TE MANATŪ WAKA
MINISTRY OF TRANSPORT

OC220388

18 May 2022

Tēnā koe,

I refer to your email of 10 May 2022, requesting the following under the Official Information Act 1982 (the Act):

> *"Sad to see the death toll creeped up another 7 or so deaths. What's the current social economic cost for them to date for 2022. And may I ask how you guys work this out please."*

As of 18 May 2022, there have been 146 fatalities on NZ roads. The current average social cost per fatality is estimated to be $4,934,900. By multiplying those two numbers together we estimate the social cost of these to be about $720,495,400 (in June 2021 prices).

Reporting of year-to-date road deaths are updated daily. This is a headline statistic that can be found on the front page of our website: **https://www.transport.govt.nz/**. You can use this to estimate the latest social cost of road fatalities as the statistic is updated.

We update the average social cost of road crashes and injuries annually based on updated crash data for the most recent three-year period, and prices indices sourced from Statistics NZ. We have recently published our latest update at: **https://www.transport.govt.nz/area-of-interest/safety/social-cost-of-road-crashes-and-injuries/**, which provides a brief explanation on how these estimates are calculated. For more details on the methodology, I refer you to *the attached Social cost of road crashes and injuries June 2006 update*.

In addition to the average social cost of road fatalities, these reports also provided average social cost values for serious and minor injuries as well as for non-injury crashes. However, we have not provided estimates of social cost for all year-to-date injury and non-injury crashes as it generally takes around six months for related crash reports to be fully captured and reflected in Waka Kotahi's Crash Analysis System. In addition, reported road fatalities can also be revised if subsequent investigations determine that the cause of death was not due to an on-road accident (e.g., medical condition or suicide).

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You have the right to seek an investigation and review of this response by the Ombudsman, in accordance with section 28(3) of the Act. The relevant details can be found on the Ombudsman's website **www.ombudsman.parliament.nz**

The Ministry publishes our Official Information Act responses and the information contained in our reply to you may be published on the Ministry website. Before publishing we will remove any personal or identifiable information.

Nāku noa, nā

Joanne Leung
Chief Economist and Manager, Research, Economics and Evaluation

Annex 1 - Document Schedule

Doc#	Document	Decision on release
1	Social cost of road crashes and injuries 2006 update	Released in full

Ministry of Transport
TE MANATŪ WAKA

The social cost of road crashes and injuries June 2006 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 the total social cost of road crashes and injuries that occurred in New Zealand in 2005. It also reports the average social cost per injury and crash, with and without adjustment for the level of non-reporting.

The social cost of road crashes and injuries in 2005

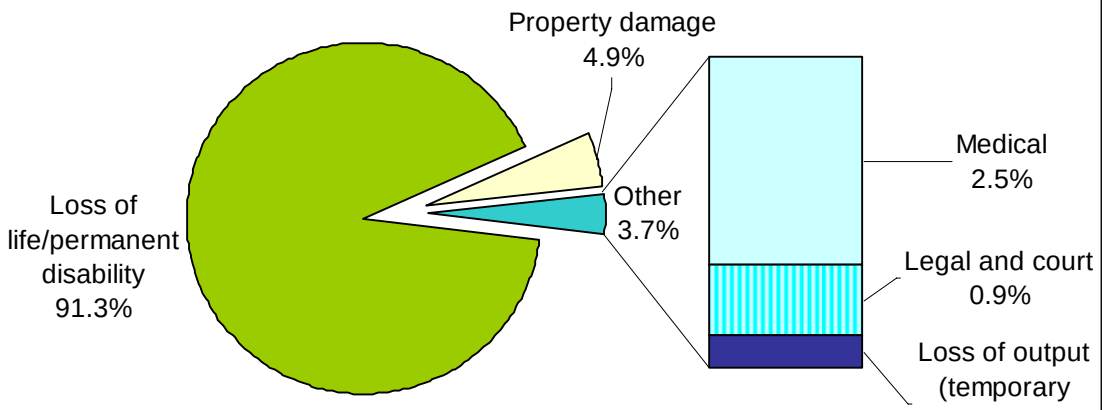
The total social cost of motor vehicle injury crashes in 2005 is estimated at approximately $3.3 billion (down from $3.34 billion in 2004), at June 2006 prices. This estimate includes both reported and non-reported casualties and can be broken down by injury severity as follows:

- fatalities $1,241 million (down from $1,336 in 2004)
- serious injuries $1,353 million (up from $1,325 in 2004)
- minor injuries $713 million (up from $678 in 2004)

The total social cost of all motor vehicle crashes, including property damage only crashes, in 2005 is estimated at approximately $4.1 billion, at June 2006 prices.

The social cost of road crashes and injuries includes several components. In 2005, 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 damages accounting for 5% and other cost components making up the remaining 4% (see Figure S1).

Figure S1: Total social cost of injury crashes in 2005 (by cost component), $m at June 2006 prices



Note: Excluding non-injury crashes

Average social cost of injury and crash

The updated value of statistical life (VOSL) is $3.05 million per fatality, at June 2006 prices. This gives the updated average social cost per fatality of $3,065,000. For non-fatal injuries, the updated average social cost is estimated at $535,000 per reported serious injury and $60,000 per reported minor injury. In per crash terms, the updated average social cost is estimated at $3,721,000 per fatal crash, $649,000 per reported serious crash and $81,000 per reported minor crash. Table S1 summarises the average social cost per reported crash and injury, at June 2006 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.

Compared to the June 2005 estimates, the estimates of average social cost per reported fatal injury and crash have increased by around 3.7% in most cases. This increase is in line with inflation. However, the average social cost per reported fatal crash in rural areas has increased by 6.9%, due to an increase in the average number of casualties per crash in those areas.

The estimates of average social cost per reported serious or minor injury and crash are 8% to 11.1% higher than the June 2005 estimates. The increase over and above the inflation effect reflects the result of a reduced level of police reporting for these incidents.

Table S1: Average social cost per crash and injury

	June 2006 prices ($)		
Per reported crash *(Note 1)*	**All areas**	**Rural**	**Urban**
Fatal	3,721,000	3,850,000	3,390,000
Serious	649,000	700,000	600,000
Minor	81,000	87,000	78,000
Per reported injury *(Note 1)*	**All areas**	**Rural**	**Urban**
Fatal	3,065,000	3,065,000	3,065,000
Serious	535,000	538,000	533,000
Minor	60,000	58,000	61,000
Per PDO crash *(Note 2)*	**All areas**	**Rural**	**Urban**
Property damage only	2,200	2,400	2,100

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.

Trend in road trauma

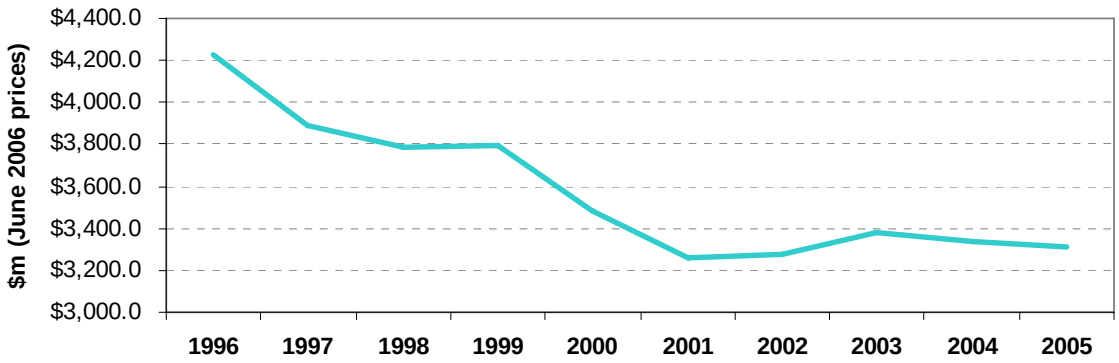
Statistics on road injuries, the number of hospitalisations for more than one day and the total number of Accident Compensation Corporation (ACC) new Motor Vehicle Account entitlement claims are given in Table S2. It shows that the number of ACC motor vehicle new claims has been increasing steadily since 2001.

Figure S2 shows the trend of the estimated annual total social cost of injury crashes for the last ten years to 2005. This shows that the reduction during 1996-2001 has levelled out in recent years.

Table S2: Statistics on road injuries, hospitalisations and ACC claims

Year	Road deaths	Reported serious injuries	Reported minor injuries	Hospitalisations for more than one day	ACC motor vehicle new claims
2001	455	2,435	9,933	3,180	33,700
2002	404	2,600	11,318	3,022	35,800
2003	461	2,578	11,794	2,994	39,800
2004	436	2,469	11,351	3,025	42,200
2005	405	2,519	11,906	3,153	45,500

Figure S2: Estimated annual total social cost of injury crashes, $m at June 2006 prices



Note: Excluding non-injury crashes

Technical queries and comments on this report should be referred to:

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Contents

1. Introduction

1.1 Background

Road trauma is usually measured in terms of fatalities, casualties and social cost. Injuries are classified into fatal, serious and minor injuries as reported by police. 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.

To support the New Zealand Transport Strategy in the area of road safety, it is essential that road safety resources are utilised efficiently. It is therefore desirable that each safety intervention is evaluated, wherever possible, in terms of social cost to enable evaluation of the intervention cost against the resulting benefit (i.e. reduction in social cost of road crashes and injuries). When there are different solutions or options to a transport problem, social cost information also facilitates consistent comparison between solutions or options, especially when these solutions have different impacts on injury and crash risks.

Inflation has caused a steady increase in the average social cost associated with road crashes. The Ministry of Transport publishes *The Social Cost of Road Crashes and Injuries* every year to provide estimates of the social costs of road crashes and injuries in current prices.

1.2 Objective

This report provides estimates of the total social cost of road crashes and injuries that occurred in New Zealand in 2005. It also reports the average social cost per injury and crash, with and without adjustment for the level of non-reporting. The analysis is based on crash and injury data from 2003 to 2005. Unless otherwise indicated, all social cost estimates are expressed at June 2006 prices.

1.3 The update

This paper 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 cost per injury and crash. A detailed discussion of the methodology is 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 required two stages of analysis. Because not all crashes are reported and recorded in the Traffic Crash Reports (TCRs), looking solely at the reported[1] number of injuries or crashes would underestimate road safety risks and the potential benefits that might be achieved through intervention. Thus, the first stage of the analysis is to estimate the total number of crashes and injuries that occurred at different levels of severity.

The second stage involves quantifying the impacts in monetary terms, taking into account the non-reported incidents. An 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 for the years from 2003 to 2005 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 take into account any regional variations, regional conversion factors are developed for serious injuries and crashes. Due to 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 are developed by area (rural and urban) and by injury or crash severity (serious, minor and property damage only).

The estimated total number of crashes and injuries for years 2003 to 2005 are given in Table B1 (Appendix B). A more detailed discussion of the methodology used is included in Appendix A1.

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. It includes loss of life and life quality, loss of output due to temporary incapacitation, medical costs, legal costs and property damage costs. Most of the 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.

The product of the average social cost per incident and the estimated total number of incidents give the estimated total social cost of incidents. These incidents refer to crashes or injuries by severity, area and/or region. The average social cost per **reported** incident is obtained by dividing the estimated total social cost by the corresponding number of reported incidents.

The price indices used in updating the social cost components are included in Table B2 (Appendix B). An explanation of the methodologies used is given in Appendix A2.

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

3. Guidance on using the social cost estimates

3.1 Adjustment for non-reported incidents

Not all motor vehicle injury crashes are reported. For the three years to 2005, only around 58% of all serious crashes and 27% of all crashes causing minor injury are recorded in crash statistics.

Non-reported incidents can be accounted for by applying the injury or crash conversion factors. However, this additional process may be somewhat tedious if it is done separately each time. For application convenience, the estimates of average social cost per reported crash and per reported injury provided has been adjusted to allow for the level of non-reporting (Tables 4.3a to 4.3c). When these estimates are used in the calculation of total social cost, no further adjustment for the level of non-reporting is necessary. If a programme is expected to reduce the number of injuries but not crashes, use estimates from Table 4.3c. Otherwise, use estimates from Tables 4.3a and 4.3b, depending on data availability and the purpose of the analysis.

When the total number of crashes and injuries involved are known, estimates of average social cost per crash and per injury (Tables 4.1a and 4.1b) should be used. These estimates do not include any adjustment for the non-reported incidents.

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 impacts 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, at June 2006 prices, without any adjustment for the non-reported incidents. All other tables with estimates by area include adjustment for under-reporting.

3.3 Estimates by region and vehicle movement

For certain policies or programmes that focus on specific vehicle movement classification (e.g. head-on crashes) or region, special average social cost estimates are required to account for any differences in the level of severity.

Table 4.4 provides estimates of the average social cost per reported crash by vehicle movement, using crash data from 2001 to 2005. These estimates have been adjusted for the level of non-reporting.

Due to differences in physical locations, size of the regions, availability of facilities and other reasons, the proportions of injury crashes that are reported to police differ across regions. Furthermore, the mix of rural and urban crashes differs across regions. As a result, there are regional variations in the average social cost per reported injury and crash. Tables 4.5a and 4.5b provide the average social costs per reported crash and per reported injury respectively by region. These estimates have been adjusted for the level of non-reporting and are useful for the evaluation of regional programmes or policies.

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). We have therefore provided the estimates with WTA-based VOSL at three times the value of WTP (Tables 4.6a to 4.6c). 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 with a low probability of occurrence. These estimates are particularly useful when there are insufficient data on historical crashes or injuries to quantify the risks separately.

4. Cost estimates

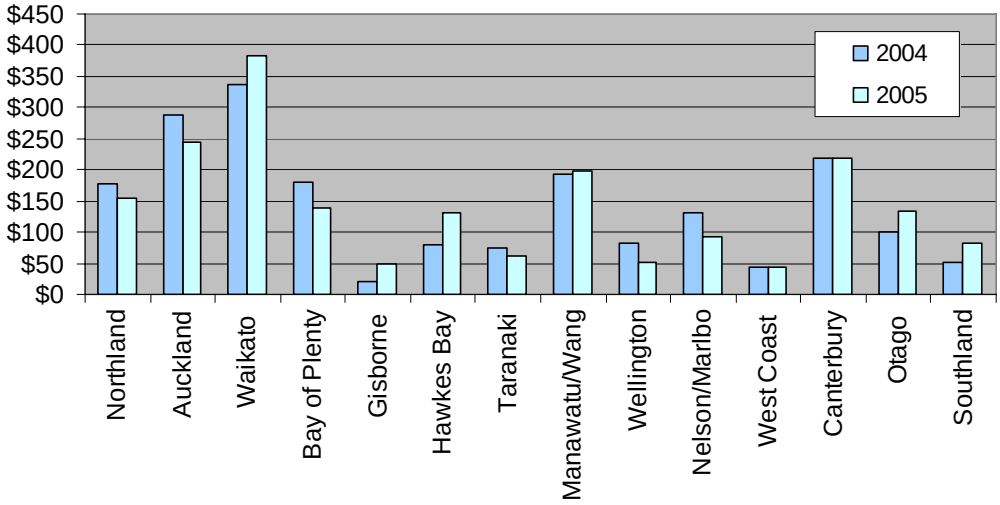
The updated value of statistical life is $3.05 million per fatality, at June 2006 prices. This gives the updated average social cost per fatality of $3,065,000. For non-fatal injuries, the updated average social cost is estimated at $535,000 per reported serious injury and $60,000 per reported minor injury. In per crash terms, the updated average social cost is estimated at $3,721,000 per fatal crash, $649,000 per reported serious crash and $81,000 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 2005 is estimated at approximately $3.3 billion (down from $3.34 billion in 2004), at June 2006 prices. This estimate includes both reported and non-reported casualties and can be broken down by injury severity as follow:

- fatalities $1,241 million (down from $1,336 in 2004)
- serious injuries $1,353 million (up from $1,325 in 2004)
- minor injuries $713 million (up from $678 in 2004)

On average, around 60% of the total social cost of injury crashes 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 injury crashes in Rural areas,
$m at June 2006 prices



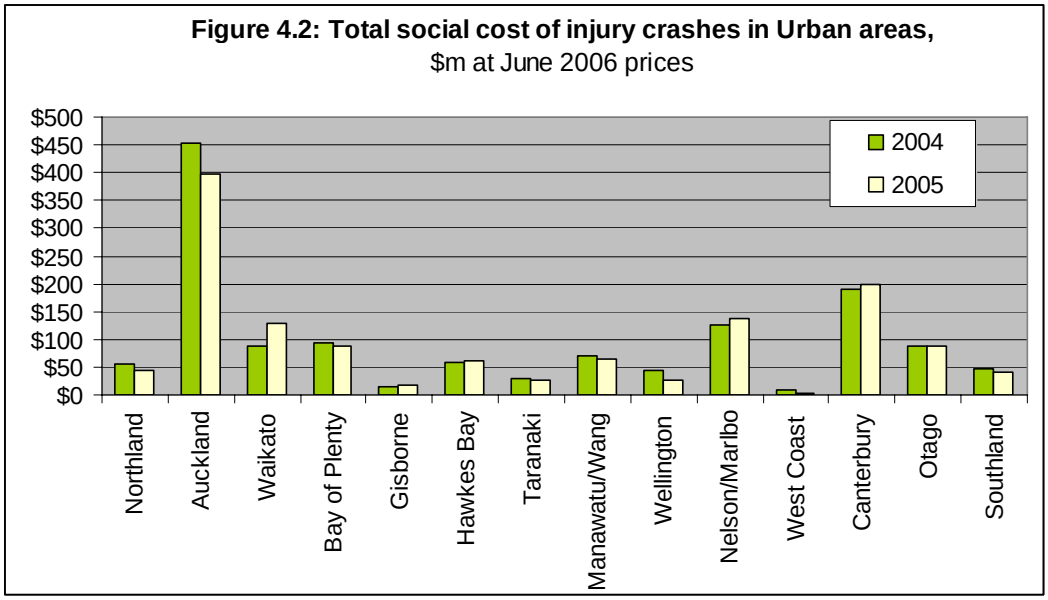
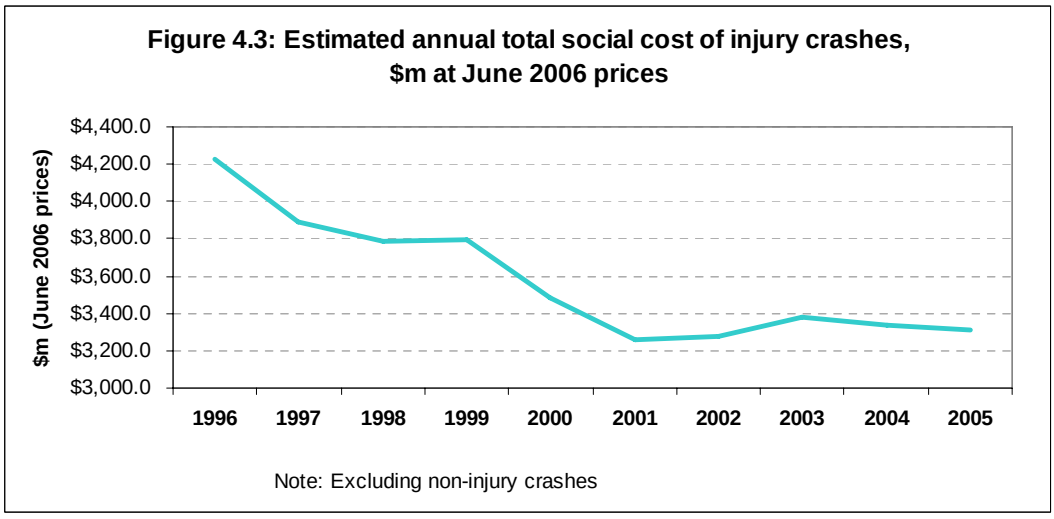


Figure 4.3 shows the trend in social cost of road injury crashes for the last ten years to 2005. This shows that the reduction during 1996-2001 has levelled out in recent years.



The estimated total social cost of all motor vehicle crashes, including property damage only crashes, in 2005 is estimated approximately $4.1 billion, at June 2006 prices.

The average social costs by cost component, area, severity and region are given in the following sections. Apart from those tabulated 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 2006 prices ($)		
Loss of life/permanent disability	3,687,800	357,000	15,600
Loss of output (temporary disability)	600	1,200	300
Medical -			
Hospital/Medical	7,300	8,800	100
Emergency/Pre-hospital	3,600	1,300	700
Follow-on	1,800	4,400	100
Legal and court	10,800	2,300	500
Property damage	8,800	5,600	4,500
Total	**3,720,800**	**380,700**	**21,800**

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 2006 prices ($)		
Loss of life/permanent disability	3,046,700	304,700	12,200
Loss of output (temporary disability)	0	1,000	200
Medical -			
Hospital/Medical	3,100	7,600	100
Emergency/Pre-hospital	2,500	900	500
Follow-on	0	3,700	100
Legal and court	8,400	1,900	400
Property damage *(Note 3)*	4,400	3,300	3,500
Total	**3,065,000**	**323,100**	**17,000**

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 higher than that for 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 2006 prices ($)				
	Average per crash			Average per injury	
Crash Severity	All Areas	Rural Areas	Urban areas	Include property damage cost	Exclude property damage cost
Fatal	3,720,800	3,850,000	3,389,600	3,065,000	3,060,600
Serious	380,700	401,500	359,400	323,100	319,800
Minor	21,800	23,500	20,800	17,000	13,500
S & M	58,500	73,600	48,800	45,300	41,800
F & S	705,500	858,700	534,500	581,100	577,700
F, S & M	98,300	148,500	65,700	74,000	70,500
PDO	2,200	2,400	2,100		

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 2006 prices ($)		
Crash severity	**All**	**Rural**	**Urban**
Fatal	3,721,000	3,850,000	3,390,000
Serious	649,000	700,000	600,000
Minor	81,000	87,000	78,000
Serious and minor	195,000	238,000	166,000
Fatal and serious	1,126,000	1,362,000	859,000
Fatal, serious and minor	319,000	461,000	220,000

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

	June 2006 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	3,065,000	3,065,000	3,065,000
Serious	535,000	538,000	533,000
Minor	60,000	58,000	61,000
Serious and minor	144,000	162,000	130,000
Fatal and serious	907,000	1,019,000	758,000
Fatal, serious and minor	231,000	301,000	172,000

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

	June 2006 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	3,061,000	3,061,000	3,061,000
Serious	530,000	532,000	528,000
Minor	48,000	46,000	49,000
Serious and minor	133,000	150,000	119,000
Fatal and serious	902,000	1,013,000	752,000
Fatal, serious and minor	220,000	291,000	161,000

4.4 Average social cost per reported injury crash by vehicle movement

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

	June 2006 prices ($)		
Vehicle movement classification	**All**	**Rural**	**Urban**
Overtaking or lane change	427,000	524,000	281,000
Head-on, not overtaking	885,000	1,134,000	444,000
Lost control, straight roads	341,000	371,000	293,000
Cornering	366,000	397,000	304,000
Collision with obstruction	216,000	300,000	183,000
Rear end collision	136,000	160,000	119,000
Turning versus same direction	221,000	315,000	170,000
Crossing, no turns	243,000	631,000	193,000
Crossing, vehicle turning	217,000	381,000	165,000
Vehicles merging	172,000	279,000	152,000
Right turn against	217,000	447,000	173,000
Vehicle manoeuvring	213,000	477,000	161,000
Pedestrian crossing road	295,000	890,000	272,000
Pedestrian other	481,000	1,167,000	339,000
Miscellaneous	493,000	602,000	402,000

4.5 Average social cost by local government region

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

Region	Crash severity					
	Fatal	Serious	Minor	S+M	F+S	F+S+M
	June 2006 prices ($)					
All areas						
Northland	3,632,000	909,000	84,000	264,000	1,442,000	434,000
Auckland	3,521,000	533,000	80,000	143,000	982,000	225,000
Waikato	3,885,000	553,000	82,000	179,000	1,325,000	397,000
Bay of Plenty	3,811,000	1,066,000	85,000	308,000	1,643,000	508,000
Gisborne	4,904,000	1,149,000	80,000	319,000	1,618,000	461,000
Hawkes Bay	3,673,000	553,000	82,000	184,000	1,120,000	345,000
Taranaki	3,972,000	607,000	86,000	190,000	1,134,000	326,000
Manawatu-Wanganui	4,088,000	784,000	80,000	257,000	1,313,000	432,000
Wellington	3,742,000	631,000	78,000	181,000	1,047,000	281,000
Nelson-Marlborough	3,314,000	649,000	80,000	211,000	1,049,000	332,000
West Coast	3,208,000	665,000	88,000	238,000	1,215,000	438,000
Canterbury	3,636,000	741,000	80,000	224,000	1,157,000	345,000
Otago	3,786,000	468,000	87,000	186,000	671,000	246,000
Southland	3,528,000	608,000	88,000	226,000	826,000	296,000
New Zealand	**3,721,000**	**649,000**	**81,000**	**195,000**	**1,126,000**	**319,000**
Rural areas						
Northland	3,723,000	929,000	87,000	290,000	1,470,000	477,000
Auckland	3,592,000	587,000	85,000	156,000	1,357,000	315,000
Waikato	4,030,000	572,000	86,000	204,000	1,458,000	500,000
Bay of Plenty	3,990,000	1,151,000	93,000	368,000	1,962,000	709,000
Gisborne	5,592,000	1,145,000	86,000	407,000	1,768,000	650,000
Hawkes Bay	3,660,000	572,000	87,000	225,000	1,224,000	467,000
Taranaki	4,162,000	638,000	92,000	213,000	1,391,000	436,000
Manawatu-Wanganui	4,119,000	812,000	88,000	314,000	1,481,000	592,000
Wellington	4,022,000	702,000	84,000	222,000	1,485,000	467,000
Nelson-Marlborough	3,339,000	680,000	87,000	258,000	1,200,000	459,000
West Coast	3,222,000	669,000	90,000	248,000	1,307,000	496,000
Canterbury	3,716,000	788,000	86,000	289,000	1,424,000	544,000
Otago	3,967,000	491,000	91,000	213,000	815,000	328,000
Southland	3,647,000	631,000	93,000	275,000	910,000	388,000
New Zealand	**3,850,000**	**700,000**	**87,000**	**238,000**	**1,362,000**	**461,000**

Table 4.5a continued

Urban areas	Crash severity					
Region	**Fatal**	**Serious**	**Minor**	**S+M**	**F+S**	**F+S+M**
Northland	3,394,000	852,000	80,000	214,000	1,366,000	347,000
Auckland	3,447,000	514,000	77,000	139,000	819,000	192,000
Waikato	3,330,000	511,000	79,000	145,000	988,000	242,000
Bay of Plenty	3,150,000	974,000	78,000	257,000	1,205,000	324,000
Gisborne	3,298,000	1,155,000	76,000	247,000	1,370,000	299,000
Hawkes Bay	3,708,000	526,000	77,000	150,000	944,000	234,000
Taranaki	3,182,000	569,000	80,000	168,000	762,000	211,000
Manawatu-Wanganui	3,910,000	735,000	72,000	196,000	964,000	250,000
Wellington	3,133,000	594,000	76,000	165,000	769,000	202,000
Nelson-Marlborough	3,148,000	596,000	74,000	163,000	745,000	194,000
West Coast	3,074,000	654,000	83,000	215,000	885,000	284,000
Canterbury	3,454,000	706,000	78,000	194,000	928,000	246,000
Otago	3,106,000	445,000	85,000	166,000	515,000	184,000
Southland	3,131,000	572,000	85,000	182,000	688,000	210,000
New Zealand	**3,390,000**	**600,000**	**78,000**	**166,000**	**859,000**	**220,000**

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

Region	Injury severity					
	Fatal	Serious	Minor	S+M	F+S	F+S+M
	June 2006 prices ($)					
All areas						
Northland	3,065,000	726,000	60,000	188,000	1,143,000	302,000
Auckland	3,065,000	449,000	61,000	111,000	813,000	171,000
Waikato	3,065,000	443,000	58,000	131,000	1,003,000	275,000
Bay of Plenty	3,065,000	810,000	60,000	214,000	1,237,000	344,000
Gisborne	3,065,000	929,000	61,000	238,000	1,240,000	332,000
Hawkes Bay	3,065,000	459,000	59,000	136,000	901,000	247,000
Taranaki	3,065,000	496,000	60,000	138,000	885,000	227,000
Manawatu-Wanganui	3,065,000	617,000	58,000	182,000	998,000	295,000
Wellington	3,065,000	537,000	60,000	141,000	873,000	214,000
Nelson-Marlborough	3,065,000	551,000	60,000	161,000	877,000	248,000
West Coast	3,065,000	557,000	59,000	168,000	1,015,000	302,000
Canterbury	3,065,000	624,000	60,000	168,000	960,000	254,000
Otago	3,065,000	393,000	59,000	130,000	557,000	170,000
Southland	3,065,000	510,000	58,000	152,000	692,000	197,000
New Zealand	**3,065,000**	**535,000**	**60,000**	**144,000**	**907,000**	**231,000**
Rural areas						
Northland	3,065,000	717,000	61,000	200,000	1,119,000	321,000
Auckland	3,065,000	442,000	61,000	113,000	1,006,000	219,000
Waikato	3,065,000	440,000	57,000	142,000	1,052,000	326,000
Bay of Plenty	3,065,000	780,000	59,000	228,000	1,331,000	425,000
Gisborne	3,065,000	912,000	61,000	276,000	1,298,000	421,000
Hawkes Bay	3,065,000	456,000	57,000	151,000	952,000	305,000
Taranaki	3,065,000	487,000	59,000	143,000	1,000,000	278,000
Manawatu-Wanganui	3,065,000	612,000	56,000	194,000	1,080,000	354,000
Wellington	3,065,000	525,000	58,000	152,000	1,083,000	308,000
Nelson-Marlborough	3,065,000	544,000	59,000	182,000	949,000	314,000
West Coast	3,065,000	550,000	60,000	171,000	1,069,000	334,000
Canterbury	3,065,000	616,000	58,000	196,000	1,102,000	361,000
Otago	3,065,000	392,000	57,000	141,000	636,000	213,000
Southland	3,065,000	509,000	56,000	171,000	732,000	240,000
New Zealand	**3,065,000**	**538,000**	**58,000**	**162,000**	**1,019,000**	**301,000**

Table 4.5b continued

Urban areas	Injury severity					
Region	**Fatal**	**Serious**	**Minor**	**S+M**	**F+S**	**F+S+M**
Northland	3,065,000	758,000	61,000	161,000	1,220,000	262,000
Auckland	3,065,000	452,000	61,000	110,000	715,000	151,000
Waikato	3,065,000	451,000	60,000	114,000	857,000	186,000
Bay of Plenty	3,065,000	857,000	62,000	198,000	1,068,000	250,000
Gisborne	3,065,000	957,000	62,000	199,000	1,133,000	239,000
Hawkes Bay	3,065,000	462,000	61,000	119,000	806,000	183,000
Taranaki	3,065,000	509,000	61,000	131,000	680,000	163,000
Manawatu-Wanganui	3,065,000	629,000	61,000	163,000	802,000	203,000
Wellington	3,065,000	546,000	61,000	135,000	707,000	165,000
Nelson-Marlborough	3,065,000	565,000	61,000	136,000	704,000	161,000
West Coast	3,065,000	582,000	60,000	158,000	798,000	209,000
Canterbury	3,065,000	632,000	61,000	153,000	821,000	192,000
Otago	3,065,000	395,000	60,000	121,000	459,000	134,000
Southland	3,065,000	513,000	60,000	131,000	619,000	151,000
New Zealand	**3,065,000**	**533,000**	**61,000**	**130,000**	**758,000**	**172,000**

4.6 Average social cost with WTA-based VOSL (3 times WTP-based VOSL)

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

	June 2006 prices ($)		
Crash severity	**All**	**Rural**	**Urban**
Fatal	11,096,000	11,481,000	10,112,000
Serious	1,868,000	2,010,000	1,727,000
Minor	198,000	211,000	190,000
Serious and minor	531,000	655,000	448,000
Fatal and serious	3,300,000	4,002,000	2,507,000
Fatal, serious and minor	905,000	1,322,000	612,000

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

	June 2006 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	9,159,000	9,159,000	9,159,000
Serious	1,545,000	1,551,000	1,538,000
Minor	145,000	141,000	148,000
Serious and minor	394,000	445,000	353,000
Fatal and serious	2,663,000	3,000,000	2,214,000
Fatal, serious and minor	654,000	865,000	477,000

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

	June 2006 prices ($)		
Injury severity	**All**	**Rural**	**Urban**
Fatal	9,154,000	9,154,000	9,154,000
Serious	1,539,000	1,545,000	1,533,000
Minor	133,000	129,000	137,000
Serious and minor	383,000	433,000	342,000
Fatal and serious	2,657,000	2,994,000	2,209,000
Fatal, serious and minor	643,000	854,000	466,000

Appendix A Technical notes

A1 Estimation of the number of injuries and crashes

A methodology has been developed to estimate the total number of crashes and injuries. The estimates for years 2003 to 2005 are given in Table B1 (Appendix B). The data and methodology used for the analysis are discussed below.

A1.1 Data

Annual crash and injury data, hospitalisation data and Accident Corporation Compensation (ACC) new Motor Vehicle claims data for years 2003 to 2005 were used to estimate the total numbers of road crashes and injuries.

(i) Crash and injury data

Under the law, any motor vehicle crash that results in someone being injured needs to be reported to the police. Amongst other duties, the reporting officer will also complete a Traffic Crash Report (TCR) when attending the crash scene. The TCR collects detailed information about each crash and injury including details of the vehicles involved, personal details of the drivers and the injured, possible contributing factors and location of crash, etc. The TCR is examined and coded by traffic engineers and the information is stored in the crash and injury database. The numbers of reported injuries for the five yeas to 2005 are tabulated in Table A1.

(ii) Hospitalisation data

Hospital discharge data are collected from the New Zealand Health Information Service (NZHIS). This dataset contains information about each in-patient and hospital event provided in all public hospitals in New Zealand. Motor vehicle injuries that require any hospital treatments are usually taken to a public hospital in the first instance. Hospitalisation (discharge) data are matched with the crash and injury database to populate the serious injury profile. The numbers of hospitalisations of more than one day for the five yeas to 2005 are tabulated in Table A1.

(iii) ACC Motor Vehicle Account New Claims data

ACC collects a tax on fuel sales and a component of the annual vehicle licensing fees to provide insurance cover for all motor vehicle injuries that happen on public roads. The premium paid and the injury costs are assigned to the Motor Vehicle Account. ACC cover and assistance are provided on a no fault basis, except for cases of suicide and intentional self-injury. Each ACC claim has a unique ACC claim number, which is attached to all the claims that are related to the injury. ACC claims include medical treatment (e.g. General Practitioners, Physiotherapists, Specialists and Radiologists) and entitlement claims (e.g. income maintenance, childcare, attendant care and transport assistance). ACC uses a number of data fields to categorise injury claims as ‘new’ and ‘on-going’. As ‘on-going’ claims are those which received entitlements in previous years, only the new claims data is relevant for estimating the total number of road injuries during any given year. The numbers of ACC new claims for the five years to 2005 are tabulated in Table A1.

ACC claims data include both claims from 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 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 which also do not have an ACC claim. However, these injuries are likely to have negligible social cost implications and therefore can be ignored.

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

Year	Road deaths	Reported serious injuries	Reported minor injuries	Hospitalisations for more than one day	ACC motor vehicle new claims
2001	455	2,435	9,933	3,180	33,700
2002	404	2,600	11,318	3,022	35,800
2003	461	2,578	11,794	2,994	39,800
2004	436	2,469	11,351	3,025	42,200
2005	405	2,519	11,906	3,153	45,500

A1.2 Conversion factors

Injury and crash conversion factors are developed for estimating the total number of injuries and crashes from their reported numbers.

The conversion factor is defined as the ratio of ***estimated*** to ***reported*** numbers of incidents (injuries or crashes). Thus, if the conversion factor and the number of reported injuries are known, the total number of injuries can be estimated as the product of the two.

$$\left[\begin{array}{l}\text{Injury}\\ \text{conversion}\\ \text{factor}\end{array}\right]_k = \frac{\left[\begin{array}{l}\text{Estimated total}\\ \text{number of injuries}\end{array}\right]_k}{\left[\begin{array}{l}\text{Number of}\\ \text{reported injuries}\end{array}\right]_k}$$

$$\Rightarrow \quad \left[\begin{array}{l}\text{Estimated total}\\ \text{number of injuries}\end{array}\right]_k = \left[\begin{array}{l}\text{Injury}\\ \text{conversion}\\ \text{factor}\end{array}\right]_k * \left[\begin{array}{l}\text{Number of}\\ \text{reported injuries}\end{array}\right]_k$$

where k = injury severity

Although it is conceivable that the average number of serious and/or minor injuries per non-reported crash may be lower because non-reported crashes tend to be less severe, there is no information available for such assessment. Thus, if we assume the average number of injuries per injury crash is the same irrespective of whether a crash is reported, the injury conversion factor is also the conversion factor for estimating the total number of injury crashes.

$$\left[\begin{array}{l}\text{Estimated total}\\ \text{number of}\\ \text{injury crashes}\end{array}\right]_k = \frac{\left[\begin{array}{l}\text{Estimated total}\\ \text{number of injuries}\end{array}\right]_k}{\left[\begin{array}{l}\text{Average number}\\ \text{of injuries per crash}\end{array}\right]_k} = \frac{\left[\begin{array}{l}\text{Number of}\\ \text{reported injuries}\end{array}\right]_k \times \left[\begin{array}{l}\text{Injury}\\ \text{conversion factor}\end{array}\right]_k}{\left[\begin{array}{l}\text{Number of}\\ \text{reported injuries}\end{array}\right]_k \div \left[\begin{array}{l}\text{Number of}\\ \text{reported crashes}\end{array}\right]_k}$$

$$= \left[\begin{array}{l}\text{Injury}\\ \text{conversion factor}\end{array}\right]_k \times \left[\begin{array}{l}\text{Number of}\\ \text{reported crashes}\end{array}\right]_k$$

Similarly, the conversion factors can also be used in the estimation of the total social cost.

As the level of reporting is unlikely to remain constant over time, all conversion factors are updated annually based on the data for the most recent three years.

(i) National and regional conversion factors

The proportion of injury crashes that are reported to police differs across regions due to differences in physical locations, size of the regions, availability of facilities and/or some other reasons. To take into account any regional variations, the conversion factors are developed for serious injuries and crashes at the regional level.

Due to lack of data, separate regional crash conversion factors for rural and urban areas and for minor and property only crashes could not be determined. Thus, the same regional conversion factors are used for rural and urban areas. For minor and property damage only crashes, we assume the conversion factors are the same for all regions and areas.

The regional conversion factors are used to estimate the total number of crashes and injuries by severity for each region. These estimates are then aggregated to obtain the national totals for estimating the national conversion factors. Since different regions have different proportions of rural versus urban crashes, the ***national crash conversion factors*** for rural and urban areas are different.

The ***national injury conversion factors*** for rural and urban areas are derived based on the mix of injury crashes and the corresponding average number of injuries per crash in the corresponding areas. As the travelling speed in rural locations is usually higher, crashes in these locations tend to be more severe and therefore are more likely to be reported. Rural crashes also tend to result in a larger number of injuries at each injury severity level. Since the mix of injury crashes and the corresponding average number of injuries per crash are not the same across regions, the national injury conversion factors for rural and urban areas are also different.

(ii) Fatal crashes and associated injuries

A motor vehicle crash is classified as fatal if it results in death to at least one person. Fatal injuries are defined as injuries that result in death within 30 days of the crash. These are consistent with the international definitions.

Only very few fatal crashes do not have the associated Traffic Crash Reports (TCRs). Apart from the corresponding fatalities, not all the injuries associated with the non-TCR fatal crashes would have been recorded in the injury statistics. However, we do not expect the number of non-reported non-fatal injuries from non-TCR fatal crashes to be high. The reasons are twofold. Firstly, some of the fatal crashes that do not have TCRs are single vehicle crashes and usually have lower occupancy rate. Secondly, police have improved the filing of TCRs for fatal crashes in recent years and the improvement is expected to continue. Thus, a conversion factor of one is used for estimating the number of injuries associated with fatal crashes. In other words, no adjustment for the level of non-reporting is made for fatal crashes and the associated injuries.

(iii) Serious crashes and associated injuries

Any injury that resulted in fractures, concussions, internal injuries, crushings, severe cuts and lacerations, severe general shock necessitating medical treatment and any other injury involving removal to and detention in hospital are classified as serious injuries. All serious injuries are expected to require some forms of medical treatment, but only a certain proportion would need to be hospitalised.

The total number of hospitalisations is made up of reported and non-reported injuries. The total number of serious injuries can be classified into those resulted from fatal and serious crashes. Since a factor of one is used for injuries from fatal crashes, only those from serious crashes need to be estimated.

Unless there were obvious symptoms, police officers would not have had the expertise to accurately classify injuries by severity. Over the last three years, there were about 11,500 reported minor injuries per annum, around 2,500 of which were matched with hospitalisation data. It is difficult to estimate how many of the hospitalised reported minor injuries were actually serious. This could have some influences on the total social cost because the average social cost for a serious injury is more than 10 times higher than that for a minor injury.

A small proportion of minor injuries cause long-term impairments to the injured individuals. In view of this, the average social cost per minor injury includes a small reduction in life quality due to long term impairments, estimated at 0.4% of the Value of Statistical Life[2]. As minor injuries with long-term impairments may also require hospital treatment, the average social cost per minor injury has already included some allowances for such needs. Therefore, further classifying reported minor injuries that were hospitalised as serious could over-compensate for the effects of these injuries on the total social cost. For the purposes of estimating the total social cost, all hospitalised injuries that are matched with reported minor injuries are classified as minor injuries. The number of reported minor injuries that were hospitalised represents around 6% of the estimated total number of minor injuries.

As different levels of serious injuries have different medical needs, we would expect a small year to year fluctuation in the proportion of serious injuries requiring detention in hospitals. Earlier data matching exercises found certain districts had made a change in hospital admission criteria during 2000 to 2001, making some of those previously classified as outpatients/day-patients now being "admitted". To adjust for this, while retaining the possibility of stochastic fluctuations, we limit the increase in the ratio of 'total hospitalisation' to 'hospitalisations for more than one day' to 10% of the 1997 to 1999 value and assume any increase above this level would be the result of a change in the admission criteria. No adjustment would be made if the ratio were reduced. As the adjustment has essentially separated the more severe hospitalised injuries from the less severe injuries, all the adjusted total number of hospitalisations can be classified as serious injuries.

The estimated national serious crash and serious injury conversion factors using 2003 to 2005 data are summarised in Table A2. For estimating the number of serious injury crashes and the associated injuries, the conversion factors are 1.74 and 1.67 for rural and urban areas respectively. The injury conversion factors for serious injuries from both fatal and serious crashes are 1.66 and 1.65 in rural and urban areas respectively.

(iv) Minor crashes and associated injuries

Minor injuries are defined as injuries of a minor nature such as sprains and bruises. On average, around 90% of the reported serious injuries and 70% of the reported minor injuries matched with ACC claims data. With the average number of minor injuries per serious crash assumed to be the same irrespective of whether a crash is reported, the number of minor injuries from serious crashes for 2003 to 2005 can be estimated using the same regional conversion factor as for serious crashes. The number of minor injuries from minor crashes is the difference between the estimated total number of

[2] This is explained in Appendix A2.

minor injuries and the number of minor injuries from fatal and serious crashes. Because proportionately more fatal and serious crashes, which have higher levels of crash reporting, occur in rural areas, the minor injury conversion factor for rural areas is lower than for urban areas.

The estimated national minor crash and minor injury conversion factors using 2003 to 2005 data are summarised in Table A2. For estimating the number of minor injury crashes and the associated injuries, the conversion factor is 3.74 for both rural and urban areas respectively. The injury conversion factors for minor injuries from all crash severities are 3.40 and 3.60 in rural and urban areas respectively.

Table A2: National crash and injury conversion factors

Crash conversion factors						
	June 2005 update			**June 2006 update**		
Severity	**All**	**Rural**	**Urban**	**All**	**Rural**	**Urban**
Serious	1.62	1.67	1.57	1.71	1.74	1.67
Minor	3.52	3.52	3.52	3.74	3.74	3.74
Injury conversion factors						
	June 2005 update			**June 2006 update**		
Severity	**All**	**Rural**	**Urban**	**All**	**Rural**	**Urban**
Serious	1.57	1.59	1.55	1.66	1.66	1.65
Minor	3.30	3.19	3.39	3.51	3.40	3.60

(v) Property damage only crashes

The level of reporting for property damage only (PDO) crashes is very low (less than 3%). By establishing a relationship between the number of reported minor injury crashes and PDO crashes, Guria (1994) estimated that the total number of PDO crashes was about 36 times the total number of reported minor injury crashes. This multiplying factor has been used until 2002.

Since the improvement in the level of reporting occurred after 2000, in the recent updates we have assumed the ratio between the estimated total number of PDO crashes and the estimated total number of minor injury crashes to remain the same as in 1997 to 1999. Based on the same assumption, the updated multiplying factor for the 2006 updates is 31.4 (up from 29.6 for the 2005 update).

A1.3 Summary

The first step of the two-stage analysis is to estimate the total number of incidents (i.e. reported plus non-reported). Separate estimates can be generated by severity, region and/or road type using the following equality.

$$\begin{bmatrix}\text{Estimated total}\\ \text{number of}\\ \text{incidents}\end{bmatrix}_k = \begin{bmatrix}\text{Number of}\\ \text{reported}\\ \text{incidents}\end{bmatrix}_k * \begin{bmatrix}\text{Conversion}\\ \text{factor}\end{bmatrix}_k$$

where k = incident type; crashes or injuries; by severity and/or road type.

For the three years to 2005, only around 58% of crashes causing serious injury and 27% of all crashes causing minor injury are recorded in crash statistics. The estimated numbers of injuries and crashes are given in Table B1 (Appendix B).

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 given below:

(i) Loss of life and life quality

The cost of pain and suffering due to a 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 $3.05 million, at June 2006 prices.

Prior to 1999, the average loss of life quality due to permanent impairments from a serious injury was estimated at 8% (based on Guria, 1993a and Guria, 1993b). In the 1997/98 Value of Safety survey (Guria et al, 2003), the value of preventing a serious injury was found to be between 7% and 13% of the VOSL. Considering the values used in other countries such as the United States and the United Kingdom, the survey report recommended a value of 10%, which was first adopted in the 1999 social cost update.

Miller et al (1991) estimated that the average loss of life quality due to permanent disability caused by non-fatal injuries was equivalent to 1.5% of the remaining lifespan of an average person. Based on the distribution of injury by severity and an average loss of life quality for a serious injury, the estimated average loss of life quality for a minor injury was estimated at 0.4% of the VOSL (Guria, 1993a and Guria, 1993b). This value has been used since 1993. As the 0.4% is within the range obtained from the 1997/98 Value of Safety survey and is also in line with those used in the United States and the United Kingdom, no change to this value has been made.

As decided by the Government in 1991 (NZ Gazette notice 4983), the same VOSL for a fatality has been used in estimating the loss of life and life quality component of the social cost across all three transport modes (road, maritime and aviation). This practice has also been extended to non-fatal injuries.

The values of loss of life and life quality are calculated on a per injury basis. These values are incorporated in the average cost per crash considering the prevailing average number of injuries (for each injury severity) involved in a crash.

(ii) Loss of output due to temporary incapacitation

The level of production or output lost depends on a range of factors such as the type of work that is carried out by the injured person; the level of internal labour reserves and the level of unemployment. For short-term absenteeism, certain work may be taken over by other employees with no additional cost or by the injured employee on his/her return to work. In other situations, there will be a loss of production. This happens if the work cannot be taken over by other resources; if the production cost

increases (e.g. when other employees have to work overtime to maintain output) or if the production level reduces (e.g. when the work of highly skilled employees is taken over by less skilled colleagues). For long-term absenteeism, certain work can be taken over by reallocating existing employees over jobs or by recruiting new staff. In these situations, the loss of output (including additional costs associated with recruitment and training) would be temporary only.

As the Value of Safety survey conducted during 1989/90, from which the current VOSL is established, did not explicitly separate out the potential loss of income from cost of pain and suffering, individuals might have included an allowance for income losses due to loss of life or permanent disability when they responded to the survey. Therefore, we assumed the loss of output due to permanent impairments is covered under the loss of life and life quality component. In other words, the loss of output component only covers any productivity loss due to temporary incapacitations. There is no allowance for any loss in non-labour market activities, such as housekeeping. Also, we assume there is no loss of output due to temporary incapacitation from injuries that result in death within 30 days of the crash.

Average loss of output due to temporary incapacitation per injury is estimated by the product of the average time loss per injury and the average earnings per person. The average time loss per injury consists of two components: (1) the average time spent in the hospital; and (2) the average time off work after leaving the hospital. While some serious injuries may result in permanent disability, a large proportion does not. On the other hand, some minor injuries may not require hospitalisation but may result in some permanent disability. Thus, estimation of the average loss of output due to temporary incapacitations from a non-fatal injury is a difficult task.

Guria (1991) assumed the average time lost due to temporary disability can be estimated by the average length of hospitalisation. This assumption implies that when calculating the averages, the bias from including the length of stay for injuries with permanent disability will offset the bias from excluding the outside-the-hospital recuperation period for injuries with temporary disability. Due to lack of better information, we adopt the same assumption in this update. The matching of the TCR injury data with the hospitalisation data[3] for the three years to 2005 show that the mean lengths of hospital stay are 12.2 days and 2.6 days for a reported serious and minor injuries respectively[4].

In New Zealand, only a proportion of the population hold paid positions. The remainder are children, students, retired persons, unemployed persons, voluntary workers and other people who are not part of the labour force. The distributions between the population and the injury victims are not the same. Thus, the average earnings estimates need to be adjusted for different employment and wage rates for different age groups and genders. For each age group and gender, the average daily earnings is estimated as the total daily earnings from wage and salary (including self-employment) divided by the total number of people (i.e. employed, self-employed, unemployed or not in labour force) in the same age group and gender. Using the income distribution information obtained from Statistics New Zealand's household income and expenditure survey and the distribution of injuries by age and gender, Guria (1991) estimated that the average daily earnings for the road injury population was $31.93, at September 1988 prices. This value has been updated to current prices by indexing to average ordinary hourly earnings. The last updated value was $53.34 per day, at June 2005 prices.

[3] Estimates of mean and median length of hospital stay were generated from around 12,400 TCR recorded hospitalised injuries that occurred over the period from 2003 to 2005.

[4] As this dataset has a skewed distribution, the median lengths of hospital stay were lower (4.5 days and 0.6 day for a serious and minor injury respectively). These figures show that the average length of stay is inflated by severe injuries.

To better reflect any changes in employment and wage rates over time, the analysis of Guria (1991) is repeated using income data for 2005 and injury data for the three years to 2005. The estimated average daily earnings for the working age population (i.e. aged 15 and over) for 2005 varied between $27.0 and $211.5 per day, with a weighted average of $102.4 per day (at 2005 prices). Using the average daily earnings distributions by age group and gender, the weighted average daily earnings for the road injury population is estimated at $81.4, at June 2006 prices. This estimate is lower than that for the working age population due to the differences in the distributions by age group and gender and the existence of non-earners under 15 in the injury statistics.

The loss of output due to temporary incapacitation is estimated by the product of average daily earnings and the average length of hospital stay by injury severity, and is calculated on a per injury basis. This cost is incorporated in the average cost per crash by considering the prevailing average number of injuries, for each injury severity, involved in a crash.

(iii) Medical costs

Medical costs include three components: hospital in-patient medical costs, emergency treatment costs and follow on treatment costs.

The in-patient medical cost for a serious injury was based on those estimated in Langley et al (1991) and Guria (1993a). Langley et al estimated the in-patient medical costs of road traffic injuries based on Dunedin Hospital data for the period from April 1988 to March 1990. Guria, on the other hand, used data from Waikato Hospital for the period from May 1990 to March 1992. Based on these two datasets, Guria found the average in-patient medical cost per serious traffic injury patient was around $6,260, at July 1992 prices.

It was estimated that the emergency costs and follow-on costs per serious injury were 12% and 49% of the in-patient medical cost (Table A3). The relative cost structure for other medical costs estimated by Guria (1991) are summarised in Table A4. Without further information, it is assumed these relativities continue to hold. All the resulting cost estimates are updated for price changes using the producer input price index for health and community services.

Table A3: Emergency and follow-on treatment costs relative to in-patient medical cost for serious injuries

Medical cost	Serious injury
In-patient medical cost *(Note 1)*	100%
Emergency treatment *(Note 2)*	12%
Follow-on treatment *(Note 1)*	49%

Notes:
1. Source: Guria (1993a)
2. Source: Langley et al (1991)

Table A4: Medical costs for fatal and minor injuries relative to serious injuries

Medical costs	Minor injury	Fatal injury
In-patient medical cost	1.4%	40.5%
Emergency treatment	60%	270%
Follow-on treatment	2.4%	none

Source: Guria (1991)

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.

The justice system cost of dealing with traffic offences are based on the total court time spent on traffic offences and the associated court costs, which were compiled by Guria (1991) using data from 1988. The estimated total court cost is distributed amongst each type of crash using the relative structure of legal costs (see Table A5) observed in an Australian study by Atkins (1981). Due to lack of NZ data, we continue to adopt these relativities in this update. The estimates (Table A6) are updated for price changes with the producer input price index for legal services.

Table A5: Legal & court costs for fatal, minor and PDO crashes relative to serious crashes

Crash type	Relative to serious crash
Fatal	6.92
Minor	0.46
Property damage only	0.05

Source: Atkins, 1981 (cited in Guria 1991)

Table A6: Estimated legal & court costs per crash

Crash type	Average court cost per crash (July 1992 prices) (Note1)	Average court cost per crash (June 2006 prices)	Average cost of Police (July 1992 prices) (Note 1)	Average cost of Police (June 2006 prices)
Fatal	$2,292	$3,398	$1,651	$4,178
Serious	$331	$491	$239	$604
Minor	$152	$225	$110	$278
PDO	$17	$25	$12	$14

Notes:
1. Source: Guria (1993a)
2. The estimates have NOT been adjusted for the level of non-reporting.

Annual budgeted police resources for crash attendance and investigation were obtained from the Land Transport New Zealand Authority's Land Transport Programme (previously known as the Safety Administration Programme). These figures cover the government's financial year, therefore the average value for 2004/05 and 2005/06 was used as the estimate for 2005, and so forth.

The cost of imprisoning traffic offenders was first included as one of the social cost components in 1998 (Barnett and Clough, 1998). As the major purpose of the legal and correction framework is to minimise re-offending by the offenders and to deter offending by the general population, the fixed cost component of the imprisonment cost should be classified as a preventative cost and, hence, should be excluded. Annual data of convictions and sentencing details were obtained from the Ministry of Justice. According to the Department of Corrections, 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 producer input price index for legal services. The variable cost component of the imprisonment cost for driving causing death and injury 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. The following formulae were used to obtain the injury cost estimates.

$$LCI_M = \frac{NC_M * LCC_M}{NI_{MM}}$$

$$LCI_S = \frac{NC_S * LCC_S - NI_{SM} * LCI_M}{NI_{SS}}$$

$$LCI_F = \frac{NC_F * LCC_F - NI_{FS} * LCI_S - NI_{FM} * LCI_M}{NI_{FF}}$$

where LCI_i = Legal and court costs for an injury of severity i
LCC_i = Legal and court costs for a crash of severity i
NC_i = Number of crashes of severity i
NI_{ij} = Number of injuries of crash severity i and injury severity j
i, j = F, S and M

(v) Property damage cost

Most motor vehicle crashes result in some property damage, either to the vehicles involved in the crashes or to other property such as goods carried in the vehicles and roadside fixtures. However, we have only considered the costs associated with vehicle damage due to two reasons. First, no information is currently available regarding the costs of damage to other property as a result of a road crash. Second, while the majority of motor vehicle crashes results in some form of vehicle damage, only a small proportion of crashes causes damage to other property. The cost associated with damage to other property should be relatively small. Therefore, ignoring such cost should not result in a significant impact on the average cost per vehicle.

Guria (1995) estimated the average cost of vehicle damage by crash severity using insurance claim data. His estimates took into account the “excess” and included adjustments for uninsured and unclaimed cases. The average property damage costs by crash type and area were updated for price changes using the consumer price index under the vehicle servicing and repairs category (Table A7).

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. These estimates were obtained using formulae similar to those described under legal and court costs.

Table A7: Average property damage cost per crash by crash type and area

Crash type	Average property damage cost per crash			
	Original estimates *(Note 1)* at June 1994 prices		Updated estimates at June 2006 prices	
	Urban	Rural	Urban	Rural
Fatal	$5,100	$6,700	$7,200	$9,500
Serious	$3,300	$4,600	$4,700	$6,500
Minor	$2,900	$3,600	$4,100	$5,100
PDO	$1,500	$1,700	$2,100	$2,400

Notes:
1. Source: Guria (1995)
2. The estimates have NOT been adjusted for the level of non-reporting.

A2.2 Summary

The second step involves updating each social cost component to current dollars and estimating the average and total social cost of crash or injury. An 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.

The formulae used in the analysis can be summarised in the following equalities:

$$\begin{bmatrix}\text{Estimated}\\ \text{total cost of}\\ \text{incidents}\end{bmatrix}_k = \begin{bmatrix}\text{Average}\\ \text{total cost}\\ \text{per incident}\end{bmatrix}_k * \begin{bmatrix}\text{Estimated total}\\ \text{number of}\\ \text{incidents}\end{bmatrix}_k$$

$$\begin{bmatrix}\text{Average}\\ \text{social cost}\\ \text{per reported}\\ \text{incident}\end{bmatrix}_k = \frac{\begin{bmatrix}\text{Estimated total}\\ \text{cost of incidents}\end{bmatrix}_k}{\begin{bmatrix}\text{Total number of}\\ \text{reported incidents}\end{bmatrix}_k}$$

where k = incident type; crashes or injuries; by severity and/or road type.

The total social cost of motor vehicle injuries in 2005 is estimated at approximately $3.3 billion, at June 2006 prices. The total social cost of all motor vehicle crashes, including property damage only crashes, in 2005 is estimated at approximately $4.1 billion, at June 2006 prices. Table A8 summarised the estimated total social cost of road crashes and injuries for 2004 and 2005.

Table A8: Total social cost of road crashes and injuries, at June 2006 prices

Severity type	Total social cost of road injuries, $ billion June 2006 prices		Total social cost of road crashes, $ billion June 2006 prices	
	2004	2005	2004	2005
Fatal	$ 1.34	$ 1.24	$ 1.39	$ 1.27
Serious	$ 1.33	$ 1.36	$ 1.31	$ 1.35
Minor	$ 0.68	$ 0.71	$ 0.65	$ 0.68
PDO	-	-	$ 0.74	$ 0.77
Total	**$ 3.34**	**$ 3.31**	**$ 4.09**	**$ 4.07**

Appendix B Crash statistics and price indices

Table B1: Reported and estimated number of crashes and injuries from 2003 to 2005

All areas								
	Reported	Reported injuries			Estimated	Estimated injuries		
	Crash	Fatal	Serious	Minor	Crash	Fatal	Serious	Minor
Fatal	1,122	1,302	535	645	1,122	1,302	535	645
Serious	6,105	0	7,031	2,969	10,416	0	12,002	5,109
Minor	24,500	0	0	31,437	91,515	0	0	117,426
Total	31,727	1,302	7,566	35,051	103,053	1,302	12,537	123,180
Rural areas								
	Reported	Reported injuries			Estimated	Estimated injuries		
	Crash	Fatal	Serious	Minor	Crash	Fatal	Serious	Minor
Fatal	807	965	436	496	807	965	436	496
Serious	3,030	0	3,666	1,865	5,280	0	6,387	3,264
Minor	9,257	0	0	12,595	34,578	0	0	47,046
Total	13,094	965	4,102	14,956	40,665	965	6,823	50,806
Urban areas								
	Reported	Reported injuries			Estimated	Estimated injuries		
	Crash	Fatal	Serious	Minor	Crash	Fatal	Serious	Minor
Fatal	315	337	99	149	315	337	99	149
Serious	3,075	0	3,365	1,104	5,136	0	5,616	1,845
Minor	15,243	0	0	18,842	56,937	0	0	70,380
Total	18,633	337	3,464	20,095	62,388	337	5,715	72,375

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 2006
Loss of life & life quality Loss of output	Average hourly earnings (ordinary time)	EESQ.SAAZ9A	June 2005 Mar 2006 June 2006	$20.92 $21.59 $21.78 *	4.1%
Medical cost	Producers price input index - Health and community services	PPIQ.SNO (Base: Dec 1997=1000)	June 2005 Mar 2006 June 2006	1150 1173 1178 *	2.4%
Legal and court cost	Producers price input index – Legal services: Personal and Corporate	PPIQ.SC23 (Base: Dec 1997=1000)	June 2005 Mar 2006 June 2006	1358 1373 1389 *	2.3%
Property damage cost	Consumers price index – Vehicle servicing & repairs	CPIQ.SE9F2BA (Base: June 1999 =1000)	June 2005 Mar 2006 June 2006	1249 1295 1307 *	4.6%

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

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