

# The Social Cost of Road Crashes and Injuries

## June 2008 update

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## Overview

This is an annual update of the Social Cost of Road Crashes and Injuries published by the Ministry of Transport.

The social cost of road crashes and injuries is a measure of the total cost of road crashes to the nation. It includes loss of life and life quality, loss of productivity, medical, legal and court and property damage costs.

This report provides estimates, at June 2008 prices, of:

- the average social cost per injury and per crash
- total social cost of road crashes and injuries in 2007
- annual total social cost of road crashes and injuries for the years from 1997 to 2007.

The social cost information provided in this report facilitates consistent appraisal of the safety benefits from the prevention of road crashes and injuries.

### Average social cost per injury and per crash

The average social costs per crash and per injury, by cost component and severity, at June 2008 prices, are summarised in Table S1, which shows the updated value of statistical life (VOSL) is \$3.35 million per fatality. Table S2 shows the average social cost per property damage-only (PDO) crash. These estimates have not been adjusted for the level of non-reporting.

**Table S1: Average social cost per crash and per injury, by cost component**

Per crash (Note)	June 2008 prices (\$)		
	Fatal	Serious	Minor
Loss of life/permanent disability	4,002,000	393,200	17,200
Loss of output (temporary disability)	800	1,700	400
Medical	13,800	15,800	1,000
Legal and Court	13,400	2,900	600
Property damage	9,600	6,100	4,900
<b>Total</b>	<b>4,039,500</b>	<b>419,700</b>	<b>24,000</b>
Per injury (Note)	Fatal	Serious	Minor
Loss of life/permanent disability	3,352,400	335,200	13,400
Loss of output (temporary disability)	0	1,400	300
Medical	6,100	13,400	800
Legal and Court	10,500	2,300	500
Property damage	5,000	3,600	3,800
<b>Total</b>	<b>3,374,100</b>	<b>355,900</b>	<b>18,800</b>

Notes:

1. Figures may not sum to totals due to rounding.
2. These estimates have NOT been adjusted for the level of non-reporting.

**Table S2: Average social cost per property damage-only crash**

Per PDO crash (Note)	All areas	Rural	Urban
Property damage only	2,500	2,700	2,300

Note: These estimates have NOT been adjusted for the level of non-reporting.

Table S3 summarises the average social costs per reported crash and per reported injury, at June 2008 prices, by severity and area after adjusting for the level of non-reporting. There are slight differences between the estimates for rural and urban areas due to the differences in the average crash severity and the average number of injuries per crash.

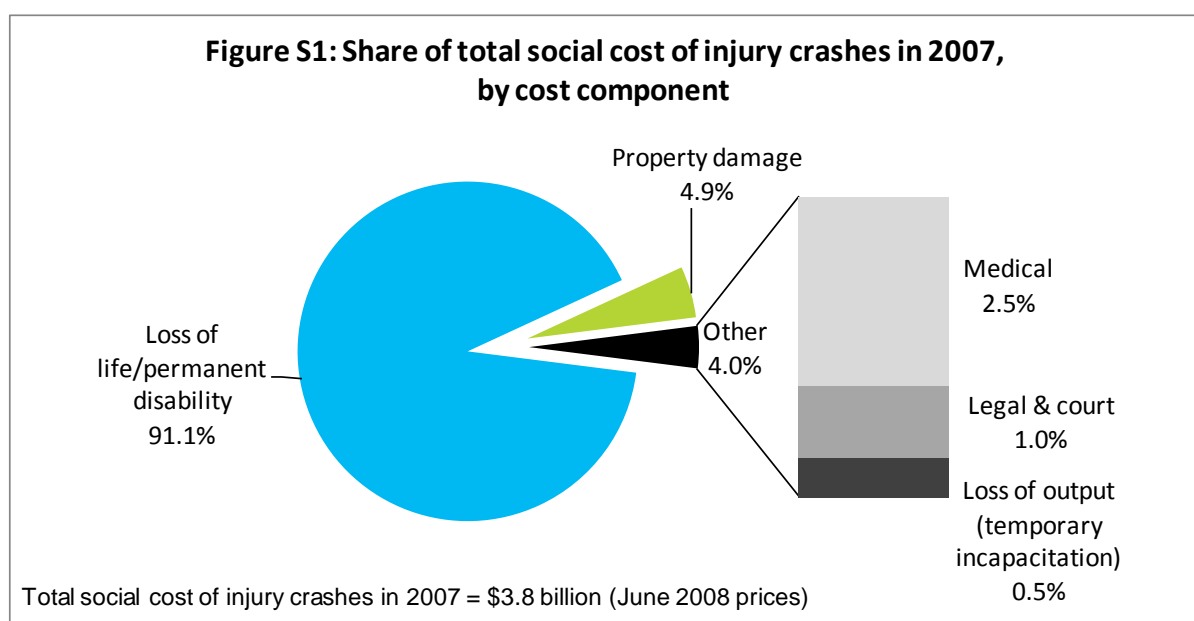
**Table S3: Average social cost per injury crash and per injury**

Per reported crash (Note)	June 2008 prices (\$)		
	All areas	Rural	Urban
Fatal	4,039,000	4,199,000	3,635,000
Serious	717,000	776,000	659,000
Minor	84,000	90,000	81,000
Per reported injury (Note)	All areas	Rural	Urban
Fatal	3,374,000	3,374,000	3,374,000
Serious	591,000	598,000	582,000
Minor	62,000	61,000	63,000

Note: These estimates have been adjusted for the level of non-reporting.

### Total social cost of road crashes and injuries in 2007

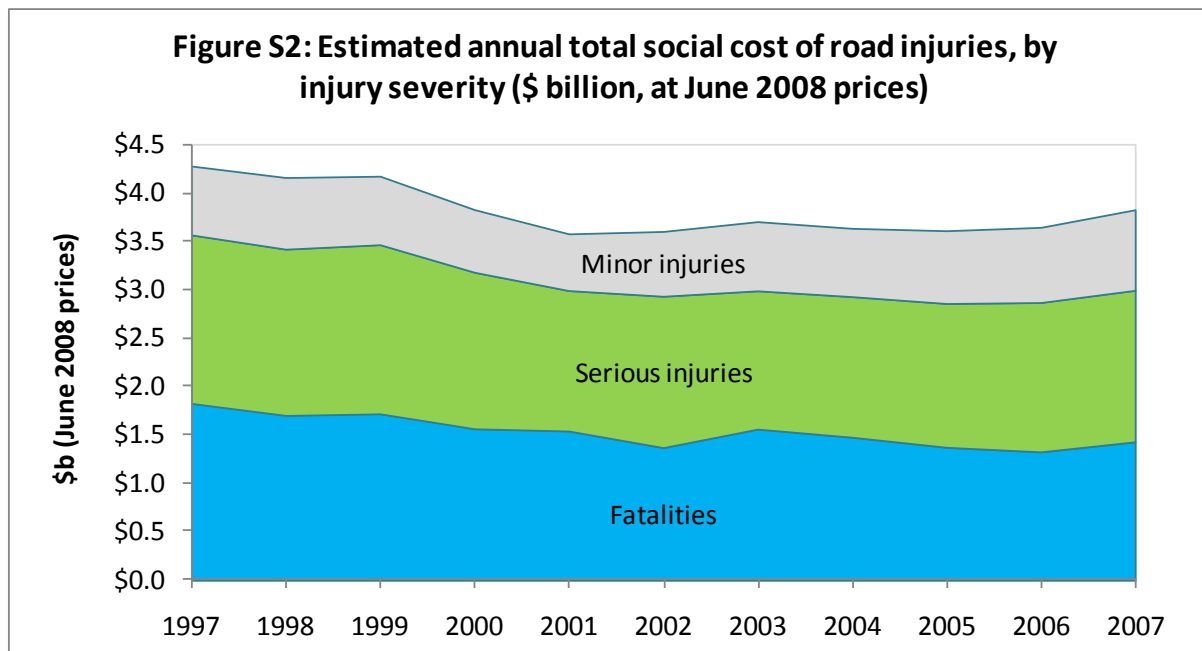
The total social cost of motor vehicle *injury crashes* in 2007 is estimated at approximately \$3.83 billion (up from \$3.65 billion in 2006) at June 2008 prices. This estimate includes both reported and non-reported casualties. The breakdowns by injury severity are: \$1.42 billion for fatalities; \$1.57 billion for serious injuries; and \$0.84 billion for minor injuries. Figure S1 shows loss of life and/or life quality due to permanent impairments accounted for approximately 91% of the total social cost of injury crashes. Property damage accounted for around 5% and other cost components made up the remaining 4%.



In addition, there are an estimated 281,500 property-damage-only crashes valued at a further \$0.7 billion. Therefore, the total social cost of **all motor vehicle crashes** in 2007 is estimated to have been \$4.5 billion (up from \$4.3 billion in 2006).

### Annual total social cost of road crashes and injuries for the years from 1997 to 2007

Figure S2 and Table S4 show the trend of the estimated annual total social cost of injury crashes for the years from 1997 to 2007. The decrease during 1997-2001 has levelled out in recent years.



Note: This chart includes allowances for non-reported injuries.

**Table S4: Total social cost of road crashes and injuries, at June 2008 prices**

Year	Injuries (\$b June 2008 prices)			Crashes (\$b June 2008 prices)			
	F	S	M	F	S	M	PDO
1997	\$1.82	\$1.75	\$0.72	\$1.89	\$1.68	\$0.63	\$0.54
1998	\$1.70	\$1.73	\$0.74	\$1.75	\$1.68	\$0.66	\$0.57
1999	\$1.71	\$1.76	\$0.71	\$1.75	\$1.69	\$0.63	\$0.54
2000	\$1.56	\$1.63	\$0.65	\$1.55	\$1.58	\$0.58	\$0.50
2001	\$1.54	\$1.46	\$0.59	\$1.60	\$1.40	\$0.53	\$0.46
2002	\$1.36	\$1.57	\$0.67	\$1.47	\$1.54	\$0.62	\$0.54
2003	\$1.56	\$1.44	\$0.72	\$1.63	\$1.38	\$0.68	\$0.58
2004	\$1.47	\$1.46	\$0.71	\$1.52	\$1.43	\$0.67	\$0.58
2005	\$1.37	\$1.49	\$0.76	\$1.38	\$1.48	\$0.72	\$0.62
2006	\$1.32	\$1.55	\$0.78	\$1.40	\$1.53	\$0.74	\$0.64
2007	\$1.42	\$1.57	\$0.84	\$1.52	\$1.52	\$0.80	\$0.69

Note: This table includes allowances for non-reported cases.

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# 1. Introduction

## 1.1 Background

The social cost of road crashes and injuries is a measure of the total cost of road crashes to the nation. It includes loss of life and life quality, loss of productivity, medical, legal and court and property damage costs. Social cost information ensures consistent appraisal of the safety benefits from the prevention of road crashes and injuries.

## 1.2 Objective

This report provides estimates of average social costs per injury and per crash, after accounting for inflationary effects and any changes in the levels of non-reporting. It also accounts for the mix of crashes by area and severity, and the average number of injuries involved in a crash. The analysis is based on crash and injury data from 2005 to 2007. Unless otherwise indicated, all social cost estimates are expressed in June 2008 prices.

This report also provides estimates of the annual total social cost of road crashes and injuries in New Zealand, from 1997 to 2007. These estimates do not necessarily represent the actual total costs incurred as a result of road crashes. This is because the total social cost of road crashes and injuries depends on the number of cost components estimated and the estimation methods adopted. More importantly, the total social cost also depends on the level of adjustments (the size and their valuation) required to account for the non-reported cases. This report provides the best estimates based on the information available.

## 1.3 The update

This report is organised as follows: Section 2 gives a brief explanation of the methodologies used for estimating the total numbers of injuries and crashes, and the average social cost per injury and crash; Section 3 provides some guidance on the application of the average social cost estimates; and Section 4 provides estimates of average social costs per injury and per crash. Some technical details are given in Appendix A. Appendix B provides estimates of the total number of crashes and injuries and the price indices used in the update.

## 2. Methodology

Estimation of the social cost of road crashes and injuries requires two stages of analysis. The first stage involves estimating the total number of crashes and injuries, because not all crashes are reported and recorded in the official Traffic Crash Reports (TCRs). Counting the reported<sup>1</sup> numbers alone would underestimate the road safety risks and the potential benefits that might be achieved through intervention.

The second stage involves quantifying the impacts in monetary terms, taking into account the non-reported incidents. The average social cost obtained after adjusting for the level of non-reporting is referred to as the average social cost per reported incident.

### 2.1 Estimation of the number of injuries and crashes

Annual crash and injury data, hospitalisation data and Accident Compensation Corporation (ACC) new claims data from the Motor Vehicle Account were used to obtain the best estimates of the total numbers of road crashes and injuries.

Injury and crash conversion factors (defined as the ratio of estimated to reported numbers of injuries or crashes) were developed for estimating the total number of incidents, taking into account the level of non-reporting. To control for any regional variations, regional conversion factors were developed for serious injuries and crashes. Due to the lack of data, separate regional conversion factors for minor and property damage-only (PDO) crashes could not be determined. For more details, please refer to Appendix A.

Annual total numbers of reported injuries and estimated numbers of non-reported injuries for the years from 2001 to 2007 are shown in Table 2.1. The estimated total numbers of crashes and injuries for the years 2005 to 2007 are given in Table B1 (Appendix B).

**Table 2.1: Annual total number of reported and non-reported injuries**

Year	Road deaths	Reported serious injuries	Reported minor injuries	Estimated non-reported serious injuries *	Estimated non-reported minor injuries *
2001	455	2,435	9,933	1,663	21,468
2002	404	2,600	11,318	1,815	24,586
2003	461	2,578	11,794	1,456	26,507
2004	436	2,469	11,351	1,632	26,472
2005	405	2,519	11,906	1,676	28,377
2006	391	2,627	12,526	1,729	29,101
2007	422	2,664	13,389	1,756	31,226

\* Estimates have been updated using latest data from Accident Compensation Corporation (ACC), New Zealand Health Information Services (NZHIS) and Traffic Crash Reports (TCRs).

<sup>1</sup> Reported injuries or crashes refer to injuries or crashes that have the associated TCRs.

## 2.2 Estimation of injury and crash costs

The social cost of a road crash or a road injury is defined as the total cost that occurs as a result of the road crash or the injury. Its value depends on the number of cost components estimated and the estimation methods adopted.

In New Zealand, the social cost of a road crash or a road injury includes the following components:

- loss of life and life quality
- loss of output due to temporary incapacitation
- medical costs
- legal costs
- property damage costs.

Most of these social cost components are either measurable or can be estimated in dollar terms. A 'willingness-to-pay' valuation technique is used to express pain and suffering from loss of life or life quality in dollar terms. Various methodologies have been developed to estimate the value of other social cost components (see Appendix A).

The average social cost per **reported** incident is obtained by dividing the estimated total social cost by the corresponding number of reported incidents. Assuming everything else remains constant, an increase in the number of reported incidents will decrease the average social cost per reported incident (since a smaller allowance for non-reported incidents is required).

The price indices used in updating the social cost components are included in Table B2 (Appendix B).

## 3. Guidance on using the social cost estimates

### 3.1 Adjustment for non-reported incidents

Tables 4.1a and 4.1b provide the estimates of average social costs per crash and per injury, without adjustment for under-reporting. These estimates are suitable only for cases where we know the total number of crashes and injuries.

For convenience of application, Tables 4.3a to 4.3c provide the estimates of average social costs per reported crash and per reported injury, after adjusting for the level of non-reporting. If a programme is expected to reduce the number of injuries, but not the number of crashes, use the estimates from Table 4.3c. Otherwise, use the estimates from Tables 4.3a and 4.3b, depending on data availability and the purpose of the analysis.

### 3.2 Estimates for rural and urban areas

The estimated average social cost per crash for rural areas tends to be higher than that for urban areas, because rural crashes tend to be more severe and often result in a larger number of fatal and serious injuries. Thus, if an intervention affects only one area type (either rural or urban), the corresponding social cost estimates should be used.

Table 4.2 shows the estimated average social cost per crash by area and severity, without any adjustment for non-reported incidents. All other tables with estimates by area include adjustments for under-reporting.

### 3.3 Estimates by region and vehicle movement

Table 4.4 provides estimates of the average social cost per reported crash by vehicle movement, using crash data from 2003 to 2007. These estimates have been adjusted for the level of non-reporting and are suitable for analysing policies or programmes that focus on specific vehicle movement classifications (eg head-on crashes).

Due to differences in physical locations, sizes of regions, the availability of facilities, and for other reasons, the proportions of injury crashes that are reported to the police differ across regions. Furthermore, the mix of rural and urban crashes also differs across regions. As a result, there are regional variations in the average social costs per reported injury and per crash.

Tables 4.5a and 4.5b provide the regional average social costs per reported crash and per reported injury respectively, using crash data from 2005 to 2007. These estimates have been adjusted for the level of non-reporting and are useful for the evaluation of regional programmes or policies. Table 4.5c provides the regional average social costs per reported injury, excluding the associated property damage costs. These estimates have been adjusted for the level of non-reporting and are useful for estimating the social cost of injuries associated with pedestrians and cyclists at the regional level.

Historical regional estimates using year-specific crash and injury conversion factors are incorporated into the Ministry's Crash Analysis System and are available upon request.

### **3.4 Estimates for an increase in risk**

While the majority of safety programmes or projects intend to reduce crash or injury risk, some programmes or projects could result in an increase in risk but produce other benefits. In this situation, the estimate of social cost for an increase in risk should be based on those derived from the willingness-to-accept (WTA)-based Value of Statistical Life (VOSL). The WTA-based value represents the amount of money the public would need to receive or save in exchange for an increase in risk. In a value of safety study conducted in 1997/98, the WTA-based value was found to be around three to five times the willingness-to-pay (WTP)-based value (Guria et al., 2003).

Tables 4.6a to 4.6c provide the estimates with WTA-based VOSL at three times the WTP value. These estimates have been adjusted for the level of non-reporting and are useful for analysing any programme that may result in an increase in risk of crash or injury to road users.

### **3.5 Estimates for infrequent events**

Some of the social cost estimates in this document include estimates for a combination of crash or injury types: fatal and serious, serious and minor, and all three. These estimates are useful for assessing safety risks that could cause severe injury to road users but have a low probability of occurrence (eg in situations where the crash or injury numbers are small).

## 4. Cost estimates

The updated value of statistical life is \$3.35 million per fatality, at June 2008 prices. This gives an updated average social cost per fatality of \$3,374,000. For non-fatal injuries, the updated average social cost is estimated at \$591,000 per reported serious injury and \$62,000 per reported minor injury.

In per-crash terms, the updated average social cost is estimated at \$4,309,000 per fatal crash, \$717,000 per reported serious crash and \$84,000 per reported minor crash. These estimates include an adjustment for the level of non-reporting.

The total social cost of motor vehicle injury crashes in 2007 is estimated at approximately \$3.83 billion (up from \$3.65 billion in 2006), at June 2008 prices. In addition, there are an estimated 281,500 property damage-only crashes, valued at a further \$0.7 billion. Therefore, the total social cost of all motor vehicle crashes is estimated to have been \$4.5 billion (up from \$4.3 billion in 2006). These estimates include both reported and non-reported cases.

The total social cost of injuries, at \$3.83 billion in 2007, can be broken down by injury severity as follows:

- fatalities : \$1.42 billion (up from \$1.32 billion in 2006)
- serious injuries : \$1.57 billion (up from \$1.55 billion in 2006)
- minor injuries : \$0.84 billion (up from \$0.78 billion in 2006)

The social cost loss of life and/or life quality due to permanent impairments accounted for approximately 91% of the total social cost of injury crashes, with property damage accounting for around 5% and other cost components making up the remaining 4% (see Figure 4.1).

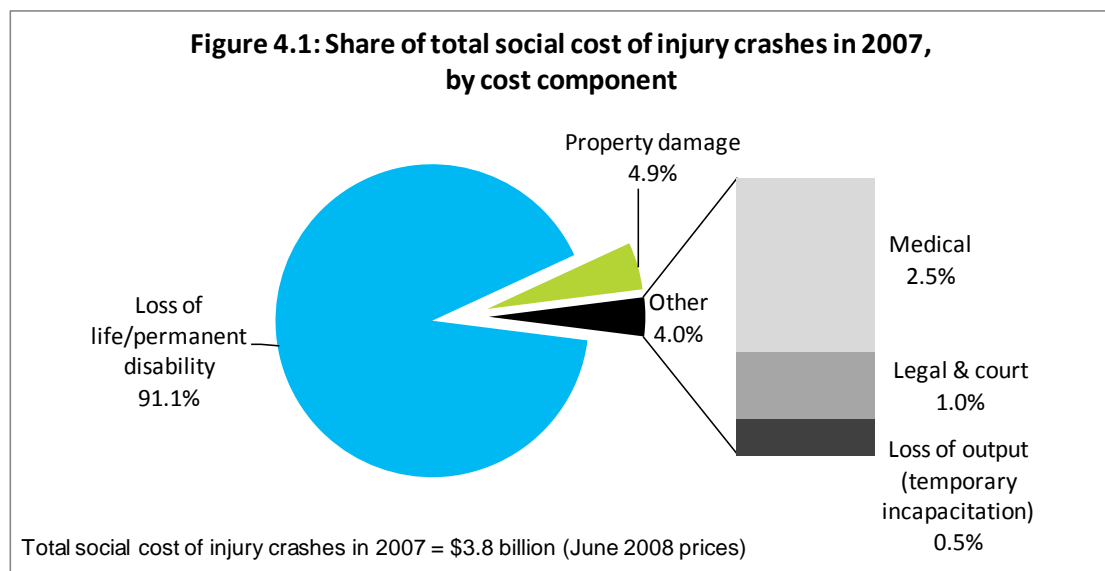


Figure 4.2 shows the trend in social costs of road injuries by injury severity for the years from 1997 to 2007. This shows that the reduction during 1997-2001 has levelled out in recent years.

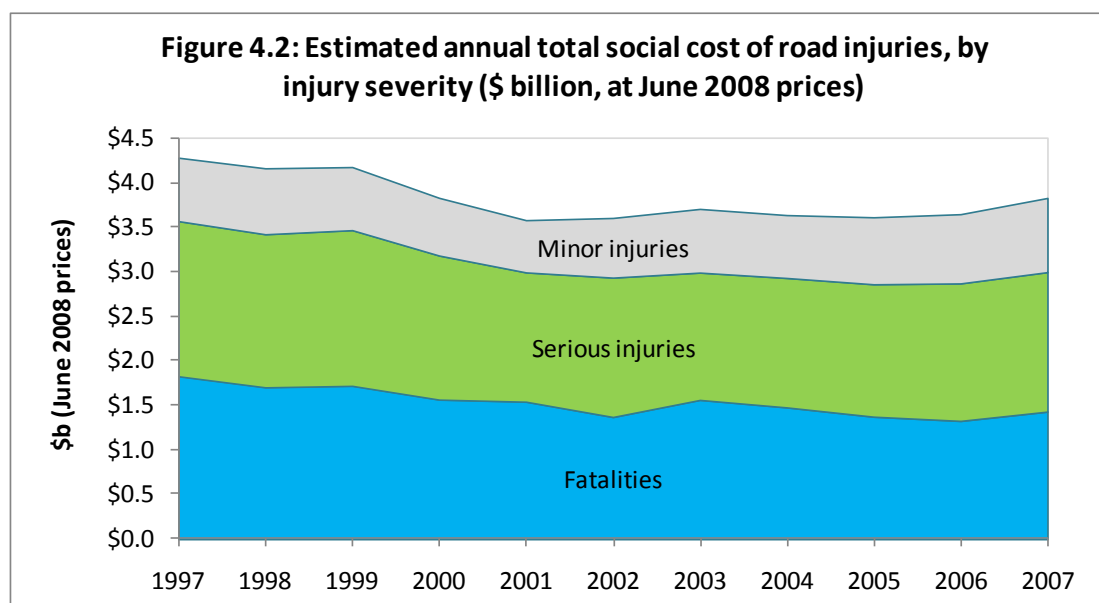


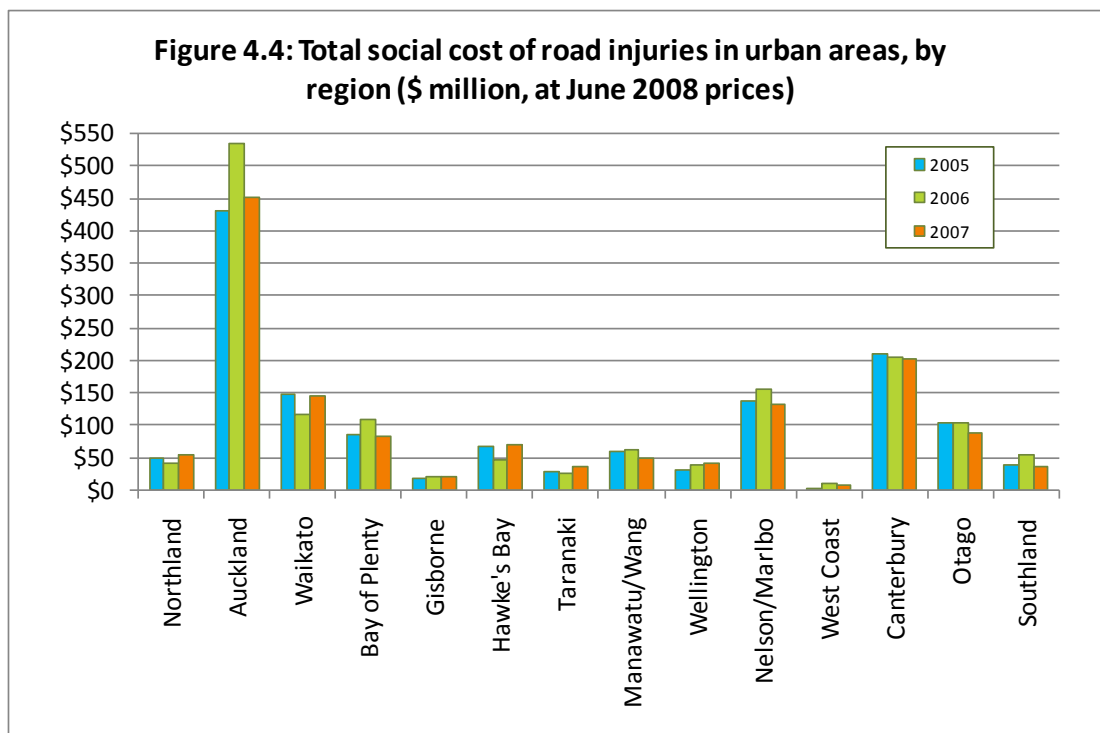
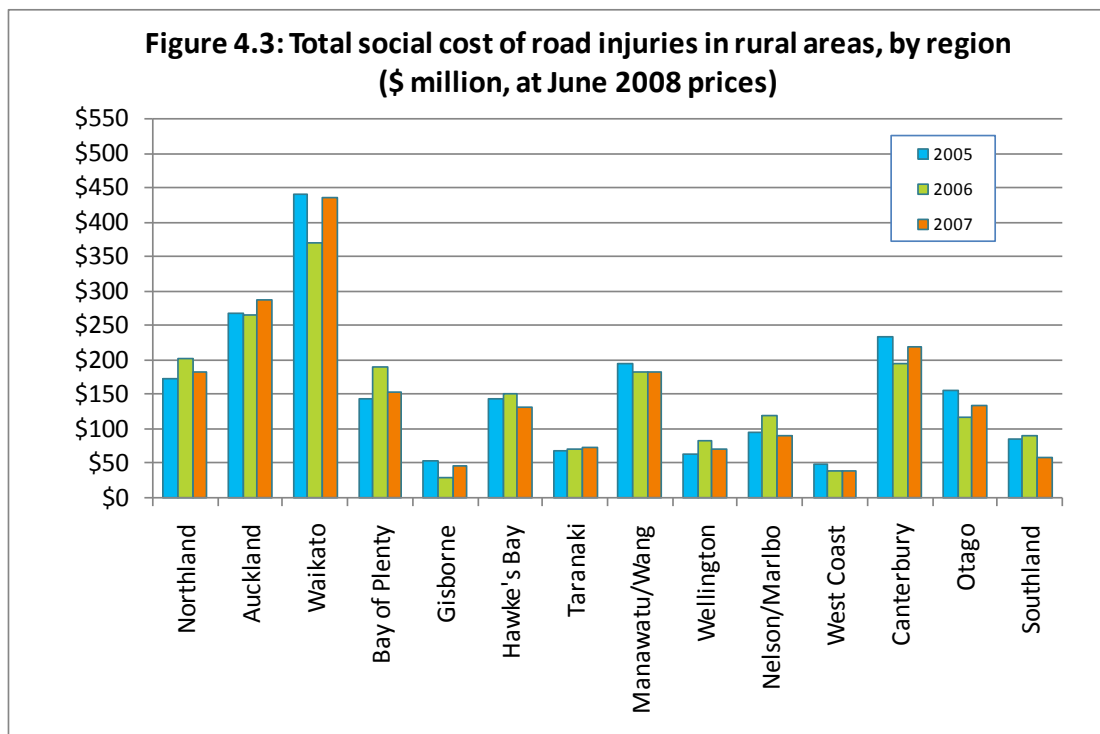
Table 4.0 summarises the estimated total social cost of road crashes and injuries from 1997 onwards, using year-specific crash and injury conversion factors.

**Table 4.0: Total social cost of road crashes and injuries, at June 2008 prices**

Year	Injuries (\$b June 2008 prices)			Crashes (\$b June 2008 prices)			
	F	S	M	F	S	M	PDO
1997	\$1.82	\$1.75	\$0.72	\$1.89	\$1.68	\$0.63	\$0.54
1998	\$1.70	\$1.73	\$0.74	\$1.75	\$1.68	\$0.66	\$0.57
1999	\$1.71	\$1.76	\$0.71	\$1.75	\$1.69	\$0.63	\$0.54
2000	\$1.56	\$1.63	\$0.65	\$1.55	\$1.58	\$0.58	\$0.50
2001	\$1.54	\$1.46	\$0.59	\$1.60	\$1.40	\$0.53	\$0.46
2002	\$1.36	\$1.57	\$0.67	\$1.47	\$1.54	\$0.62	\$0.54
2003	\$1.56	\$1.44	\$0.72	\$1.63	\$1.38	\$0.68	\$0.58
2004	\$1.47	\$1.46	\$0.71	\$1.52	\$1.43	\$0.67	\$0.58
2005	\$1.37	\$1.49	\$0.76	\$1.38	\$1.48	\$0.72	\$0.62
2006	\$1.32	\$1.55	\$0.78	\$1.40	\$1.53	\$0.74	\$0.64
2007	\$1.42	\$1.57	\$0.84	\$1.52	\$1.52	\$0.80	\$0.69

Note: This table includes allowances for non-reported cases.

On average, around 60% of the total social cost of road injuries relates to crashes that occurred in rural areas. The regional distributions by area are plotted in Figures 4.3 and 4.4.



The average social costs by cost component, area, severity and region are given in the following sections. Apart from those shown in Tables 4.1a, 4.1b and 4.2, all estimates have been adjusted for the level of non-reporting.

#### 4.1 Average social cost by cost component

**Table 4.1a: Average social cost per crash, by cost component**

Cost components	Crash type		
	Fatal	Serious	Minor
	June 2008 prices (\$)		
Loss of life/permanent disability	4,002,000	393,200	17,200
Loss of output (temporary disability)	800	1,700	400
Medical –			
Hospital/medical	7,900	9,700	100
Emergency/pre-hospital	3,900	1,400	800
Follow-on	2,000	4,700	100
Legal and court	13,400	2,900	600
Property damage	9,600	6,100	4,900
<b>Total</b>	<b>4,039,500</b>	<b>419,700</b>	<b>24,000</b>

Notes:

1. Figures may not sum to totals due to rounding.
2. These estimates have not been adjusted for the level of non-reporting.

**Table 4.1b: Average social cost per injury, by cost component**

Cost components	Injury type		
	Fatal	Serious	Minor
	June 2008 prices (\$)		
Loss of life/permanent disability	3,352,400	335,200	13,400
Loss of output (temporary disability)	0	1,400	300
Medical –			
Hospital/medical	3,400	8,300	100
Emergency/pre-hospital	2,700	1,000	600
Follow-on	0	4,100	100
Legal and court	10,500	2,300	500
Property damage ( <i>Note 3</i> )	5,000	3,600	3,800
<b>Total</b>	<b>3,374,100</b>	<b>355,900</b>	<b>18,800</b>

Notes:

1. Figures may not sum to totals due to rounding.
2. These estimates have not been adjusted for the level of non-reporting.
3. Estimates of total property damage cost by crash severity were apportioned to all injuries caused by the same crash severity, to generate the average cost per injury by severity. Since serious crashes resulted in more injuries than minor crashes, but the cost of vehicle damage did not increase proportionately, the estimated average property damage cost per minor injury is slightly higher than that for a serious injury.

## 4.2 Average social cost by area and severity

**Table 4.2: Average social cost per crash and per injury, by area and severity**

Crash severity	June 2008 prices (\$)				
	Average per crash			Average per injury	
	All areas	Rural areas	Urban areas	Include property damage cost	Exclude property damage cost
Fatal	4,039,500	4,198,800	3,635,400	3,374,100	3,369,100
Serious	419,700	441,400	397,500	355,900	352,300
Minor	24,000	25,700	23,000	18,800	15,000
S & M	64,900	81,500	54,300	50,300	46,500
F & S	744,900	901,700	571,000	615,100	611,400
F, S & M	105,000	157,200	71,100	79,300	75,500
PDO	2,500	2,700	2,300		

Note: These estimates have not been adjusted for the level of non-reporting.

### 4.3 Average social cost per reported incident, by severity

**Table 4.3a: Average social cost per reported crash, by severity**

Crash severity	June 2008 prices (\$)		
	All	Rural	Urban
Fatal	4,039,000	4,199,000	3,635,000
Serious	717,000	776,000	659,000
Minor	84,000	90,000	81,000
Serious and minor	205,000	252,000	174,000
Fatal and serious	1,196,000	1,450,000	915,000
Fatal, serious and minor	325,000	468,000	226,000

**Table 4.3b: Average social cost per reported injury, by severity**

Injury severity	June 2008 prices (\$)		
	All	Rural	Urban
Fatal	3,374,000	3,374,000	3,374,000
Serious	591,000	598,000	582,000
Minor	62,000	61,000	63,000
Serious and minor	153,000	173,000	137,000
Fatal and serious	966,000	1,092,000	804,000
Fatal, serious and minor	237,000	312,000	176,000

**Table 4.3c: Average social cost per reported injury, excluding associated property damage costs, by severity**

Injury severity	June 2008 prices (\$)		
	All	Rural	Urban
Fatal	3,369,000	3,369,000	3,369,000
Serious	585,000	592,000	577,000
Minor	50,000	48,000	51,000
Serious and minor	141,000	162,000	125,000
Fatal and serious	960,000	1,086,000	799,000
Fatal, serious and minor	225,000	300,000	165,000

#### 4.4 Average social cost per reported injury crash, by vehicle movement

**Table 4.4: Average social cost per reported injury crash (F+S+M), by vehicle movement**

Vehicle movement classification	June 2008 prices (\$)		
	All	Rural	Urban
Overtaking or lane change	452,000	558,000	294,000
Head-on, not overtaking	904,000	1,179,000	429,000
Lost control, straight roads	339,000	371,000	288,000
Cornering	368,000	399,000	306,000
Collision with obstruction	219,000	309,000	184,000
Rear-end collision	142,000	163,000	128,000
Turning versus same direction	225,000	344,000	166,000
Crossing, no turns	256,000	695,000	202,000
Crossing, vehicle turning	228,000	432,000	169,000
Vehicles merging	189,000	289,000	172,000
Right turn against	231,000	493,000	181,000
Vehicle manoeuvring	222,000	478,000	176,000
Pedestrian crossing road	312,000	966,000	288,000
Pedestrian other	568,000	1,323,000	417,000
Miscellaneous	523,000	644,000	421,000

## 4.5 Average social cost by local government region

**Table 4.5a: Average social cost per reported injury crash, by local government region**

Region	Fatal	Serious	Crash severity			
			Minor	S+M	F+S	F+S+M
June 2008 prices (\$)						
<b>All areas</b>						
Northland	3,692,000	1,071,000	88,000	300,000	1,590,000	472,000
Auckland	3,886,000	597,000	83,000	152,000	1,029,000	226,000
Waikato	4,192,000	731,000	85,000	210,000	1,544,000	434,000
Bay of Plenty	4,240,000	956,000	87,000	322,000	1,463,000	506,000
Gisborne	5,030,000	1,274,000	82,000	341,000	1,885,000	530,000
Hawke's Bay	4,113,000	678,000	84,000	205,000	1,360,000	393,000
Taranaki	4,214,000	699,000	86,000	190,000	1,265,000	317,000
Manawatu-Wanganui	4,134,000	647,000	84,000	221,000	1,237,000	406,000
Wellington	3,709,000	846,000	81,000	239,000	1,143,000	319,000
Nelson-Marlborough	3,761,000	605,000	79,000	174,000	924,000	245,000
West Coast	3,560,000	844,000	91,000	295,000	1,254,000	445,000
Canterbury	4,067,000	743,000	83,000	219,000	1,145,000	326,000
Otago	4,391,000	595,000	91,000	201,000	870,000	272,000
Southland	3,643,000	628,000	92,000	234,000	841,000	301,000
<b>New Zealand</b>	<b>4,039,000</b>	<b>717,000</b>	<b>84,000</b>	<b>205,000</b>	<b>1,196,000</b>	<b>325,000</b>
<b>Rural areas</b>						
Northland	3,754,000	1,081,000	91,000	332,000	1,631,000	534,000
Auckland	4,187,000	651,000	87,000	160,000	1,443,000	307,000
Waikato	4,367,000	757,000	88,000	241,000	1,647,000	527,000
Bay of Plenty	4,458,000	1,017,000	96,000	389,000	1,729,000	701,000
Gisborne	5,478,000	1,300,000	85,000	431,000	2,151,000	774,000
Hawke's Bay	4,052,000	717,000	91,000	258,000	1,568,000	576,000
Taranaki	4,448,000	698,000	90,000	218,000	1,386,000	409,000
Manawatu-Wanganui	4,250,000	688,000	91,000	267,000	1,421,000	549,000
Wellington	3,819,000	915,000	88,000	307,000	1,333,000	456,000
Nelson-Marlborough	3,924,000	637,000	86,000	205,000	1,202,000	365,000
West Coast	3,534,000	855,000	92,000	333,000	1,258,000	503,000
Canterbury	4,231,000	793,000	87,000	282,000	1,463,000	529,000
Otago	4,488,000	609,000	96,000	223,000	1,064,000	359,000
Southland	3,644,000	646,000	100,000	272,000	970,000	396,000
<b>New Zealand</b>	<b>4,199,000</b>	<b>776,000</b>	<b>90,000</b>	<b>252,000</b>	<b>1,450,000</b>	<b>468,000</b>

Table 4.5a continued

Urban areas	Average social cost per reported crash					
	Region	Fatal	Serious	Crash severity		
				Minor	S+M	F+S
Northland	3,428,000	1,041,000	81,000	232,000	1,448,000	332,000
Auckland	3,607,000	579,000	81,000	148,000	866,000	196,000
Waikato	3,658,000	670,000	81,000	165,000	1,284,000	290,000
Bay of Plenty	3,551,000	887,000	81,000	267,000	1,115,000	336,000
Gisborne	3,388,000	1,236,000	80,000	265,000	1,438,000	316,000
Hawke's Bay	4,429,000	619,000	79,000	160,000	971,000	224,000
Taranaki	3,480,000	701,000	82,000	159,000	1,025,000	213,000
Manawatu-Wanganui	3,667,000	579,000	77,000	172,000	885,000	243,000
Wellington	3,472,000	785,000	77,000	199,000	958,000	237,000
Nelson-Marlborough	3,444,000	587,000	76,000	160,000	748,000	192,000
West Coast	3,741,000	771,000	90,000	181,000	1,228,000	264,000
Canterbury	3,678,000	710,000	81,000	192,000	898,000	234,000
Otago	3,863,000	582,000	88,000	185,000	659,000	202,000
Southland	3,628,000	604,000	86,000	198,000	646,000	208,000
<b>New Zealand</b>	<b>3,635,000</b>	<b>659,000</b>	<b>81,000</b>	<b>174,000</b>	<b>915,000</b>	<b>226,000</b>

**Table 4.5b: Average social cost per reported injury, by local government region**

Region	Fatal	Serious	Injury severity			
			Minor	S+M	F+S	F+S+M
<b>All areas</b>						
Northland	3,374,000	845,000	63,000	212,000	1,264,000	327,000
Auckland	3,374,000	502,000	63,000	117,000	851,000	172,000
Waikato	3,374,000	581,000	62,000	155,000	1,190,000	308,000
Bay of Plenty	3,374,000	772,000	63,000	229,000	1,153,000	351,000
Gisborne	3,374,000	1,064,000	65,000	257,000	1,495,000	390,000
Hawke's Bay	3,374,000	529,000	61,000	152,000	1,022,000	278,000
Taranaki	3,374,000	567,000	63,000	139,000	1,005,000	228,000
Manawatu-Wanganui	3,374,000	520,000	60,000	159,000	957,000	281,000
Wellington	3,374,000	702,000	63,000	184,000	946,000	244,000
Nelson-Marlborough	3,374,000	524,000	63,000	138,000	795,000	193,000
West Coast	3,374,000	672,000	62,000	201,000	1,002,000	299,000
Canterbury	3,374,000	646,000	63,000	169,000	976,000	247,000
Otago	3,374,000	489,000	62,000	139,000	697,000	184,000
Southland	3,374,000	509,000	60,000	153,000	684,000	196,000
<b>New Zealand</b>	<b>3,374,000</b>	<b>591,000</b>	<b>62,000</b>	<b>153,000</b>	<b>966,000</b>	<b>237,000</b>
<b>Rural areas</b>						
Northland	3,374,000	834,000	63,000	225,000	1,265,000	355,000
Auckland	3,374,000	495,000	63,000	118,000	1,066,000	218,000
Waikato	3,374,000	580,000	61,000	168,000	1,223,000	353,000
Bay of Plenty	3,374,000	756,000	62,000	249,000	1,253,000	435,000
Gisborne	3,374,000	1,024,000	65,000	309,000	1,571,000	529,000
Hawke's Bay	3,374,000	523,000	59,000	173,000	1,112,000	364,000
Taranaki	3,374,000	564,000	62,000	153,000	1,081,000	279,000
Manawatu-Wanganui	3,374,000	514,000	58,000	173,000	1,019,000	338,000
Wellington	3,374,000	694,000	63,000	214,000	1,013,000	313,000
Nelson-Marlborough	3,374,000	519,000	62,000	148,000	966,000	258,000
West Coast	3,374,000	675,000	61,000	223,000	1,004,000	334,000
Canterbury	3,374,000	635,000	61,000	201,000	1,142,000	366,000
Otago	3,374,000	484,000	61,000	147,000	806,000	228,000
Southland	3,374,000	508,000	59,000	166,000	768,000	241,000
<b>New Zealand</b>	<b>3,374,000</b>	<b>598,000</b>	<b>61,000</b>	<b>173,000</b>	<b>1,092,000</b>	<b>312,000</b>

Table 4.5b continued

Urban areas	Average social cost per reported injury					
	Fatal	Serious	Injury severity			F+S
Minor			S+M			
Region						
Northland	3,374,000	884,000	64,000	178,000	1,258,000	255,000
Auckland	3,374,000	505,000	63,000	117,000	751,000	153,000
Waikato	3,374,000	584,000	63,000	132,000	1,095,000	226,000
Bay of Plenty	3,374,000	794,000	63,000	208,000	994,000	260,000
Gisborne	3,374,000	1,135,000	64,000	208,000	1,333,000	249,000
Hawke's Bay	3,374,000	542,000	63,000	129,000	822,000	177,000
Taranaki	3,374,000	573,000	64,000	123,000	845,000	164,000
Manawatu-Wanganui	3,374,000	532,000	62,000	139,000	807,000	195,000
Wellington	3,374,000	711,000	64,000	164,000	868,000	195,000
Nelson-Marlborough	3,374,000	527,000	63,000	133,000	673,000	159,000
West Coast	3,374,000	647,000	64,000	132,000	988,000	186,000
Canterbury	3,374,000	654,000	63,000	153,000	824,000	185,000
Otago	3,374,000	495,000	62,000	132,000	563,000	144,000
Southland	3,374,000	511,000	60,000	139,000	545,000	145,000
<b>New Zealand</b>	<b>3,374,000</b>	<b>582,000</b>	<b>63,000</b>	<b>137,000</b>	<b>804,000</b>	<b>176,000</b>

**Table 4.5c: Average social cost per reported injury, excluding associated property damage costs, by local government region**

Region	Fatal	Serious	Injury severity			
			Minor	S+M	F+S	F+S+M
June 2008 prices (\$)						
<b>All areas</b>						
Northland	3,369,000	836,000	50,000	200,000	1,256,000	315,000
Auckland	3,369,000	497,000	51,000	105,000	845,000	160,000
Waikato	3,369,000	575,000	49,000	143,000	1,184,000	297,000
Bay of Plenty	3,369,000	764,000	50,000	217,000	1,146,000	340,000
Gisborne	3,369,000	1,053,000	52,000	245,000	1,486,000	377,000
Hawke's Bay	3,369,000	524,000	49,000	141,000	1,017,000	267,000
Taranaki	3,369,000	561,000	50,000	128,000	1,000,000	217,000
Manawatu-Wanganui	3,369,000	514,000	48,000	149,000	952,000	271,000
Wellington	3,369,000	695,000	51,000	173,000	939,000	233,000
Nelson-Marlborough	3,369,000	519,000	50,000	127,000	790,000	181,000
West Coast	3,369,000	665,000	49,000	190,000	995,000	288,000
Canterbury	3,369,000	639,000	50,000	157,000	969,000	235,000
Otago	3,369,000	484,000	49,000	128,000	692,000	173,000
Southland	3,369,000	504,000	47,000	142,000	679,000	185,000
<b>New Zealand</b>	<b>3,369,000</b>	<b>585,000</b>	<b>50,000</b>	<b>141,000</b>	<b>960,000</b>	<b>225,000</b>
<b>Rural areas</b>						
Northland	3,369,000	826,000	49,000	212,000	1,257,000	342,000
Auckland	3,369,000	489,000	50,000	106,000	1,061,000	206,000
Waikato	3,369,000	574,000	48,000	156,000	1,217,000	342,000
Bay of Plenty	3,369,000	748,000	49,000	237,000	1,245,000	423,000
Gisborne	3,369,000	1,013,000	51,000	296,000	1,562,000	516,000
Hawke's Bay	3,369,000	518,000	46,000	162,000	1,106,000	354,000
Taranaki	3,369,000	558,000	49,000	140,000	1,076,000	267,000
Manawatu-Wanganui	3,369,000	508,000	45,000	163,000	1,014,000	328,000
Wellington	3,369,000	687,000	49,000	202,000	1,006,000	301,000
Nelson-Marlborough	3,369,000	513,000	48,000	136,000	961,000	246,000
West Coast	3,369,000	668,000	48,000	211,000	997,000	322,000
Canterbury	3,369,000	628,000	48,000	189,000	1,136,000	355,000
Otago	3,369,000	478,000	48,000	136,000	801,000	216,000
Southland	3,369,000	502,000	46,000	155,000	763,000	230,000
<b>New Zealand</b>	<b>3,369,000</b>	<b>592,000</b>	<b>48,000</b>	<b>162,000</b>	<b>1,086,000</b>	<b>300,000</b>

Table 4.5c continued

<b>Urban areas</b>		<b>Average social cost per reported injury, excluding associated property damage costs</b>				
<b>Region</b>	<b>Fatal</b>	<b>Serious</b>	<b>Injury severity</b>		<b>F+S</b>	<b>F+S+M</b>
			<b>Minor</b>	<b>S+M</b>		
Northland	3,369,000	876,000	51,000	166,000	1,250,000	243,000
Auckland	3,369,000	500,000	51,000	105,000	746,000	142,000
Waikato	3,369,000	578,000	51,000	121,000	1,089,000	214,000
Bay of Plenty	3,369,000	787,000	51,000	197,000	986,000	249,000
Gisborne	3,369,000	1,124,000	52,000	196,000	1,323,000	237,000
Hawke's Bay	3,369,000	537,000	51,000	118,000	817,000	166,000
Taranaki	3,369,000	567,000	51,000	112,000	840,000	152,000
Manawatu-Wanganui	3,369,000	527,000	50,000	129,000	802,000	184,000
Wellington	3,369,000	704,000	51,000	152,000	862,000	183,000
Nelson-Marlborough	3,369,000	523,000	51,000	122,000	668,000	148,000
West Coast	3,369,000	641,000	51,000	121,000	982,000	174,000
Canterbury	3,369,000	648,000	51,000	141,000	818,000	174,000
Otago	3,369,000	491,000	50,000	121,000	558,000	133,000
Southland	3,369,000	507,000	49,000	128,000	541,000	135,000
<b>New Zealand</b>	<b>3,369,000</b>	<b>577,000</b>	<b>51,000</b>	<b>125,000</b>	<b>799,000</b>	<b>165,000</b>

#### 4.6 Average social cost with WTA-based VOSL (three times WTP-based VOSL)

**Table 4.6a: Average social cost per reported crash, with WTA-based VOSL**

Crash severity	June 2008 prices (\$)		
	All	Rural	Urban
Fatal	12,043,000	12,518,000	10,841,000
Serious	2,060,000	2,228,000	1,897,000
Minor	204,000	217,000	197,000
Serious and minor	559,000	692,000	471,000
Fatal and serious	3,500,000	4,256,000	2,665,000
Fatal, serious and minor	917,000	1,339,000	626,000

**Table 4.6b: Average social cost per reported injury, with WTA-based VOSL**

Injury severity	June 2008 prices (\$)		
	All	Rural	Urban
Fatal	10,079,000	10,079,000	10,079,000
Serious	1,704,000	1,724,000	1,680,000
Minor	151,000	148,000	154,000
Serious and minor	417,000	477,000	370,000
Fatal and serious	2,834,000	3,210,000	2,347,000
Fatal, serious and minor	668,000	892,000	488,000

**Table 4.6c: Average social cost per reported injury, excluding associated property damage costs, with WTA-based VOSL**

Injury severity	June 2008 prices (\$)		
	All	Rural	Urban
Fatal	10,074,000	10,074,000	10,074,000
Serious	1,698,000	1,718,000	1,674,000
Minor	139,000	135,000	142,000
Serious and minor	406,000	465,000	359,000
Fatal and serious	2,828,000	3,204,000	2,342,000
Fatal, serious and minor	657,000	880,000	476,000

## Appendix A Technical notes

This appendix should be read in conjunction with Section 2 of this report.

### A1 Estimation of the number of injuries and crashes

The estimated total numbers of injuries and crashes for the years 2005 to 2007 are given in Table B1 (Appendix B). **For a detailed discussion of the methodology, please refer to *The Social Cost of Road Crashes and Injuries: June 2006 update*.**

#### A1.1 Data

Annual crash and injury data, hospitalisation data and Accident Compensation Corporation (ACC) new motor vehicle claims data (see Table A1) were used to estimate the total numbers of road crashes and injuries summarised in Table A2.

ACC claims data include claims from both hospitalised and non-hospitalised injuries. Ongoing data-matching exercises found that around 90% of the reported serious injuries and 70% of the reported minor injuries were matched with ACC claims data. For the purposes of estimating the average and total social costs of road crashes and injuries, injuries that are neither hospitalised nor reported, and which also do not have an associated ACC claim, are excluded from this analysis.

**Table A1: Statistics on road injuries, hospitalisations and ACC claims**

Year	Road deaths	Reported serious injuries	Reported minor injuries	Total hospital admissions*	Hospital admissions over 1 day*	ACC motor vehicle new claims*
2001	455	2,435	9,933	6,699	2,868	33,847
2002	404	2,600	11,318	6,506	2,730	36,314
2003	461	2,578	11,794	6,564	2,740	39,008
2004	436	2,469	11,351	6,568	2,699	39,017
2005	405	2,519	11,906	7,210	2,854	41,290
2006	391	2,627	12,526	7,700	3,039	43,001
2007	422	2,664	13,389	7,416	3,039	43,010

\* Data have been updated based on the latest information provided by New Zealand Health Information Services and ACC.

**Table A2: Estimated total number of road crashes and injuries**

Year	Estimated total number of crashes				Estimated total number of injuries		
	Fatal	Serious	Minor	PDO	Fatal	Serious	Minor
2001	395	3,339	22,112	185,740	455	4,098	31,401
2002	364	3,675	25,943	217,920	404	4,415	35,904
2003	405	3,301	28,241	237,220	461	4,034	38,301
2004	376	3,421	28,048	235,600	436	4,101	37,823
2005	341	3,522	30,054	252,450	405	4,195	40,283
2006	348	3,642	30,804	258,750	391	4,356	41,627
2007	376	3,622	33,509	281,470	422	4,420	44,615

## A1.2 Conversion factors

Injury and crash conversion factors (defined as the ratio of **estimated** to **reported** numbers of incidents) are derived from the estimated and reported numbers of injuries and crashes.

To minimise the random effect associated with year-to-year variations, the conversion factors for any crash year are based on data for a three-year period centred at the crash year. Due to a lag effect, provisional estimates for the latest year will be based on the most recent three years' data (eg data for 2005-2007 will be used for 2006 as well as for the provisional estimates for 2007), and will be updated during the following year.

Serious injury and crash conversion factors are derived at the regional level. Estimates are then used to derive the conversion factors for rural and urban areas at the national level. Due to a lack of data, we assume that the conversion factors for minor and property damage-only injuries and crashes are the same for all regions and areas.

The estimated national crash and injury conversion factors since 1998 are summarised in Table A3. There are slight changes in the historical factors from those published in the previous update, as a result of adopting the revised hospital admissions and ACC new claims data.

For the three years to 2007, only about 58% of all serious injury crashes and 28% of all minor injury crashes are recorded in crash statistics. The estimated numbers of injuries and crashes are given in Table B1 (Appendix B).

**Table A3: National crash and injury conversion factors**

Year	Serious crash conversion factors			Serious injury conversion factors		
	Rural	Urban	All areas	Rural	Urban	All areas
1998-2000	2.12	2.12	2.12	1.97	2.10	2.03
2001-2003	1.74	1.74	1.74	1.71	1.66	1.69
2002-2004	1.62	1.62	1.62	1.59	1.55	1.57
2003-2005	1.71	1.71	1.71	1.66	1.65	1.66
2004-2006	1.71	1.71	1.71	1.68	1.65	1.66
2005-2007	1.71	1.71	1.71	1.68	1.64	1.66
Year	Minor crash conversion factors *			Minor injury conversion factors *		
	Rural	Urban	All areas	Rural	Urban	All areas
1998-2000	4.28	4.28	4.28	3.80	4.09	3.98
2001-2003	3.37	3.37	3.37	3.07	3.25	3.18
2002-2004	3.46	3.46	3.46	3.14	3.33	3.25
2003-2005	3.53	3.53	3.53	3.23	3.41	3.33
2004-2006	3.58	3.58	3.58	3.29	3.46	3.39
2005-2007	3.50	3.50	3.50	3.23	3.39	3.32

\* Estimates have been updated based on the latest ACC data.

## A2 Estimation of injury and crash costs

### A2.1 Cost components

The price indices used in updating the social cost components are included in Table B2 (Appendix B). **For a detailed discussion of the methodology, please refer to *The Social Cost of Road Crashes and Injuries: June 2006 update*.**

#### (i) **Loss of life and life quality**

- The cost of pain and suffering due to the loss of an unidentified life from a road crash is estimated by the amount of money the New Zealand population would be willing to pay for a safety improvement that results in the expected avoidance of one premature death (ie the willingness-to-pay-based value of statistical life or VOSL).
- The VOSL was established at \$2 million in 1991. This has been indexed to the average hourly earnings (ordinary time) to express the value in current dollars. The updated VOSL is \$3.35 million, at June 2008 prices.
- As in the previous update, the average loss of life quality due to permanent impairments from a serious injury is estimated at 10% of the VOSL (or \$335,200), and 0.4% (or \$13,400) for a minor injury (see Miller et al., 1991; Guria, 1993a; and Guria, 1993b).
- These values also include the loss of productivity caused by long-term impairments (see Miller and Guria, 1991; and Guria, 1993a).
- The values of loss of life and life quality are calculated on a per-injury basis. These values are incorporated into the average cost per crash, considering the average number of injuries (for each injury severity) involved in a crash during the three years to 2007.

#### (ii) **Loss of output due to temporary incapacitation**

- The loss of output due to temporary incapacitation is estimated by the product of average daily earnings per person and the average time loss per injury, and is calculated on a per-injury basis.
- The matching of the TCR injury data with the hospitalisation data for the three years to 2007 shows that the mean length of hospital stay is 12.57 days for a reported serious injury and 2.52 days for a reported minor injury. These data are used to approximate the average time loss per injury.
- Using the average daily earnings distributions by age group and gender, the weighted average daily earnings for the road crash injury population for 2005 to 2007 are estimated at \$109.7 at June 2008 prices.
- The cost estimate is incorporated into the average cost per crash by considering the average number of injuries involved in a crash, for each injury severity, during the three years to 2007.

#### (iii) **Medical costs**

- Medical costs include three components: hospital in-patient medical costs; emergency treatment costs; and follow-on treatment costs.
- The methodology used to allocate medical costs by injury severity and cost component is the same as that in the previous updates. All cost estimates were updated for price changes using the producers' input price index for health and community services.
- The in-patient hospitalisation cost for a serious injury was based on those estimated in (Langley et al., 1991).

- The in-patient hospitalisation costs for fatal and minor injury were assumed to be 40.5% and 1.4% of the same costs for a serious injury, respectively (see Guria, 1993a).
- The emergency treatment cost for a serious injury was assumed to be 12% of its in-patient hospitalisation cost. Emergency treatment costs for fatal and minor injury were assumed to be 270% and 60% of the emergency treatment cost for a serious injury respectively.
- The follow-on costs for a serious and minor injury were assumed to be 49% and 2.4% of their in-patient hospitalisation costs respectively. There is no follow-on cost for a fatal injury.
- Medical costs are calculated for each injury severity type and are incorporated into the average cost per crash, considering the average number of injuries (for each injury severity) involved in a crash.

**(iv) Legal and court costs**

- Legal and court costs include three components: the justice system costs of dealing with traffic offences; the cost of police crash attendance and investigation; and the cost of imprisonment.
- Legal and court costs were based on those estimated in 1993 (Guria, 1993a) and were updated for price changes with the producers' input price index for legal services.
- The relativities of legal and court costs between serious crashes and other crashes were assumed to be the same as those in the previous updates. It was assumed that a fatal crash would incur legal and court costs 6.92 times those of the cost for a serious crash. For minor crashes and property-damage-only crashes, the legal and court costs were assumed to be 46% and 5% of those for a serious crash, respectively (see Atkins, 1981 and Guria, 1991).
- Annual budgeted police resources for crash attendance and investigation were obtained from NZ Transport Agency's National Land Transport Programme.
- Annual data on convictions and sentencing details were obtained from the Ministry of Justice. The costs of imprisonment for driving causing death and injury (excluding fixed costs as they are preventative costs) were attributed to fatal and serious crashes only.
- The average legal costs per injury were estimated by equating the total legal cost of each injury crash type to that for all injuries caused by those crashes.

**(v) Property damage cost**

- The average property damage costs by crash type and area were based on those estimated in Guria (1995) and were updated for price changes using the consumer price index under the vehicle servicing and repairs category.
- The average property damage cost per injury was obtained by equating the total property damage cost of each injury crash type to that for all injuries caused by those crashes.

## **A2.2 Regional average social cost by year**

Historical regional estimates of average social costs per reported crash and per reported injury, by severity and area, using year-specific crash and injury conversion factors are incorporated into the Ministry's Crash Analysis System. These estimates are available upon request.

## Appendix B Crash statistics and price indices

**Table B1: Reported and estimated number of crashes and injuries from 2005 to 2007**

	All areas							
	Reported crashes	Reported injuries			Estimated crashes	Estimated injuries		
		Fatal	Serious	Minor		Fatal	Serious	Minor
Fatal	1,065	1,218	512	538	1,065	1,218	512	538
Serious	6,318	0	7,298	3,043	10,791	0	12,450	5,173
Minor	26,749	0	0	34,240	93,699	0	0	119,939
<b>Total</b>	<b>34,132</b>	<b>1,218</b>	<b>7,810</b>	<b>37,821</b>	<b>105,554</b>	<b>1,218</b>	<b>12,962</b>	<b>125,650</b>
	Rural areas							
	Reported crashes	Reported injuries			Estimated crashes	Estimated injuries		
		Fatal	Serious	Minor		Fatal	Serious	Minor
Fatal	764	905	412	423	764	905	412	423
Serious	3,113	0	3,771	1,838	5,473	0	6,614	3,198
Minor	10,080	0	0	13,604	35,309	0	0	47,653
<b>Total</b>	<b>13,957</b>	<b>905</b>	<b>4,183</b>	<b>15,865</b>	<b>41,546</b>	<b>905</b>	<b>7,026</b>	<b>51,275</b>
	Urban areas							
	Reported crashes	Reported injuries			Estimated crashes	Estimated injuries		
		Fatal	Serious	Minor		Fatal	Serious	Minor
Fatal	301	313	100	115	301	313	100	115
Serious	3,205	0	3,527	1,205	5,318	0	5,837	1,975
Minor	16,669	0	0	20,636	58,390	0	0	72,285
<b>Total</b>	<b>20,175</b>	<b>313</b>	<b>3,627</b>	<b>21,956</b>	<b>64,008</b>	<b>313</b>	<b>5,937</b>	<b>74,375</b>

**Table B2: Price indices for updating unit costs**

Cost components	Indices/measures	Series references	Period	Indices/ values	% change over the 12 months to June 2008
Loss of life & life quality	Average hourly earnings (ordinary time)	EESQ.SAAZ9A	June 2007	22.77	5.3%
Loss of output			June 2008	23.97	
Medical cost	Producers price input index – Health and community services	PPIQ.SNO (Base: Dec 1997=1000)	June 2007 June 2008	1219 1285	5.4%
Legal and court cost	Producers price input index – Legal services: Personal and Corporate	PPIQ.SC23 (Base: Dec 1997=1000)	June 2007 June 2008	1441 1488	3.3%
Property damage cost	Consumers price index – Vehicle servicing & repairs	CPIQ.SE907204 (Base: June 2006 =1000)	June 2007 June 2008	1044 1094	4.8%

Source: PCINFOS, Statistics New Zealand

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