Ministry of Transport
TE MANATŪ WAKA

The social cost of road crashes and injuries
June 2007 update

Overview

This is an annual update of the Social Cost of Road Crashes and Injuries published by the Ministry of Transport. This report provides estimates of average social cost per injury and per crash (with and without adjustment for the level of non-reporting) at June 2007 prices. These estimates are useful for estimating the safety benefits from the prevention of road crashes and injuries. This report also provides estimates of the total social cost of road crashes and injuries that have occurred in New Zealand since 1997.

Average social cost of injury and crash

The updated value of statistical life (VOSL) is $3.19 million per fatality, at June 2007 prices. This gives an updated average social cost per fatality of $3,211,000. For non-fatal injuries, the updated average social cost is estimated at $563,000 per reported serious injury and $61,000 per reported minor injury.

In per-crash terms, the updated average social cost is estimated at $3,881,000 per fatal crash, $680,000 per reported serious crash and $83,000 per reported minor crash.

Table S1 summarises the average social costs per reported crash and per reported injury, at June 2007 prices, by severity and area. Apart from the estimates for property-damage-only (PDO) crashes, all estimates have been adjusted 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 S1: Average social cost per crash and per injury

	June 2007 prices ($)		
Per reported crash *(Note 1)*	**All areas**	**Rural**	**Urban**
Fatal	3,881,000	4,016,000	3,539,000
Serious	680,000	735,000	626,000
Minor	83,000	88,000	79,000
Per reported injury *(Note 1)*	**All areas**	**Rural**	**Urban**
Fatal	3,211,000	3,211,000	3,211,000
Serious	563,000	568,000	558,000
Minor	61,000	60,000	61,000
Per PDO crash *(Note 2)*	**All areas**	**Rural**	**Urban**
Property-damage-only	2,300	2,500	2,200

Notes:
1. These estimates have been adjusted for the level of non-reporting.
2. The estimates per PDO crash have NOT been adjusted for the level of non-reporting.

The social cost of road crashes and injuries in 2006

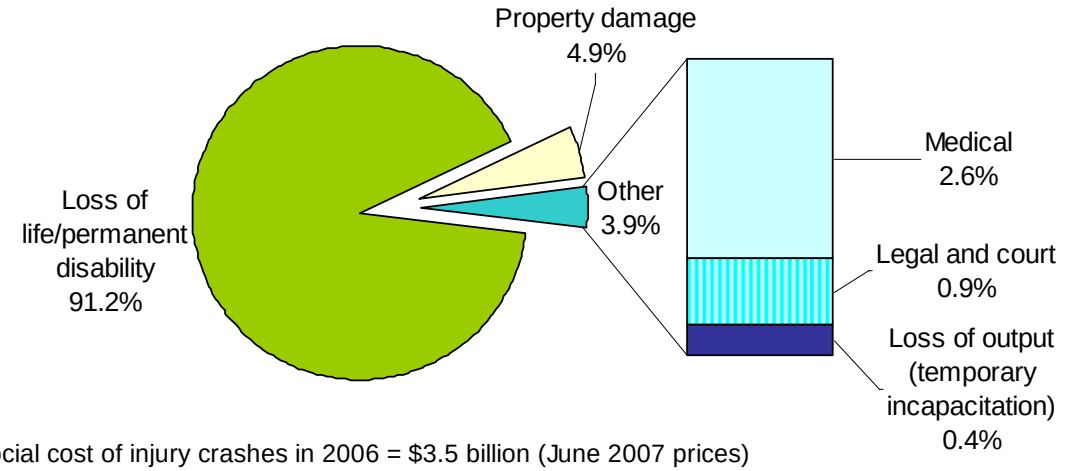
The total social cost of motor vehicle injury crashes in 2006 is estimated at approximately $3.5 billion (up from $3.4 billion in 2005), at June 2007 prices. This estimate includes both reported and non-reported casualties and can be broken down by injury severity as follows:

- fatalities : $1.26 billion (down from $1.30 billion in 2005)
- serious injuries : $1.48 billion (up from $1.42 billion in 2005)
- minor injuries : $0.76 billion (up from $0.72 billion in 2005)

In addition, there are an estimated 267,000 property-damage-only crashes valued at a further $0.6 billion. Therefore, the total social cost of all motor vehicle crashes in 2006 is estimated to have been $4.1 billion (up from $4.0 billion in 2005).

The social cost of road crashes and injuries includes several components. In 2006, 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 S1).

Figure S1: Share of total social cost of injury crashes in 2006, by cost component



Total social cost of injury crashes in 2006 = $3.5 billion (June 2007 prices)

Trend in road trauma

Statistics on the number of reported injuries and estimates of the number of non-reported injuries for the years from 2001 are given in Table S2. This shows that, while the number of road fatalities has been decreasing over time, the number of non-fatal injuries has in fact increased.

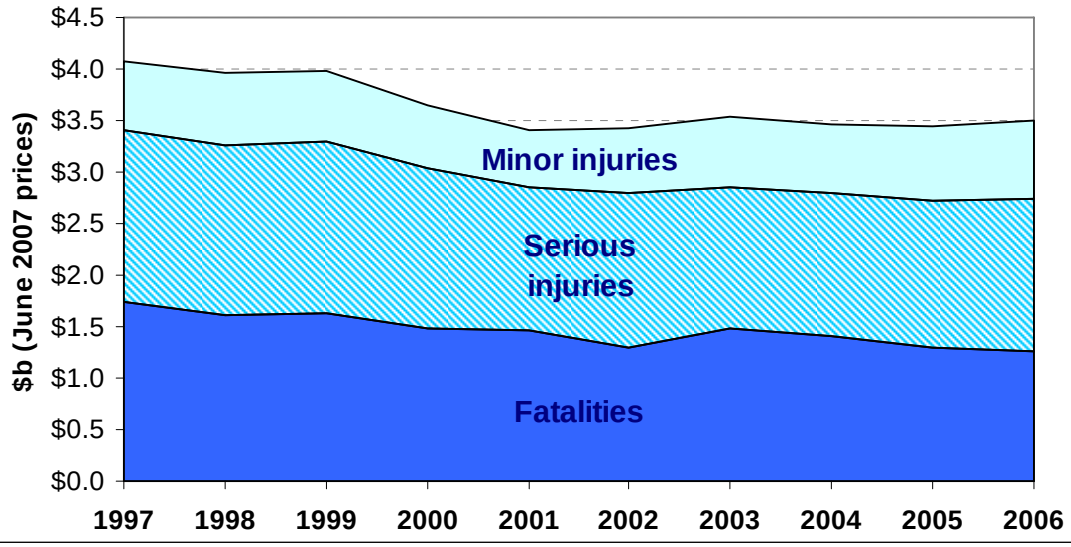
Figure S2 shows the trend of the estimated annual total social cost of injury crashes for the ten years to 2006. The decrease during 1997-2001 has levelled out in recent years.

Table S2: 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	1,660	21,560
2002	404	2,600	11,318	1,815	24,690
2003	461	2,578	11,794	1,455	26,660
2004	436	2,469	11,351	1,630	26,665
2005	405	2,519	11,906	1,675	28,700
2006	391	2,627	12,526	1,740 (P)	30,350 (P)

* Estimated using data from Accident Compensation Corporation, New Zealand Health Information Services and Traffic Crash Reports. P – Provisional estimates.

Figure S2: Estimated annual total social cost of road injuries, by injury severity ($ bilion, at June 2007 prices)



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

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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 facilitates 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, in the mix of crashes by area and severity, and in the average number of injuries involved in a crash. The analysis is based on crash and injury data from 2004 to 2006. Unless otherwise indicated, all social cost estimates are expressed in June 2007 prices.

This report also provides estimates of the total social cost of road crashes and injuries that have occurred in New Zealand since 1997. 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. Because not all crashes are reported and recorded in the official Traffic Crash Reports (TCRs), the first stage involves estimating the total number of crashes and injuries. Counting the reported[1] 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 that is 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. At the national level, conversion factors are estimated from the regional estimates, and developed by area (rural and urban) and by injury or crash severity (serious, minor and property-damage-only).

Annual total numbers of reported injuries and estimated numbers of non-reported injuries for the years from 2001 to 2006 are shown in Table 2.1. The estimated total numbers of crashes and injuries for the years 2004 to 2006 are given in Table B1 (Appendix B).

While the number of road fatalities has decreased over time, the estimated total number of non-fatal injuries has in fact increased in recent years. There are several possible explanations: firstly, exposure to risk increases as traffic volumes grow; secondly, some road safety interventions reduce crash severity rather than crash occurrence (this means that some avoided deaths could become serious and/or minor injuries, for example); thirdly, more people are becoming aware of the ACC scheme; and fourthly, there are some counting or coding errors.

[1] Reported injuries or crashes refer to injuries or crashes that have the associated TCRs.

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	1,660	21,560
2002	404	2,600	11,318	1,815	24,690
2003	461	2,578	11,794	1,455	26,660
2004	436	2,469	11,351	1,630	26,665
2005	405	2,519	11,906	1,675	28,700
2006	391	2,627	12,526	1,740 (P)	30,350 (P)

* Estimated using data from Accident Compensation Corporation (ACC), New Zealand Health Information Services (NZHIS) and Traffic Crash Reports (TCRs). P – provisional estimates.

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 loss of life and life quality, loss of output due to temporary incapacitation, medical costs, legal costs and 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.

As in the previous updates, we assume that reported and non-reported injuries of the same severity category have the same average social cost. Thus, the product of the average social cost per incident and the estimated total number of incidents gives the estimated total social cost of incidents (for crashes, we need an additional assumption that the average number of injuries is the same irrespective of whether or not a crash is reported). To account for the differences in the levels of reporting and other regional differences, estimates are made at the regional level by severity and area.

In New Zealand, there are only two levels of non-fatal injury severity. This means that the variation in the level of injury impairments within each severity category can be quite large. According to ACC claims cost data, non-reported injuries tend to incur lower total claim costs than reported injuries. Thus, assuming that reported and non-reported injuries have the same value may over-state the cost of non-reported injuries. However, a preliminary analysis shows that the relative cost between reported and non-reported injuries only affects the scale of the total social cost, but not its overall trend (see Appendix A2.2).

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 2002 to 2006. 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 (e.g. 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 2004 to 2006. These estimates have been adjusted for the level of non-reporting and are useful for the evaluation of regional programmes or policies. Historical regional estimates using year-specific crash and injury conversion factors are incorporated in 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 value of WTP. 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 (e.g. in situations where the crash or injury numbers are small).

4. Cost estimates

The updated value of statistical life is $3.19 million per fatality, at June 2007 prices. This gives an updated average social cost per fatality of $3,211,000. For non-fatal injuries, the updated average social cost is estimated at $563,000 per reported serious injury and $61,000 per reported minor injury.

In per-crash terms, the updated average social cost is estimated at $3,881,000 per fatal crash, $680,000 per reported serious crash and $83,000 per reported minor crash. These estimates include an adjustment for the level of non-reporting.

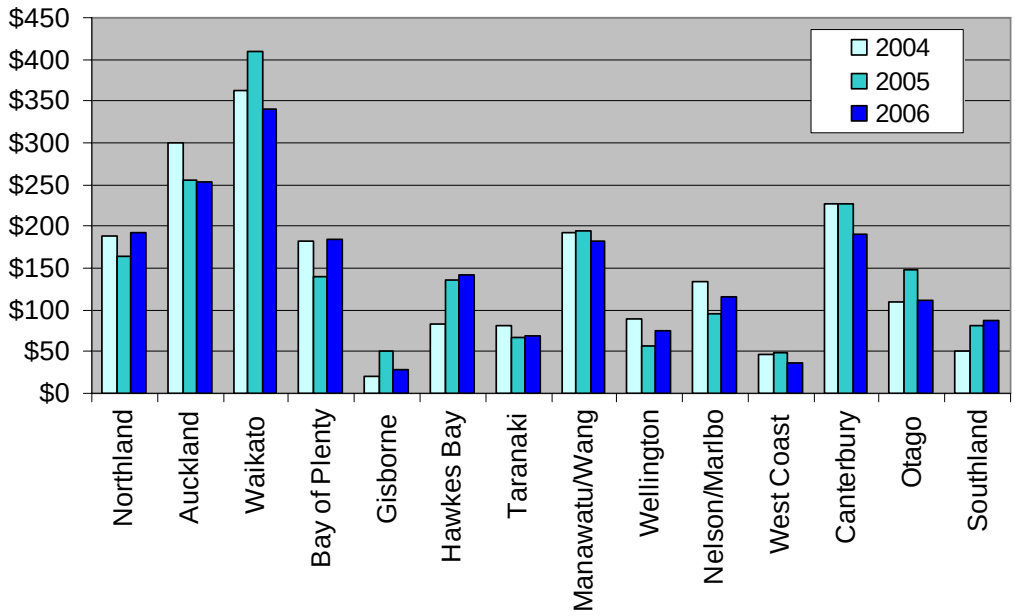
The total social cost of motor vehicle injury crashes in 2006 is estimated at approximately $3.50 billion (down from $3.4 billion in 2005), at June 2007 prices. In addition, there are an estimated 267,000 property-damage-only crashes valued at a further $0.6 billion. Therefore, the total social cost of all motor vehicle crashes is estimated to have been $4.1 billion (up from $4.0 billion in 2005). These estimates include both reported and non-reported cases.

The total social cost of injuries, of $3.5 billion in 2006, can be broken down by injury severity as follows:

- fatalities : $1.26 billion (down from $1.30 billion in 2005)
- serious injuries : $1.48 billion (up from $1.42 billion in 2005)
- minor injuries : $0.76 billion (up from $0.72 billion in 2005)

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 4.1 and 4.2.

Figure 4.1: Total social cost of road injuries in rural areas, by region ($ million, at June 2007 prices)



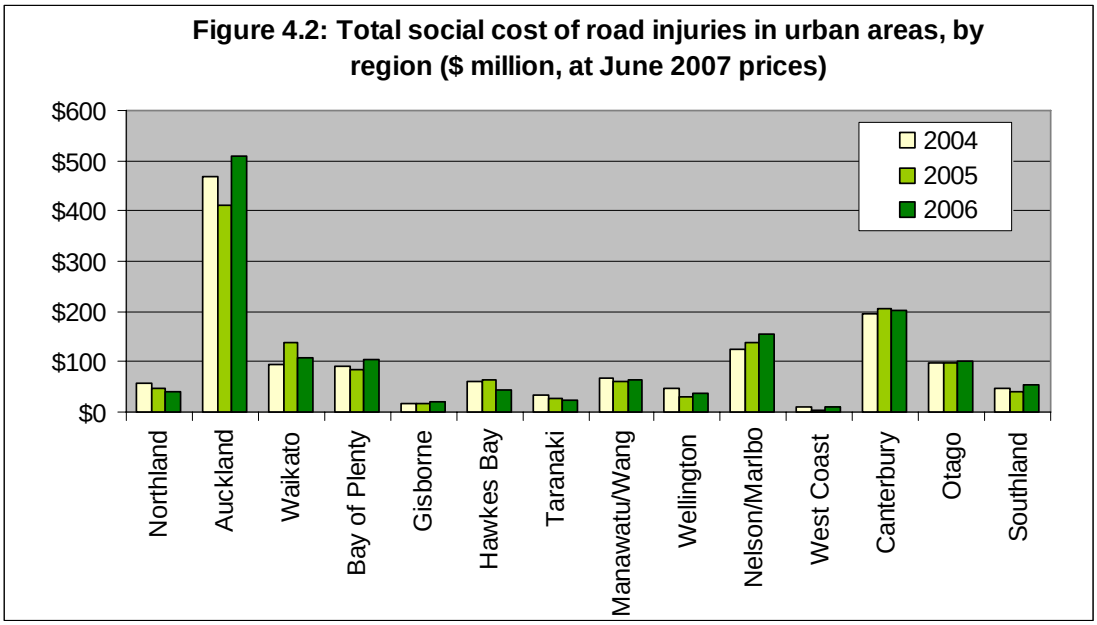


Figure 4.3 shows the trend in social costs of road injuries by injury severity for the ten years to 2006. This shows that the reduction during 1997-2001 has levelled out in recent years.

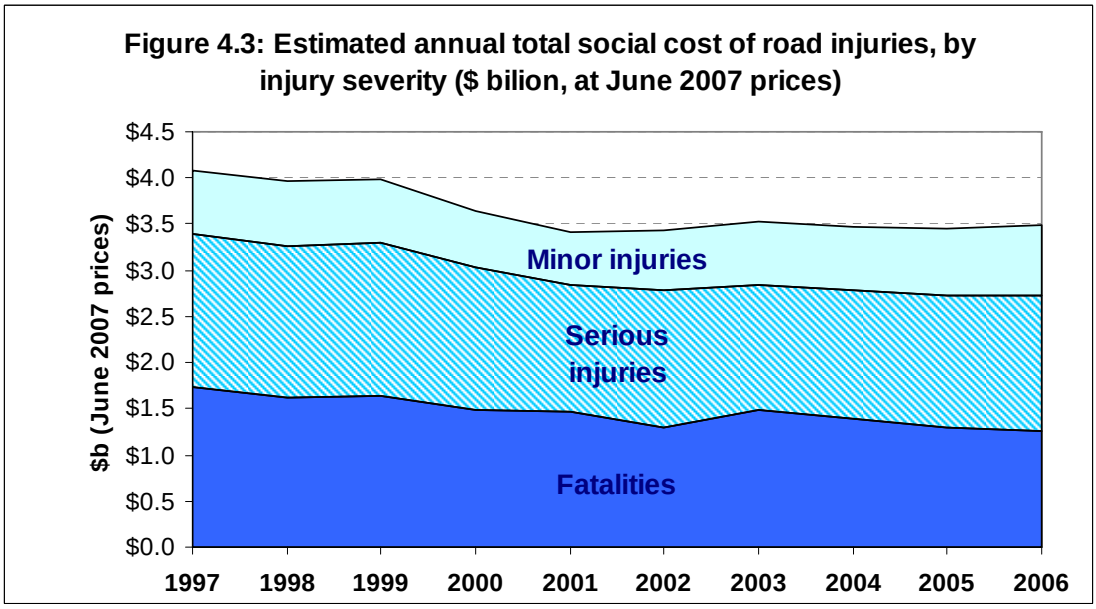


Table 4.0 summarises the estimated total social cost of road crashes and injuries from 1997 onwards, using year-specific crash and injury conversion factors.

Table 4.0: Total social cost of road crashes and injuries, at June 2007 prices

Year	Injuries ($b June 2007 prices)			Crashes ($b June 2007 prices)			
	F	S	M	F	S	M	PDO
1997	$1.73	$1.67	$0.68	$1.82	$1.59	$0.60	$0.51
1998	$1.62	$1.64	$0.71	$1.69	$1.59	$0.63	$0.54
1999	$1.63	$1.67	$0.68	$1.69	$1.60	$0.60	$0.51
2000	$1.48	$1.55	$0.62	$1.49	$1.49	$0.55	$0.48
2001	$1.46	$1.39	$0.56	$1.53	$1.32	$0.51	$0.43
2002	$1.30	$1.49	$0.64	$1.41	$1.46	$0.59	$0.51
2003	$1.48	$1.37	$0.68	$1.57	$1.31	$0.65	$0.56
2004	$1.40	$1.39	$0.68	$1.46	$1.35	$0.64	$0.55
2005	$1.30	$1.42	$0.72	$1.32	$1.40	$0.69	$0.59
2006	$1.26	$1.48	$0.76	$1.35	$1.45	$0.72	$0.62

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

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 2007 prices ($)		
Loss of life/permanent disability	3,846,400	372,100	16,400
Loss of output (temporary disability)	700	1,500	300
Medical –			
Hospital/Medical	7,400	9,000	100
Emergency/Pre-hospital	3,700	1,400	700
Follow-on	1,800	4,500	100
Legal and court	12,300	2,700	500
Property damage	9,100	5,800	4,600
Total	**3,881,400**	**396,900**	**22,800**

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 2007 prices ($)		
Loss of life/permanent disability	3,191,000	319,100	12,800
Loss of output (temporary disability)	0	1,200	200
Medical –			
Hospital/Medical	3,200	7,800	100
Emergency/Pre-hospital	2,500	900	600
Follow-on	0	3,800	100
Legal and court	9,600	2,100	400
Property damage *(Note 3)*	4,700	3,500	3,600
Total	**3,211,000**	**338,600**	**17,800**

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

	June 2007 prices ($)				
	Average per crash			Average per injury	
Crash Severity	All Areas	Rural Areas	Urban areas	Include property damage cost	Exclude property damage cost
Fatal	3,881,400	4,016,200	3,539,100	3,211,000	3,206,300
Serious	396,900	418,800	374,500	338,600	335,100
Minor	22,800	24,500	21,800	17,800	14,200
S & M	62,000	77,900	51,800	47,900	44,400
F & S	714,700	866,700	546,400	593,200	589,600
F, S & M	101,700	152,300	68,700	76,600	73,000
PDO	2,300	2,500	2,200		

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

	June 2007 prices ($)		
Crash severity	**All**	**Rural**	**Urban**
Fatal	3,881,000	4,016,000	3,539,000
Serious	680,000	735,000	626,000
Minor	83,000	88,000	79,000
Serious and minor	201,000	246,000	170,000
Fatal and serious	1,149,000	1,390,000	881,000
Fatal, serious and minor	322,000	462,000	223,000

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

	June 2007 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	3,211,000	3,211,000	3,211,000
Serious	563,000	568,000	558,000
Minor	61,000	60,000	61,000
Serious and minor	149,000	168,000	134,000
Fatal and serious	932,000	1,048,000	780,000
Fatal, serious and minor	233,000	305,000	174,000

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

	June 2007 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	3,206,000	3,206,000	3,206,000
Serious	557,000	562,000	552,000
Minor	48,000	47,000	50,000
Serious and minor	138,000	157,000	123,000
Fatal and serious	926,000	1,043,000	775,000
Fatal, serious and minor	222,000	294,000	163,000

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

	June 2007 prices ($)		
Vehicle movement classification	**All**	**Rural**	**Urban**
Overtaking or lane change	432,000	532,000	284,000
Head-on, not overtaking	886,000	1,136,000	437,000
Lost control, straight roads	339,000	373,000	283,000
Cornering	360,000	388,000	306,000
Collision with obstruction	216,000	298,000	185,000
Rear end collision	141,000	167,000	123,000
Turning versus same direction	221,000	326,000	168,000
Crossing, no turns	237,000	635,000	189,000
Crossing, vehicle turning	228,000	423,000	167,000
Vehicles merging	177,000	263,000	162,000
Right turn against	224,000	475,000	176,000
Vehicle manoeuvring	214,000	485,000	162,000
Pedestrian crossing road	300,000	932,000	276,000
Pedestrian other	523,000	1,259,000	368,000
Miscellaneous	512,000	605,000	437,000

4.5 Average social cost by local government region

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

Region	Crash severity					
	Fatal	Serious	Minor	S+M	F+S	F+S+M
	June 2007 prices ($)					
All areas						
Northland	3,757,000	974,000	85,000	283,000	1,491,000	451,000
Auckland	3,734,000	563,000	81,000	150,000	1,021,000	235,000
Waikato	4,080,000	632,000	84,000	194,000	1,399,000	406,000
Bay of Plenty	3,808,000	942,000	86,000	303,000	1,443,000	482,000
Gisborne	5,274,000	1,177,000	84,000	325,000	1,632,000	457,000
Hawke's Bay	3,937,000	602,000	81,000	196,000	1,170,000	357,000
Taranaki	4,243,000	687,000	86,000	198,000	1,296,000	349,000
Manawatu-Wanganui	4,104,000	726,000	82,000	242,000	1,288,000	425,000
Wellington	3,964,000	711,000	79,000	204,000	1,078,000	296,000
Nelson-Marlborough	3,572,000	622,000	78,000	186,000	1,045,000	295,000
West Coast	3,387,000	810,000	89,000	285,000	1,311,000	476,000
Canterbury	3,822,000	752,000	80,000	220,000	1,144,000	325,000
Otago	3,997,000	546,000	89,000	200,000	753,000	257,000
Southland	3,323,000	602,000	90,000	224,000	787,000	282,000
New Zealand	**3,881,000**	**680,000**	**83,000**	**201,000**	**1,149,000**	**322,000**
Rural areas						
Northland	3,747,000	1,005,000	89,000	314,000	1,559,000	515,000
Auckland	3,892,000	618,000	86,000	161,000	1,415,000	325,000
Waikato	4,193,000	652,000	87,000	223,000	1,521,000	511,000
Bay of Plenty	3,963,000	1,011,000	95,000	362,000	1,700,000	656,000
Gisborne	5,858,000	1,169,000	90,000	392,000	1,839,000	636,000
Hawke's Bay	3,886,000	640,000	87,000	241,000	1,352,000	507,000
Taranaki	4,352,000	707,000	90,000	223,000	1,565,000	479,000
Manawatu-Wanganui	4,250,000	766,000	90,000	299,000	1,477,000	589,000
Wellington	4,282,000	775,000	85,000	252,000	1,415,000	458,000
Nelson-Marlborough	3,740,000	658,000	86,000	223,000	1,260,000	417,000
West Coast	3,368,000	832,000	90,000	318,000	1,357,000	545,000
Canterbury	3,949,000	798,000	86,000	288,000	1,397,000	517,000
Otago	4,155,000	561,000	94,000	222,000	872,000	321,000
Southland	3,343,000	619,000	96,000	265,000	884,000	369,000
New Zealand	**4,016,000**	**735,000**	**88,000**	**246,000**	**1,390,000**	**462,000**

Table 4.5a continued

Urban areas	Crash severity					
Region	**Fatal**	**Serious**	**Minor**	**S+M**	**F+S**	**F+S+M**
Northland	3,805,000	878,000	79,000	216,000	1,264,000	308,000
Auckland	3,583,000	544,000	79,000	145,000	859,000	202,000
Waikato	3,601,000	583,000	80,000	152,000	1,062,000	243,000
Bay of Plenty	3,320,000	865,000	78,000	252,000	1,104,000	324,000
Gisborne	3,230,000	1,188,000	80,000	268,000	1,316,000	301,000
Hawke's Bay	4,162,000	546,000	77,000	156,000	858,000	218,000
Taranaki	3,475,000	659,000	81,000	173,000	825,000	206,000
Manawatu-Wanganui	3,363,000	652,000	74,000	180,000	884,000	233,000
Wellington	3,307,000	670,000	76,000	181,000	837,000	218,000
Nelson-Marlborough	3,273,000	594,000	73,000	164,000	854,000	222,000
West Coast	3,559,000	702,000	87,000	194,000	1,059,000	275,000
Canterbury	3,539,000	717,000	78,000	188,000	925,000	233,000
Otago	3,540,000	532,000	86,000	182,000	627,000	205,000
Southland	3,225,000	580,000	86,000	189,000	652,000	207,000
New Zealand	**3,539,000**	**626,000**	**79,000**	**170,000**	**881,000**	**223,000**

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

	Injury severity					
Region	**Fatal**	**Serious**	**Minor**	**S+M**	**F+S**	**F+S+M**
	June 2007 prices ($)					
All areas						
Northland	3,211,000	787,000	62,000	204,000	1,191,000	317,000
Auckland	3,211,000	474,000	62,000	116,000	844,000	178,000
Waikato	3,211,000	505,000	60,000	142,000	1,069,000	283,000
Bay of Plenty	3,211,000	759,000	61,000	213,000	1,157,000	335,000
Gisborne	3,211,000	1,004,000	63,000	237,000	1,316,000	325,000
Hawke's Bay	3,211,000	491,000	59,000	146,000	915,000	255,000
Taranaki	3,211,000	560,000	61,000	146,000	1,004,000	246,000
Manawatu-Wanganui	3,211,000	563,000	58,000	168,000	973,000	286,000
Wellington	3,211,000	609,000	61,000	159,000	907,000	227,000
Nelson-Marlborough	3,211,000	550,000	61,000	148,000	911,000	231,000
West Coast	3,211,000	652,000	60,000	195,000	1,058,000	320,000
Canterbury	3,211,000	646,000	61,000	168,000	965,000	245,000
Otago	3,211,000	459,000	60,000	138,000	622,000	176,000
Southland	3,211,000	499,000	58,000	147,000	656,000	185,000
New Zealand	**3,211,000**	**563,000**	**61,000**	**149,000**	**932,000**	**233,000**
Rural areas						
Northland	3,211,000	777,000	62,000	217,000	1,196,000	347,000
Auckland	3,211,000	467,000	61,000	117,000	1,050,000	228,000
Waikato	3,211,000	501,000	59,000	155,000	1,115,000	337,000
Bay of Plenty	3,211,000	748,000	61,000	231,000	1,261,000	414,000
Gisborne	3,211,000	966,000	62,000	268,000	1,387,000	414,000
Hawke's Bay	3,211,000	486,000	57,000	164,000	987,000	325,000
Taranaki	3,211,000	550,000	61,000	155,000	1,145,000	316,000
Manawatu-Wanganui	3,211,000	558,000	56,000	184,000	1,046,000	348,000
Wellington	3,211,000	599,000	60,000	177,000	1,066,000	314,000
Nelson-Marlborough	3,211,000	543,000	60,000	160,000	1,019,000	292,000
West Coast	3,211,000	654,000	60,000	214,000	1,080,000	362,000
Canterbury	3,211,000	637,000	60,000	199,000	1,095,000	350,000
Otago	3,211,000	455,000	59,000	146,000	685,000	206,000
Southland	3,211,000	497,000	57,000	162,000	715,000	224,000
New Zealand	**3,211,000**	**568,000**	**60,000**	**168,000**	**1,048,000**	**305,000**

Table 4.5b continued

Urban areas	Injury severity					
Region	**Fatal**	**Serious**	**Minor**	**S+M**	**F+S**	**F+S+M**
Northland	3,211,000	826,000	62,000	169,000	1,170,000	239,000
Auckland	3,211,000	476,000	61,000	115,000	745,000	158,000
Waikato	3,211,000	514,000	61,000	119,000	918,000	186,000
Bay of Plenty	3,211,000	774,000	61,000	194,000	990,000	248,000
Gisborne	3,211,000	1,063,000	63,000	206,000	1,186,000	232,000
Hawke's Bay	3,211,000	502,000	61,000	126,000	766,000	174,000
Taranaki	3,211,000	576,000	62,000	134,000	711,000	157,000
Manawatu-Wanganui	3,211,000	577,000	60,000	145,000	779,000	187,000
Wellington	3,211,000	615,000	62,000	148,000	768,000	178,000
Nelson-Marlborough	3,211,000	557,000	62,000	139,000	801,000	187,000
West Coast	3,211,000	641,000	61,000	141,000	927,000	193,000
Canterbury	3,211,000	654,000	62,000	151,000	836,000	185,000
Otago	3,211,000	463,000	61,000	131,000	547,000	148,000
Southland	3,211,000	502,000	60,000	133,000	568,000	146,000
New Zealand	**3,211,000**	**558,000**	**61,000**	**134,000**	**780,000**	**174,000**

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

	June 2007 prices ($)		
Crash severity	**All**	**Rural**	**Urban**
Fatal	11,574,000	11,975,000	10,556,000
Serious	1,954,000	2,110,000	1,801,000
Minor	201,000	214,000	193,000
Serious and minor	548,000	677,000	462,000
Fatal and serious	3,364,000	4,080,000	2,567,000
Fatal, serious and minor	910,000	1,325,000	621,000

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

	June 2007 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	9,593,000	9,593,000	9,593,000
Serious	1,625,000	1,638,000	1,609,000
Minor	148,000	144,000	151,000
Serious and minor	407,000	462,000	363,000
Fatal and serious	2,735,000	3,085,000	2,277,000
Fatal, serious and minor	661,000	875,000	484,000

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

	June 2007 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	9,588,000	9,588,000	9,588,000
Serious	1,619,000	1,632,000	1,604,000
Minor	136,000	132,000	139,000
Serious and minor	396,000	451,000	352,000
Fatal and serious	2,729,000	3,079,000	2,272,000
Fatal, serious and minor	650,000	864,000	473,000

Appendix A Technical notes

A1 Estimation of the number of injuries and crashes

The estimated total numbers of injuries and crashes for the years 2004 to 2006 are given in Table B1 (Appendix B). The methodology adopted in this update (discussed briefly below) has not changed from the last update. **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 were used to estimate the total numbers of road crashes and injuries (see Table A1). Note that historical data on hospital admissions and ACC claims have been revised based on the latest information provided by New Zealand Health Information Services and ACC.

ACC claims data include claims from both hospitalised and non-hospitalised injuries. In a data matching exercise, it was found that around 90% of the reported serious injuries and 70% of the reported minor injuries were matched with ACC claims data. It is possible that there are a small number of serious and minor injuries that are neither hospitalised nor reported and which also do not have an associated ACC claim. However, these injuries are likely to have negligible social cost implications and can therefore be ignored.

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	3,167	33,965
2002	404	2,600	11,318	6,506	3,008	36,444
2003	461	2,578	11,794	6,564	3,079	39,107
2004	436	2,469	11,351	6,568	3,030	39,292
2005	405	2,519	11,906	7,198	3,194	41,490
2006	391	2,627	12,526	7,491 (P)	3,266 (P)	43,654 (P)

* Data have been updated. P – provisional estimates.

A1.2 Conversion factors

Injury and crash conversion factors (defined as the ratio of ***estimated*** to ***reported*** numbers of incidents) are developed for estimating the total numbers of injuries and crashes from their reported numbers.

Depending on a range of factors, such as police resources, the level of regional reporting could vary dramatically between years. To minimise this random effect, the conversion factors for any crash year would be based on data for a three-year period centred at the crash year. For instance, the conversion factors using 2003-2005 data are for the estimation of the incidents occurring during 2004, and those based on 2004-2006 data are for incidents from 2005, and so on. Due to a lag effect, provisional estimates for the latest year will be based on the most recent three years' data (e.g. data for 2004-2006 will be used for 2005 as well as for the provisional estimates for 2006), and will be updated during the following year.

Serious injury and crash conversion factors are developed at the regional level first. Estimates are then used to estimate 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 A2. 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. However, such changes have not altered the overall trends of the social cost of road trauma in recent years.

For the three years to 2006, 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 A2: National crash and injury conversion factors

	Serious crash conversion factors			Serious injury conversion factors		
Year	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
	Minor crash conversion factors			**Minor injury conversion factors**		
Year	Rural	Urban	All areas	Rural	Urban	All areas
1998-2000	4.28	4.28	4.28	3.80	4.09	3.97
2001-2003	3.39	3.39	3.39	3.08	3.26	3.18
2002-2004	3.47	3.47	3.47	3.15	3.34	3.26
2003-2005	3.55	3.55	3.55	3.24	3.43	3.35
2004-2006	3.61	3.61	3.61	3.31	3.49	3.41

Note: There are slight changes in the historical factors as a result of adopting the revised hospital admissions and ACC new claims 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) and the methodologies used are briefly discussed below:

(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 (i.e. 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 $3.19 million, at June 2007 prices.
- As in the June 2006 update, the average loss of life quality due to permanent impairments from a serious injury is estimated at 10% of the VOSL (or $319,100) and 0.4% (or $12,800) 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 2006.

(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 2006 shows that the mean length of hospital stay is 12.3 days for a reported serious injury and 2.5 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 2004 to 2006 is estimated at $95.4, at June 2007 prices.
- The cost estimate is incorporated in 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 2006.

(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 in 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 Land Transport New Zealand's Land Transport Programme.
- Annual data on convictions and sentencing details were obtained from the Ministry of Justice. The average cost per inmate per day for 2003/04 was $155 (Department of Corrections, 2004). This estimate is updated for price changes with the producers' input price index for legal services. 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 in the Ministry's Crash Analysis System. These estimates are available upon request.

A2.3 Sensitivity analysis on valuation of non-reported injuries

Due to a lack of information, the average social cost per non-reported incident is assumed to be the same as that for a reported incident (also see Section 2.2). However, more severe injuries are likely to be reported. According to ACC claims cost data (covering mainly the costs of medical treatments, rehabilitation and weekly compensation), non-reported injuries tend to incur lower total claims costs. A preliminary analysis suggests that the total ACC claim cost per non-reported serious injury could be as low as 10% of the cost per reported serious injury. Similar conclusions can be drawn for minor injuries.

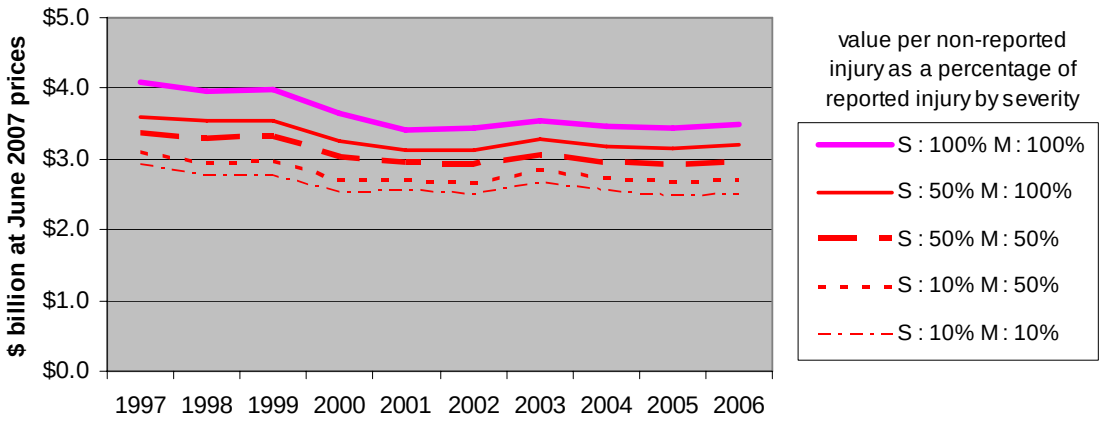
The major component of the social cost of injuries is the value of loss of life and life quality. Some injuries that result in long-term impairments may not require on-going medical treatment and other ACC compensation but could still result in a significant reduction in quality of life. Therefore, although we would expect non-reported injuries to have a lower average social cost than reported injuries, we do not expect the difference to be as large as that for ACC claim cost.

To minimise the errors from using the same average social cost for both reported and non-reported injuries, one possible solution would be to classify non-fatal injuries into finer severity categories (instead of serious or minor only), and to develop a different average social cost or cost weight for each severity category.

While such an analysis cannot be carried out without obtaining more detailed data on hospitalisations and ACC claims, a sensitivity analysis is possible with current data to see how changes in the values we place on non-reported injuries affect the total social cost and its trends.

Figure A1 shows the estimated annual total social cost of road injuries, with different assumptions on the average social cost per non-reported injury relative to the cost of a reported injury. The numbers of non-reported injuries behind this chart are based on year-specific conversion factors developed using the methodology discussed in Section A1.2. This sensitivity analysis shows that despite some changes in scale, the overall trend of the total social cost has not changed materially under different scenarios. It indicates that the reduction in the annual total social cost has levelled out since around 2001.

Figure A1: Estimated annual total social cost of road injuries with different average social cost per non-reported injury relative to reported injury



Appendix B Crash statistics and price indices

Table B1: Reported and estimated number of crashes and injuries from 2004 to 2006

All areas								
	Reported	Reported injuries			Estimated	Estimated injuries		
	Crash	Fatal	Serious	Minor	Crash	Fatal	Serious	Minor
Fatal	1,065	1,232	495	558	1,065	1,232	495	558
Serious	6,199	0	7,120	2,985	10,613	0	12,173	5,099
Minor	25,125	0	0	32,240	90,764	0	0	116,466
Total	**32,389**	**1,232**	**7,615**	**35,783**	**102,442**	**1,232**	**12,668**	**122,123**
Rural areas								
	Reported	Reported injuries			Estimated	Estimated injuries		
	Crash	Fatal	Serious	Minor	Crash	Fatal	Serious	Minor
Fatal	764	911	401	422	764	911	401	422
Serious	3,062	0	3,698	1,830	5,372	0	6,474	3,174
Minor	9,491	0	0	12,902	34,286	0	0	46,608
Total	**13,317**	**911**	**4,099**	**15,154**	**40,422**	**911**	**6,875**	**50,204**
Urban areas								
	Reported	Reported injuries			Estimated	Estimated injuries		
	Crash	Fatal	Serious	Minor	Crash	Fatal	Serious	Minor
Fatal	301	321	94	136	301	321	94	136
Serious	3,137	0	3,422	1,155	5,242	0	5,699	1,925
Minor	15,634	0	0	19,338	56,478	0	0	69,858
Total	**19,072**	**321**	**3,516**	**20,629**	**62,020**	**321**	**5,793**	**71,919**

Table B2: Price indices for updating unit costs

Cost components	Indices/measures	Series references	Period	Indices/ values	Estimated % change over the 12 months to June 2007
Loss of life & life quality	Average hourly earnings (ordinary time)	EESQ.SAAZ9A	June 2006 Mar 2007 June 2007	$21.84 $22.59 $22.82 *	4.5%
Loss of output					
Medical cost	Producers price input index – Health and community services	PPIQ.SNO (Base: Dec 1997=1000)	June 2006 Mar 2007 June 2007	1191 1204 1212 *	1.7%
Legal and court cost	Producers price input index – Legal services: Personal and Corporate	PPIQ.SC23 (Base: Dec 1997=1000)	June 2006 Mar 2007 June 2007	1375 1421 1428 *	3.9%
Property damage cost	Consumers price index – Vehicle servicing & repairs	CPIQ.SE907204 (Base: June 2006 =1000)	June 2006 Mar 2007 June 2007	1000 1034 1038 *	3.8%

Notes:
1. Source - PCINFOS, Statistics New Zealand
2. An * denotes an estimated value.

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