SAFETY PERFORMANCE OF MAJOR TOURIST ROUTES - PILOT STUDY

by

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Safety Performance of Major Tourist Routes - Pilot Study

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- Transport Accident Commission

Abstract:
This pilot study aimed to examine road traffic crashes along a major Victorian tourist route, addressing the likely growth in crashes, potential countermeasures, including proven road-based measures applied at high crash locations, and road user and vehicle issues. Because of its strong national and international promotion, and anticipated high growth in tourism in coming years, the Great Ocean Road was chosen for investigation.

The road safety problem along the Great Ocean Road was defined through analysis of reported casualty crash data, and discussions with local Police, and representatives of VicRoads and Community Road Safety Councils. Route inspections were also conducted. An average of some 60 casualty crashes were reported for the Great Ocean Road each year, during the period 1985-1994. While the overall crash problem appears not to be growing, motorcyclist crashes are both substantial in number and increasing. Crashes tended to be of above-average severity, with running off the road on curves being the single, most frequent crash type, followed by collisions between vehicles from opposite directions. Most crashes occurred in 100 km/h speed zones, with summer months and weekends, especially Sundays, being the most common crash times. A large majority of crash-involved drivers and riders resided in Victoria, while less than 5% reported overseas addresses.

Serious safety concerns are closely related to the unique geographic and topographical features, and physical restrictions of the Great Ocean Road. Given these conditions and the road’s tourist function, extra attention should be paid to road quality to compensate for inherent hazards. Many sections have experienced high casualty crash concentrations and are amenable to enhanced safety from properly targeted road improvements, supported by enforcement and behavioural change initiatives addressing excessive driver and rider speeds, risk-taking, and lane tracking errors/compliance. Scope also exists for improving pedestrian safety in townships.

The pilot study recommends a strategic approach for the Great Ocean Road and for tourist routes in general. The strategy includes reducing speed limits, in recognition of the tourist function of the route and its inherent dangers, supporting enforcement and publicity, and programs of low-cost road improvements at locations with high crash concentrations, safety-oriented education and marketing strategies, and police enforcement directed at unsafe behaviours at high risk times. The strategy’s potential should be further strengthened through effective partnerships between tourism, Police and other state agencies, municipalities and local communities.

The potential benefits of such a strategy are likely to be comparable with those of high-performing “black spot” programs which reduce casualty crash frequencies and costs, and deliver benefit-to-cost ratios typically ranging from 4:1 up to 8:1. Many of the proposed road-based countermeasures can achieve crash savings of 10 to 60%.

Key Words:
casualty crashes, Great Ocean Road, drivers, road improvements, education, police enforcement, tourist routes, motorcyclists, speed limits, countermeasures

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EXECUTIVE SUMMARY

This pilot study aimed to examine road traffic crashes along a major Victorian tourist route, addressing the likely growth in crashes, potential crash countermeasures, including proven road-based measures applied at high crash locations, and road user and vehicle issues. The project has indicated the level of benefits expected from the recommended countermeasures.

After assessment and discussions with officers of Tourism Victoria, the Great Ocean Road was chosen for pilot investigation. It is being strongly promoted nationally and internationally, and is expected to experience the highest growth in Victoria’s tourism market in coming years. The road safety problem was defined through analysis and assessment of reported casualty crash data for the ten-year period 1985-1994, discussions with local Police and VicRoads’ officers, and with members of the Barwon Region and Warrnambool Community Road Safety Councils. Route inspections were conducted by MUARC staff.

An average of some 60 reported casualty crashes have occurred along the Great Ocean Road each year. While the overall crash problem appears not to be growing, motorcycle crashes are increasing. Crashes tended to be of above-average severity, with running off the road on curves being the single, most frequent crash type, followed by collisions between vehicles from opposite directions. Most crashes occurred in 100 km/h speed zones, with summer months and weekends, especially Sundays, being the most common days for crash occurrence.

The vast majority of crashes-involved drivers and riders were Victorian residents, while less than 5% reported overseas addresses. Male drivers were more often involved in casualty crashes than were female drivers. In particular, male drivers and riders in the range 18 to 25 years were highly represented. Crashes involving motorcyclists (overwhelmingly males, and most frequently aged between 18 and 35 years) represented about a third of all casualty crashes. Off-path on curves, on straight sections and collisions with vehicles from the opposite direction were the three major crash types for motorcyclists.

Serious safety concerns are closely related to unique geographic and topographical features, and physical restrictions of the Great Ocean Road. Frequent changes in horizontal and vertical alignment, narrow lanes and a hazardous roadside, together with the tendency for road users to be unfamiliar with the route, exacerbate crash risks. The very factors which elevate crash risk are an intrinsic part of the road’s attraction for tourists. Eliminating these factors may prove impracticable in some cases, too costly in others, or cost-effective in yet others.

Given the road’s tourist function and physical nature, extra attention should be paid to road quality (i.e. design, operation and maintenance) to compensate for inherent hazards. Many sections have experienced high casualty crash concentrations and are amenable to enhanced safety from properly targeted road improvements, supported by enforcement and behavioural change initiatives. Scope also exists for improving pedestrian safety in townships.

In the absence of cost-effective road improvements, increased safety may result from targeting undesirable forms of road user behaviour in these high risk environments. The main behaviours include excessive vehicle speeds and/or risk-taking (especially by motorcyclists), lane tracking errors, and disregard for double centre lines.

It is important that a strategic approach be adopted to assist in maximising countermeasure effectiveness and cost-effectiveness. This pilot study suggests a strategic approach for the Great Ocean Road and for tourist routes in general. Desirably, the strategy should target a
sizeable portion of the crash problem, be based on proven approaches to reducing crashes, use cost-effective measures, and be practical and readily achievable. Having regard to these criteria, the suggested approach to enhancing route safety is:

1. Reduce the speed limit along relevant sections of the Great Ocean Road from 100 km/h to either 70 or 80 km/h, in recognition of the route’s predominant tourist function, its inherently hazardous alignment, topography and roadside features, and the lack of familiarity many drivers and riders have with the route. Reducing the speed limit is inexpensive and can affect safety over long distances. If supported with appropriate enforcement and publicity, this measure would address the main crash types, the hazardous roadside, lane tracking errors and conflicts with unexpected manoeuvres by tourists. Realistic speed limits should improve the effectiveness of Police enforcement.

2. Implement a program of low-cost road improvements, at locations with high concentrations of target crash types. Measures might include limited road widening, tactile edge and double centre lining, shoulder sealing, elimination of potholes, loose material and surface irregularities, skid resistant pavements, improved superelevation on curves, clearing or shielding of roadside hazards, sealing of intersection and driveway approaches to the Great Ocean Road, channelisation of high-crash intersections, reduction in excess road widths in townships, upgrading and signing of alternative routes connecting with the Great Ocean Road and extra turn-out facilities.

3. Implement targeted safety-oriented education and marketing strategies for tourist activities along the Great Ocean Road, drawing upon the collective expertise and roles of tourism agencies, related enterprises and community groups.

4. Increase targeted police enforcement of unsafe behaviours, during high risk times.

A generic, tourist route safety strategy should be based not only on the above principles, but should be flexible enough to address both the generic and route-specific crash characteristics, using relevant vehicle, behavioural, and road-based countermeasures, which might include:

1. **Reduce speed limits** if road alignment, topography or roadsides are inherently hazardous.

2. **Implement targeted programs:**
   - of low-cost, proven road and traffic engineering improvements;
   - of safety-oriented education and marketing strategies;
   - of police enforcement, directed at unsafe behaviours at high risk times;
   - established upon effective partnerships between tourism and state agencies, local government, Police and local communities.

Being a pilot study, potential benefits of countermeasures could not be thoroughly examined. However, implementing low-cost, targeted road-based improvements is consistent with the highly successful "black spot" principles which reduce casualty crash frequencies and costs, and deliver benefit-to-cost ratios typically ranging from 4:1 up to 8:1. Furthermore, many of the proposed road-based countermeasures can achieve crash savings of 10 to 60%.

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  Matthew Blythe and Michael Fisher at Apollo Bay
  Mick Atkinson and Kevin Jones at Lorne, and
  Don Phalp and Reg Kent at Anglesea.

• Members of the Barwon Region and the Warmambool Community Road Safety Councils.

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• Officers of Tourism Victoria, including Dorana Bettiol and Ken Turner.

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CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

As a consequence of vigorous tourism promotion by the Victorian Government it is anticipated that there will be significant growth in tourist travel demand in the medium term.

The roads which provide the principal access to many of Victoria's prime tourist destinations are used by large numbers of private motorists and commercial coach operators, providing for overseas, interstate and local tourists, school groups and others. For many tourist destinations, highly seasonal patterns of activity result in higher concentrations of traffic than averaged annual daily traffic flows would suggest. Furthermore some of the major tourist routes pass through areas made more hazardous by their geographic features (e.g. winding mountain roads, narrow, two-lane coastal roads, and areas of high pedestrian activity). Many of these roads are neither designed nor constructed to modern standards and, in some cases, are not well placed to cope with the future growth in tourism planned for Victoria.

There are strong social and economic reasons for ensuring that proper levels of safety are provided on roads serving tourist destinations. Past experience (e.g. Tziotis, 1992) indicates that where land use development and/or road use demand surpass the safety standards of the road system, crash problems will arise.

Victorian tourism is potentially an important beneficiary of overseas visitors to Australia in the lead-up to the Sydney Olympics in 2000 and afterwards, and it is timely for an investigation of the safety performance of Victorian tourist routes, in readiness for the expected increase in road use demand and its consequent safety implications.

1.2 OBJECTIVES

The objectives of this project are to:

- examine and report on the number and nature of road traffic crashes along a chosen route;
- comment on the likely growth of the crash problem;
- identify potential crash countermeasures
  - relating to general road upgrading;
  - proven road and traffic engineering safety improvements targeted at high crash frequency locations and crash types;
  - addressing road user and vehicle issues;
- indicate the level of benefits expected from the recommended countermeasures.
CHAPTER 2. PROJECT METHOD

Chapter 2 outlines the main steps followed in the pilot study, including the selection of a suitable tourist route for investigation, the definition of the road safety problem along that route, the identification of possible contributing factors to crash occurrence and severity, the identification of potential countermeasures and interventions and, finally, the development of a recommended approach to addressing safety along the selected route. Where relevant, aspects of the method or findings which are generic in nature have been highlighted because of their potential to be applied along other tourist routes in Victoria, or elsewhere in Australia.

2.1 ROUTE SELECTION

The selection of a route for pilot investigation was made to enable the nature and growth of road-based tourist traffic to be examined, and opportunities for developing cost-effective road safety programs to be assessed. The main route selection issues considered were:

Major Tourist Destinations - the route should have one or more major tourist destinations along its length, with these destinations being accessed primarily by road. Priority would be given to tourist routes carrying significant coach and other “high occupancy” vehicular traffic, given the potential for vastly higher losses in the event of a serious crash involving buses and coaches. A major destination was interpreted as one which rated highly in Tourism Victoria’s market research data, in terms of domestic and international visitors.

Dominant Tourist Route Function - the route should be performing a dominant tourist access function. Tourist travel on Victoria’s National and major State Highways is overshadowed by business/private travel and by freight transport and, as such, any investigation of the tourist component of travel and crash characteristics may be overwhelmed or confounded.

Growth - forecast growth in tourism during the next five years is significant and the tourist destination(s) is targeted for vigorous promotion to international and/or domestic markets.

Crash History - the route should have a crash history of substantial concern, to ensure that the pilot investigation proves meaningful in understanding crash characteristics of tourist traffic and in generating potential countermeasures.

The characteristics of a number of Victoria’s major tourist destinations are set out in Table 2.1. Based on these data, it was considered that the pilot study could be carried out on any one of the four routes or route categories shaded in Table 2.1, namely:

- Great Ocean Road to Port Campbell National Park
- Princes Highway East/Omeo/Ovens Highways/Alpine Road, Kiewa Valley, Hume/Goulburn Valley, Maroondah/ Melba Highways, serving the High Country
- South Gippsland and Bass Highways to the Wildlife Coast
- South Gippsland and Bass Highways to Phillip Island

In the case of Phillip Island, data on overnight domestic visits tend to understate the level of tourist activity. Many tourist coaches, carrying mainly international visitors, travel daily to wildlife attractions, including the Island’s Penguin Parade (typically 50 coaches/day throughout the year, with a peak of 73 coaches/day), but don’t involve overnight stays.
After further assessment and discussions with officers of Tourism Victoria, the Great Ocean Road was selected as it is being strongly promoted both overseas and within Australia, and is expected to experience the greatest growth in Victoria's tourism market in coming years.

This selection is consistent with the priorities of VICROADS 2000 Rural Arterial Road Strategy (1990) which addressed, among other road and traffic issues, the importance of servicing future international and domestic tourism markets.

2.2 DEFINITION OF THE ROAD SAFETY PROBLEM

Defining the road safety problem along the Great Ocean Road took place through analysis and assessment of a variety of sources of information. The main sources were:

- reported casualty crash data for the ten-year period 1985 to 1994 (as contained in VicRoads' traffic crash database);
- information provided by Police officers stationed at Anglesea, Apollo Bay and Lorne, who have extensive experience in attending traffic crashes along the Great Ocean Road;
- reports and other information from staff of VicRoads' South-Western Region office;
- information provided by members of both the Barwon Region and Warrnambool Community Road Safety Councils;
- specific information from a range of sources, such as tourism agencies, car rental companies, coach drivers and other users of the route;
- inspection by MUARC staff of physical features, including road and traffic engineering conditions along the Great Ocean Road, and observation of traffic operation.

Important findings of this stage of the pilot study are presented in Chapter 3.

2.3 IDENTIFICATION OF POSSIBLE CONTRIBUTING FACTORS

The identification of possible contributing factors to crash occurrence and severity, described in Chapter 4, was based on an assessment of the various sources of information listed above and, in particular, by relating predominant crash circumstances to the observed road and traffic conditions. That is, at locations along the Great Ocean Road where a logical relationship was apparent between the predominant crash circumstances and the prevailing physical conditions, behaviour of users of the route or other relevant factors, possible contributing factors may be identified.

Given the varying characteristics of crashes along the route and the changing nature of geographic features, this stage of the study considered the route in separate segments. For example, it was assumed that the physical nature of the road, and hence crash risk, is clearly different along the narrow, winding, coastal sections between Eastern View and Apollo Bay, compared to the mountainous/inland sections between Apollo Bay and Port Campbell. Thus, the analysis of the safety performance of the route was best carried out in segments.
Table 2.1 - Summary Description of Victoria’s Major Tourist Destinations

<table>
<thead>
<tr>
<th>Tourist Destination (beyond Melbourne)</th>
<th>Relevant Routes (to/from Melbourne)</th>
<th>1994 Domestic O'night Visits (000's)</th>
<th>I’national Travel (% share)</th>
<th>Crash Record</th>
<th>Tourist Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Great Ocean Road</td>
<td>Great Ocean Road</td>
<td>1,565</td>
<td>15</td>
<td>M-H</td>
<td>H</td>
</tr>
<tr>
<td>2. Goldfields</td>
<td>Western/ Calder/ Midland/ Pyrenees/ Sunraysia Highways</td>
<td>1433</td>
<td>13</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>3. Lower Murray</td>
<td>Calder/Loddon Valley/Murray Valley Highways</td>
<td>960</td>
<td>n.a.</td>
<td>M</td>
<td>L-M</td>
</tr>
<tr>
<td>4. Upper Murray</td>
<td>Hume/Goulburn Valley/ Murray Valley and Northern Highways</td>
<td>803</td>
<td>n.a.</td>
<td>M-H</td>
<td>L-M</td>
</tr>
<tr>
<td>5. High Country</td>
<td>Princes Highway East/Omeo/Ovens Highways/Alpine Road, Kiewa Valley, Hume/Goulburn Valley, Maroondah/ Melba Highways</td>
<td>751</td>
<td>3</td>
<td>M-H</td>
<td>M</td>
</tr>
<tr>
<td>6. Wildlife Coast</td>
<td>South Gippsland and Bass Highways</td>
<td>748</td>
<td>n.a.</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>7. The Lakes</td>
<td>Princes Highway East</td>
<td>526</td>
<td>n.a.</td>
<td>H</td>
<td>L-M</td>
</tr>
<tr>
<td>8. Mornington Peninsula</td>
<td>Nepean Highway/Mornington Peninsula Freeway</td>
<td>514</td>
<td>n.a.</td>
<td>H</td>
<td>M-H</td>
</tr>
<tr>
<td>9. Desert Wilderness</td>
<td>Western/Henty/Sunraysia, Calder/Mallee Highways</td>
<td>350</td>
<td>n.a.</td>
<td>M</td>
<td>L-M</td>
</tr>
<tr>
<td>10. Phillip Island</td>
<td>South Gippsland/Bass Highways</td>
<td>258</td>
<td>28</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>11. The Grampians</td>
<td>Western/Pyrenees Highways</td>
<td>237</td>
<td>5</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>12. Wineries</td>
<td>Maroondah/Melba/Warburton Highways, Hume/Ovens/Kiewa Valley and Goulburn Valley Highways</td>
<td>n.a.</td>
<td>6</td>
<td>M-H</td>
<td>M-H</td>
</tr>
</tbody>
</table>
2.4 IDENTIFICATION OF POTENTIAL COUNTERMEASURES

Chapter 5 describes the process of identifying potential crash countermeasures. At locations along the Great Ocean Road where a clear understanding had been developed of the nature of common crash circumstances and the corresponding factors likely to be contributing to crash occurrence, severity or both, candidate countermeasures which would target the main crash types and/or the contributing factors were proposed as part of the pilot study. These countermeasures spanned a range of types, including improvements to the road environment, police enforcement directed at unsafe behaviours, education of road users and improved approaches to marketing tourism along the Great Ocean Road. Where applicable, emphasis was placed on measures which are known, as a result of past evaluations, to be effective in treating the target crash types. For example, shoulder sealing has been shown in several research studies (e.g. Ogden, 1993 and Corben et al. 1996) to be effective in treating run-off-road crashes in rural areas and, therefore, has the potential to be used along the Great Ocean Road in selected circumstances.

2.5 A RECOMMENDED APPROACH TO ADDRESSING SAFETY ALONG THE GREAT OCEAN ROAD

Drawing on the findings of the pilot study, Chapter 6 recommends a strategic approach to the treatment of casualty crashes along the Great Ocean Road. The proposed approach comprised elements which can either be targeted at specific locations identified because of their high crash risk, or which can be expected to have a general effect on crash risk. An important aspect of a strategic approach to applying road environment countermeasures is the identification of locations at which the greatest crash savings can be achieved at the lowest cost. Similar principles apply to the implementation of other countermeasure types, such as education, enforcement and marketing.

Where reliably supported by past research findings, indications of the likely benefits of the strategy for improving safety are also provided.
CHAPTER 3. THE ROAD SAFETY PROBLEM

3.1 LOCAL COMMUNITY ROAD SAFETY COUNCILS

Valuable information was provided by members of both the Barwon Region and Warrnambool Community Road Safety Councils. This information was provided at meetings and through discussions with members of Councils. The main issues are summarised below.

3.1.1 Barwon Region Community Road Safety Council

The role of severe traffic congestion in crash occurrence - for at least seven days per year (e.g. Boxing Day, New Year's Eve, New Year's Day, "Pier to Pub Swim", Australia Day, and others such as during warm/hot weather on weekends, surf carnivals, Anglesea market, etc), traffic congestion is high and delays in either direction along the Great Ocean Road can be substantial. Long delays, in the absence of adequate and safe alternative routes, may lead to increased driver impatience, longer travel times and greater fatigue due, in part, to forgone rest breaks. Congested traffic conditions also lead to drivers/riders taking risks when re-entering the traffic flow, either at intersections or from car parks/driveways.

The extent to which bicyclists are a road safety problem, now and in the future - there is concern that the apparent growth in bicycle riding on the Great Ocean Road may translate into a serious road safety problem, given the narrow, winding nature of the route (it was estimated that about 10% of international visitors to the Great Ocean Road travel by bicycle). Specifically, there was concern that crashes may be caused by drivers having to avoid cyclists on narrow pavements.

The contribution to understanding crash circumstances from local Police input - it was suggested that discussions with local police members for more detailed advice about crash circumstances would be valuable. Members at Anglesea, Lorne and Apollo Bay were recommended, as they have considerable knowledge as a result of past attendance at and reporting of crashes on the Great Ocean Road.

The extent to which sun glare contributes to crash occurrence - sun glare in late afternoon (and early morning) is believed to be a factor in some crashes. Possible associations can be examined by studying the crash patterns by time-of-day and month-of-year, ensuring that any such associations are not simply due to travel occurring up to dusk and then declining.

Consultation with professional drivers on the route - truck drivers (e.g. newspaper deliverers) and coach/bus drivers should be consulted about hazards encountered by them, given their frequent use of the route and the significance of large (passenger) vehicles in ensuring safety.

Barwon Region Motorcycle Council - in recognition of the problem involving motorcycles on the Great Ocean Road, the Barwon Community Road Safety Council held a public forum to seek ideas on how to improve motorcyclists' safety. As a result of this forum, the Barwon Region Motorcycle Council (BRMC) was formed. The Council is an independent body of motorcycle riders representing various clubs and interests. A preliminary road safety audit of the Great Ocean Road from Torquay to Lorne was completed by the BRMC, and referred to VicRoads for attention. Following a submission by the BRMC, the BCRSC commenced subsidising rider training courses for local riders. In addition, information regarding the forum and crash statistics were published in motorcycle magazines and local newspapers.
3.1.2 Warrnambool Community Road Safety Council

Alternative routes, connecting the Great Ocean Road with the Princes Highway West, are in need of improved direction signing. Intersections of these alternative routes with the Princes Highway West are inherently hazardous, especially to overseas tourists (eg. at Tomahawk Creek Road, Lapent Road, etc.). A fatal crash involving several Japanese tourists occurred at such an intersection in recent years.

Tourist visits to the Great Ocean Road cannot reasonably be undertaken as “a day trip”, yet they are being marketed in this way by the tourist industry. Vans and other multi-passenger vehicles are commonly being used for such trips, placing more lives at risk in the event of a crash. It was suggested that information be sought from hire car companies on the use of hire vehicles by overseas tourists and how this might affect safety. For more detailed information on crashes resulting in non-serious injuries, local hire car and tow-truck operators were suggested as a valuable source of insights into crash circumstances, not normally covered in Police reported databases.

Emergency service response time is regarded as an important safety issue, especially in regard to the operation of air ambulance services to and from the Warrnambool Hospital. It was also noted that communications around Peterborough are difficult as mobile phones do not operate effectively in this area of Victoria.

Re-entry from tourist car parks can be hazardous due to poor sight distances, especially for the common circumstance of driveways situated on the inside of curves.

3.2 INFORMATION PROVIDED BY LOCAL POLICE

Discussions with local Police officers stationed at Anglesea, Apollo Bay and Lorne, yielded valuable information based on their extensive experience in attending traffic crashes along the Great Ocean Road. The main issues are described in the following sections.

3.2.1 Apollo Bay Police

Apollo Bay has a permanent population of about 1,200, and a total population of about 3000, i.e. there is typically about 2,000 tourists or other visitors per night in the township. A major road safety issue along the Great Ocean Road concerns motorcycle safety. Relevant factors, including those that are of specific importance to motorcycle safety, are summarised below:

Road Users in General

- many routes connecting directly or indirectly with the Great Ocean Road have no overtaking opportunities, tend to be in poor condition relevant to traffic demand and are inherently hazardous. Some routes are used frequently by locals residents to obtain provisions and for general shopping, by recreational and tourist traffic as an alternative to the Great Ocean Road (especially when roads are congested during holiday and weekend periods), by logging trucks, and to provide access to areas of significance in terms of conservation and environment. Specific examples include Forrest-Apollo Bay Road, Blanket Bay Track (unsealed, narrow), Wild Dog Road which experiences single-vehicle off-path type crashes, Otway Lighthouse Road, Binns Road and Turtons Road;
• **damage to road pavements**, due to heavy vehicles using the Great Ocean Road, contributes to crash risk;

• **overseas tourists, especially from Asian countries, are prominent in crash occurrence along the Great Ocean Road and on connecting roads.** One example occurred at Tomahawk Creek Road at Churches Corner, where a group of eight Asian tourists, travelling in a small passenger van were involved in a serious high speed collision;

• **tourist coaches and other long vehicles experience difficulty remaining within their lanes** due to the narrowness of lanes and the severe curvature of the Great Ocean Road in places;

• **there are too few “turn-out” lanes**, which enable slower vehicles to move to the left, out of the traffic lane, so faster vehicles may overtake safely. This concern applies mainly to traffic travelling along the Great Ocean Road towards Melbourne.

• **the role of alcohol** in crashes along the Great Ocean Road may be understated in that local residents tend not to report such events unless serious injuries are involved;

• **some hire car companies won’t hire to Great Ocean Road travellers.** Most hire cars have front-wheel drive, making them potentially more difficult to control, especially for drivers not familiar with their different handling characteristics.

**Motorcyclists:**

• **excessive speed** by riders. For many curves, speeds of 50 km/h are excessive, e.g. curves at Smythes Creek;

• **the combination of excessive speed, rider inexperience and inappropriate power to weight ratio bikes** has also been found to be a factor in motorcycle-involved crashes along the Great Ocean Road;

• **the combination of slippery road surfaces, rigid bridge structures and changes in both vertical and horizontal alignment** commonly prevail at and on the approaches to bridges over creeks. These conditions are of particular concern to road users in general, but to motorcyclists in particular. In the vicinity of creek valleys, road surfaces are often damp due to slow drying at bridges where winds tend to be light, drainage collection high and there are extended periods of shade;

• **wind gusts** can present particular difficulties for motorcyclists (and for cyclists and vehicles towing caravans);

• **encroachment by other vehicles into opposing lanes** presents an obvious threat to motorcyclists, especially if the other vehicles are wide or long (e.g. passenger/tourist coaches, semi-trailers, etc.);

• **the presence of loose stones, adverse super-elevation on bends or both,** affect vehicle and motorcycle stability. Many intersections have loose gravel scattered around the intersection mouth, offering little traction for drivers endeavouring to enter the traffic stream along the Great Ocean Road. Examples of this form of problem exist at Skene’s Creek and at also locations where vehicles turn to and from scenic look-outs or parking areas;
• poor pavement condition, and haphazard road maintenance and repairs, combine to create substantial risks for motorcyclists. Specifically, repairs to pot-holes and broken pavement edges, and removal of loose gravel from travelling lanes could be improved in terms of responsiveness and technique (e.g. Petticoat Creek). Where roadworks are underway and loose gravel is present, drivers and riders not adjusting to the poorer surface. This problem is exacerbated during holiday periods when traffic volumes are higher.

3.2.2 Lorne Police

The Great Ocean Road, on both of its approaches to Lorne, one of Victoria’s most popular seaside townships, is severely constrained by the geographic features of the surrounding coastline. The main factors affecting road safety along the Great Ocean Road and within the Lorne Police District are described below:

• road user error associated with speed on curves, especially by motorcyclists, are key factors in safety along the Great Ocean Road on either side of Lorne. Motorcycle speeds of 140 km/h crossing Cumberland River, Spout Creek and in the Big Hill and Eastern View areas are notable examples;

• unsealed access to and egress from the Great Ocean Road presents problems with vehicle traction;

• the narrow pavements common along the Great Ocean Road, offer no recovery area for straying vehicles, while tri-axle trucks can’t track within these narrow lanes (e.g. semi-trailer, near legal length). This also applies to Deans Marsh Road, Forrest-Apollo Bay Road and Skene’s Creek Road.

• despite poor road pavement conditions at scenic look-out car parks (e.g. pot-holes, oil spills, blind entry and adverse super-elevation at Urquhart’s Bluff, sloping car parks leading to gradual movement of gravel and other loose material onto the Great Ocean Road, etc.), beach access remains.

• broken edges and a lack of (in some cases, effective) edge lining exacerbates the crash risk associated with narrow pavements (see above);

• Police currently work with motorcyclists of the area, using peer-groups in an attempt to change rider attitude.

3.2.3 Anglesea Police

The Anglesea Police District averages about 20 casualty crashes on the Great Ocean Road per year, though many crashes are not reported. The major road safety issues along the Great Ocean Road in the Anglesea District are summarised below:

• speed limits along the Great Ocean Road are generally too high for the road and roadside conditions and would be more appropriately set at no more than 80 km/h;

• extreme speeding is a major issue among some motorcyclists using the Great Ocean Road, especially at weekends. It has become the practice of some motorcyclists, usually travelling in large groups, of riding at very high speeds, crossing double centre lines in an effort to set “Personal Best” times. Riders travel at or near the limits of their abilities,
often riding so fast that they cannot be apprehended (safely) by police pursuit vehicles. Riders may also be distracted to some extent by the scenery of the Great Ocean Road;

- *speed enforcement is generally difficult* in that unsafe speeds are within the State limits and extreme speeds are too dangerous to pursue. Consideration may be given to adapting speed camera technology for use at high risk locations, such as from the Urquhart's Bluff car park area, to deal with extreme speeds by motorcyclists;

- *crash risks are elevated around scenic look-outs and car parks* due to the higher levels of traffic activity;

- *insufficient use is made of double lines and of advisory speed and curve warning signs*, given the frequently changing horizontal alignment of the Great Ocean Road;

- *road and roadside gravel is a problem* for all road users but for bicyclists and motorcyclists in particular;

- *there is a specific problem of run-off-road crashes for motorcyclists* on the approach to Anglesea, near the Eumarella Scout Camp. This may be associated with the downhill approach and the changing horizontal alignment of the road in this vicinity;

- *the Great Ocean Road cannot cope with traffic congestion* on a number of specific days each year (New Year's Day, the "Pier to Pub" Swim event, hot weather on Sundays). The congestion produces long delays, frustration among road users and consequent increase in speeding and unsafe over-taking manoeuvres. Solutions to one problem, such as redirecting traffic to the Princes Highway West before reaching Anglesea, tends to shift the problem elsewhere to alternative routes of inadequate standards to cope with high traffic demand;

- *the signing of alternatives is inadequate* and also leads to frustration and higher levels of risk taking by drivers and riders;

- *there is considerable concern about the safety of international visitors*. For example, some Asian drivers and riders, when apprehended by police for traffic infringements, seem not to understand traffic signing nor the significance of posted speed limits and advisory speed signing.

### 3.3 ANALYSIS OF REPORTED CASUALTY CRASH DATA

Reported casualty crash data were analysed for the ten-year period 1985 to 1994, throughout the length of the Great Ocean Road from Torquay at the eastern end to Allansford at the western extremity. Figure 3.0 shows casualty crash data plotted on a map of the Great Ocean Road, for both road intersections and segments. Casualty crashes are colour-coded along the route, to indicate the number of crashes which have occurred at an intersection or within a road segment, during the ten year study period. As described earlier, the analysis was also segmented into three broadly defined sections, namely:

**Section A (92 kms approx.) - Torquay to Marengo:** four lengths of open road along this section, including a number of intersections, were identified as problem areas for closer examination.
LEGEND

- Towns
- L.G.A (old)

Number crashes on road segments:
- 1 - 3
- 3 - 6
- 6 - 11
- 11 - 17
- 17 - 36

Number of crashes at intersections:
- ▲ 1
- ▲ 1 - 2
- ▲ 2 - 3
- ▲ 3 - 5
- ▲ 6 - 10

Great Ocean Rd

Lakes

Kilometers

Section C
Section B (84 kms approx.) - Marengo to Princetown: one length of open road along this section was identified for detailed investigation.

Section C (75 kms approx.) - Princetown to Allansford: one length of open road along this section, including two of intersections, was identified for detailed examination.

In addition to these sections of the Great Ocean Road, casualty crash histories for the townships of Anglesea, Lorne and Apollo Bay were also separately analysed, given their urban character, concentrated levels of tourist/recreational traffic and related activities.

3.3.1 Great Ocean Road Overall

The main crash circumstances along the Great Ocean Road over the ten-year period 1985 to 1994 are summarised below:

**Single-Vehicle vs Multi-Vehicle Casualty Crashes** - throughout the period from 1985 to 1994, single-vehicle crashes have been consistently higher than multi-vehicle crashes. Both crash types showed a similar trend over time, with single-vehicle crashes generally about 50% more frequent than multi-vehicle crashes (refer Figure 3.1).

![Figure 3.1: Casualty Crashes on Great Ocean Road by Single/Multi Vehicle 1985 to 1994](image)

**Speed Zone** - Figure 3.2 shows the relationship between speed zone and crash occurrence over the study period. The major portion of the crash problem occurred in higher speed zones, i.e. there were two to three times more crashes in 80 km/h or higher speed zones.
Road Alignment - Figure 3.3 shows that casualty crashes along the Great Ocean Road occurred more frequently on curved than on straight sections of road. This may be due at least in part to the winding nature of the route.

Road Conditions - Figure 3.4 shows that most of the casualty crashes on the Great Ocean Road have occurred in dry conditions.
Light Conditions - Figure 3.5 indicates that crashes on the Great Ocean Road took place predominantly during daylight hours. This, together with the predominance of crashes in dry conditions and on curves, may be indicative of the bulk of the problem being related to the road itself rather than to environmental influences.

Crash Severity - Figure 3.6 shows a reasonably constant high proportion (45% over the ten year period, compared to approximately 32% over the entire state) of crashes on the Great Ocean Road have involved serious injury or fatality to one or more persons. In other words, there was a tendency for crash severity along the Great Ocean Road to be above the State average.
Crash Type and Motorcycle Involvement - Figure 3.7 shows the dominant accident type (42%) was vehicles running off the road on curves. Note also that this accident type was even more prevalent amongst motorcycle crashes. Motorcycle crashes form 33% of the overall number of crashes over the 10 year period. Motorcycle crashes are in examined in more detail in section 3.3.3.

Key to Abbreviations in Figure 3.7:

- PED: Pedestrian accident
- VAD(INT): Vehicles travelling in adjacent directions (at intersection)
- VOD: Vehicles travelling in opposite directions
- VSD: Vehicles travelling in the same direction
- MAN: Manoeuvring or parking
A finer analysis of these data found that the crashes were distributed according to the vehicle movements involved, as shown in Table 3.1.

Table 3.1: Distribution of Main Crash Types for All Vehicle Types and for Motorcycle Crashes Only

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>% of All Casualty Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Vehicle Types</td>
<td>Motorcycles Only</td>
</tr>
<tr>
<td>head-on impacts (not during overtaking manoeuvres)</td>
<td>13.0</td>
</tr>
<tr>
<td>running off right bends and striking fixed roadside objects or parked vehicles</td>
<td>12.3</td>
</tr>
<tr>
<td>running off left bends and striking fixed roadside objects or parked vehicles</td>
<td>11.5</td>
</tr>
<tr>
<td>running off right bends</td>
<td>8.2</td>
</tr>
<tr>
<td>out-of-control on carriageway</td>
<td>6.2</td>
</tr>
<tr>
<td>left off straight carriageway striking fixed roadside objects or parked vehicles</td>
<td>4.4</td>
</tr>
<tr>
<td>rear-end impacts</td>
<td>4.4</td>
</tr>
<tr>
<td>running off left bends</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Examination of these results shows that the percentage of motorcycle crashes involving running off right bends was substantially higher than for all vehicle types, (29.8% c.f. 20.5%). Similarly, and perhaps not surprisingly, the percentage of motorcycle crashes involving loss of control on carriageway was also substantially higher than for all vehicle types (13.3% c.f. 6.2%).

Objects Struck - Of the 36 objects reported in the data as having been struck in crashes which occurred during the study period, 17 (47%) involved embankments, with other types of objects distributed more evenly. Motorcyclists were recorded as having struck ten objects, having hit embankments on only two occasions, suggesting that the problem involved mainly other vehicle types. Thirteen of the 17 embankment crashes occurred on curves, with no marked tendency to left or right curves. These data are tabulated below.
Table 3.2: Distribution of Objects Struck for All Vehicle Types and for Motorcycle Crashes Only

<table>
<thead>
<tr>
<th>Object Struck</th>
<th>Number Hit by All Vehicle Types</th>
<th>Number Hit by Motorcyclists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Embankment</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Guide Post</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Traffic Sign</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Guard Rail</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Other Fixed Object</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traffic Island</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Time of Year - Figure 3.8 shows that crashes were most frequent on the Great Ocean Road during holiday months over summer, which may be explained in part by higher traffic volumes during such periods.

Figure 3.8: Casualty Crashes on Great Ocean Road by Month 1985 to 1994

Time of Crashes - Figure 3.9 shows that crashes on the Great Ocean Road tended to happen most often at weekends, particularly on Sundays during the day. Together with the trend towards summer holiday months, this indicates that a high proportion of recreational traffic may be involved in crashes.
Age and Sex of Persons Involved - Age and sex profiles of persons involved in crashes over the study period are shown in Figures 3.10 to 3.12. The main findings from these analyses were that:

- the majority of drivers involved in casualty crashes were males (62%). This percentage tended to be consistent across all ages, ranging between 62% and 70% for most age categories. About three-quarters of all male drivers were aged between 18 and 45 years, with drivers in the range 18 to 25 years being highly represented;

- approximately half of all passengers tended to be female, with this proportion increasing markedly with age. The most common age categories of those passengers involved in casualty crashes were the adjacent categories of 0 to 17 years and 18 to 21 years;

- only two percent of motorcyclists involved in casualty crashes on the Great Ocean Road were females. The vast majority of riders (85%) were aged between 18 and 35 years.
Figure 3.10: Age and Sex of Drivers involved in casualty crashes on Great Ocean Road 1985 to 1994

Figure 3.11: Age and Sex of Passengers involved in casualty crashes on Great Ocean Road 1985 to 1994
Figure 3.12: Age and Sex of Motorcycle Riders involved in casualty crashes on Great Ocean Road 1985 to 1994

Licence Type - Some 8.8% (49 of 555) of drivers with known licence state involved in casualty crashes over the study period were licensed outside Victoria. The figure was marginally higher for motorcyclists at 9.2% (17 of 185). This compares to a state average of approximately 3% for drivers and 7% for motorcyclists, indicating the higher rate of tourist traffic.

Vehicle Type - Table 3.3 shows the vehicle types recorded in the accident database during the study period. Passenger cars (481, or 61%) were the most prominent. Motorcycles, however, with 25%, were over-represented when compared to the overall state average of 6%. Only six buses of any type were involved in casualty crashes over the study period, despite the tourist function of the route.

Table 3.3: Distribution of Vehicle Types involved in Crashes

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Cars</td>
<td>481</td>
</tr>
<tr>
<td>Utility/Panel Van</td>
<td>61</td>
</tr>
<tr>
<td>Trucks (incl semi)</td>
<td>13</td>
</tr>
<tr>
<td>Bus/Coach/Mini Bus</td>
<td>6</td>
</tr>
<tr>
<td>Motor Cycle</td>
<td>194</td>
</tr>
<tr>
<td>Bicycle</td>
<td>20</td>
</tr>
<tr>
<td>Other/Unknown</td>
<td>15</td>
</tr>
</tbody>
</table>
3.3.2 Motorcycle Crashes

Over the period 1985 to 1994, some 188 casualty crashes, or 33% of the overall number of reported casualty crashes on the Great Ocean Road, have involved motorcycles. This rate of involvement is more than three times the statewide average of 10.3% for the same period (refer Diamantopoulou, Brumen, Dyte and Cameron, 1995). In this section some of the characteristics of these crashes are examined.

Single/Multi Vehicle - Figure 3.13 shows a similar tendency for motorcycle crashes as for all crashes, with a consistently greater proportion of single-vehicle crashes over the study period. The proportion of single-vehicle crashes is higher for motorcycles, however, at 65% over the ten years.

![Figure 3.13: Motorcycle Casualty Crashes on Great Ocean Road by Single/Multi Vehicle 1985 to 1994](image)

Speed Zone and Road Alignment - Motorcycle crashes on the Great Ocean Road in the ten year period occurred almost entirely in high speed zones (80 km/h or higher). Only in 1988 did more than five motorcycle crashes take place in lower speed zones. Similarly, a large proportion of crashes occurred on curved sections of road, which may be partly explained by the winding nature of the route, and potentially by motorcyclist behaviour along the Great Ocean Road.
Figure 3.14: Motorcycle Casualty Crashes on Great Ocean Road by Speed Zone 1985 to 1994

Figure 3.15: Motorcycle Casualty Crashes on Great Ocean Road by Road Alignment 1985 to 1994

Road and Light Conditions - Crashes involving motorcycles on the Great Ocean Road displayed much the same pattern as for all crashes- a predominance of dry conditions and daylight, indicating a lack of outside environmental influences.

Crash Severity - Figure 3.16 shows that, with some degree of year to year variation (probably due to the smaller numbers involved), the severity of motorcycle crashes on the Great Ocean Road was very high over the ten year period, with 52% of crashes resulting in serious injury or fatality to one or more persons. This compares to an average of 46% for motorcycle crashes across Victoria.
**Time of Crashes** - Figures 3.17 and 3.18 show motorcycle crashes on the Great Ocean Road to have occurred mainly at weekends and in summer holiday months, to a greater degree than for the overall statistics over the ten year period (refer Figures 3.8 and 3.9). This may be explained by the largely recreational nature of motorcycle usage along the Great Ocean Road.
Figure 3.18: Motorcycle Casualty Crashes on Great Ocean Road by Hour of Week 1985 to 1994

### 3.3.3 Crashes at Specific Locations

Casualty crash data, covering the section of the Great Ocean Road from Torquay to Allansford, for the period 1985 to 1994, were analysed to identify locations with the highest incidence of crashes, and to characterise these locations in terms of their particular crash histories, the physical features of the road environment and the nature of traffic movement. Associations among these variables helped with the identification of factors which may be contributing to crash occurrence, severity or both. The findings of these analyses and related investigations are described below.

**Section A - Torquay to Marengo (92 kms approx.):** Torquay (refer VicRoads Country Directory, Map 93 G07) to Marengo (Map 101 C06), consisting mainly of a winding, narrow, two-lane, undivided carriageway, forms an immediate border to the coastline for much of its length. Four lengths of open road along this section, including a number of intersections, were identified as problem areas for closer scrutiny.

1. **Between Torquay and Point Addis Road** - there were four intersections and two road lengths with significant casualty crash records.

   **Intersection Crashes** - over the ten year period under study, the intersections of the Great Ocean Road with Hoylake Avenue, Duffields Road, Bells Beach Road and Anglesea Road each experienced between five and nine casualty crashes. Hoylake Avenue and Duffields Road are important access routes for Jan Juc Surf Beach, camping/caravan park and residential development, while the Bells Beach Road provides access to one of Victoria’s major surf beaches. Anglesea Road forms a major T-intersection with the Great Ocean Road and is controlled by give way signs.

   The dominant crash types (67%) among these four intersections involved vehicles either attempting to cross the Great Ocean Road, or to turn right from an approach controlled by stop or give way signs, i.e. usually to join the Great Ocean Road traffic flow. There was a tendency for crashes to cluster around the months of December to February, while others
occurred in the months of September or October. There was also a tendency for crashes to occur during the late afternoon and early evening.

The following physical and traffic flow features were found among these four intersections:

- sight distance problems for vehicles on the minor approach, due to horizontal and/or vertical road alignment, positioning of road signs or the presence of trees and shrubs;

- the road surface is worn, uneven and scattered with loose material, all of which would diminish traction for drivers attempting to enter the Great Ocean Road’s high-speed traffic flow, often having infrequent safe gaps. At the intersection with Anglesea Road, this unevenness of surface leads to “ponding” of water during periods of rain, also adversely affecting the traction available to drivers who are subject to the give way sign control;

- difficulties in selecting safe gaps in the Great Ocean Road, which is undivided and consists of a single lane only in each direction. This problem is clearly accentuated during certain times of the day, days of the week and periods of the year;

- in the case of the Duffields Road approach to the Great Ocean Road, a substantial upgrade to the intersection tends to obscure the pavement line markings which help to define the conflict area. This upgrade, combined with the above-mentioned problem of loose material at the mouth of the intersection, makes entry into the traffic stream more hazardous.

Road Lengths - over the period 1985 to 1994, the Great Ocean Road between Bell Street and Hoylake Avenue, and between Bones Road and Jarosite Road had seven and eight casualty crashes, respectively, including a total of three fatal crashes. No clear patterns in crash occurrence were evident within either length. Road safety improvements were carried out in about 1993 under the Transport Accident Commission’s Accident Black Spot Program along the Great Ocean Road between Bones Road and Jarosite Road. Improvements took the form of shoulder sealing and edge line markings, and have changed circumstances substantially since most of these crashes occurred.

2. From Golf Links Avenue 1.32 kilometres west to Grassy Creek - this winding coastal road length had 31 casualty crashes over the period from 1985 to 1994. It is approximately 1.3 kilometres long, giving it the highest number of casualty crashes per kilometre over the full length of the Great Ocean Road. Twenty three of the 31 casualty crashes (74%) involved only a single vehicle running off-path on a curve, and in most instances, striking a roadside object or parked vehicle. Ten crashes involved motorcyclists. About one third of all casualty crashes occurred from 3.15 p.m. to 4.45 p.m. and another third from 10.20 a.m. to 12.30 p.m. Seven of the casualty crashes lead to serious injuries, but none was fatal.

This section of the Great Ocean Road is a two-lane, undivided road with an existing posted speed limit of 80 km/h, however, all but one of the crashes occurred at a time when the posted speed limit was 100 km/h. Lanes are very narrow in each direction, while the road pavement has broken edges and unsealed gravel shoulders showing clear signs of rutting and erosion. These road surface conditions are present in combination with frequently changing vertical and horizontal road alignment. The bridge over Mogg’s Creek, situated on an “S-shaped” curve, has unprotected structures close to the travelling lanes.
Edgeline markings are present but, in places, their effectiveness is diminished by sand and gravel spilling onto the already narrow lanes. Where formal and informal parking arrangements exist for beach access, it is common to find sand and gravel scattered over the roadway.

3. From Hird Street to Sheoak Creek - this winding coastal road length had 24 casualty crashes over the ten years under study. It is approximately 3.4 kilometres long, rating it among the worst locations along the Great Ocean Road in terms of casualty crashes per kilometre. Fifteen of the 24 casualty crashes (63%) involved only a single vehicle running off-path, mainly on curves, and in about 40% of these cases, striking a roadside object or parked vehicle. A further seven casualty crashes involved head-on collisions (not overtaking), five of which involved motorcyclists. Sixteen, or two-thirds, of the 24 casualty crashes involved motorcyclists who, in all but one case, ran off-path, mainly on curves, or had head-on collisions, as described above. Over 80% of all casualty crashes occurred between noon and 7 p.m. Ten of the casualty crashes lead to serious injuries, but none was fatal.

This section of the Great Ocean Road is a two-lane, undivided road with a posted speed limit of 100 km/h for the majority of its length - all but one of the crashes occurred in this high speed zone. As with the previously described section (near Eastern View), lanes are very narrow, road pavement edges are broken, and shoulders unsealed and showing clear signs of rutting and erosion. These conditions occur in combination with frequent and often severe changes in vertical and/or horizontal road alignment. There are a number of bridges over rivers or creeks which are situated on curves and have unprotected bridge structures close to the travelling lanes.

Edgeline markings are either non-existent or worn and, in places, their conspicuity is reduced as result of loose material spilling onto the already narrow lanes. Where parking arrangements exist at scenic look-outs, loose stones and gravel tend to be scattered in larger amounts along the edge of the traffic lanes.

4. Between Grey River to Hitchcock Gully - this winding coastal road length had 12 casualty crashes over the ten years under study. It is approximately 1.2 kilometres long, rating it among the worst locations along the Great Ocean Road in terms of casualty crashes per kilometre.

This road length has very similar characteristics to others already described. The main characteristics can be summarised as follows:

- the main crash type (75% of total) involved single-vehicles, with all but one of these vehicles running off-path on curves. In about 30% of these cases, a roadside object or parked vehicle was struck;
- eight, or two-thirds, of the 12 casualty crashes involved motorcyclists who, in most cases, ran off-path on curves;
- three-quarters of all casualty crashes occurred between 10.15 a.m. and 4 p.m.;
- three of the 12 casualty crashes lead to serious injuries, but none was fatal.
This section of the Great Ocean Road continues as a two-lane, undivided road with a posted speed limit of 100 km/h for the majority of its length. All but three of the crashes occurred in this high speed zone. Road environment characteristics include:

- **narrow lanes**, in general, with **failed sections and broken edges**;

- **unsealed shoulders** which drop sharply into drainage channels or follow the natural slope towards the coastal edge;

- frequent and often **severe changes in vertical and/or horizontal road alignment**;

- **no edgeline markings** to delineate the changing road alignment;

- **loose material** spilling onto the road surface from unsealed shoulders, and from parking areas and driveways;

- **Grey River bridge**, situated between two curved descents, although delineated with hazard markers, has **loose material** within travelling lanes, **unprotected bridge structures** close to lanes and **no edgeline markings** on the approach to, or on, the bridge.

5. **From Forrest-Apollo Bay Road to Wild Dog Road, Apollo Bay** - the Great Ocean Road continues to follow closely the coastline, until reaching the Apollo Bay township. This road length had eight casualty crashes in ten years, over a distance of about three kilometres.

The main casualty crash characteristics were:

- four of the eight crashes involved **single-vehicles running off-path**, mainly on straight sections of road;

- **only one** of the eight crashes involved a **motorcyclist**, who ran off-path on a curve;

- five of the eight crashes lead to serious injuries, including one fatal pedestrian crash;

- six of the eight crashes occurred in a 100 km/h speed zone;

- no other significant crash characteristics were evident.

This section of the Great Ocean Road has many of the same features of road sections described earlier, namely:

- a two-lane, undivided road with a speed limit of 100 km/h for most of its length;

- **narrow lanes**, in general, with **failed sections and broken edges**;

- **unsealed/rutted shoulders**, located immediately adjacent to deep drainage channels and/or narrow roadsides sloping towards the coastal edge;

- frequent and often **severe changes in vertical and/or horizontal road alignment**;

- **limited use of edgeline markings** to delineate the changing road alignment;

- **loose material** accumulating in lanes from gravel shoulders, driveways and parking areas.
Section B - Marengo to Princetown (84 kms approx.): Marengo (101 C06) to Princetown (100 D05), also a winding, two-lane, undivided carriageway but of more generous width. This section is situated entirely inland, passing through substantial areas of forest and mountainous terrain. Only one length of open road along this section was identified as a problem area for more detailed examination.

1. From Binns Road/Parker Ridge Road 2.3 kilometres south to an unnamed creek - The particular road length with the worst crash record between Marengo and Princetown is approximately 2.28 kilometres in length and has experienced five casualty crashes in ten years.

The main casualty crash characteristics were:

- three of the five crashes involved single-vehicles running off-path, on straight and curved sections of road;
- two of these five crashes involved a motorcyclist, one of whom ran off-path on a curve while the other collided head-on with another motorcyclist;
- three of the five crashes lead to serious injuries, but none was fatal;
- four of the five crashes occurred in a 100 km/h speed zone;
- four of the five crashes occurred between 2 p.m. and 5.15 p.m.

This section of the Great Ocean Road differs in some significant features to road sections described earlier:

- also a two-lane, undivided road with a speed limit of 100 km/h throughout its length;
- wide lanes, with pavement surfaces and edges generally in good condition;
- long sections of kerbing which help to delineate pavement edges and keep loose material from spilling into traffic lanes. Other sections have unsealed gravel or grassed shoulders which allow build-up at the pavement edges of loose material and forest debris, such as leaves and bark. Forest debris also tends to accumulate along carriageway centre lines;
- frequent, but only occasionally severe, changes in vertical and/or horizontal road alignment;
- limited use of edgeline markings to delineate the changing road alignment;
- loose material building up on the road surface from parking areas and driveways.

Section C - Princetown to Allansford (75 kms approx.): Princetown (100 D05) to Allansford (90 B08), is a two-lane, undivided carriageway, whose variations in road alignment and pavement widths are less constrained by coastal and other geographic features. Only one length of open road along this section was identified for site-specific examination.

1. Between Blakes and White Road, Nirranda - comprises one road length and the two intersections at either end of this length. The particular road length with the worst crash...
record between Princetown and Allansford is approximately two kilometres in length and has experienced a total of six casualty crashes in ten years.

The main casualty crash characteristics were:

- four of the six crashes involved a **single-vehicle, running off-path**, either on curved or straight sections of road;
- **none** of the crashes involved a **motorcyclist**;
- only one of the six crashes lead to serious injuries;
- all crashes occurred in a **100 km/h speed zone**;
- four of the six crashes occurred at an intersection, with three of these crashes occurring where Whites Road intersects with the Great Ocean Road. Each of these crashes occurred between 12 noon and 4.40 p.m.

This section of the Great Ocean Road differs in some significant features to road sections described earlier:

- a two-lane, undivided road with a speed limit of 100 km/h throughout its length;
- **narrow lanes**, with damaged pavement surfaces, broken edges and no edgeline markings;
- infrequent changes in vertical and horizontal road alignment, compared with other sections of the Great Ocean Road;
- **unsealed shoulders with loose material** building up on the road surface, especially at driveways and intersections where good traction can be essential;
- the **geometric layout** of the intersection of the Great Ocean Road and Whites Road has the potential to cause uncertainty and possible confusion about right-of-way among approaching drivers and riders (refer Figure 3.19 over).

3.3.4 Main Townships

1. **Anglesea** - two adjacent intersections and the intervening, 200 metre length of the Great Ocean Road collectively represented the highest concentration of casualty crashes in the township of Anglesea.

Over the ten year period under study, the intersections of the Great Ocean Road with Camp Road and Purnell Street experienced only one and two casualty crashes, respectively, while the intervening road length experienced three crashes, of which two involved pedestrians. With such small crash numbers overall, no reliable patterns are discernible, however, it is worth noting that three of the six casualty crashes involved pedestrians and one of these crashes was fatal. Two other crashes involved motorcyclists running off-path. Half of all crashes occurred in the month of January.
No major deficiencies are evident along this section of the Great Ocean Road. The Camp Road intersection is controlled by a large diameter roundabout, access from Purnell Street onto the Great Ocean Road is prevented and the intervening road segment is bordered by hedges which limit pedestrian crossing movements to only a few selected locations. Shopping activity and parking are restricted to the northern side of the Great Ocean Road, substantially reducing pedestrian activity across the Great Ocean Road. The south-bound approach to this road length is on a long downgrade, with a sweeping right-hand bend just west of Purnell Street. Notwithstanding the posted 60 km/h speed limit in the township, the downgrade is likely to increase the risk of excessive speeds for south-bound traffic.

2. **Lorne** - between the Erskine River and Armytage Street, 19 casualty crashes have occurred over ten years. Four of these crashes involved pedestrians and six involved vehicles running off-path on either straight or curved sections of road. Only one crash involved a motorcyclist, none of the 19 crashes was fatal and eight crashes involved serious injuries.

The curved nature of the Great Ocean Road through the Lorne township may be a factor in the predominance of off-path crashes. Although all shopping activity is confined to the western side of the Great Ocean Road, considerable pedestrian activity occurs between the beach and car parking on one side and the shops, accommodation and residences on the other. Being an undivided road, pedestrians have no opportunities to stage their crossing movements of the Great Ocean Road. Between Beal Street and Armytage Street the roadside development reverts to residential, and road conditions change to narrower lanes and unsealed gravel shoulders without edgeline markings to delineate the changing horizontal road alignment.

3. **Apollo Bay** - a total of seven casualty crashes occurred between Milford and Thomson Streets. There was a range of crash types with no predominate type. They included one pedestrian crash, two off-path crashes and two other crashes involving motorcyclists. None of the seven crashes was fatal and five crashes involved serious injuries. Five crashes occurred
on either a Saturday or Sunday and most occurred within a 75 km/h speed zone. Five of the seven crashes occurred between 1.10 p.m. and 4.45 p.m.

These crashes were confined mainly to the outskirts of the township, where houses abut the roadway on the western side of the Great Ocean Road and the beach skirts the eastern side. This section is essentially straight and flat and characterised by unsealed shoulders, broken pavement edges, limited edgeline markings and large trees located within a few metres of the eastern edge of the road pavement. Some loose material builds up on the edge of the road pavement, and in the mouth of intersections and entrances to informal beach parking areas.

3.3.5 Postcode of Drivers and Motorcyclists

In an effort to quantify the extent of involvement of tourists in casualty crashes along the Great Ocean Road, an analysis of residential postcodes of drivers and riders involved in casualty crashes was undertaken. The results of the analysis are shown in Figures 20 and 21, for drivers and motorcyclists, respectively.

It is evident that for both drivers and motorcyclists, residents of the Melbourne Statistical Division were the most frequently involved category (31.7% and 45.4% of total known driver and rider postcodes, respectively). Geelong and “Other Local” are the next most frequently involved categories for both drivers and motorcyclists. “Other Local” was defined as the continuous geographic region extending from Lara, north of Geelong, to Warrnambool in the west, to Colac in the north, but excluding the urban area of Geelong and the four main townships along the Great Ocean Road, as defined in Figures 3.20 and 3.21 (i.e. Torquay, Anglesea, Lorne and Apollo Bay).

Drivers with overseas residential addresses comprised only 26 of a total of 628 drivers whose residential postcodes were known (4.1%), and 4 of a total of 185 motorcyclists (2.1%). Only 3.6% of drivers and 7.0% of motorcyclists had interstate postcodes. It is noteworthy that a substantial number of driver postcodes were concentrated in the four main townships along the Great Ocean Road (Anglesea - 5.8%, Torquay - 4.7%, Apollo Bay - 4.1% and Lorne - 3.8%). Corresponding involvement rates for motorcyclists were very much lower in the main townships, while the urban area of Geelong (24.3%) was second only to the Melbourne Statistical Division (45.4%) in terms of postcode frequencies.
3.4 OTHER POTENTIAL SOURCES OF INFORMATION

A number of other potentially valuable sources of information were identified during this project. However, the limited resources available to the pilot study made it infeasible to pursue them individually. Nevertheless, they are noted here to assist and guide any further
work which may occur in the future (beyond the pilot study), and to provide guidance for the
generic study of traffic safety along tourist routes. In addition to sources of information
described earlier in Section 3, the main opportunities for gaining further insights into the
nature of safety problems along the Great Ocean Road would include consultation with:

1. *professional drivers* on the route, e.g. truck drivers, such as fuel tanker drivers and those
   making daily newspaper and food deliveries, and coach/bus drivers, both commercial and
government operated;

2. *local and other Victorian/national motorcycle clubs*;

3. *Australian hire car companies* whose scope of operation includes the Great Ocean Road;

4. *national and state tourism authorities, travel agencies* and other segments of the tourism
   industry whose scope of operation includes the Great Ocean Road;

5. *local tow-truck operators*;

6. *emergency service operators* in the region, such as air and road-based ambulance services,
   State Emergency Service (SES) members, and staff of local hospitals, such as the
   Warrnambool Hospital;

7. *insurers of motor vehicles*.

### 3.5 SUMMARY OF MAIN CRASH CHARACTERISTICS

The main crash characteristics and circumstances identified from the analyses described in
section 3.3 are summarised below.

**Single-vehicle crashes** were the predominant crash type and were generally about 50% more
frequent than multi-vehicle crashes.

**Curved road alignments** tended to be involved more often than crashes on straight sections
of the Great Ocean Road.

**Running off the road on curves** was the single most frequent crash type, followed by
collisions between vehicles from opposite directions and vehicles running off-path on straight
sections of road.

**Higher speed zones** (i.e. 100 km/h) experienced two to three times more crashes than lower
speed zones.

**Dry roads and daylight** were the predominant conditions for the majority of reported
casualty crashes.

**Crash severity** tended to be above the State average (45% of reported casualty crashes
involved serious injury or fatality, compared to approximately 32% for Victoria overall).

**The summer holiday months** were the most frequent of the year for crash occurrence.

**Weekends, especially Sundays**, were the most common days for crash occurrence.
Male drivers were more often involved in casualty crashes than were female drivers, with about three-quarters of male drivers being aged between 18 and 45 years. In particular, both male drivers in the range 18 to 25 years were highly represented.

The vast majority of drivers and riders involved in casualty crashes along the Great Ocean Road were residents of Victoria, while less than 5% of drivers and riders were reported as having overseas addresses.

Motorcyclists represented a substantial proportion of all casualty crashes along the Great Ocean Road. There main characteristics are therefore described separately in some detail. Motorcyclists were:

- highly involved in the three major crash types, namely off-path on curves, on straight sections and in collisions with vehicles from the opposite direction;
- overwhelmingly males, and most frequently aged between 18 and 35 years;
- increasingly involved in casualty crashes on the Great Ocean Road, especially in crashes in higher speed zones (i.e. 100 km/h) and running off the road on curves;
- most commonly involved in crashes at weekends and in summer holiday months, to a greater degree than for the overall statistics along the Great Ocean Road.
- involved in higher-than-average crash severities along the Great Ocean Road than across Victoria generally (i.e. 52% of crashes on the Great Ocean Road resulted in serious injury or fatality, compared to the Statewide average of 46%).

Hazardous locations along the Great Ocean Road were found to have experienced unusually high concentrations of casualty crashes over the ten year study period. The dominant crash circumstances at these locations were:

- the vast majority of casualty crashes occurred in 100 km/h speed zones;
- crashes along road lengths which involved only a single vehicle running off-path mainly on a curve, and in many cases, striking a roadside object or parked vehicle. Many of these crashes involved motorcyclists and most crashes tended to occur during the afternoon and early evening;
- crashes along road lengths also frequently involved head-on collisions (not over-taking), many of which also involved motorcyclists;
- intersection crashes which involved vehicles either attempting to cross the Great Ocean Road, or to turn right from an approach controlled by stop or give way signs;
- in townships, the most common casualty crashes types involved vehicles running off-path on curves and straight sections, and pedestrian crashes, both crash types being more frequent in Lorne than in either Anglesea or Apollo Bay.
CHAPTER 4. DISCUSSION OF POTENTIAL CONTRIBUTING FACTORS TO CRASH OCCURRENCE AND SEVERITY

Chapter 3 concluded with a summary of the main crash characteristics along the Great Ocean Road, based on the analysis of reported casualty crash data described in section 3.3. This summary, together with the other main sources of information, namely local Police, and members of the Barwon Region and Warrnambool Community Road Safety Councils, were then used to generate ideas on potential contributing factors to the main crash types or circumstances. It is emphasised that in many instances, potential contributing factors were not necessarily founded on scientific studies but, rather, reflect a qualitative assessment of the factors considered likely to contribute to crash risk. Based on these factors, a range of potential countermeasures was identified. Potential countermeasures are described and discussed in Chapter 5.

4.1 BEHAVIOURAL FACTORS

4.1.1 Exposure

This pilot study has examined patterns in casualty crash frequencies, but because of limited project resources, has been unable to quantitatively examine the role of exposure in the patterns of crash occurrence. In other words, it has been possible to quantify the extent to which various factors were involved in crashes, but not whether they were over-represented relative to their presence.

High exposure, as a contributing factor to crash occurrence along the Great Ocean Road, may take various forms. For example, the much higher traffic volumes during summer and other holiday periods, may largely explain the predominance of crashes, particularly those involving motorcyclists. Weekends, especially Sundays, are highly involved in crash occurrence. Similarly, more male than female drivers or riders may explain, at least in part, the higher involvement of males than females in casualty crashes. Other crash variables that may be similarly influenced by exposure include male motorcyclists aged between 18 and 35 years, and pedestrians in townships.

4.1.2 Excessive Speed

Excessive speed is a potential contributing factor to many crash types along the Great Ocean Road, but especially single-vehicle crashes and crashes involving vehicles running off the road on curves. The potential contribution of excessive speed to crash occurrence and severity is supported by the observed higher-than-average crash severity and the high proportion of crashes which occurred in 100 km/h speed zones. Excessive speeds would appear to be of particular significance for motorcyclists, some of whom reportedly travel at extreme speeds along some sections of the Great Ocean Road.

There is also potential for drivers and riders (especially for tourists who, by definition, are unlikely to be familiar with the route and possibly with Victoria’s speed zoning practices, and for the young and/or inexperienced), to not fully understand the intended message of existing speed zone signs along many sections of the Great Ocean Road. Drivers and riders may regard 100 km/h speed zones as generally indicating safe and appropriate speeds, rather than an absolute maximum speed, determined by the lack of roadside development. As is
discussed later in Chapter 4, speeds of 100 km/h can rarely be achieved with safety along those sections of the Great Ocean Road characterised by serious crash histories.

Another behavioural consideration relates to drivers who choose to travel well below the 100 km/h speed limit, but who may become intimidated by the drivers of close-following vehicles. As a result, the “intimidated drivers” may feel pressured to drive at higher speeds than they are comfortable with or which they are capable of safely sustaining.

Motorists approaching the Great Ocean Road along side roads or when exiting from car parking areas, may have difficulty in selecting safe gaps in Great Ocean Road traffic in circumstances where approach speeds are high (e.g. in the section between Jan Juc and Eastern View).

### 4.1.3 Impatient and Aggressive Driving

It was noted in discussions with both local Police and members of community road safety councils that delays, caused by traffic congestion during holiday periods and on weekends when significant events are held in the region, contribute to driver impatience and increased aggression. Such circumstances, combined with the lack of overtaking opportunities, especially for Melbourne-bound traffic along the Great Ocean Road, may increase risk-taking, and lead to head-on crashes during over-taking manoeuvres and to run-off-road crashes on straight or curved sections. There is also a lack of good standard alternative routes, connecting the Great Ocean Road with the Princes Highway West, to enable traffic to be diverted and hence delays eased during highly congested periods. Without safe alternative routes, redirecting traffic to low standard alternatives may actually lead to more crashes.

### 4.1.4 Intentional Risk-Taking

Anecdotal evidence gathered during the course of this pilot study indicated that some drivers and riders deliberately engage in high risk driving or riding simply because of the excitement it offers. This is especially relevant to some motorcyclists who use the Great Ocean Road as a “Grand Prix” track, riding at extreme speeds, endeavouring to set record times over a chosen course. These practices involve motorcyclists operating well beyond the normal limits of safety and, until now, have proven difficult for Police and community road safety councils to moderate.

### 4.1.5 Fatigue, Alcohol or Other Drugs

Single-vehicle crashes tend to be associated with the effects of fatigue, alcohol (e.g. Armour and Cinquegrana, 1990, Krantz, 1979) or possibly other drugs on driver or rider performance. Analyses of casualty crashes along the Great Ocean Road indicate that drivers or riders with a Blood Alcohol Concentrations (BAC) exceeding 0.05 represented 19% of all drivers and riders with a known BAC. Of the crash-involved drivers or riders with known BAC’s, 29% of drivers had BAC’s greater 0.05, compared to only 3% of motorcyclists. However, driver or rider BAC’s for over three-quarters of crashes were unknown. Data on the possible role of drugs other than alcohol are not available.

While corresponding data on the role of fatigue in casualty crashes along the Great Ocean Road are not available either, concern was expressed by both local police and members of community road safety councils that some international tourists set off from, say, Melbourne, already tired from recent overseas travel, expecting to be able to complete in a single day the
return trip along the Great Ocean Road. Typically, these tourists realise, late in the day, that they still require many hours to complete the return leg of their trips and have to choose between finding unplanned accommodation, which may not be available in peak tourism periods, or attempting the unfamiliar and demanding return journey to Melbourne, feeling particularly fatigued. Further, as outlined in section 3.1.1, severe traffic congestion is frequently experienced along the Great Ocean Road during holiday periods, causing substantial delays. In turn, long delays increase the risk of driver and rider fatigue due, in part, to longer journey times and forgone rest breaks.

4.1.6 Driver Misjudgment/Inattention

Driving along the Great Ocean Road can be a challenging and exacting task given the constantly changing vertical and horizontal road alignment, the narrow road pavements and numerous other factors described in this report. Some drivers and riders may not have the necessary skills and judgement to sustain safe driving performance over long periods and, in a sense, are destined to eventually misjudge critical aspects of the driving task. For example, failure to detect opposing vehicles, particularly motorcyclists, may lead to unsafe overtaking, while failure by drivers at intersections to select safe gaps when either crossing or turning right onto the Great Ocean Road, is likely to account for a substantial proportion of intersection crashes which have occurred along the route. There are frequent indications, such as rutting in gravel shoulders, of vehicles “cutting corners” on left bends, thereby increasing the risk of loss-of-vehicle control.

Added to this is the frequent temptation for drivers and riders to view the scenery for which the Great Ocean Road is famous. Thus, the combination of inattention in its various forms and the exacting nature of the driving task, suggest that drivers are more likely on routes such as the Great Ocean Road, to encroach into opposing lanes or into gravel shoulders at the edge of the paved surface. In the former case, the risk of head-on collisions and crashes involving vehicles running-off-road to the right will be increased, while in the latter scenario, vehicles may leave the carriageway to the left possibly striking rigid roadside objects (e.g. embankments, trees, etc.), or lose control in gravel, also leading to run-off-road or head-on crash types.

Further, it seems reasonable to expect these scenarios to be more likely to occur when vehicle speeds and/or levels of driver risk-taking are high, or if driver or rider performance are diminished by fatigue, alcohol or other drugs.

4.1.7 Disregard for Road Rules

From the analysis of crash data, it was found that 14.7% of reported casualty crashes involved drivers or riders striking other vehicles heading in the opposite direction. While possible explanations include drivers or riders losing control after encroaching into gravel shoulders, or misjudging safe gaps when attempting to overtake slower vehicles, another possible contributing factor is the practice of drivers or riders intentionally crossing centre lines on right curves in order to take the shortest path. If these encroachments also include illegally crossing double centre lines (which are generally limited to road sections where sight distances are severely restricted), it could be argued that the disregard for road rules implied by this practice may lead to driver or rider complacency and ultimately to greater crash risk along the Great Ocean Road.
4.1.8 Unsafe Parking

Among the main crash types identified in this study were crashes with roadside objects or parked vehicles. This crash type is consistent with observations of informal parking arrangements operating along the roadside in the vicinity of surf beaches (e.g. Eastern View) and scenic look-outs, of which there are many located along the Great Ocean Road. Road conditions at these locations tend to be sub-standard due to general topography, narrow road reserves and hence traffic lanes, and the presence of loose material which has built up on the edges of traffic lanes. Because of the limited road widths, parked vehicles tend to be very close to, if not on, the road pavement, which increases the risk of passing vehicles striking parked vehicles or roadside objects, such as embankments, in an effort to avoid them.

4.1.9 Pedestrian Misjudgment

Pedestrian crashes tended to occur, not surprisingly, in the main townships such as Lorne, Anglesea and Apollo Bay. While the higher incidence of pedestrian crashes is most probably due to their higher exposure in townships, their involvement in crashes might also be due to their failure to select safe gaps in busy holiday traffic. In the main townships, beach, recreational and parking activities occur on one side of the Great Ocean Road while shops, cafes, hotels, other business activities, etc., are located on the other side, necessitating a high levels of pedestrian crossing activity. This situation, combined with possible inattention by pedestrians and possible excessive speed (for township conditions) by drivers, are also possible contributing factors to pedestrian crashes along the Great Ocean Road.

4.2 ROAD ENVIRONMENT FACTORS

The following characteristics of the road and roadside environment were identified as possible contributing factors to crashes along the Great Ocean Road. The nature of their relationship to crash occurrence and to particular types of crashes is discussed below.

4.2.1 Hazardous Roadsides

Collisions with roadside objects were found to be characteristic of crash occurrence along most sections of the Great Ocean Road. These crashes were associated with vehicles running off the road on curves or on straight sections, and striking rock embankments, trees, or other roadside objects. They also tend to produce high severity impacts which may partly explain the above-average crash severities found along the Great Ocean Road. Though not found in the crash data, there also appears to be a significant risk of collisions with unprotected bridge structures close to travelling lanes. Bridges are often unprotected by guard-rail or other forms of barrier (refer to section 3.2.1).

The presence of a hazardous roadside is largely due to the natural features of a coastal route and the physical constraints imposed on a road which so closely follows the coastline for much of its length. The Great Ocean Road between Anglesea and Apollo Bay was constructed close to the coastline and has very narrow lateral separation between the edge of the roadway and rock embankments, trees and steep slopes falling towards the sea. Thus, relatively small errors by drivers or riders in maintaining correct position within narrow road pavements can result in serious crashes with roadside objects or the potential for vehicles to roll down steep embankments towards the sea.
4.2.2 Road Surface

There are a number of aspects of road surface conditions that are likely to have contributed to the main crash types, namely single-vehicle crashes, especially those involving vehicles running off the road on curves or straight sections, head-on crashes (not overtaking), and intersection crashes involving side road traffic crossing or entering the Great Ocean Road traffic flow. The possible contributing aspects of road surface are narrow lanes, adverse super-elevation on curves and within roundabouts, loose material on the road surface affecting steering and traction, unsealed and/or rutted shoulders, road pavements with low skid resistance, broken pavement edges and failed pavements producing uneven and unstable surfaces. Loose material on pavements, low skid resistance or adverse super-elevation on curves, and failed or uneven surfaces present particular hazards for motorcyclists.

A number of the intersections, inspected because of their higher crash frequencies had significant quantities of gravel and other loose material on the road surface within the mouth of the intersection. This presents an inherent risk for drivers attempting to cross or enter the Great Ocean Road traffic stream in that traction is severely diminished. Problems related to the lack of good traction are accentuated on upgrade intersection approaches and when the Great Ocean Road is busy and few safe gaps are available to side road traffic.

4.2.3 Road Alignment

In a study of rural crashes in Victoria, curves, narrow lanes, unsealed shoulders and low skid resistance were found by Armour and Cinquegrana (1990) to be associated with increased crash rates. The Great Ocean Road is characterised by frequently changing vertical and horizontal alignment, in combination with narrow lanes and unsealed shoulders, and probably low skid resistance along some sections. These changes in road alignment are often severe and as a result restrict the sight distances available to drivers and riders, which has the potential to contribute to head-on crashes involving drivers intentionally crossing centre lines to shorten and straighten the path required to negotiate a curve. Changing road alignment is another of the natural characteristics of coastal routes. Intuitively, there is an obvious interaction between this form of road alignment, and collisions with roadside hazards and vehicles speeds which are excessive for the physical features of the road.

4.2.4 Road Delineation

Given the curvilinear nature of the Great Ocean Road, the frequently changing vertical alignment, combined with narrow lanes, broken pavement edges gravel shoulders and other factors described in section 4.2.2, it would appear that inadequate standards of road delineation may have contributed to crash occurrence, especially those involving vehicles running off the road or colliding head-on with approaching vehicles. The challenging nature of the Great Ocean Road suggests there is a strong case for providing high standard delineation of the roadway alignment in general, and of the traffic lanes in particular.

While much of the route is delineated by guide posts to define the general alignment of the roadway, long sections of the Great Ocean Road, known to have serious crash records, have poor standards of delineation in general, no edge line markings, and no adequate centre lines. Notwithstanding the obvious desirability of high standard road delineation, narrow lanes and shoulders, together with the abundance of loose material at the edge of the pavement, would present some maintenance challenges if edge line markings were provided. The narrow road
reserves, immediately adjacent to rock embankments and to steep drop-offs, also make the provision of sealed shoulders more difficult.

4.2.5 Inadequate Provision for Parking

As discussed in section 4.1.8, a significant crash type involves collisions with parked vehicles and may be due in part to informal roadside parking arrangements in the vicinity of surf beaches and scenic look-outs. Despite the clear demand for parking, road conditions at these locations are often not suited to tourist and recreational parking, and as a consequence can be regarded as a possible contributing factor to crash occurrence. It should be noted that the limited road widths and other constraining physical features make it difficult to address some of these factors.

4.2.6 Traffic Engineering Features

Intersection crashes were among the predominant crash types identified and described in Chapter 3. Poor gap selection by drivers and riders approaching the Great Ocean Road from side roads was mentioned as a possible contributing factor, while road surface deficiencies, such as uneven pavements and loose material accumulating on intersection approaches were also considered to contribute to crash risk.

In addition to the above factors, the existence of some intersections is not clearly evident to approaching drivers, especially side road drivers, nor are intersection conflict areas clearly defined (e.g. stop and give way line markings may be obliterated by gravel). At some intersections, such as the Great Ocean Road/ Anglesea Road, Bellbrae, and the Great Ocean Road/Duffields Road, Jan Juc, sight distances are limited by roadside embankments, vertical geometry, or the placement of traffic signs. These factors, in combination with the challenges of selecting safe gaps in high speed, high volume Great Ocean Road traffic along, appear to be too demanding for some drivers.

4.2.7 Pedestrian Facilities

While section 4.1.9 mentioned that pedestrian crashes tended to occur in the main townships and were probably due largely to their higher exposure in townships, the failure by pedestrians to select safe gaps in the Great Ocean Road traffic stream is also considered likely to contribute to crash risk. The high levels of pedestrian crossing activity resulting from the patterns of township development mean that, in peak traffic periods of the year, pedestrians may need assistance to safely cross the busy Great Ocean Road. This is especially important for young and older pedestrians, who are known to have difficulty safely crossing wide roads, such as the Great Ocean Road in most townships. There are no facilities such as pedestrian refuges or road narrowings to assist pedestrians with the gap selection task.

4.2.8 Inappropriate Speed Zoning

Section 4.1.2 describes the possible wide-spread role of excessive speed as a contributing factor to the incidence and severity of many of the main crash types found along the Great Ocean Road, especially single-vehicle crashes and crashes involving vehicles running off the road on curves. In particular, it mentions the potential for drivers and riders, especially the young and/or inexperienced, to not fully appreciate the subtle message implied in zoning a road, such as the Great Ocean Road, at 100 km/h. A proportion of the driving (and riding) population, on entering a 100 km/h speed zone, may regard the speed zone signs as indicating
safe and appropriate speeds for most of the zone, with only the occurrence of changing traffic conditions, such as congestion, slow moving vehicles, turning traffic, etc., likely to require drivers to travel more slowly.

This contrasts with the real intent of the speed zone of defining an absolute maximum speed, based on the extent and type of roadside development (generally none in the case of the Great Ocean Road). In reality, it is rarely safe to travel at speeds of 100 km/h along many of the most hazardous sections of the Great Ocean Road, with safe speeds of around 50 to 60 km/h being more common. This view is directly supported by local police who report that speed enforcement aimed at crash reductions tends to be ineffective, as unsafe speeds along the Great Ocean Road are generally well within the posted speed limits.

4.3 VEHICLE FACTORS

Several vehicle-related factors have the potential to contribute to the incidence of crashes along the Great Ocean Road. They are discussed below.

4.3.1 Motorcycles

The role of exposure in explaining the apparently high incidence of motorcyclists in reported casualty crashes along the Great Ocean Road was discussed in section 4.1.1. In addition to exposure, there are other factors related to motorcycles which may also contribute to the incidence and severity of crashes. Motorcyclists are more vulnerable to severe injuries than are occupants of cars, trucks, etc., due largely to the lack of protection offered by motorcycles to crash involved riders. Further, motorcyclists are believed to be less conspicuous to drivers than are most other vehicle types (Haworth and Schulze, 1996). This characteristic may lead motorcyclists to be more involved in head-on type crashes or crashes at intersections.

Motorcyclists are also potentially more vulnerable to loss-of-control type crashes on poor road surfaces. Road surface deficiencies, common along the Great Ocean Road, might include loose material or low skid resistance, especially on curves, damp or wet surfaces in the vicinity of creek valleys (refer to section 3.2.1), or damaged, uneven or unstable pavements. Wind gusts represent another factor to which motorcyclists and (vehicle-trailer combinations) appear vulnerable. As identified in discussions with local Police, wind gusts can be experienced throughout the Great Ocean Road, but especially in the vicinity of creek and river valleys where wind speeds can be abnormally high.

4.3.2 Tourist Coaches and Other Large Vehicles

As a major Victorian tourist route, the Great Ocean Road caters for a sizeable and growing number of private tourist and government-operated public transport coaches, as well as a significant amount of truck traffic carrying freight to and from the region. Vehicle dimensions represent an important safety issue for the Great Ocean Road, given the severe restrictions on lane widths, and the tight and constantly changing road alignment. Although large vehicles are not highly represented in the reported casualty crash data for the Great Ocean Road, wide vehicles, such as coaches and fuel tankers, have the potential to encroach more often into opposing traffic lanes, with the risk of colliding with opposing traffic or forcing these vehicles from the carriageway. This circumstance would be exacerbated for long vehicles (e.g. semi-trailers), the drivers of which have considerable difficulty in maintaining their position wholly within their lane, especially on curves.
Given the large number of passengers carried by tourist coaches, it is vital that their safety be assured in order to avoid major loss of life in the event of a serious crash.

4.3.3 Front-wheel Drive Vehicles

This pilot study has not been able to study several safety issues in detail. However, there are suggestions from local Police that front-wheel-drive rental cars may be contributing to crash occurrence in cases where drivers are unfamiliar with their different handling characteristics. The exacting nature of the driving task, the challenging road environment features and the unfamiliarity of the route to tourists suggest that this combination of factors may also be contributing to crash occurrence.

4.4 OTHER FACTORS

A number of other factors likely to contribute to crash occurrence or severity are described below.

4.4.1 Remoteness of the Great Ocean Road

Discussions with members of the Warrnambool Community Road Safety Council indicated that due to the remoteness of some sections of the Great Ocean Road, emergency service response time is potentially an important contributing factor to crash severity. Air ambulance services from Warrnambool Hospital may be affected by the remoteness of the area it serves, while mobile phones are largely ineffective in the area around Peterborough, extending the time required to make initial contact emergency medical services.

4.4.2 Tourist and Recreational Activity

By its nature, the Great Ocean Road hosts a high level of tourist and recreational activity. Typically, this translates into drivers and riders entering and leaving scenic look-outs and parking areas, commonly located in hazardous situations, parking in unexpected locations, undertaking U-turns in risky circumstances, attempting, while driving, to view scenery and/or read route direction signs, and generally coping with a variety of other distractions.

Such activities are potential contributing factors to a range of crash types where other drivers or riders are required to take evasive action to avoid conflict with tourist and recreational traffic ahead. Avoiding these conflicts can result in run-off-road or head-on type crashes, each of which is a predominant crash type along the Great Ocean Road.

Drivers and riders of the Great Ocean Road possess a wide range of abilities and experience - with many driving along the route (and possibly in Australia) for the first time. All drivers and riders travelling along the Great Ocean Road will be confronted with the inherent hazards of the route, together with the risks associated with the tourist and recreational factors described above, all in a predominantly high-speed (100 km/h) environment.
CHAPTER 5. POTENTIAL COUNTERMEASURES FOR CRASH OCCURRENCE AND SEVERITY

Chapter 5 describes potential countermeasures for the principal crash types and the contributing factors to crashes along the Great Ocean Road. As with the previous chapter, the discussion concentrates on behavioural, road environment, vehicle categories.

5.1 BEHAVIOURAL COUNTERMEASURES

The main options proposed for addressing behavioural factors are described below.

5.1.1 Education and Marketing Strategies

Considerable scope exists to develop and implement safety-oriented education and marketing strategies for tourist activities along the Great Ocean Road. These strategies could draw on the collective expertise and roles of state and regional tourism agencies, the local hospitality industry, airline, hire car and tourist coach companies, public transport operators, heavy vehicle operators and members of motorcycle clubs (a wide range of activities has already been initiated by the Barwon Region Community Road Safety Council on this latter item), etc. Some of the following safety issues could be considered for targeting within these proposed strategies:

- raising awareness of the pleasures and the risks of travelling along the Great Ocean Road;
- informing drivers and riders of the dangers and the penalties associated with excessive speeds, and unsafe behaviour, which may be due to impatient and aggressive driving/riding, inattention and intentional risk-taking, etc.;
- raising awareness of the importance of lane discipline;
- promoting the safe use of alternative routes during periods of high congestion;
- highlighting the effects of fatigue, alcohol and other drugs on driver/rider performance and hence on crash risks;
- promoting safe behaviour for drivers and pedestrians in townships;
- raising awareness of the different handling characteristics of front-wheel drive vehicles;
- promoting proper trip planning and trip times to avoid fatigue and unwanted night driving.

5.1.2 Enforcement Strategies

Enforcement strategies for the Great Ocean Road should be reviewed and, where necessary, increased emphasis should be given to the months of the year between October and April, to weekends, especially Sundays and the period of the day from about 8 a.m. to 9 p.m. The main focus of enforcement effort should be directed to behaviours such as:

- excessive speed by all drivers and by motorcyclists in particular;
• drink-driving (especially by motorists), targeting the high-risk circumstances, as indicated by crash histories along the Great Ocean Road;

• failure of drivers and riders to remain within lanes;

• unsafe parking, and

• dangerous manoeuvres in the vicinity of parking areas, scenic look-outs and driveways.

5.2 ROAD ENVIRONMENT COUNTERMEASURES

Of the road environment factors with the potential to contribute to the main crash types, most can be addressed by implementing a number of proven countermeasures. Apart from the cost of a countermeasure program, a major challenge in implementing these measures lies in the physical and geographical constraints characterising the Great Ocean Road.

The primary aim of countermeasures should be to eliminate factors initiating or forming an important part of the sequence of steps leading to a crash. By undertaking measures described in the following sections, crash risk should be substantially reduced.

5.2.1 Road Geometry and Delineation

• **widen traffic lanes** along selected lengths of the Great Ocean Road to reduce the risk of drivers encroaching into opposing lanes or into gravel shoulders and losing control of their vehicles. Given the practical difficulties of improving the road alignment, widening traffic lanes is potentially valuable for addressing the problems of coaches, trucks and other large vehicles straying into gravel shoulders or encroaching into opposing traffic lanes;

• **provide high-standard delineation of general roadway alignment and of traffic lanes** to help drivers accurately perceive the true road alignment, and hence remain on the paved surfaces and within their traffic lanes. As mentioned earlier in relation to speed limits, the natural topography of the Great Ocean Road severely constrains the opportunities available for improving vertical and horizontal road geometry and, therefore, high standard delineation becomes even more important for both day and night conditions. Measures such as reflective curve delineation signs, guide posts, and raised reflective pavement markers on edge and centre lines are likely to offer the greatest benefits;

• **provide tactile double centre lining, possibly to above-standard width, throughout lengths of the Great Ocean Road where it is unsafe to overtake.** Wide tactile double centre lines may help to improve lane discipline, marginally increase separation between opposing flows and improve compliance with centre lines, as discussed in section 4.1.7;

• **wherever practicable, modify private driveway access to and from properties** along the Great Ocean Road by realigning driveways where sight distance is restricted, removing obstructions to sight lines and by implementing more stringent planning controls to prevent the creation of future hazards of this type.

5.2.2 Vehicle Speeds

• **reduce speed limits along dangerous sections from 100 km/h to a level that more realistically reflects safe driving practices** (e.g. 70 or 80 km/h). Lower speeds are clearly
compatible with the traffic and economic objectives of a tourist route, while reduced speed limits should clarify for drivers and riders that moderate speeds are essential for safe travel along much of the Great Ocean Road. This measure has the potential to address the incidence and/or severity of the majority of crash types along the Great Ocean Road. The opportunities for improving road alignment in terms of vertical and horizontal geometry are severely limited by the topography and, therefore, reducing vehicles speeds offers a real option to compensate for the natural hazards of this winding, undulating route.

- **establish a number of locations suitable for automated speed camera enforcement of drivers in general, and motorcyclists in particular**, to deter speeding and to more effectively address the extreme speeds by motorcyclists in the vicinity of Cumberland River, Spout Creek and in the Big Hill and Eastern View areas of the Great Ocean Road. It was noted in section 3.2.3 that conventional speed enforcement methods tend to be ineffective because of the unacceptable risks involved in pursuing speeding motorcyclists.

- **undertake a trial of speed perceptual countermeasures** for influencing driver or rider speeds on the approach to and within curves. An example of such measures, drawn from the work of Fildes and Jarvis (1994), is shown in Figure 5.1.

### 5.2.3 Road Surface

- **remove gravel and other loose material from traffic lanes** through improved maintenance practices, particularly during the high crash and high traffic periods of October to April. Curves, intersections, and driveways to car parks and scenic look-outs along the Great Ocean Road should be given priority;

- **minimise potholes and other surface irregularities, and the response time to repair them.** This will reduce the risk of motorcyclists (and drivers) losing control, especially in 100 km/h speed zones, on curves and where adverse superelevation exists;

- **seal gravel shoulders and provide tactile edge line markings** to help drivers of errant vehicles to recover control before entering hazardous roadsides or into the path of opposing vehicles. Priority should be given to the inside of left curves as site observations highlight rutting and broken pavement edges, suggesting that vehicle paths frequently encroach into unsealed shoulders in such circumstances;

- **correct adverse super-elevation on curves in high risk locations** to reduce the risk of run-off-road crashes involving motorcyclists and other vehicle types. Locations in high speed zones, adjacent to hazardous roadsides, should receive priority;

- **provide skid-resistant pavement surfaces in high crash risk locations**, such as on specific curves, on the approaches to and across bridges over creek valleys, or in circumstances where proper road design standards cannot be provided due to topographical or other physical constraints;

- **seal approaches to intersections and to driveways providing car park access along the Great Ocean Road and use kerbing to permanently keep gravel from the pavement.** If effectively implemented, this countermeasure should substantially improve the traction available to drivers crossing or entering the Great Ocean Road traffic flow. This should assist drivers approaching on side roads during holiday season and other periods when traffic volumes on the Great Ocean Road are high and safe gaps rare.
5.2.4 Impact Attenuation

- install guard-rail at locations with a high risk of run-off-road crashes and where the consequences of such an event could result in fatal or serious injury. Unprotected bridges structures over creek valleys, and sections of the Great Ocean Road which are unavoidably close to the edge of coastline or to rock embankments, would be among the highest priority situations for this countermeasure;

5.2.5 Pedestrian Facilities

- eliminate excess road widths in townships by widening footpaths, and constructing kerb outstands and indented parking bays, to assist pedestrians to select safe gaps in the flow of traffic along the Great Ocean Road during peak periods. These measures could be supplemented with pedestrian refuges at selected locations to enable pedestrians to stage their crossing movements and to focus movements to these preferred, safer locations;

5.2.6 Provision for Parking

- upgrade parking facilities at selected beaches, scenic look-outs and other tourist attractions along the Great Ocean Road to overcome some of the potential conflicts associated with uncontrolled or otherwise inadequate parking arrangements.

5.2.7 Traffic Management and Operation

- upgrade alternative routes which connect the Great Ocean Road with other major routes such as the Princes Highway West. During summer and other busy periods, traffic can then be safely redirected by Police along alternative routes, thus reducing congestion, delays and hence driver fatigue, frustration and the high level of risk-taking reported to occur during peak traffic conditions. The redirection of traffic to alternative routes could potentially be achieved by means such as messages on tourist and/or local radio stations, roadside (dynamic) route signing or other innovative means;

- improve direction signing of alternative routes and of tourist attractions to assist tourists and to alert others to the potential conflict ahead;

- provide more turn-out facilities, especially for Melbourne-bound traffic, to relieve frustration and thereby reduce risk-taking caused by long delays to drivers and riders.

5.2.8 Traffic Engineering

- provide channelisation at higher crash risk intersections, to assist side road drivers and riders approaching the Great Ocean Road, to identify more easily the presence of intersections and to clearly define the conflict areas within intersections.

5.3 VEHICLE COUNTERMEASURES

Consideration should be given to promoting the use of daytime running lights on motorcycles, passenger coaches and large vehicles such as semi-trailers, to provide earlier warning to other drivers and riders of the approach of vehicle types that appear to be at higher risk of crash involvement or serious injury, or both.
5.4 OTHER COUNTERMEASURES

- request telecommunications companies to upgrade mobile phone communications in areas such as Peterborough and others similarly affected;

- establish accreditation schemes for passenger coach drivers to assure that drivers have the necessary training and capabilities for the challenges of the Great Ocean Road.

5.5 POTENTIAL SAVINGS FROM COUNTERMEASURES

Some proposed countermeasures have been evaluated in terms of their effectiveness in reducing crash frequency, costs or economic worth. While the listing is by no means comprehensive, it indicates the order of benefits possible from some countermeasures.

5.5.1 Road Geometry and Delineation

Widen traffic lanes

- 12 to 40% reduction in crash rate (Ogden, 1996)

Delineation

- as low as 2-3%, but typically ranging from 15 to 70% reduction in crashes (Ogden, 1996)
- 63% reduction in crashes for curve delineation (Corben et al., 1996)
- 85% reduction in crashes for guide post delineation (Corben et al., 1997)

5.5.2 Speed Limit Reduction

- 10-25% reduction in crashes (Ogden, 1996)

5.5.3 Shoulder Sealing

- 43% reduction in crash rate, 20-60% reduction in target crashes and a benefit-to-cost ratio 2.6 x AADT (in thousands) (Ogden, 1996);
- 23% reduction in casualty crash frequency, 30% reduction in casualty crash costs and a 3.3 benefit-to-cost ratio (Corben et al., 1996)

5.5.4 Shoulder Sealing and Tactile Edgeline Marking

- 50% reduction in crashes (VicRoads, 1992)

5.5.5 Correction of Adverse Super-elevation on Curves

- 40-60% reduction in target crash types (Ogden, 1996)

5.5.6 Skid Resistant Surfaces

- 10-60% reduction in crashes, depending on crash type (Ogden, 1996)
CHAPTER 6. CONCLUSIONS

This project aimed to examine and report on a pilot study of road traffic crashes along a major tourist route in Victoria. In particular, it addressed matters such as the likely growth of the crash problem, potential crash countermeasures, including general road upgrading, proven road and traffic engineering safety improvements targeted at high crash frequency locations and crash types, and road user and vehicle issues. The project also attempted to indicate the level of benefits expected from the recommended countermeasures.

This final section of the report summarises the main safety problems, identifies target behaviours, potential solutions and benefits, and finally recommends a strategic approach to improving safety along the route chosen for investigation, namely the Great Ocean Road, and along tourist routes in general.

6.1 MAIN SAFETY PROBLEMS

Over the ten-year period from 1985 to 1994, there was an average of some 60 reported casualty crashes per annum along the Great Ocean Road. While there is no clear indication that the overall casualty crash problem is growing, the data suggest that motorcyclist safety along the Great Ocean Road may be declining steadily.

Reported casualty crashes tended to be of above-average severity and, not surprisingly, running off the road on curves was the single most frequent crash type, followed by collisions between vehicles from opposite directions and vehicles running off-path on straight sections of road. Most crashes occurred in 100 km/h speed zones, with the summer holiday months and weekends, especially Sundays, being the most common days for crash occurrence.

The vast majority of drivers and riders involved in casualty crashes along the Great Ocean Road were residents of Victoria, while less than 5% of drivers and riders were reported as having overseas addresses. Male drivers were more often involved in casualty crashes than were female drivers. In particular, male drivers and riders in the range 18 to 25 years were highly represented.

Crashes involving motorcyclists (overwhelmingly males, and most frequently aged between 18 and 35 years) represented about a third of all casualty crashes. Off-path on curves, on straight sections and collisions with vehicles from the opposite direction were the three major crash types for motorcyclists.

A number of locations along the Great Ocean Road were found to have experienced unusually high concentrations of casualty crashes over the ten year study period, indicating that they may be amenable to enhanced safety performance from properly targeted road improvements. There also appears to be scope for improving safety in townships, especially for crashes involved vehicles running off-path on curves and straight sections, and pedestrian crashes.

6.2 CONTRIBUTING FACTORS TO CRASH OCCURRENCE AND SEVERITY

It is concluded from the analysis of reported casualty crash data, discussions with local Police and community road safety councils and from site visits, that significant safety concerns along the Great Ocean Road are, to a large extent, related to factors associated with the unique
geographic and topographical features, and physical restrictions of the route. Such factors include the frequently changing horizontal and vertical alignment of the road, its narrowness and the hazardous nature of the roadside, where steep embankments, rock walls, rigid bridge structures or large trees are frequently situated close to vehicle paths.

In many cases, the very factors which elevate crash risk are an intrinsic part of what makes the Great Ocean Road a popular tourist attraction. The elimination of these factors may prove impossible in some instances, too costly in others, or cost-effective in yet others. Where no feasible or cost-effective treatment of the road or roadside can be identified, safety may still be improved by modifying the behaviour of road users while in these high risk environments.

6.2.1 Road User Behaviour

In this context, therefore, it is concluded that successfully addressing the main target behaviours will reduce the risk of crash occurrence and serious injury. The main target behaviours include:

- **excessive vehicle speeds**, given the inherently hazardous nature of the Great Ocean Road;

- **excessive risk-taking** by all road users, but especially motorcyclists - some forms of risk-taking may be intentional, for the excitement it provides, while other forms of risk-taking may be unintentional and relate to impatient and aggressive driving caused by the high levels of congestion and delay experienced on some special days and during some known periods of the year, or to the **effects of alcohol** (29% of crash-involved drivers with a known BAC were above 0.05), fatigue or inattention;

- **misjudgment** by drivers and riders in tracking within their lane, or alternatively, disregard for road rules, particularly those applicable to the practice of crossing double centre lines in order to take the shortest path through a winding section of road.

6.2.2 Road and Roadside

It was noted in section 6.2.1 that it may be undesirable, impractical or too costly to eliminate many of the unique road and roadside features of the Great Ocean Road which contribute to crash and injury risk. Given these obvious constraints, it could be argued that added attention should be paid to road design features, traffic engineering practices and road maintenance standards, in an effort to compensate for the inherently hazardous nature of the Great Ocean Road. While there is evidence that such an approach is already taking place along the Great Ocean Road, considerable scope remains to extend the approach. The following road environment factors continue to contribute to crash risk and injury severity, in addition to the risk due to the intrinsically hazardous nature of the route:

- **road and roadside** - small lateral clearances between vehicle paths and trees, steep drops, rock embankments, walls, bridges and other rigid structures;

- **road surface** - narrow lanes, adverse super-elevation on curves and within roundabouts, loose material on the road surfaces, especially at intersections, car parks and scenic lookouts, unsealed and/or rutted shoulders, low pavement skid resistance, broken pavement edges and failed pavements producing uneven and unstable surfaces;
• **road alignment** - the changing horizontal and vertical road alignment is clearly one of the natural characteristics of a coastal route. Severe changes in road alignment, in combination with other road features, such as narrow lanes or shoulders, poor road surface, unsealed shoulders, or hazardous roadsides could be expected to further increase crash risk;

• **roadway delineation** - given the frequently changing horizontal and vertical alignment of the route, combined with narrow lanes, broken pavement edges, gravel shoulders and other factors described above, it would appear that the limited standards of road delineation along some sections of the Great Ocean Road may have contributed to crash occurrence;

• **provision for parking** - informal roadside parking arrangements in the vicinity of surf beaches and scenic look-outs, are a possible contributing factor to crash occurrence;

• **traffic engineering features** - the presence of some intersections is not clearly evident to approaching drivers, especially along side roads, nor are intersection conflict areas clearly defined;

• **pedestrian facilities** - the simple failure by pedestrians to select safe gaps in Great Ocean Road traffic, especially during busy periods and/or within the main townships, combined with the lack of safe crossing facilities, contribute to pedestrian crash risk;

• **inappropriate speed zoning** - while most crashes along the Great Ocean Road occurred in 100 km/h speed zones, it is rarely safe to travel at such speeds - safe speeds of around 50 to 60 km/h are more common. Local police report enforcing vehicle speeds to reduce crashes tends to be ineffective while unsafe speeds lie well within posted speed limits.

6.2.3 Vehicles

It is concluded from the pilot study that the following vehicle factors have the potential to contribute to both crash and injury risk along the Great Ocean Road:

• **motorcycles** - are less conspicuous than other vehicle types, are vulnerable to loss-of-control on poor road surfaces (e.g. loose material or low skid resistance, especially on curves, damp/wet surfaces, or uneven/unstable pavements. Motorcyclists are also vulnerable to wind gusts and to more severe crash injuries than vehicle occupants.

• **tourist coaches and other large vehicles** - large vehicles, such as tourist coaches, semitrailers and fuel tankers, while not highly represented in crash records, tend to encroach into opposing traffic lanes, especially on curves. High standards of safety are imperative for tourist coaches, given the large number of passengers carried.

• **front-wheel drive vehicles** - local Police suggest that front-wheel-drive rental cars may be a factor in crash occurrence in cases where drivers are unfamiliar with their different handling characteristics, with the route and with the exacting nature of the driving task.

6.2.4 Other Factors

A number of other factors may also have contributed to crash occurrence or severity:
• **remoteness** - emergency service response time is potentially an important factor in injury severity. Mobile phones are unreliable/ineffective in the area around Peterborough, thereby extending average response times for initial emergency medical services.

• **tourist and recreational activity** - typically, drivers and riders are free to undertake a variety of tourist-related manoeuvres, sometimes at unexpected locations and/or times. The difficulty for other road users in avoiding these conflicts, often in 100 km/h speed zones, is consistent with the predominant crash types found along the Great Ocean Road.

### 6.3 POTENTIAL SOLUTIONS

It was concluded in section 6.2 that much of the concern for safety along the Great Ocean Road arises from the unique geographic and topographical features, and physical restrictions of the route. Nevertheless, there are significant opportunities to cost-effectively improve safety along the Great Ocean Road, without the need for costly road improvements, such as major road realignment and widening. The main opportunities lie in the targeted application of proven, generally low-cost countermeasures to hazardous sections of the Great Ocean Road, together with a range of supporting enforcement and behavioural change initiatives. The main countermeasure options, which are described in Chapter 5, are summarised below:

#### 6.3.1 Road User Behaviour

- **education and marketing strategies** - develop and implement safety-oriented education and marketing strategies for tourist activities along the Great Ocean Road, drawing upon the collective expertise and roles of tourism agencies and enterprises, transport operators, and community groups. Strategies would target key safety issues identified in section 5.1.1, including raising awareness of crash and injury risks, such as excessive speeds, impatient and aggressive driving/riding, inattention, fatigue and intentional risk-taking;

- **enforcement strategies** - review and, where necessary, provide increased emphasis on targeted enforcement between October and April, weekends, especially Sundays, and between about 8 a.m. and 9 p.m. Enforcement effort should focus mainly on excessive speeding (especially by motorcyclists), drink-driving (especially by motorists), safe positioning within (narrow) lanes, unsafe parking, and dangerous manoeuvres around parking areas, scenic look-outs and driveways.

#### 6.3.2 Road and Roadside

**Road Geometry and Delineation**

- **widen traffic lanes** along selected lengths of the Great Ocean Road to reduce the risk of drivers encroaching into opposing lanes or into gravel shoulders and losing control of their vehicles;

- provide **high-standard delineation** of general roadway alignment and of traffic lanes to help drivers accurately perceive the true road alignment, and hence remain on the paved surfaces and within their traffic lanes;

- provide **tactile double centre lining**, possibly to above-standard width, throughout lengths of the Great Ocean Road where it is unsafe to overtake;
• wherever practicable, **improve sight distances** for private driveway access to and from properties along the Great Ocean Road.

**Vehicle Speeds**

• **reduce speed limits** along dangerous sections from 100 km/h to a level that more realistically reflects safe driving practices;

• deter excessive speeds by establishing locations suitable for **automated speed camera enforcement** of drivers in general, and motorcyclists in particular;

• undertake a trial of **speed perceptual countermeasures** for influencing driver or rider speeds on the approach to and within curves;

**Road Surface**

• remove **gravel and other loose material** from traffic lanes, particularly during the high crash and high traffic periods of October to April. Curves, intersections, and driveways to car parks and scenic look-outs should be given priority;

• minimise the number of **potholes and other surface irregularities**, and the response time to repair them, thereby reducing the risk of loss of control especially in high speed zones, on curves and where adverse superelevation exists;

• seal **gravel shoulders** and provide **tactile edge line markings** to help drivers of errant vehicles to recover control (give priority to the inside of left curves);

• correct **adverse super-elevation** on curves in high risk locations to reduce the risk of run-off-road crashes involving motorcyclists and other vehicle types;

• provide **skid-resistant pavement surfaces** in high crash risk locations;

• seal **approaches to intersections and driveways** providing car park access along the Great Ocean Road and use **kerbing** to permanently keep gravel from the pavement.

**Impact Attenuation**

• install **guard-rail** at locations with a high risk of run-off-road crashes and where the consequences of such an event could result in fatal or serious injury (e.g. unprotected bridges structures, steep/rock embankments, etc.).

**Traffic Engineering**

• provide **channelisation** at higher crash risk intersections, to identify more easily the presence of intersections and to clearly define the conflict areas within intersections.

**Pedestrian Facilities**

• eliminate **excess road widths in townships** by widening footpaths, and constructing kerb outstands and indented parking bays, to assist pedestrians with the selection of safe gaps.
Provision for Parking

- upgrade parking facilities at significant tourist attractions and beaches to reduce uncontrolled or otherwise inadequate parking arrangements.

Traffic Management and Operation

- upgrade alternative routes connecting the Great Ocean Road with other major routes (e.g., Princes Highway), thus reducing congestion, delays and hence driver fatigue, frustration and risk-taking. Also, redirect traffic to alternative routes using messages on tourist and/or local radio stations, dynamic route signing or other innovative means;
- improve direction signing of alternative routes and tourist attractions and to warn of potential conflicts/delays ahead;
- provide more turn-out facilities, especially for Melbourne-bound traffic, to relieve frustration and hence reduce risk-taking.

6.3.3 Vehicles

- promote the use of daytime running lights on motorcycles, passenger coaches and other large vehicles.

6.3.4 Other

- request telecommunications companies to upgrade mobile phone communications in areas such as Peterborough and others similarly affected;
- establish accreditation schemes for passenger coach drivers to assure that drivers have the necessary training and capabilities for the special demands of the Great Ocean Road.

6.4 POTENTIAL BENEFITS

This report presents the results of a pilot study of safety along the Great Ocean Road and, as such, was unable to comprehensively examine the expected benefits from proposed countermeasures. However, as indicated in section 5.5, many of the main road and roadside countermeasure options, such as shoulder sealing, roadway delineation and speed limit reductions, have the capacity to achieve crash savings in the range of 10 to 60%.

Many of these measures fall within the general approach of implementing low-cost, targeted road and traffic engineering improvements and are based on the highly successful "black spot" principles. Such principles have been found, both within Victoria and overseas, to reduce casualty crash frequencies and costs, with benefit-to-cost ratios typically ranging from 4:1 up to 8:1. While it is unclear whether these indicative benefit-to-cost ratios could actually be achieved along the Great Ocean Road, where numerous physical constraints exist, the principles are proven and expected to produce highly cost-effective improvements to safety.

6.5 STRATEGIC APPROACH

A valuable output of this pilot study of a major Victorian tourist route is the identification of a wide range of potential countermeasures and other interventions to address the main crash
types and target behaviours along the Great Ocean Road. It is important that a strategic approach to their application be adopted to assist in maximising their effectiveness and cost-effectiveness. Section 6.5 offers suggestions on how this might be achieved along the Great Ocean Road and along tourist routes in general.

6.5.1 The Great Ocean Road

Desirably, any strategy for treating safety problems along the Great Ocean Road should be:

- targeting a sizeable portion of the total casualty crash problem;
- based on a proven approach to reducing reported casualty crashes and use proven, cost-effective countermeasures, where practicable;
- practical, affordable, acceptable and achievable within a reasonable time frame.

Having regard to the above criteria, the suggested approach to enhancing safety along the Great Ocean Road is to:

1. Great Ocean Road Speed Limit - reduce the speed limit along relevant sections of the Great Ocean Road from 100 km/h to either 70 or 80 km/h, in recognition of the predominant tourist function of the route, its inherently hazardous alignment, topography and physical features, and the lack of familiarity many drivers and riders have with the route. Reducing the speed limit is a relatively inexpensive measure which has the potential to affect safety within long lengths of the Great Ocean Road and, if supported with appropriate levels of enforcement and publicity, will address the main crash types, the hazardous nature of the roadside, the difficulty for drivers remaining within narrow lanes and problems associated with unexpected manoeuvres by tourists. With a reduced speed limit, Police enforcement should become more realistic and effective in cutting casualty crashes.

2. Road and Traffic Engineering Improvements - implement a targeted program of generally low-cost, proven road and traffic engineering improvements to the road and roadside. Such measures would target the major crash types and be directed at locations with high concentrations of the particular target crashes. Where both practicable and cost-effective, the program should include:

   - limited road widening;
   - tactile edge and centre lining;
   - shoulder sealing;
   - elimination of potholes, loose material and irregularities from road surfaces;
   - application of skid resistant pavement surfaces;
   - correction to adverse superelevation on curves;
   - clearing or shielding of hazardous roadside objects;
   - sealing of intersection and driveway approaches to the Great Ocean Road;
- channelisation of intersections with high crash records or high side-road volumes;
- elimination of excess road widths in townships, to improve pedestrian safety;
- upgrading and signing of alternative routes connecting with the Great Ocean Road;
- provision of additional turn-out facilities.

3. **Education and Marketing** - implement targeted safety-oriented education and marketing strategies for tourist activities along the Great Ocean Road, drawing upon the collective expertise and roles of tourism agencies, related enterprises and community groups.

4. **Police Enforcement** - increase targeted enforcement of unsafe behaviours, during high risk times of day and week, and periods of the year.

The suggested strategy for improving safety along the Great Ocean Road should also endeavour to capitalise on the additional benefits possible when effective partnerships operate between tourism agencies and municipalities, VicRoads, Police and the local communities.

6.5.2 **Generic to Tourist Routes**

A generic strategy for improving the safety of Victorian tourist routes should be based on the important principles of targeting a sizeable portion of the crash problem, using proven approaches and countermeasures to achieve practical and cost-effective reductions in casualty crashes. Such a strategy should be flexible enough to:

- recognise and address the unique crash characteristics of each route, and
- draw upon the most appropriate vehicle, behavioural and road and traffic engineering countermeasures, so as to precisely target the generic and the route-specific crash characteristics of each tourist route.

Of the countermeasures and other interventions proposed in section 6.5.1, the following are considered to have potential for generic application:

1. **Reduce speed limits** along routes which are inherently hazardous due, for example, to adverse alignment, topography or physical features, together with drivers and riders who, by definition, are unfamiliar with a route.

2. **Implement targeted programs of**:

   - targeted, low-cost, proven road and traffic engineering improvements to the road and roadside;
   - safety-oriented education and marketing strategies for tourist activities along a particular route, drawing upon the collective expertise and roles of tourism agencies, related enterprises and community groups;
   - police enforcement, directed at unsafe behaviours at high risk times of week/year;
   - effective partnerships between tourism and state agencies, local government, Police and local communities.
REFERENCES


