	16.9	17.3	17.7
70	15.1	15.2	15.3	15.4	15.5	15.6	15.8	16.0	16.3	16.6	17.0	17.4	17.8
75	15.2	15.3	15.4	15.5	15.6	15.7	15.9	16.1	16.4	16.7	17.1	17.5	18.0
80	15.4	15.4	15.5	15.6	15.7	15.9	16.1	16.3	16.5	16.9	17.2	17.6	18.1
85	15.5	15.6	15.7	15.8	15.9	16.0	16.2	16.4	16.7	17.0	17.4	17.8	18.3
90	15.7	15.8	15.9	16.0	16.1	16.2	16.4	16.6	16.9	17.2	17.6	18.0	18.5
95	15.9	16.0	16.1	16.2	16.3	16.4	16.6	16.9	17.1	17.4	17.8	18.2	18.7
100	16.2	16.2	16.3	16.4	16.5	16.7	16.9	17.1	17.4	17.7	18.1	18.5	19.0
105	16.4	16.5	16.5	16.6	16.8	16.9	17.1	17.3	17.6	17.9	18.3	18.7	19.2
110	16.7	16.7	16.8	16.9	17.0	17.2	17.4	17.6	17.9	18.2	18.6	19.0	19.5
115	17.0	17.0	17.1	17.2	17.3	17.4	17.6	17.9	18.1	18.5	18.8	19.3	19.8
120	17.2	17.3	17.3	17.4	17.6	17.7	17.9	18.1	18.4	18.8	19.1	19.6	20.1



A5.7 Vehicle operating cost tables, continued

Table A5.2 LCV VOC by speed and gradient (cents/km – July 2002)

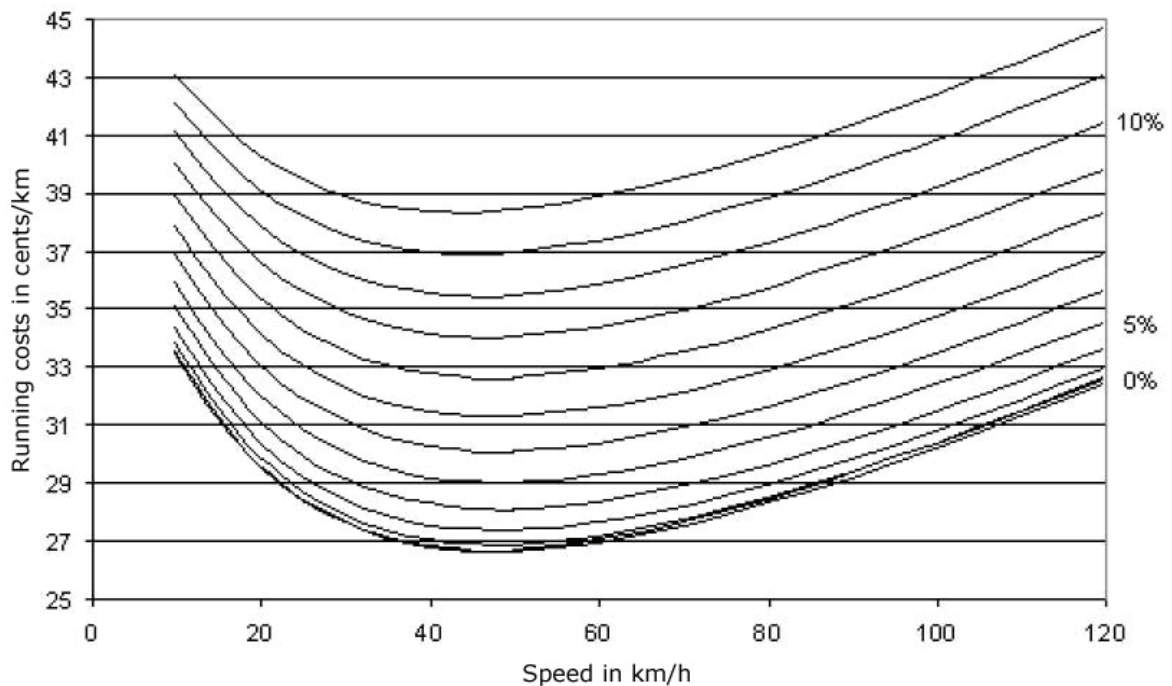
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	22.6	22.6	22.7	22.7	22.8	22.9	23.1	23.3	23.5	23.8	24.1	24.5	24.9
15	20.4	20.4	20.5	20.6	20.7	20.9	21.1	21.3	21.6	21.9	22.3	22.7	23.2
20	18.7	18.8	18.8	18.9	19.1	19.3	19.5	19.8	20.1	20.4	20.9	21.3	21.8
25	17.5	17.5	17.6	17.7	17.9	18.1	18.3	18.6	19.0	19.4	19.8	20.3	20.9
30	16.6	16.7	16.8	16.9	17.0	17.3	17.5	17.8	18.2	18.6	19.0	19.6	20.1
35	16.0	16.0	16.1	16.3	16.4	16.7	16.9	17.2	17.6	18.0	18.5	19.0	19.7
40	15.6	15.6	15.7	15.8	16.0	16.2	16.5	16.8	17.2	17.7	18.2	18.7	19.3
45	15.3	15.3	15.4	15.6	15.8	16.0	16.3	16.6	17.0	17.4	17.9	18.5	19.1
50	15.1	15.2	15.3	15.4	15.6	15.8	16.1	16.5	16.9	17.3	17.8	18.4	19.1
55	15.1	15.1	15.2	15.4	15.6	15.8	16.1	16.4	16.8	17.3	17.8	18.4	19.1
60	15.1	15.1	15.2	15.4	15.6	15.8	16.1	16.5	16.9	17.3	17.9	18.5	19.1
65	15.2	15.2	15.3	15.5	15.7	15.9	16.2	16.6	17.0	17.5	18.0	18.6	19.3
70	15.3	15.4	15.5	15.6	15.8	16.1	16.4	16.7	17.1	17.6	18.2	18.8	19.5
75	15.5	15.6	15.7	15.8	16.0	16.3	16.6	16.9	17.3	17.8	18.4	19.0	19.7
80	15.7	15.8	15.9	16.0	16.2	16.5	16.8	17.2	17.6	18.1	18.6	19.2	19.9
85	16.0	16.1	16.1	16.3	16.5	16.7	17.1	17.4	17.8	18.3	18.9	19.5	20.2
90	16.3	16.3	16.4	16.6	16.8	17.0	17.3	17.7	18.1	18.6	19.2	19.8	20.5
95	16.6	16.7	16.7	16.9	17.1	17.3	17.7	18.0	18.5	19.0	19.5	20.2	20.9
100	16.9	17.0	17.1	17.2	17.4	17.7	18.0	18.4	18.8	19.3	19.9	20.5	21.2
105	17.3	17.3	17.4	17.6	17.8	18.0	18.3	18.7	19.2	19.7	20.2	20.9	21.6
110	17.7	17.7	17.8	17.9	18.1	18.4	18.7	19.1	19.5	20.0	20.6	21.3	22.0
115	18.0	18.1	18.2	18.3	18.5	18.8	19.1	19.5	19.9	20.4	21.0	21.7	22.4
120	18.4	18.5	18.6	18.7	18.9	19.2	19.5	19.9	20.3	20.8	21.4	22.1	22.8



A5.7 Vehicle operating cost tables, continued

Table A5.3 MCV VOC by speed and gradient (cents/km – July 2002)

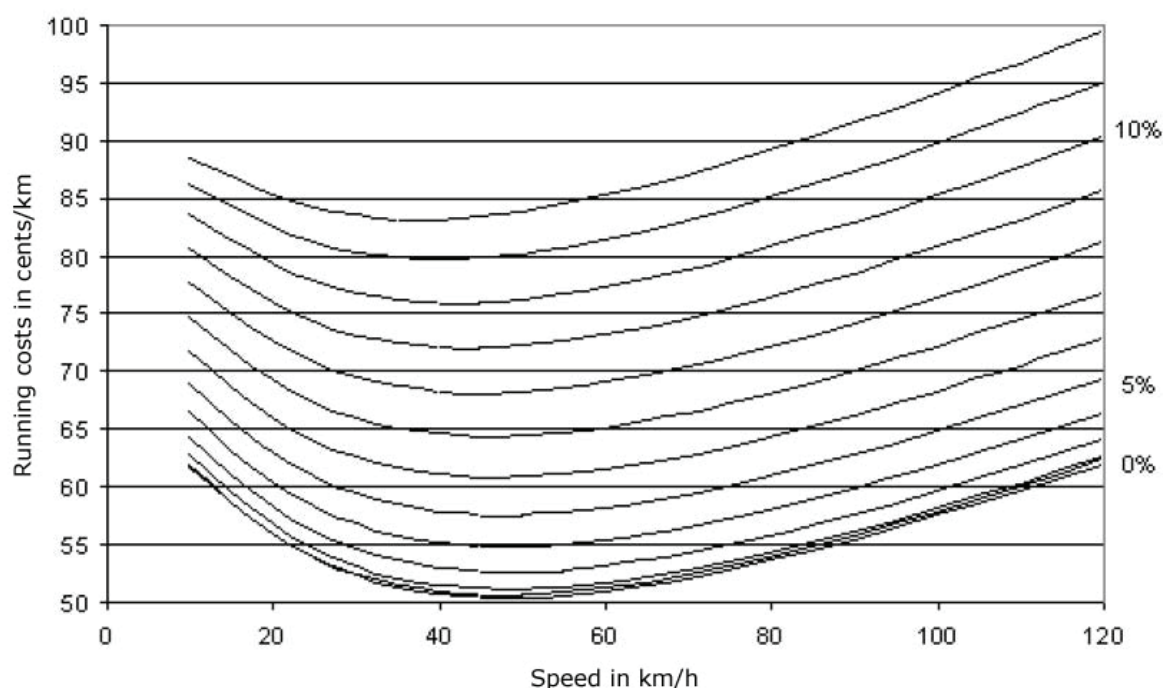
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	33.4	33.5	33.8	34.3	35.0	35.9	36.8	37.8	38.9	40.0	41.1	42.1	43.1
15	31.2	31.2	31.5	32.1	32.8	33.7	34.7	35.7	36.9	38.1	39.3	40.4	41.5
20	29.5	29.6	29.9	30.4	31.1	32.0	33.0	34.1	35.3	36.6	37.9	39.1	40.3
25	28.3	28.4	28.7	29.2	29.9	30.8	31.9	33.0	34.3	35.5	36.9	38.2	39.4
30	27.6	27.6	27.8	28.4	29.1	30.0	31.1	32.2	33.5	34.8	36.2	37.5	38.8
35	27.1	27.0	27.3	27.8	28.6	29.5	30.5	31.7	33.0	34.4	35.7	37.1	38.5
40	26.8	26.7	27.0	27.5	28.2	29.1	30.2	31.4	32.7	34.1	35.5	36.9	38.3
45	26.6	26.6	26.8	27.3	28.1	29.0	30.1	31.3	32.6	34.0	35.4	36.9	38.3
50	26.7	26.6	26.8	27.3	28.0	29.0	30.1	31.3	32.6	34.0	35.5	36.9	38.4
55	26.8	26.7	26.9	27.4	28.1	29.1	30.1	31.4	32.7	34.1	35.6	37.1	38.6
60	27.0	26.9	27.1	27.6	28.3	29.2	30.3	31.6	32.9	34.3	35.8	37.3	38.8
65	27.2	27.1	27.4	27.8	28.5	29.5	30.6	31.8	33.2	34.6	36.1	37.6	39.1
70	27.6	27.5	27.7	28.1	28.8	29.8	30.9	32.1	33.5	34.9	36.4	38.0	39.5
75	27.9	27.8	28.0	28.5	29.2	30.1	31.2	32.5	33.8	35.3	36.8	38.4	39.9
80	28.4	28.2	28.4	28.9	29.6	30.5	31.6	32.8	34.2	35.7	37.2	38.8	40.4
85	28.8	28.7	28.8	29.3	30.0	30.9	32.0	33.3	34.7	36.1	37.7	39.2	40.8
90	29.3	29.1	29.3	29.8	30.5	31.4	32.5	33.7	35.1	36.6	38.1	39.7	41.3
95	29.8	29.6	29.8	30.2	30.9	31.8	32.9	34.2	35.6	37.1	38.6	40.2	41.8
100	30.3	30.2	30.3	30.7	31.4	32.3	33.4	34.7	36.1	37.6	39.2	40.8	42.4
105	30.9	30.7	30.8	31.3	31.9	32.9	34.0	35.2	36.6	38.1	39.7	41.3	42.9
110	31.4	31.2	31.4	31.8	32.5	33.4	34.5	35.8	37.2	38.7	40.2	41.9	43.5
115	32.0	31.8	31.9	32.3	33.0	33.9	35.0	36.3	37.7	39.2	40.8	42.4	44.1
120	32.6	32.4	32.5	32.9	33.6	34.5	35.6	36.9	38.3	39.8	41.4	43.0	44.7



A5.7 Vehicle operating cost tables, continued

Table A5.4 HCVI VOC by speed and gradient (cents/km – July 2002)

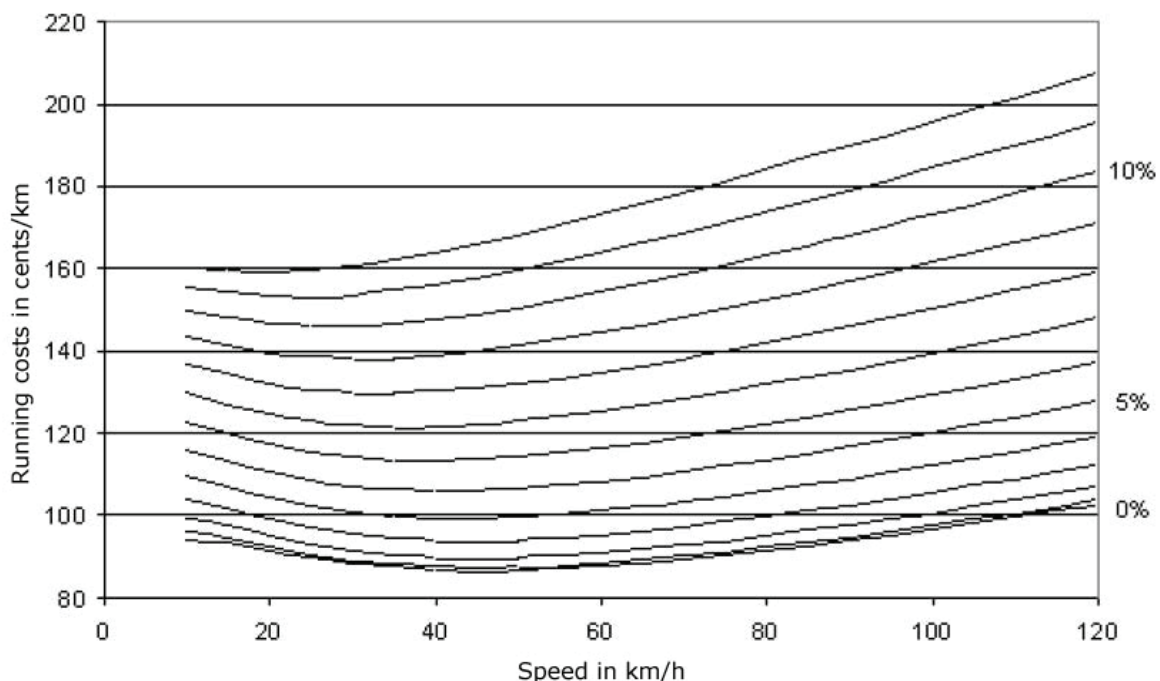
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	61.6	61.8	62.7	64.3	66.3	68.8	71.6	74.6	77.6	80.6	83.5	86.1	88.3
15	58.6	58.6	59.5	61.0	63.1	65.7	68.6	71.7	74.9	78.2	81.3	84.2	86.8
20	55.8	55.8	56.6	58.2	60.3	62.9	65.9	69.1	72.5	75.9	79.2	82.4	85.2
25	53.8	53.7	54.5	56.0	58.1	60.8	63.8	67.2	70.6	74.2	77.7	81.0	84.1
30	52.3	52.2	53.0	54.5	56.6	59.3	62.4	65.8	69.4	73.0	76.7	80.2	83.4
35	51.3	51.2	51.9	53.5	55.6	58.3	61.5	64.9	68.6	72.3	76.1	79.7	83.1
40	50.8	50.6	51.3	52.8	55.0	57.7	60.9	64.4	68.2	72.0	75.8	79.6	83.1
45	50.5	50.3	51.0	52.5	54.7	57.5	60.7	64.3	68.0	72.0	75.9	79.7	83.3
50	50.5	50.3	51.0	52.5	54.7	57.5	60.7	64.3	68.2	72.1	76.1	80.0	83.7
55	50.7	50.5	51.2	52.7	54.9	57.7	61.0	64.6	68.5	72.5	76.6	80.6	84.4
60	51.1	50.8	51.5	53.0	55.2	58.1	61.4	65.0	69.0	73.1	77.2	81.2	85.1
65	51.6	51.3	52.0	53.5	55.7	58.6	61.9	65.6	69.6	73.7	77.9	82.0	86.0
70	52.2	51.9	52.6	54.1	56.4	59.2	62.6	66.3	70.3	74.5	78.7	82.9	86.9
75	53.0	52.7	53.3	54.8	57.1	59.9	63.3	67.1	71.1	75.4	79.7	83.9	88.0
80	53.8	53.5	54.1	55.6	57.9	60.8	64.2	68.0	72.0	76.3	80.7	84.9	89.1
85	54.7	54.4	55.0	56.5	58.8	61.7	65.1	68.9	73.0	77.3	81.7	86.1	90.3
90	55.6	55.3	55.9	57.5	59.7	62.6	66.0	69.9	74.0	78.4	82.8	87.2	91.5
95	56.6	56.3	56.9	58.4	60.7	63.6	67.1	70.9	75.1	79.5	84.0	88.4	92.7
100	57.7	57.3	58.0	59.5	61.8	64.7	68.1	72.0	76.2	80.7	85.2	89.6	94.0
105	58.8	58.4	59.1	60.6	62.8	65.8	69.3	73.2	77.4	81.8	86.4	90.9	95.3
110	59.9	59.5	60.2	61.7	64.0	66.9	70.4	74.3	78.6	83.1	87.6	92.2	96.6
115	61.1	60.7	61.3	62.8	65.1	68.1	71.6	75.5	79.8	84.3	88.9	93.5	98.0
120	62.2	61.9	62.5	64.0	66.3	69.2	72.8	76.7	81.0	85.6	90.2	94.9	99.4



A5.7 Vehicle operating cost tables, continued

Table A5.5 HC VII VOC by speed and gradient (cents/km – July 2002)

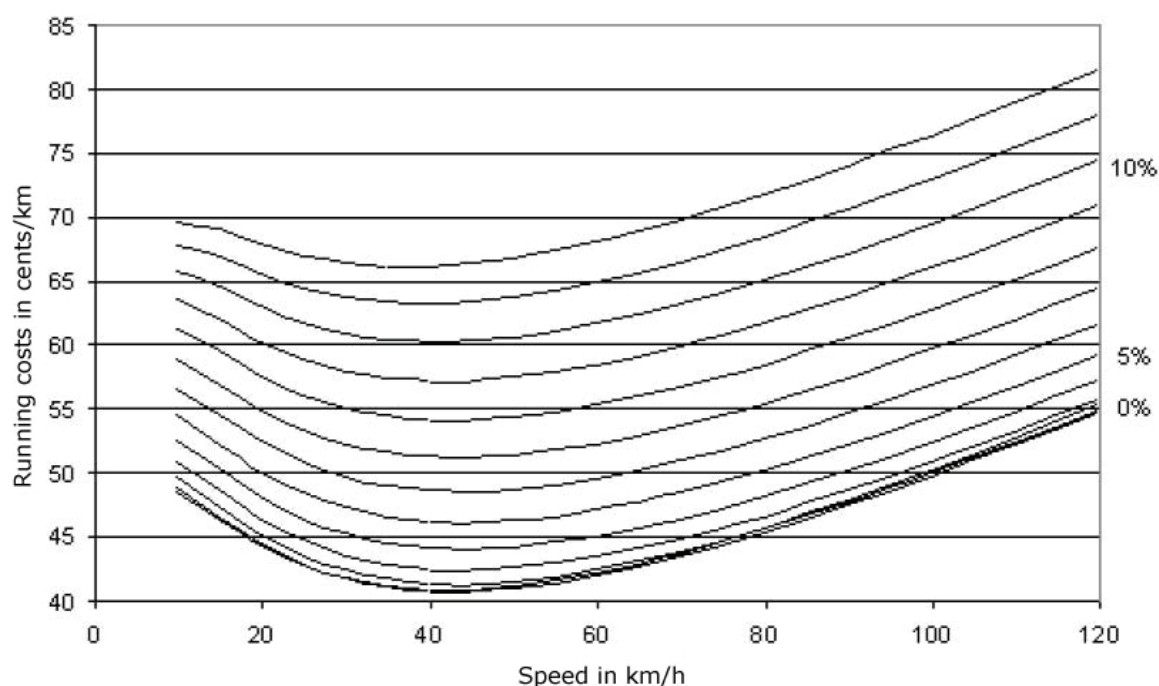
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	93.6	95.6	99.0	103.6	109.2	115.5	122.2	129.3	136.3	143.1	149.4	155.0	159.7
15	92.9	94.2	97.1	101.4	106.7	112.8	119.6	126.7	133.9	141.0	147.8	154.0	159.4
20	91.0	92.0	94.6	98.7	103.9	110.1	116.9	124.2	131.7	139.2	146.4	153.1	159.1
25	89.2	90.0	92.5	96.5	101.8	108.0	115.0	122.5	130.3	138.1	145.8	153.0	159.5
30	87.9	88.6	91.0	95.0	100.3	106.7	113.8	121.5	129.6	137.8	145.8	153.4	160.4
35	87.0	87.6	90.1	94.1	99.4	105.9	113.2	121.2	129.5	137.9	146.3	154.3	161.8
40	86.5	87.1	89.5	93.6	99.1	105.6	113.1	121.3	129.8	138.6	147.3	155.7	163.5
45	86.3	86.9	89.4	93.5	99.1	105.8	113.4	121.8	130.6	139.6	148.6	157.3	165.5
50	86.4	87.0	89.5	93.7	99.4	106.2	114.0	122.6	131.6	140.9	150.1	159.2	167.7
55	86.8	87.4	89.9	94.2	100.0	106.9	114.9	123.6	132.9	142.4	151.9	161.3	170.1
60	87.3	88.0	90.6	94.9	100.8	107.9	116.0	124.9	134.3	144.1	153.9	163.5	172.7
65	88.1	88.7	91.4	95.8	101.7	109.0	117.2	126.3	135.9	145.9	155.9	165.8	175.3
70	88.9	89.6	92.3	96.8	102.9	110.2	118.6	127.9	137.7	147.9	158.1	168.3	178.0
75	89.9	90.6	93.4	98.0	104.1	111.6	120.1	129.5	139.5	149.9	160.4	170.8	180.8
80	91.0	91.8	94.6	99.3	105.5	113.1	121.8	131.3	141.5	152.1	162.8	173.4	183.7
85	92.2	93.0	95.9	100.6	106.9	114.6	123.5	133.2	143.5	154.3	165.2	176.0	186.5
90	93.5	94.3	97.3	102.1	108.5	116.3	125.2	135.1	145.6	156.5	167.6	178.7	189.4
95	94.8	95.7	98.7	103.6	110.1	118.0	127.1	137.1	147.7	158.8	170.1	181.4	192.4
100	96.2	97.1	100.2	105.1	111.7	119.8	129.0	139.1	149.9	161.2	172.7	184.1	195.3
105	97.6	98.6	101.7	106.8	113.5	121.6	130.9	141.1	152.1	163.5	175.2	186.9	198.3
110	99.1	100.1	103.3	108.4	115.2	123.4	132.9	143.2	154.4	165.9	177.8	189.6	201.2
115	100.6	101.7	104.9	110.1	117.0	125.3	134.9	145.4	156.6	168.4	180.4	192.4	204.2
120	102.2	103.3	106.6	111.9	118.8	127.2	136.9	147.5	158.9	170.8	183.0	195.1	207.1



A5.7 Vehicle operating cost tables, continued

Table A5.6 Bus VOC by speed and gradient (cents/km – July 2002)

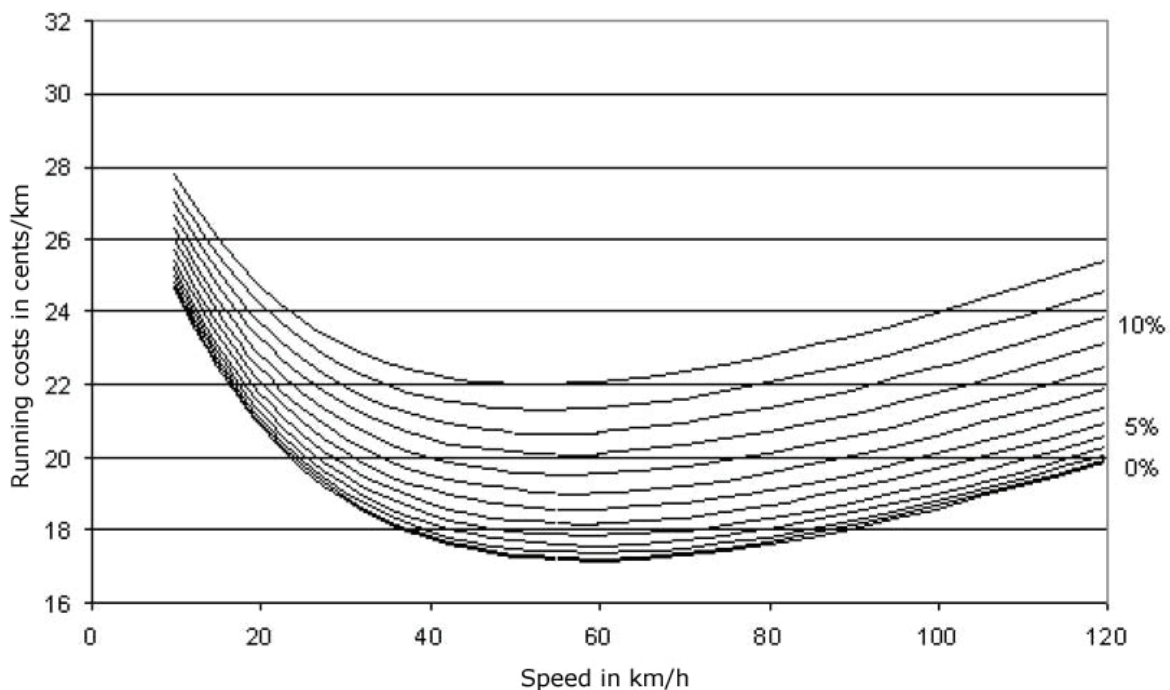
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	48.3	48.6	49.5	50.7	52.4	54.3	56.5	58.7	61.1	63.4	65.6	67.7	69.5
15	46.2	46.5	47.2	48.5	50.2	52.2	54.4	56.8	59.4	61.9	64.4	66.8	69.0
20	44.2	44.3	45.1	46.3	48.0	50.0	52.3	54.8	57.5	60.2	62.8	65.4	67.8
25	42.6	42.7	43.4	44.6	46.3	48.3	50.7	53.3	56.0	58.8	61.6	64.3	66.9
30	41.6	41.6	42.3	43.5	45.1	47.2	49.6	52.2	55.0	57.9	60.8	63.6	66.3
35	41.0	41.0	41.6	42.7	44.4	46.5	48.9	51.5	54.4	57.3	60.3	63.2	66.0
40	40.7	40.7	41.2	42.4	44.0	46.1	48.5	51.2	54.1	57.1	60.1	63.1	66.0
45	40.8	40.6	41.2	42.3	43.9	46.0	48.4	51.1	54.1	57.1	60.2	63.3	66.3
50	41.0	40.9	41.4	42.5	44.1	46.1	48.6	51.3	54.3	57.3	60.5	63.6	66.7
55	41.5	41.3	41.7	42.8	44.4	46.5	48.9	51.7	54.6	57.8	60.9	64.1	67.2
60	42.1	41.8	42.3	43.3	44.9	47.0	49.4	52.2	55.2	58.3	61.5	64.8	67.9
65	42.8	42.5	42.9	44.0	45.6	47.6	50.1	52.8	55.8	59.0	62.3	65.5	68.8
70	43.6	43.3	43.7	44.7	46.3	48.3	50.8	53.6	56.6	59.8	63.1	66.4	69.7
75	44.5	44.2	44.6	45.6	47.1	49.2	51.6	54.4	57.4	60.7	64.0	67.3	70.6
80	45.5	45.2	45.5	46.5	48.0	50.1	52.5	55.3	58.4	61.6	64.9	68.3	71.7
85	46.6	46.2	46.5	47.5	49.0	51.0	53.5	56.3	59.3	62.6	66.0	69.4	72.8
90	47.7	47.3	47.6	48.5	50.0	52.1	54.5	57.3	60.4	63.7	67.1	70.5	73.9
95	48.9	48.4	48.7	49.6	51.1	53.1	55.6	58.4	61.5	64.8	68.2	71.6	75.1
100	50.1	49.6	49.8	50.7	52.2	54.3	56.7	59.5	62.6	65.9	69.3	72.8	76.3
105	51.3	50.8	51.0	51.9	53.4	55.4	57.9	60.7	63.8	67.1	70.5	74.0	77.5
110	52.6	52.0	52.2	53.1	54.6	56.6	59.0	61.9	65.0	68.3	71.8	75.3	78.8
115	53.8	53.3	53.5	54.3	55.8	57.8	60.3	63.1	66.2	69.5	73.0	76.6	80.1
120	55.1	54.6	54.7	55.6	57.1	59.0	61.5	64.3	67.4	70.8	74.3	77.8	81.4



A5.7 Vehicle operating cost tables, continued

Table A5.7 Urban arterial VOC by speed and gradient (cents/km – July 2002)

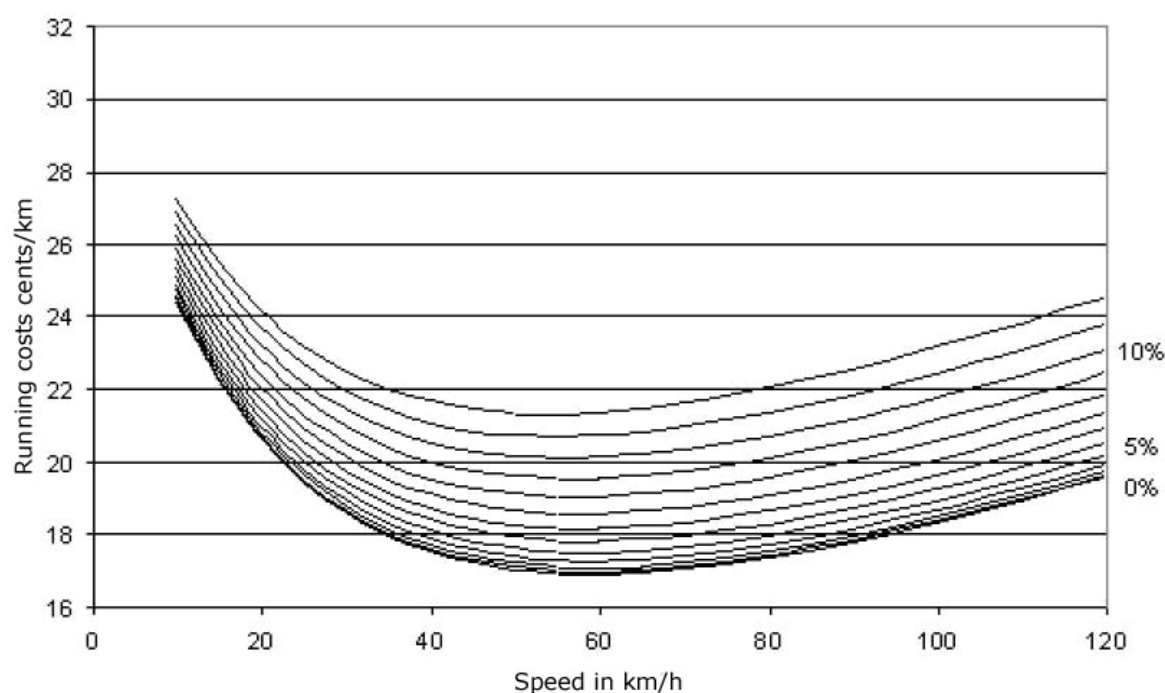
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	24.6	24.7	24.8	24.9	25.2	25.4	25.7	26.0	26.3	26.6	27.0	27.3	27.7
15	22.5	22.5	22.7	22.8	23.1	23.3	23.6	24.0	24.3	24.7	25.1	25.6	26.0
20	20.8	20.9	21.1	21.2	21.5	21.8	22.1	22.4	22.8	23.3	23.7	24.2	24.7
25	19.7	19.7	19.9	20.1	20.3	20.6	20.9	21.3	21.7	22.2	22.7	23.2	23.7
30	18.8	18.9	19.0	19.2	19.4	19.7	20.1	20.5	20.9	21.4	21.9	22.5	23.0
35	18.2	18.2	18.4	18.6	18.8	19.1	19.5	19.9	20.4	20.8	21.4	22.0	22.6
40	17.7	17.8	17.9	18.1	18.4	18.7	19.1	19.5	20.0	20.5	21.0	21.6	22.2
45	17.4	17.5	17.6	17.8	18.1	18.4	18.8	19.2	19.7	20.2	20.8	21.4	22.1
50	17.2	17.3	17.4	17.6	17.9	18.2	18.6	19.1	19.5	20.1	20.7	21.3	22.0
55	17.1	17.2	17.3	17.5	17.8	18.1	18.5	19.0	19.5	20.0	20.6	21.3	22.0
60	17.1	17.2	17.3	17.5	17.8	18.1	18.5	19.0	19.5	20.1	20.7	21.3	22.0
65	17.2	17.2	17.4	17.6	17.8	18.2	18.6	19.1	19.6	20.1	20.8	21.4	22.1
70	17.2	17.3	17.5	17.7	17.9	18.3	18.7	19.2	19.7	20.3	20.9	21.6	22.3
75	17.4	17.4	17.6	17.8	18.1	18.4	18.8	19.3	19.9	20.4	21.1	21.8	22.5
80	17.6	17.6	17.8	18.0	18.3	18.6	19.0	19.5	20.1	20.6	21.3	22.0	22.7
85	17.8	17.8	18.0	18.2	18.5	18.8	19.2	19.7	20.3	20.9	21.5	22.3	23.0
90	18.0	18.1	18.2	18.4	18.7	19.1	19.5	20.0	20.5	21.1	21.8	22.5	23.3
95	18.3	18.3	18.5	18.7	19.0	19.3	19.8	20.3	20.8	21.4	22.1	22.8	23.6
100	18.5	18.6	18.7	19.0	19.2	19.6	20.0	20.5	21.1	21.7	22.4	23.1	23.9
105	18.8	18.9	19.0	19.2	19.5	19.9	20.3	20.8	21.4	22.0	22.7	23.5	24.3
110	19.1	19.2	19.3	19.6	19.9	20.2	20.7	21.2	21.7	22.4	23.1	23.8	24.6
115	19.5	19.5	19.7	19.9	20.2	20.6	21.0	21.5	22.1	22.7	23.4	24.2	25.0
120	19.8	19.9	20.0	20.2	20.5	20.9	21.3	21.9	22.4	23.1	23.8	24.5	25.4



A5.7 Vehicle operating cost tables, continued

Table A5.8 Urban other VOC by speed and gradient (cents/km – July 2002)

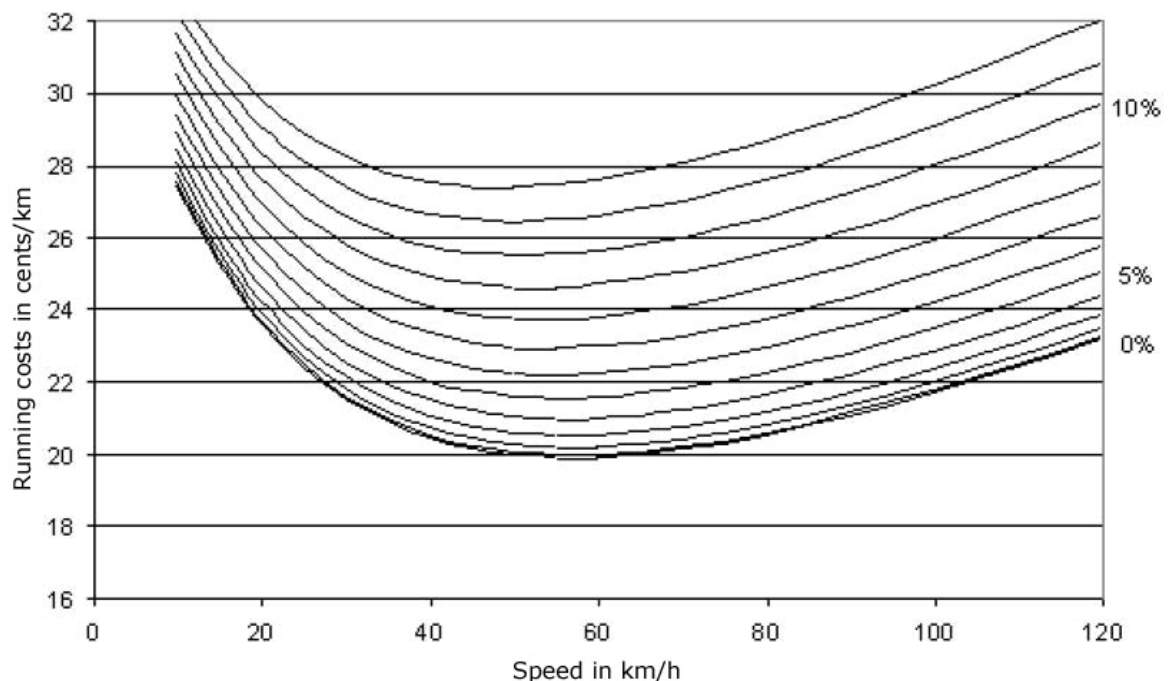
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	24.4	24.4	24.5	24.7	24.8	25.1	25.3	25.5	25.8	26.1	26.5	26.8	27.2
15	22.2	22.3	22.4	22.6	22.8	23.0	23.3	23.6	23.9	24.2	24.6	25.0	25.5
20	20.6	20.7	20.8	21.0	21.2	21.4	21.7	22.0	22.4	22.8	23.2	23.7	24.1
25	19.4	19.5	19.6	19.8	20.0	20.2	20.6	20.9	21.3	21.7	22.2	22.6	23.2
30	18.6	18.6	18.7	18.9	19.1	19.4	19.7	20.1	20.5	20.9	21.4	21.9	22.5
35	17.9	18.0	18.1	18.3	18.5	18.8	19.1	19.5	19.9	20.4	20.9	21.4	22.0
40	17.5	17.5	17.7	17.8	18.1	18.4	18.7	19.1	19.5	20.0	20.5	21.0	21.6
45	17.2	17.2	17.4	17.5	17.8	18.1	18.4	18.8	19.2	19.7	20.2	20.8	21.4
50	17.0	17.0	17.2	17.3	17.6	17.9	18.2	18.6	19.1	19.6	20.1	20.7	21.3
55	16.9	17.0	17.1	17.3	17.5	17.8	18.1	18.5	19.0	19.5	20.1	20.7	21.3
60	16.9	16.9	17.0	17.2	17.5	17.8	18.1	18.5	19.0	19.5	20.1	20.7	21.3
65	16.9	17.0	17.1	17.3	17.5	17.8	18.2	18.6	19.1	19.6	20.2	20.8	21.4
70	17.0	17.1	17.2	17.4	17.6	17.9	18.3	18.7	19.2	19.7	20.3	20.9	21.6
75	17.1	17.2	17.3	17.5	17.7	18.1	18.4	18.8	19.3	19.9	20.5	21.1	21.8
80	17.3	17.4	17.5	17.7	17.9	18.2	18.6	19.0	19.5	20.1	20.7	21.3	22.0
85	17.5	17.6	17.7	17.9	18.1	18.4	18.8	19.2	19.7	20.3	20.9	21.5	22.2
90	17.8	17.8	17.9	18.1	18.4	18.7	19.0	19.5	20.0	20.5	21.1	21.8	22.5
95	18.0	18.1	18.2	18.4	18.6	18.9	19.3	19.7	20.2	20.8	21.4	22.1	22.8
100	18.3	18.3	18.4	18.6	18.9	19.2	19.6	20.0	20.5	21.1	21.7	22.4	23.1
105	18.6	18.6	18.7	18.9	19.2	19.5	19.9	20.3	20.8	21.4	22.0	22.7	23.4
110	18.9	18.9	19.0	19.2	19.5	19.8	20.2	20.6	21.2	21.7	22.4	23.0	23.8
115	19.2	19.2	19.4	19.5	19.8	20.1	20.5	21.0	21.5	22.1	22.7	23.4	24.1
120	19.5	19.6	19.7	19.9	20.1	20.5	20.8	21.3	21.8	22.4	23.0	23.7	24.5



A5.7 Vehicle operating cost tables, continued

Table A5.9 Rural strategic VOC by speed and gradient (cents/km – July 2002)

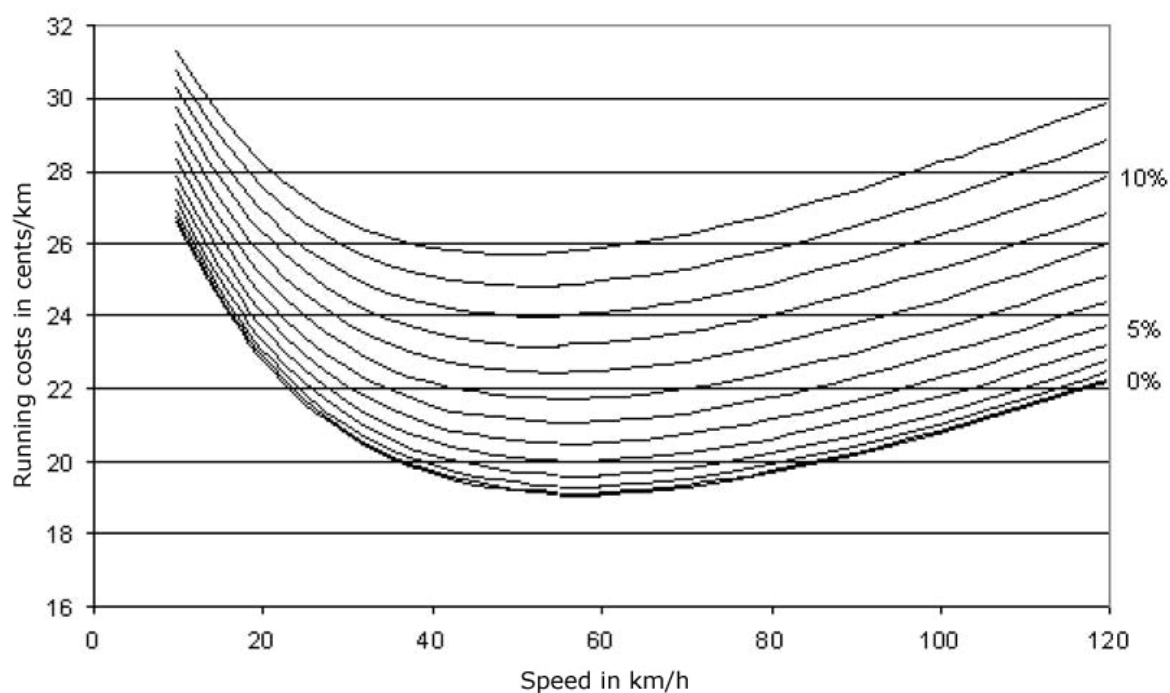
Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	27.4	27.5	27.7	28.0	28.4	28.9	29.4	29.9	30.5	31.1	31.6	32.2	32.8
15	25.3	25.4	25.6	25.9	26.3	26.8	27.3	27.9	28.5	29.1	29.8	30.5	31.1
20	23.6	23.7	23.9	24.2	24.6	25.1	25.7	26.3	27.0	27.6	28.4	29.1	29.8
25	22.4	22.5	22.7	23.0	23.4	23.9	24.5	25.1	25.8	26.6	27.3	28.1	28.9
30	21.5	21.6	21.8	22.1	22.5	23.0	23.6	24.3	25.0	25.8	26.6	27.4	28.2
35	20.8	20.9	21.1	21.5	21.9	22.4	23.0	23.7	24.5	25.2	26.1	26.9	27.8
40	20.4	20.5	20.7	21.0	21.5	22.0	22.6	23.3	24.1	24.9	25.7	26.6	27.5
45	20.1	20.2	20.4	20.7	21.2	21.7	22.4	23.1	23.8	24.7	25.6	26.5	27.4
50	19.9	20.0	20.2	20.6	21.0	21.6	22.2	22.9	23.7	24.6	25.5	26.4	27.4
55	19.9	19.9	20.1	20.5	20.9	21.5	22.2	22.9	23.7	24.6	25.5	26.5	27.4
60	19.9	19.9	20.2	20.5	21.0	21.5	22.2	23.0	23.8	24.7	25.6	26.6	27.6
65	20.0	20.0	20.2	20.6	21.0	21.6	22.3	23.1	23.9	24.8	25.8	26.8	27.8
70	20.1	20.2	20.4	20.7	21.2	21.8	22.5	23.2	24.1	25.0	26.0	27.0	28.0
75	20.3	20.3	20.5	20.9	21.4	22.0	22.7	23.4	24.3	25.2	26.2	27.3	28.3
80	20.5	20.6	20.8	21.1	21.6	22.2	22.9	23.7	24.6	25.5	26.5	27.6	28.6
85	20.7	20.8	21.0	21.4	21.9	22.5	23.2	24.0	24.9	25.8	26.8	27.9	29.0
90	21.0	21.1	21.3	21.7	22.2	22.8	23.5	24.3	25.2	26.2	27.2	28.3	29.4
95	21.3	21.4	21.6	22.0	22.5	23.1	23.8	24.6	25.5	26.5	27.6	28.6	29.8
100	21.7	21.7	21.9	22.3	22.8	23.4	24.2	25.0	25.9	26.9	27.9	29.0	30.2
105	22.0	22.1	22.3	22.7	23.2	23.8	24.5	25.4	26.3	27.3	28.3	29.5	30.6
110	22.4	22.4	22.7	23.0	23.5	24.2	24.9	25.8	26.7	27.7	28.8	29.9	31.1
115	22.8	22.8	23.0	23.4	23.9	24.6	25.3	26.2	27.1	28.1	29.2	30.3	31.5
120	23.2	23.2	23.4	23.8	24.3	25.0	25.7	26.6	27.5	28.5	29.6	30.8	32.0



A5.7 Vehicle operating cost tables, continued

Table A5.10 Rural other VOC by speed and gradient (cents/km – July 2002)

Speed (km/h)	Gradient in percent (both directions)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
10	26.6	26.7	26.9	27.1	27.5	27.8	28.3	28.7	29.2	29.7	30.2	30.7	31.2
15	24.4	24.5	24.7	25.0	25.3	25.7	26.2	26.7	27.2	27.8	28.4	28.9	29.5
20	22.8	22.9	23.1	23.3	23.7	24.1	24.6	25.1	25.7	26.3	26.9	27.6	28.2
25	21.6	21.7	21.8	22.1	22.5	22.9	23.4	24.0	24.6	25.2	25.9	26.6	27.3
30	20.7	20.8	20.9	21.2	21.6	22.0	22.5	23.1	23.7	24.4	25.1	25.8	26.6
35	20.0	20.1	20.3	20.6	21.0	21.4	21.9	22.5	23.2	23.9	24.6	25.4	26.1
40	19.6	19.7	19.8	20.1	20.5	21.0	21.5	22.1	22.8	23.5	24.3	25.0	25.8
45	19.3	19.4	19.5	19.8	20.2	20.7	21.2	21.9	22.5	23.3	24.1	24.9	25.7
50	19.1	19.2	19.4	19.7	20.1	20.5	21.1	21.7	22.4	23.2	24.0	24.8	25.7
55	19.0	19.1	19.3	19.6	20.0	20.5	21.0	21.7	22.4	23.2	24.0	24.8	25.7
60	19.0	19.1	19.3	19.6	20.0	20.5	21.1	21.7	22.4	23.2	24.0	24.9	25.8
65	19.1	19.2	19.4	19.7	20.1	20.6	21.1	21.8	22.5	23.3	24.2	25.1	26.0
70	19.2	19.3	19.5	19.8	20.2	20.7	21.3	22.0	22.7	23.5	24.4	25.3	26.2
75	19.4	19.5	19.6	19.9	20.4	20.9	21.5	22.1	22.9	23.7	24.6	25.5	26.5
80	19.6	19.7	19.9	20.2	20.6	21.1	21.7	22.4	23.1	24.0	24.9	25.8	26.8
85	19.9	19.9	20.1	20.4	20.8	21.3	21.9	22.6	23.4	24.3	25.1	26.1	27.1
90	20.1	20.2	20.4	20.7	21.1	21.6	22.2	22.9	23.7	24.6	25.5	26.4	27.4
95	20.4	20.5	20.7	21.0	21.4	21.9	22.5	23.3	24.0	24.9	25.8	26.8	27.8
100	20.7	20.8	21.0	21.3	21.7	22.2	22.9	23.6	24.4	25.2	26.2	27.2	28.2
105	21.1	21.1	21.3	21.6	22.0	22.6	23.2	23.9	24.7	25.6	26.6	27.5	28.6
110	21.4	21.5	21.7	22.0	22.4	22.9	23.6	24.3	25.1	26.0	26.9	27.9	29.0
115	21.8	21.8	22.0	22.3	22.8	23.3	24.0	24.7	25.5	26.4	27.4	28.4	29.4
120	22.2	22.2	22.4	22.7	23.2	23.7	24.3	25.1	25.9	26.8	27.8	28.8	29.8



A5.7 Vehicle operating cost tables, continued

Table A5.11 Running cost by speed and gradient regression coefficients

$$VOC_B = a + b \cdot GR + c \times \ln(S) + d \times GR^2 + e \times [\ln(S)]^2 + f \times GR \times \ln(S) + g \times GR^3 + h \times [\ln(S)]^3 + i \times GR \times [\ln(S)]^2 + j \times GR^2 \times \ln(S)$$

Regression coefficient	Vehicle class						Road category			
	PC	LCV	MCV	HCVI	HCVII	Bus	Urban arterial	Urban other	Rural strategic	Rural other
a	12.672	7.704	14.312	-7.698	-48.727	-28.093	10.776	11.306	8.9692	9.618
b (x 10 ⁻²)	-6.9141	-22.845	-6.5496	52.177	875.58	22.577	9.7581	1.8240	29.182	20.500
c	18.854	24.804	29.952	85.099	149.730	89.148	22.951	22.294	27.778	26.298
d (x 10 ⁻⁴)	-138.50	-7.4420	896.92	3081.4	4979.6	1853.3	29.802	18.808	249.51	186.87
E	-8.7295	-10.963	-13.063	-32.374	-50.673	-32.937	-10.115	-9.9296	-11.750	-11.264
f (x 10 ⁻²)	8.2079	14.058	8.1974	-35.619	-465.26	7.3384	-1.1210	3.0610	-11.903	-7.2255
g (x 10 ⁻⁴)	6.6692	4.0297	-50.723	-186.16	-399.46	-126.57	-4.7899	-3.1878	-19.851	-15.196
h	1.0424	1.3056	1.5882	3.6868	5.4270	3.7489	1.1937	1.1764	1.3717	1.3197
i (x 10 ⁻³)	-12.614	-18.752	-30.345	11.166	587.51	-68.261	-1.3357	-7.1536	11.022	5.2602
j (x 10 ⁻³)	4.7432	5.1976	17.927	52.303	149.28	48.292	8.4185	7.5705	13.000	11.417
Standard error	0.10	0.14	0.23	0.55	1.17	0.54	0.12	0.11	0.12	0.11

Notes: VOC_B = Base vehicle operating costs in cents/km

GR = Absolute value of average gradient (ie, > 0) over range of 0 – 12%

S = Speed in km/h over range of 10 – 120 km/h

ln = Natural logarithm

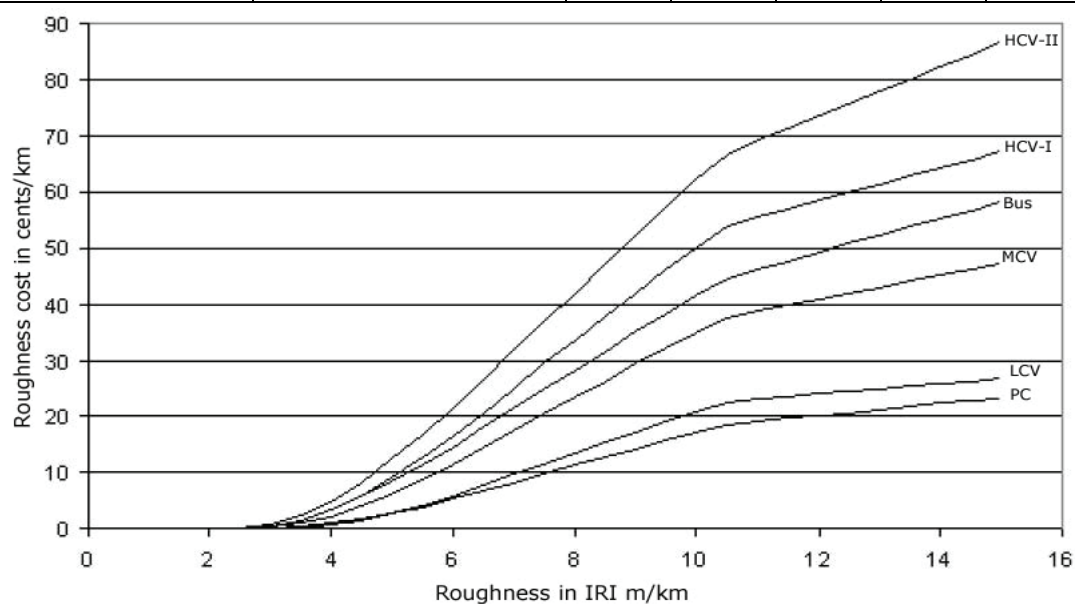
Sample equation for passenger cars (PC):

$$VOC_B = 12.672 - 6.9141 \times GR + 18.854 \times \ln(S) - 138.50 \times 10^{-4} \times GR^2 - 8.7295 \times [\ln(S)]^2 + 8.2079 \times 10^{-2} \times GR \times \ln(S) + 6.6692 \times 10^{-4} \times GR^3 + 1.0424 \times [\ln(S)]^3 - 12.614 \times 10^{-3} \times GR \times [\ln(S)]^2 + 4.7432 \times 10^{-3} \times GR^2 \times \ln(S)$$

A5.7 Vehicle operating cost tables, continued

Table A5.12 Urban additional VOC due to roughness by vehicle class (cents/km – July 2002)

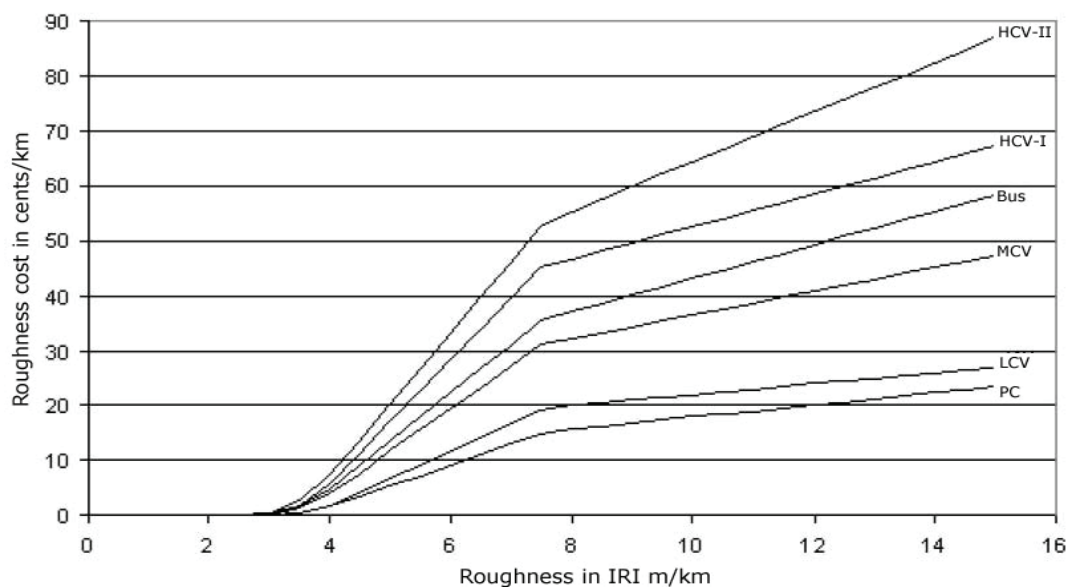
Roughness		Additional VOC in cents/km by vehicle class					
IRI (m/km)	NAASRA (count/km)	PC	LCV	MCV	HCVI	HCVII	Bus
0 - 2.5	0 - 66	0.0	0.0	0.0	0.0	0.0	0.0
3.0	79	0.2	0.1	0.3	0.5	0.8	0.5
3.5	92	0.4	0.2	1.1	1.5	2.4	1.6
4.0	106	0.9	0.7	2.3	3.3	4.9	3.3
4.5	119	1.6	1.5	4.1	5.9	8.2	5.6
5.0	132	2.7	2.7	6.3	9.0	12.2	8.3
5.5	145	3.9	4.2	8.9	12.6	16.7	11.3
6.0	158	5.2	5.9	11.6	16.6	21.5	14.6
6.5	172	6.7	7.7	14.5	20.7	26.6	17.9
7.0	185	8.2	9.6	17.5	25.0	31.7	21.4
7.5	198	9.7	11.5	20.5	29.3	36.9	24.8
8.0	211	11.3	13.5	23.5	33.6	42.1	28.3
8.5	224	12.8	15.4	26.4	37.9	47.3	31.7
9.0	238	14.3	17.3	29.3	42.1	52.3	35.1
9.5	251	15.8	19.1	32.1	46.2	57.3	38.3
10.0	264	17.1	20.8	34.9	50.1	62.1	41.5
10.5	277	18.5	22.4	37.5	53.9	66.7	44.6
11.0	290	19.1	23.1	38.8	55.6	69.2	46.3
11.5	304	19.7	23.6	39.8	57.1	71.4	47.8
12.0	317	20.2	24.0	40.9	58.5	73.6	49.3
12.5	330	20.7	24.5	42.0	60.0	75.8	50.8
13.0	343	21.3	25.0	43.0	61.4	78.0	52.2
13.5	356	21.8	25.4	44.1	62.9	80.2	53.7
14.0	370	22.3	25.9	45.2	64.4	82.4	55.2
14.5	383	22.8	26.4	46.2	65.8	84.6	56.7
15.0	396	23.4	26.8	47.3	67.3	86.8	58.2



A5.7 Vehicle operating cost tables, continued

Table A5.13 Rural additional VOC due to roughness by vehicle class (cents/km – July 2002)

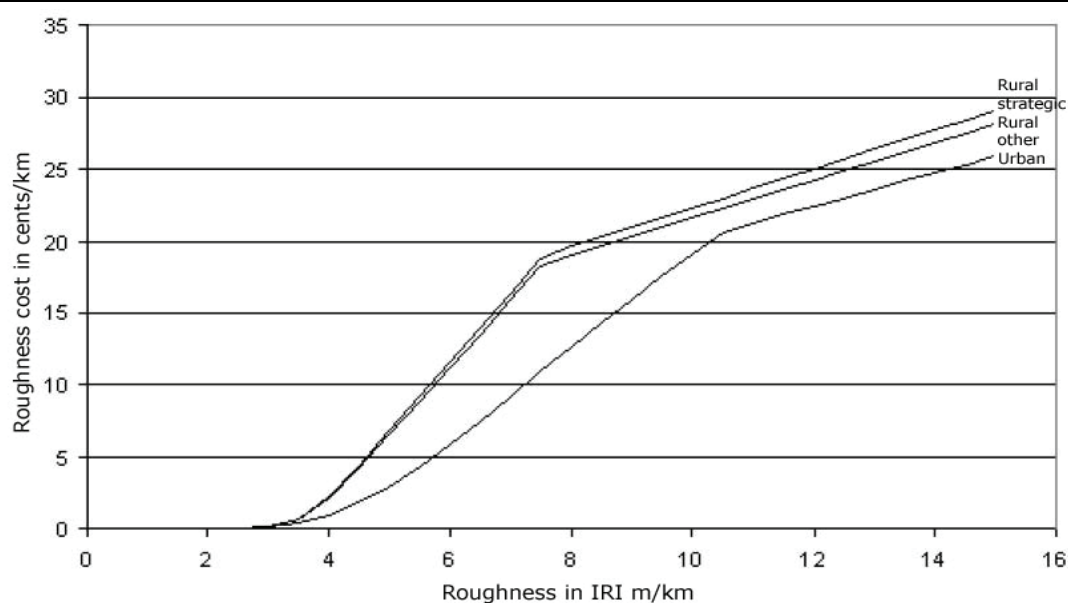
Roughness		Additional VOC in cents/km by vehicle class					
IRI (m/km)	NAASRA (count/km)	PC	LCV	MCV	HCVI	HCVII	Bus
0 - 2.5	0 - 66	0.0	0.0	0.0	0.0	0.0	0.0
3.0	79	0.1	0.1	0.2	0.3	0.6	0.3
3.5	92	0.5	0.4	1.3	1.9	2.8	1.8
4.0	106	1.7	1.9	4.0	5.8	7.5	5.0
4.5	119	3.4	4.1	7.7	11.2	13.6	9.1
5.0	132	5.3	6.7	11.7	17.0	20.3	13.6
5.5	145	7.3	9.3	15.7	22.8	26.9	18.1
6.0	158	9.2	11.8	19.5	28.5	33.4	22.5
6.5	172	11.1	14.2	23.3	33.9	39.8	26.7
7.0	185	13.0	16.7	27.1	39.4	46.1	31.0
7.5	198	15.0	19.4	31.0	45.1	52.7	35.4
8.0	211	15.7	20.0	32.2	46.7	55.4	37.1
8.5	224	16.3	20.5	33.3	48.2	57.6	38.6
9.0	238	16.8	21.0	34.4	49.6	59.9	40.1
9.5	251	17.4	21.5	35.5	51.1	62.1	41.6
10.0	264	17.9	22.0	36.5	52.6	64.4	43.2
10.5	277	18.5	22.5	37.6	54.1	66.7	44.7
11.0	290	19.0	23.0	38.7	55.5	68.9	46.2
11.5	304	19.6	23.5	39.8	57.0	71.2	47.7
12.0	317	20.1	24.0	40.9	58.5	73.4	49.2
12.5	330	20.7	24.5	42.0	60.0	75.7	50.7
13.0	343	21.2	25.0	43.1	61.4	78.0	52.3
13.5	356	21.8	25.4	44.1	62.9	80.2	53.8
14.0	370	22.4	25.9	45.2	64.4	82.5	55.3
14.5	383	22.9	26.4	46.3	65.9	84.8	56.8
15.0	396	23.5	26.9	47.4	67.3	87.0	58.3



A5.7 Vehicle operating cost tables, continued

Table A5.14 Additional VOC due to roughness by road category (cents/km – July 2002)

Roughness		Additional VOC in cents/km by vehicle class		
IRI (m/km)	NAASRA (count/km)	Urban	Rural strategic	Rural other
0 - 2.5	0 - 66	0.0	0.0	0.0
3.0	79	0.2	0.1	0.1
3.5	92	0.4	0.7	0.6
4.0	106	1.0	2.2	2.1
4.5	119	1.8	4.3	4.2
5.0	132	3.0	6.8	6.5
5.5	145	4.3	9.2	8.9
6.0	158	5.9	11.6	11.2
6.5	172	7.5	14.0	13.5
7.0	185	9.2	16.3	15.8
7.5	198	10.9	18.8	18.2
8.0	211	12.6	19.7	19.1
8.5	224	14.3	20.3	19.7
9.0	238	15.9	21.0	20.4
9.5	251	17.5	21.7	21.0
10.0	264	19.1	22.3	21.7
10.5	277	20.5	23.0	22.3
11.0	290	21.3	23.7	22.9
11.5	304	21.9	24.4	23.6
12.0	317	22.4	25.0	24.2
12.5	330	23.0	25.7	24.9
13.0	343	23.6	26.4	25.5
13.5	356	24.2	27.0	26.2
14.0	370	24.7	27.7	26.8
14.5	383	25.3	28.4	27.5
15.0	396	25.9	29.0	28.1



A5.7 Vehicle operating cost tables, continued

Table A5.15 Additional VOC due to roughness – regression coefficients

$$VOC_{RI} = \min (\{a + b \times \ln(RI) + c \times [\ln(RI)]^2 + d \times [\ln(RI)]^3 + e \times [\ln(RI)]^4 + f \times [\ln(RI)]^5 \}, \{g \times RI + h \})$$

Road category	Vehicle class	Regression coefficient										Standard error
		a	b	c	d	e	f	g	h			
Urban	PC	-27.654	85.088	-94.081	43.090	-6.345	0.000	1.059	7.49	0.13		
	LCV	-42.253	129.376	-141.572	64.034	-9.462	0.000	0.937	12.78	0.17		
	MCV	-32.840	107.057	-125.834	60.764	-9.016	0.000	2.133	15.32	0.23		
	HCVI	-51.353	165.213	-191.690	91.632	-13.564	0.000	2.910	23.61	0.34		
	HCVII	-45.675	150.983	-181.391	89.623	-13.245	0.000	4.406	20.69	0.33		
	Bus	-25.204	86.727	-107.931	54.715	-8.136	0.000	2.973	13.59	0.23		
	PC	-214.923	799.120	-1150.182	798.248	-267.192	35.033	1.108	6.84	0.08		
Rural	LCV	-389.760	1442.972	-2072.428	1440.261	-484.830	63.985	0.985	12.15	0.10		
	MCV	-458.833	1724.908	-2512.672	1766.143	-598.728	79.385	2.170	14.84	0.11		
	HCVI	-701.264	2632.614	-3831.148	2691.846	-912.795	121.075	2.951	23.07	0.17		
	HCVII	-652.227	2468.381	-3618.750	2557.015	-869.769	115.684	4.524	19.16	0.16		
	Bus	-425.052	1614.662	-2374.356	1681.332	-572.622	76.213	3.035	12.80	0.11		
Urban	All	-31.075	95.745	-106.008	48.648	-7.192	0.000	1.152	8.60	0.14		
Rural strategic	All	-298.456	1110.453	-1601.592	1115.762	-375.511	49.507	1.339	8.95	0.06		
Rural other	All	-287.470	1069.561	-1542.439	1074.318	-361.457	47.642	1.296	8.69	0.06		

Notes: VOC_{RI} = Additional vehicle operating costs due to roughness in cents/km

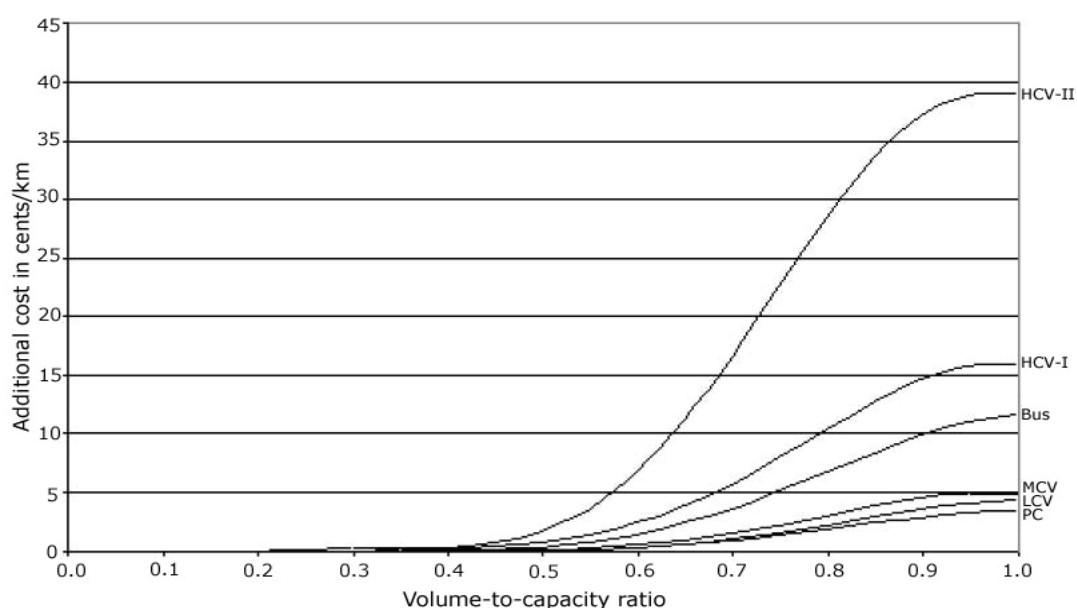
RI = max (2.5, roughness in IRI m/km)

ln = Natural logarithm

A5.7 Vehicle operating cost tables, continued

Table A5.16 Urban arterial and urban other: additional VOC due to congestion by vehicle class (cents/km – July 2002)

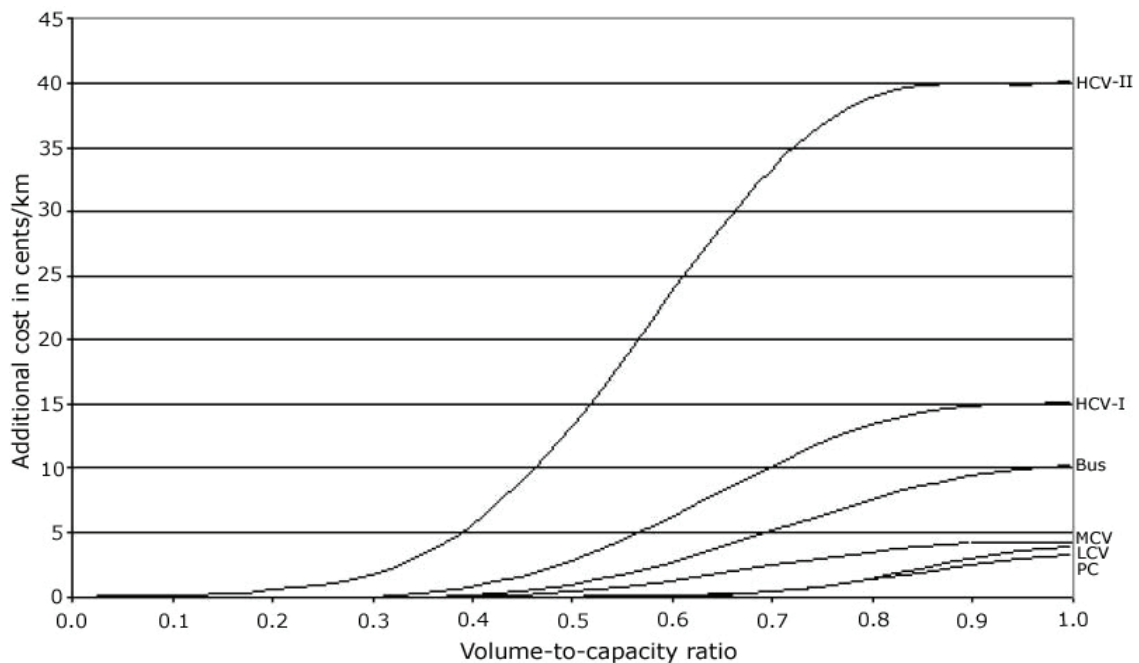
VC ratio	Additional cost in cents/km					
	PC	LCV	MCV	HCVI	HCVII	Bus
0.00	0.0	0.0	0.0	0.0	0.0	0.0
0.05	0.0	0.0	0.0	0.0	0.0	0.0
0.10	0.0	0.0	0.0	0.0	0.0	0.0
0.15	0.0	0.0	0.0	0.0	0.0	0.0
0.20	0.0	0.0	0.0	0.0	0.0	0.0
0.25	0.0	0.0	0.0	0.0	0.1	0.0
0.30	0.0	0.0	0.0	0.0	0.2	0.0
0.35	0.0	0.0	0.0	0.1	0.2	0.0
0.40	0.0	0.0	0.0	0.2	0.3	0.1
0.45	0.1	0.0	0.1	0.4	0.7	0.1
0.50	0.1	0.1	0.1	0.8	1.7	0.4
0.55	0.2	0.2	0.3	1.4	3.7	0.8
0.60	0.4	0.4	0.5	2.4	6.8	1.4
0.65	0.6	0.7	0.9	3.8	11.2	2.4
0.70	0.9	1.1	1.5	5.7	16.6	3.6
0.75	1.4	1.6	2.2	8.0	22.6	5.1
0.80	1.9	2.2	3.1	10.4	28.5	6.7
0.85	2.4	2.9	3.9	12.7	33.6	8.4
0.90	2.9	3.6	4.6	14.6	37.2	9.9
0.95	3.3	4.1	4.9	15.8	38.9	11.0
1.00	3.5	4.4	4.9	15.9	39.0	11.7
1.05	3.5	4.4	4.9	15.9	39.0	11.7
1.10	3.5	4.4	4.9	15.9	39.0	11.7
1.15	3.5	4.4	4.9	15.9	39.0	11.7
1.20	3.5	4.4	4.9	15.9	39.0	11.7



A5.7 Vehicle operating cost tables, continued

Table A5.17 Rural strategic and rural other: additional VOC due to congestion by vehicle class (cents/km – July 2002)

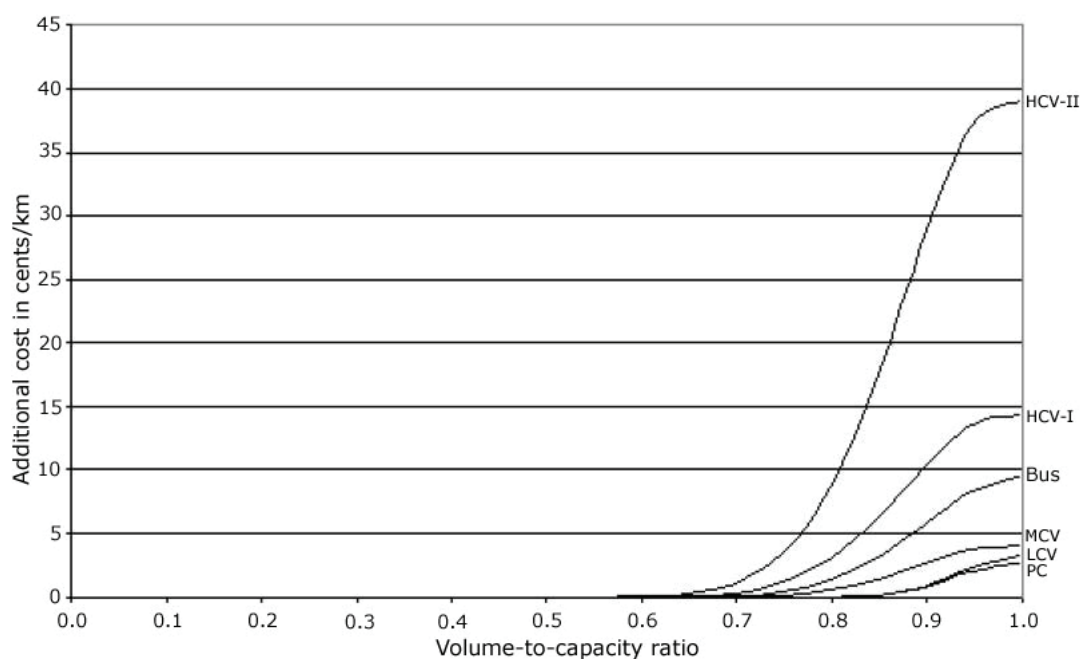
VC ratio	Additional cost in cents/km					
	PC	LCV	MCV	HCVI	HCVII	Bus
0.00	0.0	0.0	0.0	0.0	0.0	0.0
0.05	0.0	0.0	0.0	0.0	0.1	0.0
0.10	0.0	0.0	0.0	0.0	0.2	0.0
0.15	0.0	0.0	0.0	0.0	0.3	0.0
0.20	0.0	0.0	0.0	0.0	0.5	0.0
0.25	0.0	0.0	0.0	0.0	0.9	0.0
0.30	0.0	0.0	0.0	0.0	1.7	0.0
0.35	0.0	0.0	0.0	0.3	3.2	0.0
0.40	0.0	0.0	0.1	0.8	5.6	0.1
0.45	0.0	0.0	0.2	1.6	9.0	0.4
0.50	0.0	0.0	0.4	2.9	13.3	1.0
0.55	0.1	0.0	0.8	4.4	18.3	1.7
0.60	0.1	0.1	1.2	6.2	23.6	2.7
0.65	0.3	0.2	1.8	8.2	28.8	3.9
0.70	0.5	0.4	2.4	10.1	33.3	5.1
0.75	0.8	0.8	3.0	11.9	36.7	6.4
0.80	1.3	1.5	3.5	13.4	38.8	7.6
0.85	1.9	2.2	4.0	14.4	39.8	8.6
0.90	2.5	3.0	4.2	14.9	40.0	9.5
0.95	2.9	3.6	4.3	15.0	39.9	10.0
1.00	3.2	3.8	4.3	15.1	40.1	10.2
1.05	3.2	3.8	4.3	15.1	40.1	10.2
1.10	3.2	3.8	4.3	15.1	40.1	10.2
1.15	3.2	3.8	4.3	15.1	40.1	10.2
1.20	3.2	3.8	4.3	15.1	40.1	10.2



A5.7 Vehicle operating cost tables, continued

Table A5.18 Motorway: additional VOC due to congestion by vehicle class (cents/km – July 2002)

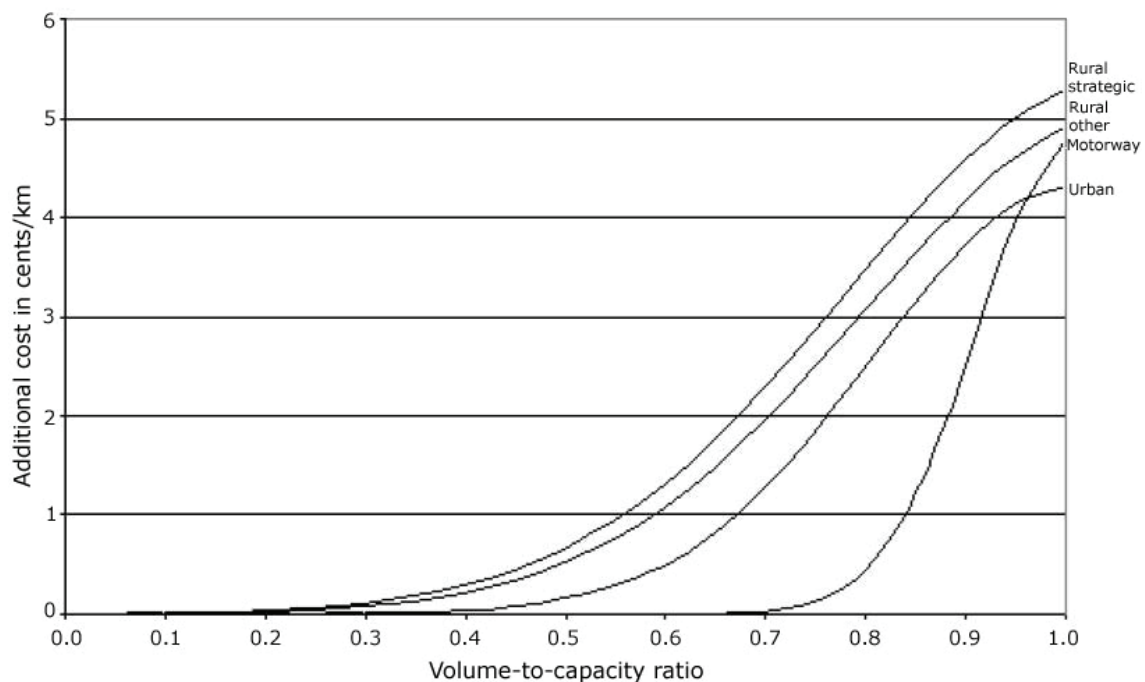
VC ratio	Additional cost in cents/km					
	PC	LCV	MCV	HCVI	HCVII	Bus
0.00	0.0	0.0	0.0	0.0	0.0	0.0
0.05	0.0	0.0	0.0	0.0	0.0	0.0
0.10	0.0	0.0	0.0	0.0	0.0	0.0
0.15	0.0	0.0	0.0	0.0	0.0	0.0
0.20	0.0	0.0	0.0	0.0	0.0	0.0
0.25	0.0	0.0	0.0	0.0	0.0	0.0
0.30	0.0	0.0	0.0	0.0	0.0	0.0
0.35	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.0	0.0	0.0	0.0	0.0	0.0
0.45	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.0	0.0	0.0	0.0	0.0	0.0
0.55	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.0	0.0	0.0	0.0	0.1	0.0
0.65	0.0	0.0	0.0	0.1	0.3	0.0
0.70	0.0	0.0	0.0	0.4	1.1	0.1
0.75	0.0	0.0	0.2	1.2	3.4	0.4
0.80	0.0	0.0	0.6	3.1	8.6	1.3
0.85	0.2	0.1	1.5	6.3	17.4	3.1
0.90	0.8	0.8	2.7	10.3	28.4	5.8
0.95	2.1	2.3	3.8	13.6	37.2	8.4
1.00	2.7	3.2	4.0	14.4	39.0	9.5
1.05	2.7	3.2	4.0	14.4	39.0	9.5
1.10	2.7	3.2	4.0	14.4	39.0	9.5
1.15	2.7	3.2	4.0	14.4	39.0	9.5
1.20	2.7	3.2	4.0	14.4	39.0	9.5



A5.7 Vehicle operating cost tables, continued

Table A5.19 Additional VOC due to congestion by road category (cents/km – July 2002)

VC ratio	Additional VOC in cents/km			
	Urban	Rural strategic	Rural other	Motorway
0.00	0.0	0.0	0.0	0.0
0.05	0.0	0.0	0.0	0.0
0.10	0.0	0.0	0.0	0.0
0.15	0.0	0.0	0.0	0.0
0.20	0.0	0.0	0.0	0.0
0.25	0.0	0.1	0.0	0.0
0.30	0.0	0.1	0.1	0.0
0.35	0.0	0.2	0.1	0.0
0.40	0.0	0.3	0.2	0.0
0.45	0.1	0.4	0.3	0.0
0.50	0.2	0.7	0.5	0.0
0.55	0.3	0.9	0.8	0.0
0.60	0.5	1.3	1.1	0.0
0.65	0.8	1.8	1.5	0.0
0.70	1.3	2.3	1.9	0.0
0.75	1.8	2.8	2.5	0.1
0.80	2.5	3.4	3.1	0.4
0.85	3.1	4.0	3.6	1.2
0.90	3.7	4.6	4.2	2.5
0.95	4.1	5.0	4.6	3.9
1.00	4.3	5.3	4.9	4.8
1.05	4.3	5.3	4.9	4.8
1.10	4.3	5.3	4.9	4.8
1.15	4.3	5.3	4.9	4.8
1.20	4.3	5.3	4.9	4.8



A5.7 Vehicle operating cost tables, continued

Table A5.20 Additional VOC due to congestion regression coefficient by vehicle class

For equation...	Use the expression...	For VC ratio
A	$VOC_{CONG} = e^{(a_0 + a_1 VC \text{ ratio} + a_2 VC \text{ ratio}^2)}$	All
B	$VOC_{CONG} = a_0 VC^8 + a_1 VC^7 + a_2 VC^6 + a_3 VC^5 + a_4 VC^4 + a_5 VC^3 + a_6 VC^2 + a_7 VC + a_8$	> VC ratio min
	$VOC_{CONG} = 0$	< VC ratio min

Notes: VOC_{CONG} = Additional vehicle operating costs due to congestion in cents/km

VC ratio = Volume to capacity ratio

VC = minimum(1.0, VC ratio)

Road type	Parameter	Regression coefficient by vehicle class					
		PC	LCV	MCV	HCVI	HCVII	Bus
Urban	Equation	A	A	A	A	B	B
	a0	-12.2911	-13.0391	-13.3075	-9.6530	0	0
	a1	26.6027	28.4746	30.5677	25.2847	3845.7716	444.0676
	a2	-13.0656	-13.9637	-15.6630	-12.8644	-12828.17	-1589.5
	a3	-	-	-	-	15944.44	2066.24
	a4	-	-	-	-	-9224.74	-1208.67
	a5	-	-	-	-	2634.0060	341.6788
	a6	-	-	-	-	-349.5035	-44.2510
	a7	-	-	-	-	17.2916	2.1182
	a8	-	-	-	-	-0.13015	-0.01506
	VC ratio min	0.0	0.0	0.0	0.0	0.2	0.2
2 lane highway	Equation	A	A	B	B	B	B
	a0	-18.2515	-23.0643	0	0	-4077.1234	0
	a1	38.2254	48.8934	236.7032	205.0043	15158.6400	0
	a2	-18.8159	-24.4849	-685.1407	-169.9105	-21008.7846	249.8613
	a3	-	-	686.7616	-571.7029	13145.0574	-791.9639
	a4	-	-	-281.5338	835.2876	-3647.0357	863.1741
	a5	-	-	52.1363	-327.5159	492.4254	-372.0891
	a6	-	-	-4.8606	45.8825	-24.7847	65.0512
	a7	-	-	0.2532	-1.9454	1.6754	-3.8747
	a8	-	-	-0.00364	0.00701	0.00898	0.03432
	VC ratio min	0.0	0.0	0.35	0.30	0.0	0.38
Motorway	Equation	A	A	A	A	A	A
	a0	-131.8912	-137.7901	-51.4201	-40.2957	-39.0039	-47.0705
	a1	266.8652	278.4161	107.0245	87.0223	86.5483	98.6165
	a2	-133.9751	-139.4647	-54.2123	-44.0602	-43.8797	-49.2987
	a3	-	-	-	-	-	-
	a4	-	-	-	-	-	-
	a5	-	-	-	-	-	-
	a6	-	-	-	-	-	-
	a7	-	-	-	-	-	-
	a8	-	-	-	-	-	-
VC ratio min	0.0	0.0	0.0	0.0	0.0	0.0	

A5.7 Vehicle operating cost tables, continued

Table A5.21 Additional VOC due to congestion regression coefficients by road category

$$VOC_{CONG} = \exp(a_0 + a_1 \times VC \text{ ratio} + a_2 \times VC \text{ ratio}^2)$$

Regression coefficient	Urban	Rural 2 lane		Motorway
		Strategic	Other	
a0	-11.7813	-5.9111	-6.4977	-54.4197
a1	26.2995	14.3851	15.2277	110.8108
a2	-13.0587	-6.8104	-7.1393	-54.8299

Notes: VOC_{CONG} = Additional vehicle operating costs due to congestion in cents/km

VC ratio = Volume to capacity ratio

VC = minimum(1.0, VC ratio)

Table A5.22 Additional VOC due to bottleneck delay by vehicle class (cents/minute – July 2002)

PC	LCV	MCV	HCVI	HCVII	Bus
1.11	1.24	1.38	2.06	2.06	1.62

Table A5.23 Additional VOC due to bottleneck delay by road category (cents/minute – July 2002)

Rural other	Rural strategic	Urban arterial	Urban other
1.197	1.211	1.158	1.158

A5.7 Vehicle operating cost tables, continued

Table A5.24 Passenger car additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.2																								
10	4.1	1.1																							
15	5.8	2.8	0.8																						
20	7.4	4.4	2.1	0.6																					
25	8.9	6.0	3.6	1.7	0.5																				
30	10.4	7.5	5.1	3.0	1.5	0.4																			
35	11.8	9.0	6.5	4.4	2.6	1.3	0.4																		
40	13.1	10.4	8.0	5.8	3.9	2.3	1.1	0.3																	
45	13.7	11.4	9.2	7.2	5.2	3.5	2.1	1.0	0.3																
50	14.3	12.1	10.0	8.1	6.3	4.7	3.2	1.9	0.9	0.3															
55	14.9	12.8	10.8	8.9	7.2	5.6	4.2	2.9	1.8	0.9	0.2														
60	15.4	13.4	11.5	9.7	8.1	6.5	5.1	3.8	2.6	1.7	0.8	0.2													
65	15.9	14.0	12.2	10.5	8.9	7.4	5.9	4.6	3.5	2.4	1.5	0.8	0.2												
70	16.4	14.6	12.9	11.2	9.6	8.2	6.8	5.5	4.3	3.2	2.2	1.4	0.7	0.2											
75	16.9	15.2	13.5	11.9	10.4	8.9	7.5	6.2	5.0	3.9	2.9	2.0	1.3	0.7	0.2										
80	17.4	15.7	14.1	12.5	11.1	9.6	8.3	7.0	5.8	4.7	3.7	2.7	1.9	1.2	0.6	0.2									
85	17.8	16.2	14.7	13.2	11.7	10.3	9.0	7.7	6.6	5.4	4.4	3.4	2.5	1.8	1.1	0.6	0.2								
90	18.3	16.7	15.2	13.8	12.4	11.0	9.7	8.5	7.3	6.2	5.1	4.1	3.2	2.4	1.7	1.0	0.5	0.2							
95	18.8	17.2	15.8	14.4	13.0	11.7	10.4	9.1	8.0	6.9	5.8	4.8	3.9	3.0	2.3	1.6	1.0	0.5	0.2						
100	19.2	17.7	16.3	14.9	13.6	12.3	11.0	9.8	8.7	7.5	6.5	5.5	4.6	3.7	2.9	2.1	1.5	0.9	0.5	0.2					
105	19.6	18.2	16.8	15.5	14.2	12.9	11.7	10.5	9.3	8.2	7.2	6.2	5.2	4.3	3.5	2.7	2.0	1.4	0.9	0.5	0.1				
110	20.1	18.7	17.3	16.0	14.7	13.5	12.3	11.1	10.0	8.9	7.8	6.8	5.9	5.0	4.1	3.3	2.6	1.9	1.3	0.8	0.4	0.1			
115	20.5	19.1	17.8	16.5	15.3	14.0	12.9	11.7	10.6	9.5	8.5	7.5	6.5	5.6	4.7	3.9	3.2	2.5	1.8	1.3	0.8	0.4	0.1		
120	20.9	19.6	18.3	17.0	15.8	14.6	13.4	12.3	11.2	10.1	9.1	8.1	7.1	6.2	5.4	4.5	3.8	3.0	2.4	1.8	1.2	0.8	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.25 Passenger car additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.0																								
10	0.1	0.0																							
15	0.1	0.1	0.0																						
20	0.2	0.1	0.1	0.0																					
25	0.2	0.2	0.1	0.1	0.0																				
30	0.3	0.2	0.2	0.1	0.1	0.0																			
35	0.4	0.3	0.3	0.2	0.2	0.1	0.0																		
40	0.4	0.4	0.3	0.3	0.2	0.1	0.1	0.0																	
45	0.5	0.5	0.4	0.4	0.3	0.2	0.2	0.1	0.0																
50	0.6	0.6	0.5	0.5	0.4	0.3	0.2	0.2	0.1	0.0															
55	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.0														
60	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.0													
65	0.9	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.0												
70	1.0	1.0	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.0											
75	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.0										
80	1.3	1.2	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0									
85	1.4	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0								
90	1.5	1.5	1.4	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0							
95	1.7	1.6	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0						
100	1.8	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0					
105	1.9	1.9	1.8	1.7	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0				
110	2.1	2.0	1.9	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0			
115	2.2	2.1	2.1	2.0	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0		
120	2.3	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0

A5.7 Vehicle operating cost tables, continued

Table A5.26 LCV additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.4																								
10	4.4	1.2																							
15	6.2	3.0	0.8																						
20	8.0	4.8	2.3	0.6																					
25	9.6	6.5	3.9	1.8	0.5																				
30	11.1	8.1	5.4	3.3	1.6	0.4																			
35	12.6	9.7	7.0	4.7	2.8	1.4	0.4																		
40	14.1	11.2	8.6	6.2	4.2	2.5	1.2	0.3																	
45	14.8	12.2	9.9	7.7	5.6	3.8	2.3	1.1	0.3																
50	15.4	13.0	10.8	8.7	6.8	5.1	3.5	2.1	1.0	0.3															
55	16.0	13.8	11.6	9.6	7.8	6.1	4.5	3.1	1.9	0.9	0.3														
60	16.6	14.5	12.5	10.5	8.7	7.0	5.5	4.1	2.8	1.8	0.9	0.2													
65	17.2	15.2	13.2	11.4	9.6	8.0	6.4	5.0	3.7	2.6	1.6	0.8	0.2												
70	17.8	15.9	14.0	12.2	10.5	8.8	7.3	5.9	4.6	3.4	2.4	1.5	0.8	0.2											
75	18.4	16.5	14.7	12.9	11.3	9.7	8.2	6.8	5.5	4.3	3.2	2.2	1.4	0.7	0.2										
80	18.9	17.1	15.4	13.7	12.0	10.5	9.0	7.6	6.3	5.1	4.0	3.0	2.1	1.3	0.7	0.2									
85	19.5	17.7	16.0	14.4	12.8	11.3	9.8	8.4	7.1	5.9	4.8	3.7	2.8	1.9	1.2	0.6	0.2								
90	20.0	18.3	16.7	15.1	13.5	12.0	10.6	9.2	7.9	6.7	5.6	4.5	3.5	2.6	1.8	1.1	0.6	0.2							
95	20.5	18.9	17.3	15.7	14.2	12.7	11.3	10.0	8.7	7.5	6.3	5.2	4.2	3.3	2.5	1.7	1.1	0.5	0.2						
100	21.0	19.4	17.9	16.3	14.9	13.4	12.1	10.7	9.5	8.3	7.1	6.0	5.0	4.0	3.1	2.3	1.6	1.0	0.5	0.2					
105	21.5	20.0	18.4	17.0	15.5	14.1	12.8	11.5	10.2	9.0	7.8	6.7	5.7	4.7	3.8	3.0	2.2	1.5	1.0	0.5	0.2				
110	22.0	20.5	19.0	17.6	16.2	14.8	13.5	12.2	10.9	9.7	8.6	7.5	6.4	5.4	4.5	3.6	2.8	2.1	1.5	0.9	0.5	0.1			
115	22.5	21.0	19.6	18.2	16.8	15.4	14.1	12.9	11.6	10.4	9.3	8.2	7.1	6.1	5.2	4.3	3.5	2.7	2.0	1.4	0.9	0.4	0.1		
120	23.0	21.5	20.1	18.7	17.4	16.1	14.8	13.5	12.3	11.1	10.0	8.9	7.9	6.8	5.9	5.0	4.1	3.3	2.6	1.9	1.3	0.8	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.27 LCV additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.1																								
10	0.1	0.0																							
15	0.2	0.1	0.0																						
20	0.2	0.1	0.1	0.0																					
25	0.3	0.2	0.2	0.1	0.0																				
30	0.4	0.3	0.2	0.2	0.1	0.0																			
35	0.5	0.4	0.3	0.3	0.2	0.1	0.0																		
40	0.6	0.5	0.4	0.4	0.3	0.2	0.1	0.1																	
45	0.7	0.6	0.6	0.5	0.4	0.3	0.2	0.1	0.1																
50	0.8	0.7	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.1															
55	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.1														
60	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.4	0.3	0.2	0.1	0.1													
65	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.3	0.2	0.1	0.1												
70	1.3	1.3	1.2	1.2	1.1	1.0	0.8	0.7	0.6	0.5	0.4	0.2	0.1	0.1											
75	1.5	1.4	1.4	1.3	1.2	1.1	1.0	0.9	0.7	0.6	0.5	0.4	0.3	0.1	0.1										
80	1.7	1.6	1.5	1.5	1.4	1.2	1.1	1.0	0.9	0.8	0.6	0.5	0.4	0.3	0.1	0.1									
85	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.1	1.0	0.9	0.8	0.6	0.5	0.4	0.3	0.1	0.0								
90	2.0	1.9	1.9	1.8	1.7	1.5	1.4	1.3	1.2	1.0	0.9	0.8	0.7	0.5	0.4	0.3	0.1	0.0							
95	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.1	0.9	0.8	0.7	0.5	0.4	0.3	0.1	0.0						
100	2.3	2.3	2.2	2.1	2.0	1.8	1.7	1.6	1.4	1.3	1.2	1.1	0.9	0.8	0.7	0.5	0.4	0.3	0.1	0.0					
105	2.5	2.4	2.3	2.2	2.1	2.0	1.8	1.7	1.6	1.4	1.3	1.2	1.0	0.9	0.8	0.7	0.5	0.4	0.3	0.1	0.0				
110	2.7	2.6	2.5	2.4	2.3	2.1	2.0	1.8	1.7	1.6	1.4	1.3	1.2	1.0	0.9	0.8	0.6	0.5	0.4	0.2	0.1	0.0			
115	2.8	2.7	2.6	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.5	1.4	1.3	1.1	1.0	0.9	0.8	0.6	0.5	0.4	0.2	0.1	0.0		
120	3.0	2.9	2.8	2.7	2.5	2.4	2.2	2.1	1.9	1.8	1.6	1.5	1.4	1.2	1.1	1.0	0.8	0.7	0.6	0.5	0.3	0.2	0.1	0.0	

A5.7 Vehicle operating cost tables, continued

Table A5.28 MCV additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.5																								
10	4.6	1.3																							
15	6.5	3.1	0.9																						
20	8.3	5.0	2.4	0.7																					
25	10.0	6.8	4.0	1.9	0.5																				
30	11.6	8.5	5.7	3.4	1.6	0.5																			
35	13.2	10.1	7.3	5.0	3.0	1.4	0.4																		
40	14.7	11.7	9.0	6.5	4.4	2.6	1.3	0.4																	
45	15.4	12.8	10.3	8.1	5.9	4.0	2.4	1.1	0.3																
50	16.1	13.6	11.3	9.1	7.1	5.3	3.6	2.2	1.0	0.3															
55	16.8	14.4	12.2	10.1	8.1	6.4	4.7	3.3	2.0	1.0	0.3														
60	17.4	15.2	13.0	11.0	9.1	7.4	5.7	4.3	3.0	1.9	0.9	0.3													
65	18.0	15.9	13.8	11.9	10.1	8.3	6.7	5.2	3.9	2.7	1.7	0.8	0.2												
70	18.6	16.6	14.6	12.7	10.9	9.2	7.7	6.2	4.8	3.6	2.5	1.6	0.8	0.2											
75	19.2	17.3	15.4	13.5	11.8	10.1	8.6	7.1	5.7	4.5	3.3	2.3	1.4	0.7	0.2										
80	19.8	17.9	16.1	14.3	12.6	11.0	9.4	8.0	6.6	5.3	4.2	3.1	2.1	1.3	0.7	0.2									
85	20.4	18.5	16.7	15.0	13.4	11.8	10.3	8.8	7.5	6.2	5.0	3.9	2.9	2.0	1.3	0.6	0.2								
90	20.9	19.1	17.4	15.7	14.1	12.6	11.1	9.7	8.3	7.0	5.8	4.7	3.7	2.7	1.9	1.2	0.6	0.2							
95	21.5	19.7	18.1	16.4	14.9	13.3	11.9	10.5	9.1	7.8	6.6	5.5	4.4	3.5	2.6	1.8	1.1	0.6	0.2						
100	22.0	20.3	18.7	17.1	15.6	14.1	12.6	11.2	9.9	8.6	7.4	6.3	5.2	4.2	3.3	2.4	1.7	1.1	0.5	0.2					
105	22.5	20.9	19.3	17.7	16.2	14.8	13.4	12.0	10.7	9.4	8.2	7.1	6.0	4.9	4.0	3.1	2.3	1.6	1.0	0.5	0.2				
110	23.0	21.4	19.9	18.4	16.9	15.5	14.1	12.7	11.4	10.2	9.0	7.8	6.7	5.7	4.7	3.8	3.0	2.2	1.5	1.0	0.5	0.2			
115	23.5	22.0	20.5	19.0	17.5	16.1	14.8	13.4	12.2	10.9	9.7	8.6	7.5	6.4	5.4	4.5	3.6	2.8	2.1	1.5	0.9	0.5	0.1		
120	24.0	22.5	21.0	19.6	18.2	16.8	15.4	14.1	12.9	11.6	10.5	9.3	8.2	7.2	6.2	5.2	4.3	3.5	2.7	2.0	1.4	0.9	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.29 MCV additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.1																								
10	0.2	0.1																							
15	0.3	0.2	0.1																						
20	0.4	0.3	0.2	0.1																					
25	0.6	0.5	0.4	0.2	0.1																				
30	0.7	0.7	0.6	0.4	0.3	0.1																			
35	1.0	0.9	0.8	0.6	0.5	0.3	0.2																		
40	1.2	1.1	1.0	0.9	0.7	0.6	0.4	0.2																	
45	1.5	1.4	1.3	1.2	1.0	0.8	0.6	0.4	0.2																
50	1.8	1.7	1.6	1.5	1.3	1.1	0.9	0.7	0.4	0.2															
55	2.2	2.1	2.0	1.8	1.7	1.4	1.2	1.0	0.7	0.5	0.2														
60	2.6	2.5	2.4	2.2	2.0	1.8	1.6	1.3	1.0	0.8	0.5	0.2													
65	3.0	2.9	2.8	2.6	2.4	2.2	2.0	1.7	1.4	1.1	0.8	0.5	0.2												
70	3.5	3.4	3.2	3.1	2.9	2.7	2.4	2.1	1.8	1.5	1.2	0.9	0.5	0.3											
75	3.9	3.8	3.7	3.5	3.3	3.1	2.9	2.6	2.3	2.0	1.6	1.3	0.9	0.6	0.3										
80	4.5	4.3	4.2	4.0	3.8	3.6	3.3	3.1	2.8	2.4	2.1	1.8	1.4	1.0	0.6	0.3									
85	5.0	4.9	4.7	4.6	4.4	4.1	3.8	3.6	3.3	2.9	2.6	2.2	1.9	1.5	1.0	0.6	0.2								
90	5.6	5.4	5.3	5.1	4.9	4.6	4.4	4.1	3.8	3.5	3.1	2.7	2.4	1.9	1.5	1.1	0.7	0.2							
95	6.2	6.0	5.9	5.7	5.5	5.2	4.9	4.6	4.3	4.0	3.6	3.3	2.9	2.5	2.0	1.6	1.1	0.7	0.2						
100	6.8	6.7	6.5	6.3	6.1	5.8	5.5	5.2	4.9	4.5	4.2	3.8	3.4	3.0	2.6	2.1	1.7	1.2	0.7	0.2					
105	7.5	7.3	7.1	6.9	6.7	6.4	6.1	5.8	5.5	5.1	4.8	4.4	4.0	3.6	3.1	2.7	2.2	1.7	1.2	0.7	0.3				
110	8.1	8.0	7.8	7.5	7.3	7.0	6.7	6.4	6.1	5.7	5.3	5.0	4.6	4.1	3.7	3.2	2.8	2.3	1.8	1.3	0.7	0.3			
115	8.8	8.7	8.4	8.2	7.9	7.6	7.3	7.0	6.7	6.3	5.9	5.5	5.1	4.7	4.3	3.8	3.4	2.9	2.4	1.8	1.3	0.8	0.3		
120	9.6	9.4	9.1	8.9	8.6	8.3	8.0	7.6	7.3	6.9	6.5	6.1	5.7	5.3	4.9	4.4	3.9	3.5	2.9	2.4	1.9	1.3	0.8	0.3	

A5.7 Vehicle operating cost tables, continued

Table A5.30 HCVI additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.9																								
10	5.3	1.5																							
15	7.6	3.6	1.0																						
20	9.6	5.7	2.8	0.8																					
25	11.6	7.8	4.7	2.2	0.6																				
30	13.5	9.8	6.6	3.9	1.9	0.5																			
35	15.3	11.7	8.5	5.7	3.4	1.6	0.5																		
40	17.0	13.5	10.3	7.5	5.1	3.0	1.5	0.4																	
45	17.8	14.8	11.9	9.3	6.8	4.6	2.7	1.3	0.4																
50	18.6	15.8	13.0	10.5	8.2	6.1	4.2	2.5	1.2	0.3															
55	19.4	16.7	14.1	11.7	9.4	7.3	5.5	3.8	2.3	1.1	0.3														
60	20.1	17.5	15.1	12.7	10.6	8.5	6.6	4.9	3.4	2.1	1.0	0.3													
65	20.9	18.4	16.0	13.8	11.6	9.6	7.8	6.1	4.5	3.1	2.0	1.0	0.3												
70	21.6	19.2	16.9	14.7	12.7	10.7	8.9	7.1	5.6	4.1	2.9	1.8	0.9	0.3											
75	22.3	20.0	17.8	15.7	13.6	11.7	9.9	8.2	6.6	5.2	3.8	2.7	1.7	0.9	0.2										
80	22.9	20.7	18.6	16.5	14.6	12.7	10.9	9.2	7.6	6.2	4.8	3.6	2.5	1.5	0.8	0.2									
85	23.6	21.5	19.4	17.4	15.5	13.6	11.9	10.2	8.6	7.2	5.8	4.5	3.3	2.3	1.4	0.7	0.2								
90	24.2	22.2	20.2	18.2	16.4	14.6	12.8	11.2	9.6	8.1	6.7	5.4	4.2	3.1	2.2	1.4	0.7	0.2							
95	24.9	22.9	20.9	19.0	17.2	15.4	13.7	12.1	10.6	9.1	7.7	6.4	5.1	4.0	3.0	2.1	1.3	0.7	0.2						
100	25.5	23.5	21.6	19.8	18.0	16.3	14.6	13.0	11.5	10.0	8.6	7.3	6.0	4.9	3.8	2.8	2.0	1.2	0.6	0.2					
105	26.1	24.2	22.4	20.6	18.8	17.1	15.5	13.9	12.4	10.9	9.5	8.2	6.9	5.7	4.6	3.6	2.7	1.9	1.2	0.6	0.2				
110	26.7	24.8	23.0	21.3	19.6	17.9	16.3	14.7	13.2	11.8	10.4	9.1	7.8	6.6	5.5	4.4	3.4	2.6	1.8	1.1	0.6	0.2			
115	27.3	25.5	23.7	22.0	20.3	18.7	17.1	15.6	14.1	12.7	11.3	9.9	8.7	7.4	6.3	5.2	4.2	3.3	2.4	1.7	1.1	0.5	0.2		
120	27.8	26.1	24.4	22.7	21.1	19.5	17.9	16.4	14.9	13.5	12.1	10.8	9.5	8.3	7.1	6.0	5.0	4.0	3.2	2.3	1.6	1.0	0.5	0.2	

A5.7 Vehicle operating cost tables, continued

Table A5.31 HCVI additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.1																								
10	0.3	0.1																							
15	0.5	0.4	0.2																						
20	0.8	0.7	0.5	0.2																					
25	1.3	1.1	0.9	0.6	0.3																				
30	1.8	1.7	1.4	1.1	0.8	0.4																			
35	2.4	2.3	2.0	1.7	1.4	0.9	0.4																		
40	3.1	3.0	2.7	2.4	2.0	1.5	1.0	0.5																	
45	4.0	3.8	3.5	3.2	2.7	2.3	1.7	1.1	0.6																
50	4.9	4.7	4.4	4.1	3.6	3.1	2.5	1.9	1.3	0.6															
55	5.9	5.7	5.5	5.1	4.6	4.1	3.4	2.7	2.0	1.4	0.7														
60	7.1	6.9	6.6	6.2	5.7	5.1	4.5	3.8	3.0	2.2	1.4	0.7													
65	8.3	8.1	7.8	7.4	6.9	6.3	5.7	4.9	4.1	3.3	2.4	1.5	0.7												
70	9.6	9.4	9.1	8.7	8.2	7.6	6.9	6.2	5.4	4.5	3.6	2.6	1.6	0.8											
75	11.0	10.8	10.5	10.1	9.6	9.0	8.3	7.5	6.7	5.8	4.8	3.8	2.8	1.7	0.8										
80	12.6	12.3	12.0	11.6	11.1	10.4	9.7	8.9	8.1	7.2	6.2	5.2	4.1	3.0	1.8	0.8									
85	14.2	13.9	13.6	13.1	12.6	11.9	11.2	10.4	9.6	8.7	7.7	6.6	5.5	4.4	3.2	1.9	0.8								
90	15.9	15.6	15.3	14.8	14.2	13.6	12.8	12.0	11.2	10.2	9.2	8.2	7.1	5.9	4.6	3.3	2.0	0.8							
95	17.7	17.4	17.0	16.5	16.0	15.3	14.5	13.7	12.8	11.9	10.9	9.8	8.7	7.5	6.2	4.9	3.5	2.1	0.8						
100	19.6	19.3	18.9	18.4	17.8	17.1	16.3	15.4	14.5	13.6	12.6	11.5	10.3	9.1	7.8	6.5	5.1	3.7	2.2	0.8					
105	21.6	21.3	20.8	20.3	19.7	18.9	18.1	17.3	16.3	15.4	14.3	13.2	12.1	10.9	9.6	8.2	6.8	5.4	3.8	2.3	0.8				
110	23.7	23.3	22.9	22.3	21.6	20.9	20.0	19.2	18.2	17.2	16.2	15.1	13.9	12.7	11.4	10.0	8.6	7.1	5.6	4.0	2.4	0.9			
115	25.9	25.5	25.0	24.4	23.7	22.9	22.0	21.1	20.2	19.2	18.1	17.0	15.8	14.5	13.2	11.9	10.4	8.9	7.4	5.8	4.1	2.5	0.9		
120	28.2	27.7	27.2	26.6	25.8	25.0	24.1	23.2	22.2	21.1	20.1	18.9	17.7	16.4	15.1	13.8	12.3	10.8	9.3	7.7	6.0	4.3	2.5	0.9	

A5.7 Vehicle operating cost tables, continued

Table A5.32 HC VII additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	3.2																								
10	6.0	1.6																							
15	8.4	4.0	1.1																						
20	10.7	6.4	3.1	0.9																					
25	12.9	8.7	5.2	2.5	0.7																				
30	15.0	10.9	7.3	4.4	2.1	0.6																			
35	17.0	13.0	9.4	6.4	3.8	1.8	0.5																		
40	18.9	15.0	11.5	8.4	5.7	3.4	1.6	0.5																	
45	19.9	16.5	13.3	10.4	7.5	5.1	3.1	1.5	0.4																
50	20.8	17.6	14.6	11.7	9.2	6.8	4.6	2.8	1.3	0.4															
55	21.7	18.6	15.7	13.0	10.5	8.2	6.1	4.2	2.6	1.2	0.3														
60	22.5	19.6	16.9	14.2	11.8	9.5	7.4	5.5	3.8	2.4	1.2	0.3													
65	23.4	20.6	17.9	15.4	13.0	10.8	8.7	6.8	5.0	3.5	2.2	1.1	0.3												
70	24.2	21.5	18.9	16.5	14.2	12.0	9.9	8.0	6.2	4.6	3.2	2.0	1.0	0.3											
75	24.9	22.4	19.9	17.5	15.3	13.1	11.1	9.2	7.4	5.8	4.3	3.0	1.9	0.9	0.3										
80	25.7	23.2	20.8	18.5	16.3	14.2	12.2	10.3	8.6	6.9	5.4	4.0	2.8	1.7	0.9	0.3									
85	26.5	24.1	21.8	19.5	17.4	15.3	13.3	11.5	9.7	8.0	6.5	5.0	3.7	2.6	1.6	0.8	0.3								
90	27.2	24.9	22.6	20.5	18.4	16.3	14.4	12.5	10.8	9.1	7.5	6.1	4.7	3.5	2.4	1.5	0.8	0.2							
95	27.9	25.7	23.5	21.4	19.3	17.3	15.4	13.6	11.8	10.2	8.6	7.1	5.7	4.5	3.3	2.3	1.4	0.7	0.2						
100	28.6	26.4	24.3	22.2	20.2	18.3	16.4	14.6	12.9	11.2	9.6	8.2	6.8	5.4	4.2	3.2	2.2	1.4	0.7	0.2					
105	29.3	27.2	25.1	23.1	21.1	19.2	17.4	15.6	13.9	12.2	10.7	9.2	7.8	6.4	5.2	4.0	3.0	2.1	1.3	0.7	0.2				
110	30.0	27.9	25.9	23.9	22.0	20.1	18.3	16.6	14.9	13.2	11.7	10.2	8.8	7.4	6.1	4.9	3.9	2.9	2.0	1.2	0.6	0.2			
115	30.7	28.7	26.7	24.7	22.9	21.0	19.2	17.5	15.8	14.2	12.7	11.2	9.7	8.4	7.1	5.9	4.7	3.7	2.7	1.9	1.2	0.6	0.2		
120	31.3	29.4	27.4	25.5	23.7	21.9	20.1	18.4	16.8	15.2	13.6	12.1	10.7	9.3	8.0	6.8	5.6	4.5	3.5	2.6	1.8	1.1	0.6	0.2	

A5.7 Vehicle operating cost tables, continued

Table A5.33 HC VII additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.2																								
10	0.5	0.3																							
15	1.0	0.7	0.4																						
20	1.6	1.4	1.0	0.5																					
25	2.5	2.3	1.9	1.4	0.7																				
30	3.6	3.4	3.0	2.4	1.7	0.9																			
35	4.9	4.7	4.3	3.7	2.9	2.0	1.0																		
40	6.4	6.2	5.8	5.2	4.4	3.4	2.4	1.2																	
45	8.3	8.0	7.5	6.8	6.0	5.0	3.9	2.7	1.4																
50	10.5	10.1	9.6	8.9	8.0	6.9	5.7	4.4	3.0	1.5															
55	12.9	12.5	12.0	11.3	10.4	9.2	7.9	6.4	4.9	3.3	1.7														
60	15.6	15.2	14.7	13.9	13.0	11.8	10.4	8.9	7.2	5.4	3.6	1.8													
65	18.5	18.1	17.6	16.8	15.8	14.6	13.3	11.7	9.9	8.0	6.0	3.9	1.9												
70	21.8	21.4	20.8	20.0	19.0	17.8	16.3	14.7	13.0	11.0	8.9	6.6	4.2	2.0											
75	25.3	24.9	24.3	23.5	22.4	21.2	19.7	18.1	16.3	14.3	12.1	9.7	7.2	4.5	2.1										
80	29.2	28.7	28.1	27.3	26.2	24.9	23.4	21.7	19.9	17.8	15.6	13.2	10.6	7.8	4.9	2.2									
85	33.4	32.9	32.2	31.3	30.2	28.9	27.4	25.6	23.7	21.7	19.4	16.9	14.3	11.4	8.4	5.3	2.3								
90	37.9	37.4	36.6	35.7	34.6	33.2	31.6	29.9	27.9	25.8	23.5	21.0	18.3	15.4	12.3	9.1	5.7	2.4							
95	42.8	42.2	41.4	40.4	39.3	37.8	36.2	34.4	32.4	30.3	27.9	25.3	22.6	19.6	16.5	13.2	9.7	6.1	2.5						
100	48.0	47.3	46.5	45.5	44.3	42.8	41.1	39.3	37.3	35.0	32.6	30.0	27.2	24.2	21.0	17.6	14.1	10.3	6.5	2.7					
105	53.6	52.9	52.0	50.9	49.6	48.1	46.4	44.5	42.4	40.1	37.7	35.0	32.2	29.1	25.9	22.4	18.8	15.0	11.0	6.9	2.8				
110	59.5	58.8	57.8	56.7	55.3	53.7	51.9	50.0	47.9	45.6	43.0	40.3	37.4	34.3	31.1	27.6	23.9	20.0	15.9	11.6	7.3	3.0			
115	65.8	65.0	64.0	62.8	61.4	59.7	57.9	55.9	53.7	51.3	48.7	46.0	43.0	39.9	36.6	33.0	29.3	25.3	21.1	16.8	12.3	7.7	3.1		
120	72.6	71.7	70.6	69.3	67.8	66.1	64.2	62.1	59.8	57.4	54.8	52.0	49.0	45.8	42.4	38.8	35.0	31.0	26.8	22.3	17.7	12.9	8.1	3.3	

A5.7 Vehicle operating cost tables, continued

Table A5.34 Bus additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.5																								
10	4.6	1.3																							
15	6.5	3.1	0.9																						
20	8.3	5.0	2.4	0.7																					
25	10.0	6.8	4.0	1.9	0.5																				
30	11.6	8.5	5.7	3.4	1.6	0.5																			
35	13.2	10.1	7.3	5.0	3.0	1.4	0.4																		
40	14.7	11.7	9.0	6.5	4.4	2.6	1.3	0.4																	
45	15.4	12.8	10.3	8.1	5.9	4.0	2.4	1.1	0.3																
50	16.1	13.6	11.3	9.1	7.1	5.3	3.6	2.2	1.0	0.3															
55	16.8	14.4	12.2	10.1	8.1	6.4	4.7	3.3	2.0	1.0	0.3														
60	17.4	15.2	13.0	11.0	9.1	7.4	5.7	4.3	3.0	1.9	0.9	0.3													
65	18.0	15.9	13.8	11.9	10.1	8.3	6.7	5.2	3.9	2.7	1.7	0.8	0.2												
70	18.6	16.6	14.6	12.7	10.9	9.2	7.7	6.2	4.8	3.6	2.5	1.6	0.8	0.2											
75	19.2	17.3	15.4	13.5	11.8	10.1	8.6	7.1	5.7	4.5	3.3	2.3	1.4	0.7	0.2										
80	19.8	17.9	16.1	14.3	12.6	11.0	9.4	8.0	6.6	5.3	4.2	3.1	2.1	1.3	0.7	0.2									
85	20.4	18.5	16.7	15.0	13.4	11.8	10.3	8.8	7.5	6.2	5.0	3.9	2.9	2.0	1.3	0.6	0.2								
90	20.9	19.1	17.4	15.7	14.1	12.6	11.1	9.7	8.3	7.0	5.8	4.7	3.7	2.7	1.9	1.2	0.6	0.2							
95	21.5	19.7	18.1	16.4	14.9	13.3	11.9	10.5	9.1	7.8	6.6	5.5	4.4	3.5	2.6	1.8	1.1	0.6	0.2						
100	22.0	20.3	18.7	17.1	15.6	14.1	12.6	11.2	9.9	8.6	7.4	6.3	5.2	4.2	3.3	2.4	1.7	1.1	0.5	0.2					
105	22.5	20.9	19.3	17.7	16.2	14.8	13.4	12.0	10.7	9.4	8.2	7.1	6.0	4.9	4.0	3.1	2.3	1.6	1.0	0.5	0.2				
110	23.0	21.4	19.9	18.4	16.9	15.5	14.1	12.7	11.4	10.2	9.0	7.8	6.7	5.7	4.7	3.8	3.0	2.2	1.5	1.0	0.5	0.2			
115	23.5	22.0	20.5	19.0	17.5	16.1	14.8	13.4	12.2	10.9	9.7	8.6	7.5	6.4	5.4	4.5	3.6	2.8	2.1	1.5	0.9	0.5	0.1		
120	24.0	22.5	21.0	19.6	18.2	16.8	15.4	14.1	12.9	11.6	10.5	9.3	8.2	7.2	6.2	5.2	4.3	3.5	2.7	2.0	1.4	0.9	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.35 Bus additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.1																								
10	0.2	0.1																							
15	0.4	0.3	0.2																						
20	0.7	0.5	0.4	0.2																					
25	1.0	0.9	0.7	0.5	0.3																				
30	1.4	1.3	1.1	0.9	0.6	0.3																			
35	1.9	1.8	1.6	1.3	1.1	0.7	0.4																		
40	2.4	2.3	2.1	1.9	1.6	1.2	0.8	0.4																	
45	3.0	2.9	2.7	2.4	2.1	1.7	1.3	0.9	0.5																
50	3.8	3.6	3.4	3.1	2.8	2.3	1.9	1.5	1.0	0.5															
55	4.5	4.4	4.2	3.9	3.5	3.1	2.6	2.1	1.6	1.1	0.5														
60	5.4	5.2	5.0	4.7	4.4	3.9	3.4	2.9	2.3	1.7	1.1	0.5													
65	6.3	6.2	5.9	5.6	5.3	4.8	4.3	3.8	3.2	2.5	1.8	1.2	0.6												
70	7.3	7.1	6.9	6.6	6.2	5.8	5.2	4.7	4.1	3.4	2.7	2.0	1.2	0.6											
75	8.4	8.2	8.0	7.6	7.2	6.8	6.2	5.7	5.1	4.4	3.7	2.9	2.1	1.3	0.6										
80	9.5	9.3	9.1	8.7	8.3	7.8	7.3	6.7	6.1	5.4	4.7	3.9	3.1	2.2	1.4	0.6									
85	10.7	10.5	10.2	9.9	9.5	9.0	8.4	7.8	7.2	6.5	5.8	5.0	4.1	3.3	2.4	1.4	0.6								
90	12.0	11.8	11.5	11.1	10.7	10.2	9.6	9.0	8.3	7.6	6.9	6.1	5.3	4.4	3.4	2.5	1.5	0.5							
95	13.4	13.1	12.8	12.4	11.9	11.4	10.8	10.2	9.5	8.8	8.1	7.3	6.4	5.5	4.6	3.6	2.6	1.5	0.6						
100	14.8	14.5	14.1	13.7	13.3	12.7	12.1	11.5	10.8	10.1	9.3	8.5	7.6	6.7	5.8	4.8	3.8	2.7	1.6	0.6					
105	16.2	15.9	15.6	15.1	14.6	14.1	13.4	12.8	12.1	11.4	10.6	9.8	8.9	8.0	7.0	6.0	5.0	3.9	2.8	1.6	0.6				
110	17.8	17.4	17.0	16.6	16.0	15.4	14.8	14.1	13.4	12.7	11.9	11.1	10.2	9.3	8.3	7.3	6.3	5.2	4.0	2.9	1.7	0.6			
115	19.4	19.0	18.5	18.1	17.5	16.9	16.2	15.5	14.8	14.0	13.2	12.4	11.5	10.6	9.6	8.6	7.6	6.5	5.3	4.2	2.9	1.7	0.6		
120	21.0	20.6	20.1	19.6	19.0	18.4	17.7	17.0	16.2	15.4	14.6	13.7	12.8	11.9	11.0	9.9	8.9	7.8	6.7	5.5	4.3	3.0	1.8	0.6	

A5.7 Vehicle operating cost tables, continued

Table A5.36 Urban arterial additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.3																								
10	4.2	1.2																							
15	6.0	2.8	0.8																						
20	7.6	4.5	2.2	0.6																					
25	9.1	6.1	3.7	1.8	0.5																				
30	10.6	7.7	5.2	3.1	1.5	0.4																			
35	12.0	9.2	6.7	4.5	2.7	1.3	0.4																		
40	13.4	10.7	8.2	5.9	4.0	2.4	1.2	0.3																	
45	14.0	11.6	9.4	7.3	5.3	3.6	2.2	1.0	0.3																
50	14.6	12.4	10.2	8.3	6.5	4.8	3.3	2.0	1.0	0.3															
55	15.2	13.1	11.0	9.2	7.4	5.8	4.3	3.0	1.8	0.9	0.2														
60	15.7	13.7	11.8	10.0	8.3	6.7	5.2	3.9	2.7	1.7	0.8	0.2													
65	16.3	14.3	12.5	10.7	9.1	7.5	6.1	4.7	3.5	2.5	1.5	0.8	0.2												
70	16.8	14.9	13.2	11.5	9.9	8.3	6.9	5.6	4.4	3.2	2.3	1.4	0.7	0.2											
75	17.3	15.5	13.8	12.2	10.6	9.1	7.7	6.4	5.2	4.0	3.0	2.1	1.3	0.7	0.2										
80	17.8	16.1	14.4	12.9	11.3	9.9	8.5	7.2	5.9	4.8	3.7	2.8	1.9	1.2	0.6	0.2									
85	18.3	16.6	15.0	13.5	12.0	10.6	9.2	7.9	6.7	5.6	4.5	3.5	2.6	1.8	1.1	0.6	0.2								
90	18.8	17.2	15.6	14.1	12.7	11.3	9.9	8.7	7.5	6.3	5.2	4.2	3.3	2.4	1.7	1.1	0.5	0.2							
95	19.2	17.7	16.2	14.7	13.3	12.0	10.6	9.4	8.2	7.0	5.9	4.9	4.0	3.1	2.3	1.6	1.0	0.5	0.2						
100	19.7	18.2	16.7	15.3	13.9	12.6	11.3	10.1	8.9	7.7	6.7	5.6	4.7	3.8	2.9	2.2	1.5	1.0	0.5	0.2					
105	20.1	18.7	17.3	15.9	14.5	13.2	12.0	10.7	9.6	8.4	7.3	6.3	5.3	4.4	3.6	2.8	2.1	1.4	0.9	0.5	0.1				
110	20.6	19.2	17.8	16.4	15.1	13.8	12.6	11.4	10.2	9.1	8.0	7.0	6.0	5.1	4.2	3.4	2.7	2.0	1.4	0.9	0.4	0.1			
115	21.0	19.6	18.3	17.0	15.7	14.4	13.2	12.0	10.9	9.8	8.7	7.7	6.7	5.7	4.9	4.0	3.3	2.5	1.9	1.3	0.8	0.4	0.1		
120	21.4	20.1	18.8	17.5	16.2	15.0	13.8	12.6	11.5	10.4	9.3	8.3	7.3	6.4	5.5	4.7	3.9	3.1	2.4	1.8	1.3	0.8	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.37 Urban arterial additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																									
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115		
5	0.0																									
10	0.1	0.0																								
15	0.1	0.1	0.0																							
20	0.2	0.1	0.1	0.0																						
25	0.3	0.2	0.2	0.1	0.1																					
30	0.4	0.3	0.3	0.2	0.1	0.1																				
35	0.5	0.4	0.4	0.3	0.2	0.1	0.1																			
40	0.6	0.6	0.5	0.4	0.3	0.2	0.1	0.1																		
45	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.2	0.1																	
50	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1																
55	1.1	1.0	0.9	0.9	0.8	0.6	0.5	0.4	0.3	0.2	0.1															
60	1.2	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.4	0.3	0.2	0.1														
65	1.4	1.4	1.3	1.2	1.1	1.0	0.9	0.7	0.6	0.5	0.3	0.2	0.1													
70	1.6	1.6	1.5	1.4	1.3	1.2	1.1	0.9	0.8	0.6	0.5	0.3	0.2	0.1												
75	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.1	1.0	0.8	0.7	0.5	0.4	0.2	0.1											
80	2.0	2.0	1.9	1.8	1.7	1.6	1.5	1.3	1.2	1.0	0.9	0.7	0.5	0.4	0.2	0.1										
85	2.3	2.2	2.2	2.1	2.0	1.8	1.7	1.5	1.4	1.2	1.1	0.9	0.7	0.6	0.4	0.2	0.1									
90	2.5	2.5	2.4	2.3	2.2	2.1	1.9	1.8	1.6	1.5	1.3	1.1	0.9	0.8	0.6	0.4	0.2	0.1								
95	2.8	2.7	2.6	2.6	2.4	2.3	2.2	2.0	1.8	1.7	1.5	1.3	1.2	1.0	0.8	0.6	0.4	0.2	0.1							
100	3.0	3.0	2.9	2.8	2.7	2.5	2.4	2.2	2.1	1.9	1.7	1.6	1.4	1.2	1.0	0.8	0.6	0.4	0.2	0.1						
105	3.3	3.3	3.2	3.1	2.9	2.8	2.6	2.5	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.1	0.9	0.7	0.4	0.3	0.1					
110	3.6	3.5	3.4	3.3	3.2	3.1	2.9	2.7	2.6	2.4	2.2	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3	0.1				
115	3.9	3.8	3.7	3.6	3.5	3.3	3.2	3.0	2.8	2.6	2.5	2.3	2.1	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3	0.1			
120	4.2	4.1	4.0	3.9	3.8	3.6	3.4	3.2	3.1	2.9	2.7	2.5	2.3	2.1	2.0	1.8	1.5	1.3	1.1	0.9	0.7	0.5	0.3	0.1		

A5.7 Vehicle operating cost tables, continued

Table A5.38 Urban other additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.3																								
10	4.2	1.2																							
15	5.9	2.8	0.8																						
20	7.6	4.5	2.2	0.6																					
25	9.1	6.1	3.7	1.8	0.5																				
30	10.6	7.7	5.2	3.1	1.5	0.4																			
35	12.0	9.2	6.7	4.5	2.7	1.3	0.4																		
40	13.4	10.6	8.1	5.9	4.0	2.4	1.2	0.3																	
45	14.0	11.6	9.4	7.3	5.3	3.6	2.2	1.0	0.3																
50	14.6	12.3	10.2	8.3	6.5	4.8	3.3	2.0	1.0	0.3															
55	15.2	13.0	11.0	9.1	7.4	5.8	4.3	3.0	1.8	0.9	0.2														
60	15.7	13.7	11.8	10.0	8.2	6.7	5.2	3.9	2.7	1.7	0.8	0.2													
65	16.2	14.3	12.5	10.7	9.1	7.5	6.1	4.7	3.5	2.5	1.5	0.8	0.2												
70	16.8	14.9	13.2	11.5	9.9	8.3	6.9	5.6	4.3	3.2	2.3	1.4	0.7	0.2											
75	17.3	15.5	13.8	12.2	10.6	9.1	7.7	6.4	5.2	4.0	3.0	2.1	1.3	0.7	0.2										
80	17.8	16.1	14.4	12.8	11.3	9.9	8.5	7.2	5.9	4.8	3.7	2.8	1.9	1.2	0.6	0.2									
85	18.3	16.6	15.0	13.5	12.0	10.6	9.2	7.9	6.7	5.5	4.5	3.5	2.6	1.8	1.1	0.6	0.2								
90	18.7	17.1	15.6	14.1	12.7	11.3	9.9	8.7	7.4	6.3	5.2	4.2	3.3	2.4	1.7	1.1	0.5	0.2							
95	19.2	17.6	16.1	14.7	13.3	11.9	10.6	9.4	8.2	7.0	5.9	4.9	4.0	3.1	2.3	1.6	1.0	0.5	0.2						
100	19.6	18.1	16.7	15.3	13.9	12.6	11.3	10.0	8.9	7.7	6.6	5.6	4.7	3.8	2.9	2.2	1.5	0.9	0.5	0.2					
105	20.1	18.6	17.2	15.8	14.5	13.2	11.9	10.7	9.5	8.4	7.3	6.3	5.3	4.4	3.6	2.8	2.1	1.4	0.9	0.5	0.1				
110	20.5	19.1	17.7	16.4	15.1	13.8	12.6	11.4	10.2	9.1	8.0	7.0	6.0	5.1	4.2	3.4	2.7	2.0	1.4	0.9	0.4	0.1			
115	21.0	19.6	18.2	16.9	15.6	14.4	13.2	12.0	10.8	9.7	8.7	7.6	6.7	5.7	4.9	4.0	3.3	2.5	1.9	1.3	0.8	0.4	0.1		
120	21.4	20.0	18.7	17.4	16.2	15.0	13.8	12.6	11.5	10.4	9.3	8.3	7.3	6.4	5.5	4.6	3.9	3.1	2.4	1.8	1.3	0.8	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.39 Urban other additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.0																								
10	0.1	0.0																							
15	0.1	0.1	0.0																						
20	0.2	0.1	0.1	0.0																					
25	0.3	0.2	0.2	0.1	0.0																				
30	0.4	0.3	0.3	0.2	0.1	0.1																			
35	0.5	0.4	0.4	0.3	0.2	0.1	0.1																		
40	0.6	0.5	0.5	0.4	0.3	0.2	0.1	0.1																	
45	0.7	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.1																
50	0.8	0.8	0.7	0.7	0.6	0.5	0.3	0.2	0.2	0.1															
55	1.0	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1														
60	1.2	1.1	1.1	1.0	0.9	0.8	0.6	0.5	0.4	0.3	0.2	0.1													
65	1.3	1.3	1.2	1.1	1.1	0.9	0.8	0.7	0.5	0.4	0.3	0.2	0.1												
70	1.5	1.5	1.4	1.3	1.2	1.1	1.0	0.8	0.7	0.6	0.4	0.3	0.2	0.1											
75	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.0	0.9	0.8	0.6	0.5	0.3	0.2	0.1										
80	1.9	1.9	1.8	1.7	1.6	1.5	1.4	1.2	1.1	0.9	0.8	0.6	0.5	0.3	0.2	0.1									
85	2.1	2.1	2.0	1.9	1.8	1.7	1.5	1.4	1.3	1.1	1.0	0.8	0.7	0.5	0.3	0.2	0.1								
90	2.3	2.3	2.2	2.1	2.0	1.9	1.8	1.6	1.5	1.3	1.2	1.0	0.9	0.7	0.5	0.4	0.2	0.1							
95	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.8	1.7	1.5	1.4	1.2	1.0	0.9	0.7	0.5	0.4	0.2	0.1						
100	2.8	2.7	2.7	2.6	2.5	2.3	2.2	2.0	1.9	1.7	1.6	1.4	1.2	1.1	0.9	0.7	0.6	0.4	0.2	0.1					
105	3.1	3.0	2.9	2.8	2.7	2.5	2.4	2.2	2.1	1.9	1.8	1.6	1.4	1.3	1.1	0.9	0.7	0.6	0.4	0.2	0.1				
110	3.3	3.2	3.1	3.0	2.9	2.8	2.6	2.5	2.3	2.2	2.0	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.6	0.4	0.2	0.1			
115	3.6	3.5	3.4	3.3	3.2	3.0	2.8	2.7	2.5	2.4	2.2	2.0	1.9	1.7	1.5	1.3	1.1	1.0	0.8	0.6	0.4	0.2	0.1		
120	3.8	3.7	3.6	3.5	3.4	3.2	3.1	2.9	2.7	2.6	2.4	2.2	2.1	1.9	1.7	1.5	1.3	1.2	1.0	0.8	0.6	0.4	0.2	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.40 Rural strategic additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																									
	0	5	10	15	20	$\frac{2}{5}$	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115		
5	2.3																									
10	4.3	1.2																								
15	6.1	2.9	0.8																							
20	7.7	4.6	2.2	0.6																						
25	9.3	6.3	3.7	1.8	0.5																					
30	10.8	7.9	5.3	3.2	1.5	0.4																				
35	12.3	9.4	6.8	4.6	2.8	1.3	0.4																			
40	13.7	10.9	8.3	6.0	4.1	2.4	1.2	0.3																		
45	14.3	11.9	9.6	7.5	5.4	3.7	2.2	1.1	0.3																	
50	14.9	12.6	10.5	8.4	6.6	4.9	3.4	2.0	1.0	0.3																
55	15.5	13.3	11.3	9.3	7.5	5.9	4.4	3.1	1.9	0.9	0.3															
60	16.1	14.0	12.0	10.2	8.4	6.8	5.3	4.0	2.8	1.7	0.8	0.2														
65	16.6	14.6	12.8	11.0	9.3	7.7	6.2	4.8	3.6	2.5	1.6	0.8	0.2													
70	17.2	15.3	13.5	11.7	10.1	8.5	7.1	5.7	4.4	3.3	2.3	1.4	0.7	0.2												
75	17.7	15.9	14.1	12.4	10.8	9.3	7.9	6.5	5.3	4.1	3.1	2.1	1.3	0.7	0.2											
80	18.2	16.4	14.8	13.1	11.6	10.1	8.7	7.3	6.1	4.9	3.8	2.8	2.0	1.2	0.6	0.2										
85	18.7	17.0	15.4	13.8	12.3	10.8	9.4	8.1	6.9	5.7	4.6	3.6	2.7	1.9	1.2	0.6	0.2									
90	19.2	17.5	16.0	14.4	13.0	11.5	10.2	8.9	7.6	6.4	5.3	4.3	3.4	2.5	1.7	1.1	0.6	0.2								
95	19.7	18.1	16.5	15.0	13.6	12.2	10.9	9.6	8.4	7.2	6.1	5.0	4.1	3.2	2.4	1.6	1.0	0.5	0.2							
100	20.1	18.6	17.1	15.6	14.2	12.9	11.6	10.3	9.1	7.9	6.8	5.8	4.8	3.8	3.0	2.2	1.6	1.0	0.5	0.2						
105	20.6	19.1	17.6	16.2	14.8	13.5	12.2	11.0	9.8	8.6	7.5	6.5	5.5	4.5	3.7	2.9	2.1	1.5	0.9	0.5	0.1					
110	21.0	19.6	18.2	16.8	15.4	14.1	12.9	11.6	10.4	9.3	8.2	7.2	6.2	5.2	4.3	3.5	2.7	2.0	1.4	0.9	0.5	0.1				
115	21.5	20.1	18.7	17.3	16.0	14.7	13.5	12.3	11.1	10.0	8.9	7.8	6.8	5.9	5.0	4.1	3.3	2.6	1.9	1.3	0.8	0.4	0.1			
120	21.9	20.5	19.2	17.9	16.6	15.3	14.1	12.9	11.7	10.6	9.5	8.5	7.5	6.5	5.6	4.8	3.9	3.2	2.5	1.9	1.3	0.8	0.4	0.1		

A5.7 Vehicle operating cost tables, continued

Table A5.41 Rural strategic additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.1																								
10	0.1	0.0																							
15	0.2	0.1	0.0																						
20	0.3	0.2	0.1	0.1																					
25	0.4	0.3	0.2	0.2	0.1																				
30	0.5	0.4	0.4	0.3	0.2	0.1																			
35	0.7	0.6	0.5	0.4	0.3	0.2	0.1																		
40	0.8	0.8	0.7	0.6	0.5	0.4	0.2	0.1																	
45	1.0	1.0	0.9	0.8	0.7	0.5	0.4	0.3	0.1																
50	1.2	1.2	1.1	1.0	0.9	0.7	0.6	0.4	0.3	0.1															
55	1.5	1.4	1.3	1.2	1.1	1.0	0.8	0.6	0.4	0.3	0.1														
60	1.7	1.7	1.6	1.5	1.4	1.2	1.0	0.9	0.7	0.5	0.3	0.1													
65	2.0	2.0	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3	0.2												
70	2.3	2.3	2.2	2.1	1.9	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.3	0.2											
75	2.7	2.6	2.5	2.4	2.3	2.1	1.9	1.7	1.5	1.3	1.1	0.8	0.6	0.4	0.2										
80	3.0	2.9	2.9	2.7	2.6	2.4	2.2	2.0	1.8	1.6	1.4	1.1	0.9	0.6	0.4	0.2									
85	3.4	3.3	3.2	3.1	3.0	2.8	2.6	2.4	2.2	1.9	1.7	1.5	1.2	0.9	0.7	0.4	0.2								
90	3.8	3.7	3.6	3.5	3.3	3.1	2.9	2.7	2.5	2.3	2.1	1.8	1.5	1.3	1.0	0.7	0.4	0.2							
95	4.2	4.1	4.0	3.9	3.7	3.5	3.3	3.1	2.9	2.7	2.4	2.2	1.9	1.6	1.3	1.0	0.7	0.4	0.2						
100	4.6	4.5	4.4	4.3	4.1	3.9	3.7	3.5	3.3	3.0	2.8	2.5	2.3	2.0	1.7	1.4	1.1	0.8	0.5	0.2					
105	5.1	5.0	4.8	4.7	4.5	4.3	4.1	3.9	3.7	3.4	3.2	2.9	2.7	2.4	2.1	1.8	1.5	1.1	0.8	0.5	0.2				
110	5.5	5.4	5.3	5.2	5.0	4.8	4.6	4.3	4.1	3.9	3.6	3.3	3.1	2.8	2.5	2.2	1.8	1.5	1.2	0.8	0.5	0.2			
115	6.0	5.9	5.8	5.6	5.4	5.2	5.0	4.8	4.5	4.3	4.0	3.7	3.5	3.2	2.9	2.6	2.2	1.9	1.6	1.2	0.9	0.5	0.2		
120	6.5	6.4	6.3	6.1	5.9	5.7	5.5	5.2	5.0	4.7	4.4	4.2	3.9	3.6	3.3	3.0	2.6	2.3	2.0	1.6	1.2	0.9	0.5	0.2	

A5.7 Vehicle operating cost tables, continued

Table A5.42 Rural other additional travel time due to speed change cycles (seconds/speed cycle)

Initial speed (km/h)	Additional travel time in seconds/speed cycle by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	2.3																								
10	4.3	1.2																							
15	6.0	2.9	0.8																						
20	7.7	4.6	2.2	0.6																					
25	9.2	6.2	3.7	1.8	0.5																				
30	10.7	7.8	5.3	3.1	1.5	0.4																			
35	12.2	9.3	6.8	4.6	2.7	1.3	0.4																		
40	13.6	10.8	8.3	6.0	4.1	2.4	1.2	0.3																	
45	14.2	11.8	9.5	7.4	5.4	3.7	2.2	1.1	0.3																
50	14.8	12.5	10.4	8.4	6.6	4.9	3.3	2.0	1.0	0.3															
55	15.4	13.2	11.2	9.3	7.5	5.8	4.4	3.0	1.8	0.9	0.3														
60	16.0	13.9	12.0	10.1	8.4	6.8	5.3	3.9	2.7	1.7	0.8	0.2													
65	16.5	14.5	12.7	10.9	9.2	7.6	6.2	4.8	3.6	2.5	1.6	0.8	0.2												
70	17.0	15.2	13.4	11.6	10.0	8.5	7.0	5.7	4.4	3.3	2.3	1.4	0.7	0.2											
75	17.6	15.8	14.0	12.4	10.8	9.3	7.8	6.5	5.2	4.1	3.0	2.1	1.3	0.7	0.2										
80	18.1	16.3	14.7	13.0	11.5	10.0	8.6	7.3	6.0	4.9	3.8	2.8	2.0	1.2	0.6	0.2									
85	18.6	16.9	15.3	13.7	12.2	10.7	9.4	8.1	6.8	5.6	4.6	3.6	2.6	1.8	1.1	0.6	0.2								
90	19.0	17.4	15.8	14.3	12.9	11.4	10.1	8.8	7.6	6.4	5.3	4.3	3.3	2.5	1.7	1.1	0.6	0.2							
95	19.5	17.9	16.4	14.9	13.5	12.1	10.8	9.5	8.3	7.1	6.0	5.0	4.0	3.1	2.3	1.6	1.0	0.5	0.2						
100	20.0	18.5	17.0	15.5	14.1	12.8	11.5	10.2	9.0	7.9	6.8	5.7	4.7	3.8	3.0	2.2	1.5	1.0	0.5	0.2					
105	20.4	19.0	17.5	16.1	14.7	13.4	12.1	10.9	9.7	8.6	7.5	6.4	5.4	4.5	3.6	2.8	2.1	1.5	0.9	0.5	0.1				
110	20.9	19.4	18.0	16.7	15.3	14.0	12.8	11.6	10.4	9.2	8.1	7.1	6.1	5.2	4.3	3.5	2.7	2.0	1.4	0.9	0.4	0.1			
115	21.3	19.9	18.6	17.2	15.9	14.6	13.4	12.2	11.0	9.9	8.8	7.8	6.8	5.8	4.9	4.1	3.3	2.6	1.9	1.3	0.8	0.4	0.1		
120	21.8	20.4	19.1	17.7	16.5	15.2	14.0	12.8	11.7	10.6	9.5	8.4	7.4	6.5	5.6	4.7	3.9	3.2	2.5	1.8	1.3	0.8	0.4	0.1	

A5.7 Vehicle operating cost tables, continued

Table A5.43 Rural other additional VOC due to speed change cycles (cents/speed cycle)

Initial speed (km/h)	Additional VOC (in cents/speed cycle) by final speed																								
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	
5	0.1																								
10	0.1	0.0																							
15	0.2	0.1	0.0																						
20	0.2	0.2	0.1	0.0																					
25	0.4	0.3	0.2	0.1	0.1																				
30	0.5	0.4	0.3	0.3	0.2	0.1																			
35	0.6	0.5	0.5	0.4	0.3	0.2	0.1																		
40	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1																	
45	0.9	0.9	0.8	0.7	0.6	0.5	0.3	0.2	0.1																
50	1.1	1.1	1.0	0.9	0.8	0.6	0.5	0.4	0.2	0.1															
55	1.3	1.3	1.2	1.1	1.0	0.9	0.7	0.5	0.4	0.3	0.1														
60	1.6	1.5	1.4	1.4	1.2	1.1	0.9	0.8	0.6	0.4	0.3	0.1													
65	1.8	1.8	1.7	1.6	1.5	1.3	1.2	1.0	0.8	0.6	0.4	0.3	0.1												
70	2.1	2.0	2.0	1.9	1.7	1.6	1.4	1.2	1.1	0.9	0.7	0.5	0.3	0.1											
75	2.4	2.3	2.2	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3	0.1										
80	2.7	2.6	2.5	2.4	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.5	0.3	0.1									
85	3.0	3.0	2.9	2.8	2.6	2.5	2.3	2.1	1.9	1.7	1.5	1.3	1.0	0.8	0.6	0.3	0.1								
90	3.4	3.3	3.2	3.1	3.0	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.3	1.1	0.9	0.6	0.4	0.1							
95	3.7	3.6	3.5	3.4	3.3	3.1	2.9	2.7	2.5	2.3	2.1	1.9	1.6	1.4	1.2	0.9	0.6	0.4	0.1						
100	4.1	4.0	3.9	3.8	3.6	3.5	3.3	3.1	2.9	2.7	2.4	2.2	2.0	1.7	1.5	1.2	0.9	0.7	0.4	0.1					
105	4.5	4.4	4.3	4.2	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.5	2.3	2.1	1.8	1.5	1.2	1.0	0.7	0.4	0.1				
110	4.9	4.8	4.7	4.5	4.4	4.2	4.0	3.8	3.6	3.4	3.1	2.9	2.6	2.4	2.1	1.9	1.6	1.3	1.0	0.7	0.4	0.2			
115	5.3	5.2	5.1	4.9	4.8	4.6	4.4	4.2	4.0	3.7	3.5	3.2	3.0	2.7	2.5	2.2	1.9	1.6	1.3	1.0	0.7	0.4	0.2		
120	5.8	5.6	5.5	5.4	5.2	5.0	4.8	4.6	4.3	4.1	3.9	3.6	3.4	3.1	2.8	2.6	2.3	2.0	1.7	1.4	1.1	0.7	0.4	0.2	