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TITLE Road safety research in Papua New Guinea

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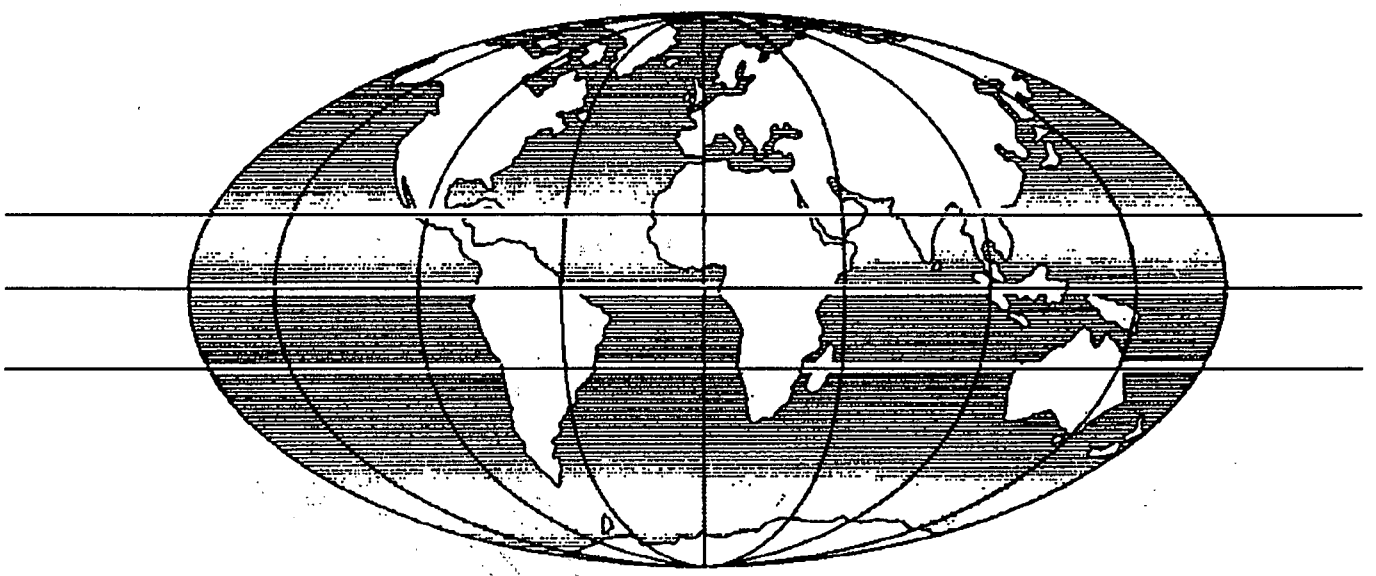

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ROAD SAFETY RESEARCH IN PAPUA NEW GUINEA

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ABSTRACT

Over the past ten years, Papua New Guinea has established one of the best nationwide road accident reporting systems available among Developing Countries. In 1987, it switched over from a mainframe system to a microcomputer system developed by the Overseas Unit of TRRL. Seven years of data, some 35,000 accident records, are now available on microcomputer. This paper reports progress on a programme of co-operative road safety research that is designed to exploit this valuable source of data. The work covers three areas of research: (i) accident blackspot investigations and the evaluation of countermeasures; (ii) the effects of highway geometric design on accident rates; and (iii) a survey of driver alcohol levels.

The accident blackspot work employs the techniques developed by Local Authorities in the UK over the past 15 years. This system is particularly orientated towards low-cost engineering measures and has proved to be highly cost-effective in the UK; it offers considerable potential for Developing Countries. Measures being evaluated in PNG include small island roundabouts, lane dividers, chevron boards, low-cost footpaths alongside rural highways and speed reduction devices.

The factors being investigated in the geometric design/accident rate study include horizontal and vertical curvature, road width, shoulder width, drainage ditch design, cross-sectional profile up to 15m from the edge of the shoulder and skid resistance. The PNG National Roads and Bridges Inventory is a valuable source of data for the study.

INTRODUCTION

Papua New Guinea's Road System

1. Papua New Guinea has a total land area of about 460,000 square kilometres, which makes it larger than Malaysia. On the other hand, its population is only about 3.5 million compared with Malaysia's 16.5 million.

2. Papua New Guinea comprises a large mountainous and very heavily forested mainland and some 600 smaller off-shore islands. A massive mountain range running north-west to south-east forms the backbone of the mainland with peaks in the centre up to 4,500 metres.

3. The country is divided into 20 Provinces. The major areas of population have traditionally been in the Highland valleys and basins, and around 33% of the population is still drawn from the five Highland Provinces. The two major urban population centres (and ports) are Port

Moresby, the capital city with a population of about 200,000 people, and Lae with over 50,000 people.

4. The transport system reflects the geographic and demographic characteristics of the country, and its improvement has generally been limited to the areas of high population and those with high potential for development. Initially, transport was largely limited to sea and air, but over the past 20 years a system of ten National Highways has been established and is being progressively upgraded. The most important of these is the Highlands Highway, which is about 500 Kms long linking Lae to the Highlands region.

5. The present network comprises some 18500 Kms of road, of which about 5% (1000 Kms) is paved. Arterial and trunk roads (4.5 to 7 metres wide) make up 5000 Kms, the remainder being collector and feeder roads. The National Government is responsible for about 20% of the roads, known as National roads, including about 800 Kms that are paved.

6. The number of registered vehicles in Papua New Guinea in 1987 was 51,000, and this has not increased significantly since about 1980.

7. Road accidents have been of concern for the past ten years and the current fatality rate of 60 deaths per 10,000 vehicles is relatively high by Developing Country standards. Also, they have been estimated to cost PNG around k25 million per annum, that is about one per cent of the Gross National Product, and this waste of scarce resources places a heavy burden on the PNG economy.

TRRL Overseas Unit's Road Safety Research

8. The Overseas Unit of TRRL began its research into the road safety problems of Developing Countries in 1972. Early research concentrated on accident rates, trends and costs, and road user behaviour and knowledge (eg Jacobs and Sayer 1982; Downing and Sayer 1982). In recent years, the emphasis has shifted towards techniques of accident data collection and analysis with a view to establishing the cost-effectiveness of road safety countermeasures in developing countries, for which there is, at present, very little data indeed (Hills and Jacobs, 1980; Hills and Yerrell, 1988).

9. Within this research programme, the Overseas Unit has had a long interest in the effects of geometric design standards on accident rates in developing countries (Jacobs 1976). This problem is of particular interest to the international aid agencies. Since the Unit's early research into geometric design, there has been very little additional work published and a higher priority is now being given to this particular area of research.

10. It has long been realised that alcohol is a major contribu- tory factor to road accidents in many Developing Countries, with the 'pay-day Friday' problem being a common phenomenon. This is another area of its road safety research that the Overseas Unit wishes to develop, partly as a result of a recent WHO initiative.

Collaboration between TRRL and PNG Department of Transport

11. In 1986 the TRRL Overseas Unit staff took part in a road safety study which was commissioned by the PNG Department of Transport and funded by the Asian Development Bank. As part of this work, the TRRL's Microcomputer Accident Analysis Package, which was specially designed for Developing Countries (Hills and Elliott, 1986), was installed on a trial basis. In January 1987, this Package became the national system of PNG, running on microcomputer systems both in the Department of Transport and in the Royal Papua New Guinea Constabulary (RPNGC) headquarters. The RPNGC had previously established a good accident reporting system but had experienced difficulties with the mainframe computing facilities. In addition, the Department of Transport found it needed more in-depth analyses of accidents than this mainframe system could provide. The police accident report form was modified both to improve its content and to enable direct entry of data from the form into the microcomputer. PNG thus became the first country to adopt the TRRL Package on a national basis. The mainframe accident data from 1982-1986, totalling over 25,000 accidents, were transcribed to the micro system.

12. The introduction of the microcomputer accident analysis system combined with the existing accident data base at the current stage of development of the PNG road system offered an excellent opportunity for research that could be of considerable value not only to PNG but to many other developing countries. For these reasons, a programme of cooperative research was agreed between the Department of Transport and the Overseas Unit in 1986. Initially it was agreed that the programme of road safety research would mainly cover the following two areas of work:

A. The evaluation of road safety countermeasures, especially low-cost engineering measures at accident blackspots; and

B. An investigation of the relationships between the various elements of geometric design and accident rates.

13. In March 1988, a Memorandum of Understanding (MOU) between the Department and TRRL was signed whereby a TRRL counterpart officer would spend two years resident in Port Moresby to enable faster progress to be made on the research programme. The original programme was extended at this stage by adding a study of the relationship between alcohol consumption and accidents. Details of the current programme are summarised in Figure 1.

DEPARTMENT OF TRANSPORT, PNG

TRANSPORT & ROAD RESEARCH LABORATORY, UK

CO-OPERATIVE ROAD SAFETY RESEARCH PROGRAMME

1. Accident Blackspot Investigations

- identification and analysis
- site studies, implementation, evaluation

2. Geometric design standards and accident rates

- horizontal and vertical curvature
- gradient
- road width and shoulder width
- drainage ditch design
- recoverability (survivability) from running-off the road
- effects on accidents of sealing a road
- etc

3. Proposed Alcohol study

- roadside survey of driver alcohol levels
- police measure alcohol levels of drivers in accidents
- hospital measure alcohol levels of casualties

4. Protection of Pick-up Passengers

- effectiveness of roll-over bars, back-supports etc

Figure 1

ROAD ACCIDENTS IN PAPUA NEW GUINEA 1987

14. The entry of 1987 accidents into the micro system was completed at the end of 1988 and following a period of analysis of these data, a report 'Road Accidents Papua New Guinea 1987' was published in May, 1989. It was intended as the first of a series of annual reports presenting the road accident situation in Papua New Guinea and it formed the basis for the planning of the Department's road safety programme. The main findings presented in this report were as follows:

(i) 15% of all vehicles on the road in Papua New Guinea were involved in a reported accident in 1987.

(ii) 46% of all accidents in Papua New Guinea involved only one vehicle, and these accidents caused 75% of all casualties, 80% of all hospitalised casualties and 86% of all fatalities (see Figure 2). These single vehicle accidents were almost entirely made up of (a) Pedestrian accidents; (b) 'Rollover' accidents; and (c) 'Struck object off the road' collisions.

(iii) Rollover (or overturn) accidents were the biggest single cause of casualties in Papua New Guinea. Although they only represented 12% of accidents, they gave rise to 30% of all casualties and 29% of all fatalities (See Figure 3).

(iv) 44% of all casualties were the occupants of pick-up type vehicles, whereas these vehicles made up 33% of registered vehicles (see Figure 4).

(v) For cars, pick-ups and Heavy Goods Vehicles involved in accidents, about 8% of drivers in each class were injured, whereas for motor-cyclists the figure was 73%.

(vi) 14% of all accidents in Papua New Guinea were reported as 'Alcohol Suspected'. On Saturdays and Sundays, about 20% of drivers involved in accidents were classed as 'Alcohol Suspected' (see Figure 5).

(vii) The National Capital District (NCD) with 32% of all accidents had only 10% of fatal accidents, whereas the Highlands Region with 22% of all accidents had 39% of fatal accidents. Thus, accidents in the Highlands Provinces tended to result in more serious injuries than accidents in the NCD.

(viii) There were, on average, 0.37 fatal or hospitalised casualties per reported accident over all Papua New Guinea. For all the National highways this figure was 0.82, and for the Southern Highlands, Ramu and

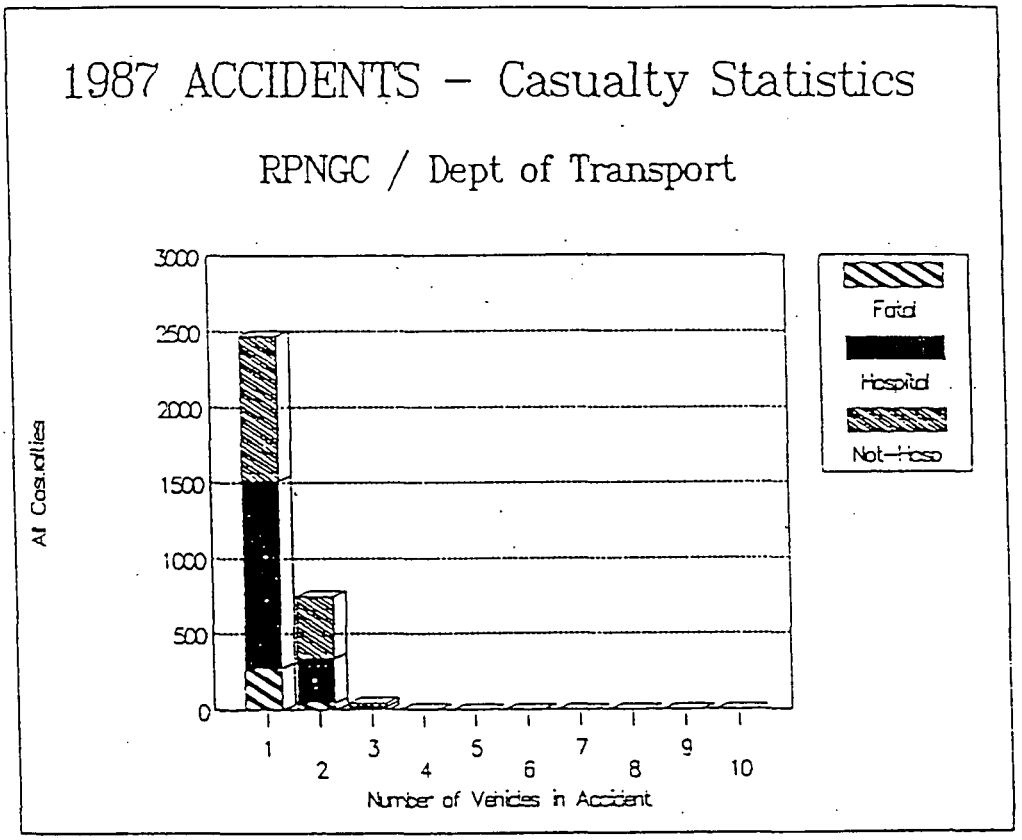


Figure 2 Casualties by Number of Vehicles involved in the accident

INJURY SEVERITY by COLLISION TYPE 1987

	Accidents	Vehicles Involved	Number of Casualties			
			Fatal	Hospital	Not-Hosp	Total
HeadOn	356	679	24	170	189	383
RearEnd	812	1650	11	43	62	116
90degree	482	951	6	56	85	147
SideSwipe	884	1706	11	116	128	255
OverTurn	599	611	87	452	386	925
Object on Rd	101	114	2	28	20	50
Object off Rd	657	671	37	251	183	471
ParkVehicle	193	387	2	13	12	27
Pedestrian	549	561	104	300	208	612
Other	161	185	15	68	58	141
Total	4794	7515	299	1497	1331	3127

Figure 3

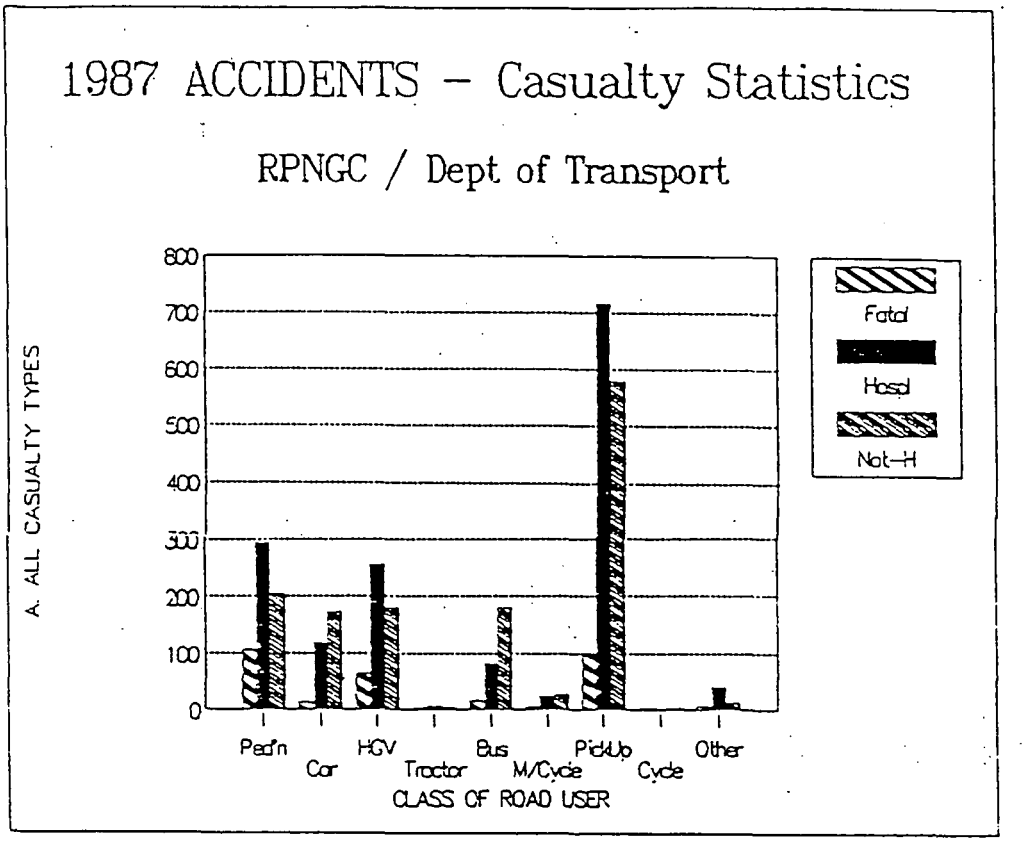


Figure 4 Casualties by Class of Road User

DRINKING AND DRIVING by DAY OF WEEK 1987

	Not Susp.	Suspected	+ ve	- ve	Unknown	TOTAL
Sun	476	100	2	0	0	578
Mon	921	37	0	0	0	958
Tue	891	46	0	0	1	938
Wed	879	47	2	0	0	928
Thu	941	90	3	3	0	1037
Fri	1237	119	2	1	0	1359
Sat	1099	293	2	1	2	1397
TOTAL	6444	732	11	5	3	7195

Figure 5

Enga Highways it was 1.15, 1.17 and 1.44 respectively. The Highlands Highway had by far the largest total of injuries.

(ix) Although there was an overall reduction in the total number of recorded accidents from 1981 to 1987, fatal accidents have increased steadily since 1982. This almost certainly indicates an increase in under-recording of minor injury and damage only accidents, rather than a genuine reduction in total number of accidents.

15. In addition to analyses of the accident data at a national level, lists of worst junctions and links in the NCD were included in the report and these formed the basis of a list of priority sites for treatment which was agreed with the NCD Interim Commission's engineers. Rural sites were also investigated and the worst sites along the major rural highway of PNG, the Highlands Highway, were identified (see Figure 6).

THE EVALUATION OF ENGINEERING COUNTERMEASURES

16. This is a continuous programme of work involving the identification of accident blackspots, analysis of the factors involved, site studies, implementation of countermeasures and evaluation of their effectiveness.

Techniques and Training

17. A significant element of the co-operative research programme is seen as the training of Transport Department staff to undertake the necessary accident investigation techniques which lead up to the development of a "preferred" solution and in the subsequent evaluation methods. The process requires, as a first stage, the identification of accident blackspots on the road network, using the TRRL accident analysis package, and their prioritising according to accident frequencies with a severity weighting based on accident costs. An in-depth study of the individual sites is then made, including the use of "stick diagram analysis" with the TRRL Package, and the preparation of collision diagrams, in an attempt to identify groups of accidents displaying particular, significant characteristics. This should then lead to the identification of appropriate countermeasures.

18. During the course of the programme, appropriate staff have been given formal and informal training so that they can carry out all stages of accident investigation through to implementation. Thus for example, one of the Department's staff produced the collision diagram shown in Figure 7. It demonstrates both the problem of rear-end shunts associated with the pedestrian crossing at the site, and the problem of vehicles turning across the road into premises with direct frontal access to the highway.

ACCIDENTS ON A ROUTE
********* ** * *****

ACCIDENT FILE: PNG87
CONDITIONS SET: LOCATION CODE 1 = HHY

KILOMETRES	ACCIDENTS	
0 - 9		
10 - 19	34	**xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
20 - 29	11	*xxxxxxxxxx
30 - 39	3	*xx
40 - 49	6	*xxxxx
50 - 59	9	*xxxxxxxx
60 - 69	0	
70 - 79	2	*x
80 - 89	6	**xxxx
90 - 99	0	
100 - 109	3	*xx
110 - 119	1	x
120 - 129	1	x
130 - 139	1	x
140 - 149	0	
150 - 159	2	xx
160 - 169	2	xx
170 - 179	3	xxx
180 - 189	5	xxxxx
190 - 199	19	*xxxxxxxxxxxxxxxxxx
200 - 209	12	xxxxxxxxxxxx
210 - 219	14	xxxxxxxxxxxxxx
220 - 229	5	**xxx
230 - 239	8	xxxxxxxx
240 - 249	0	
250 - 259	0	
260 - 269	3	xxx
270 - 279	7	xxxxxxx
280 - 289	15	xxxxxxxxxxxxxxx
290 - 299	24	****xxxxxxxxxxxxxxxxxxxx
300 - 309	19	****xxxxxxxxxxxxxxx
310 - 319	12	*xxxxxxxxxxx
320 - 329	1	*
330 - 339	0	
340 - 349	1	x
350 - 359	3	xxx
360 - 369	1	x
370 - 379	18	***xxxxxxxxxxxxxxx
380 - 389	15	**xxxxxxxxxxxxx
390 - 399	6	xxxxxx
400 - 409	2	xx
410 - 419	2	xx
420 - 429	35	**xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
430 - 439	12	*xxxxxxxxxxx
440 - 449	11	*xxxxxxxxxx
450 - 459	13	**xxxxxxxxxxx
460 - 469	11	**xxxxxxxxx
470 - 479	40	**********xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
480 - 489	6	*xxxxx
490 - 499	0	
Total=	408	

* Fatal x Injury or Damage

Figure 6 Accidents along the Highlands Highway in 1987

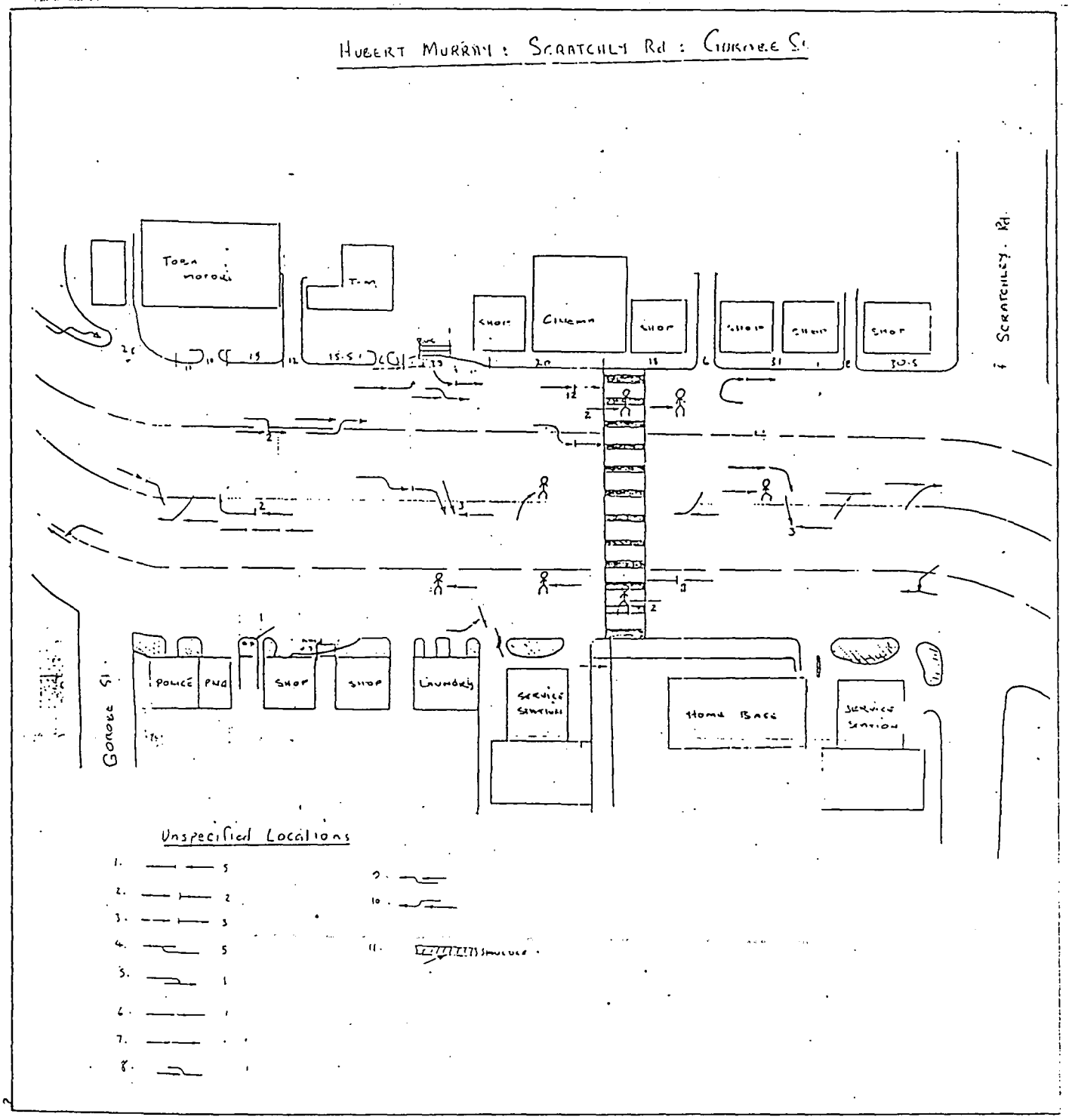


Figure 7 Collision Diagram prepared by member of DoT staff

The Range of Projects

19. A number of specified projects have been identified that will evaluate specific types of countermeasure, some of which have already been carried out. Although the primary reason for some of the measures has been for traffic management or maintenance purposes rather than safety, the inclusion of safety benefits could considerably enhance cost-benefit values obtained and might suggest further investment in the measures.

20. Figure 8 lists the various engineering countermeasures, both installed and projected, that it is planned to evaluate.

Roundabouts

21. Following research by the TRRL, roundabouts have been widely introduced in recent years in the United Kingdom and Australia to solve both traffic management and road safety problems at junctions. In many Developing Countries, on the other hand, particularly in the Middle East and South East Asia, roundabouts are being replaced by traffic lights. The failure of roundabouts in these countries can very frequently be attributed to the failure of drivers to Give Way on entering the roundabouts.

22. From 1982 to 1986, six roundabouts were installed as traffic management/road safety countermeasures in PNG's National Capital District. These were installed at uncontrolled major/minor junctions that had both traffic management and road safety problems. The drivers' give way behaviour was satisfactory and the roundabouts were generally regarded as being a successful innovation. As a result, five more roundabouts were recently constructed in Lae, the second largest city in PNG. Table 1 shows an analysis of the accident data so far accumulated for the roundabout sites in the NCD. It will be seen that generally the figures look encouraging and at all but one of the sites the number of accidents has dropped since the roundabouts were installed, whereas accident frequencies at other junctions have remained much the same.

23. Figure 9 shows accident rates at two closely located junctions on a major urban arterial, Waigani Drive. The junctions are separated by less than 200m. They are encountered at the end of a fast dual carriageway, first the Cameron Road junction and then the Wards Road junction. The Wards Road roundabout was constructed in 1983 and the Cameron Road roundabout in 1986.

24. The Waigani/Cameron roundabout clearly increased accidents at that location during its first year (1986) but, at the same time, seems to have dropped accidents at the already existing Wards/Waigani roundabout 200m down the road. The Waigani/Cameron roundabout, which was previously a T-junction, is encountered before the Wards/Waigani junction from the fast dual carriageway section, so it would appear that it now bears the brunt of the fast entry traffic. The accident types need to be

Department of Transport/TRRL

CO-OPERATIVE ROAD SAFETY RESEARCH PROGRAMME

ENGINEERING COUNTERMEASURES UNDER EVALUATION

	Location		Date Installed	Implementing Authority
Roundabouts - Installed				
•	NCD	Waigani Drive/Wards Road	1983	NCDIC
•	NCD	Waigani Drive/Koura Way	Aug 85	NCDIC
•	NCD	Waigani Drive/Goro Keaga Rd	Sept 85	NCDIC
•	NCD	Angau Drive/Lahara Avenue	Dec 85	NCDIC
•	NCD	Bisini Prde/Kaubebe/Okari	Dec 85	NCDIC
•	NCD	Waigani Drive/Cameron Rd	Feb 86	NCDIC
•	NCD	Waigani Drive/Spring Garden (Gyratory)	87	NCDIC
•	Lae	Central Avenue/9th St	1985	Lae City
•	Lae	MilfordHaven Rd/Markham Rd	Nov 88	MorobeDoW/DoT
•	Lae	Milford Haven Rd/Air Corps Rd	Nov 88	MorobeDoW/DoT
•	Lae	Milford Haven Rd/Malaita St	Nov 88	MorobeDoW/DoT
•	Lae	Huon Rd/Bumbu Rd	Sept 88	Lae City
Roundabouts - Projected				
•	NCD	Hubert Murray Hwy/Scratchley Rd		NCDIC/DoT
•	NCD	Ela Beach Rd/Lawes Rd		NCDIC/Dot
•	Lae	Milford Haven Rd/Huon Road		Lae City
•	(NCD	Waigani Drive/John Guise Drive - under consideration		NCDIC/DoT)
Traffic Lights - Projected Re-timing				
•	NCD	Hubert Murray Hwy/Taurama Rd/Wards Rd		NCDIC/DoT
•	NCD	Hubert Murray Hwy/Boroko Drive (NBC)		NCDIC/DoT
•	NCD	Hubert Murray Hwy/Waigani Drive		NCDIC/DoT
Junction Improvements - implemented				
•	Lae	Butibum Rd/Orion St	1985	Lae City
•	Lae	Central Av/7th St	1985	Lae City
•	Lae	Huon Rd/7th St	1988	Lae City
Link Improvements - projected				
•	NCD	Hubert Murrray Hwy: Scratchley Rd-Gorobe St		NCDIC/DoT
•	NCD	Waigani Drive: John Guise Drive-Koura Way		NCDIC/DoT
•	Goroko Highlands Hwy: Mack St- Brechin St			EHDoW/DoT
Pedestrian Footbridge - installed				
•	NCD	Hubert Murray Hwy (Turumu St)	1986	NCDIC
Pedestrian Footpaths - installed				
•	Goroko Highlands Highway		1988/1989	EHDoW/DoT
Pedestrian Barrier - projected				
•	NCD	Hubert Murray Hwy:Taurama Rd-Lahara Av		NCDIC/DoT

Figure 8

Chevron Boards - Installed			
•	Goroko Highlands Hwy (GKO-Kamaliki Ck)	Jan 88	EHDoW/DoT
•	NCD Baruni Coastal Rd	Sept 89	NCDIC/DoT
Chevron Boards - projected			
•	Gusap Bridge, Ramu Highway		
Speed Reduction - projected rumble strips			
•	NCD Waigani Drive/John Guise Drive		NCDIC/DoT
•	NCD Dilo Avenue		NCDIC/DoT
Lane Dividers - Implemented			
•	Goroko Highlands Highway	Jan 88	EHDoW/DoT
Central Reservations - Implemented			
•	NCD Hub Murray Hwy:Taurama Rd-Okari St	1987	NCDIC
•	NCD Waigani Drive: Tomu Place-Koani St	1988	NCDIC
Climbing Lane			
•	NCD Gavamani Rd		NCDIC
Single Lane Bridge - bar pattern			
•	Umi River, Highlands Highway	1988	MorobeDoW
•	Gusap & Boro Rivers, Ramu Highway	Aug 89	MorobeDoW/DoT
Bus Bays - Implemented			
•	NCD and Lae	1984-1989	NCDIC/Lae City

Figure 8 (continued)

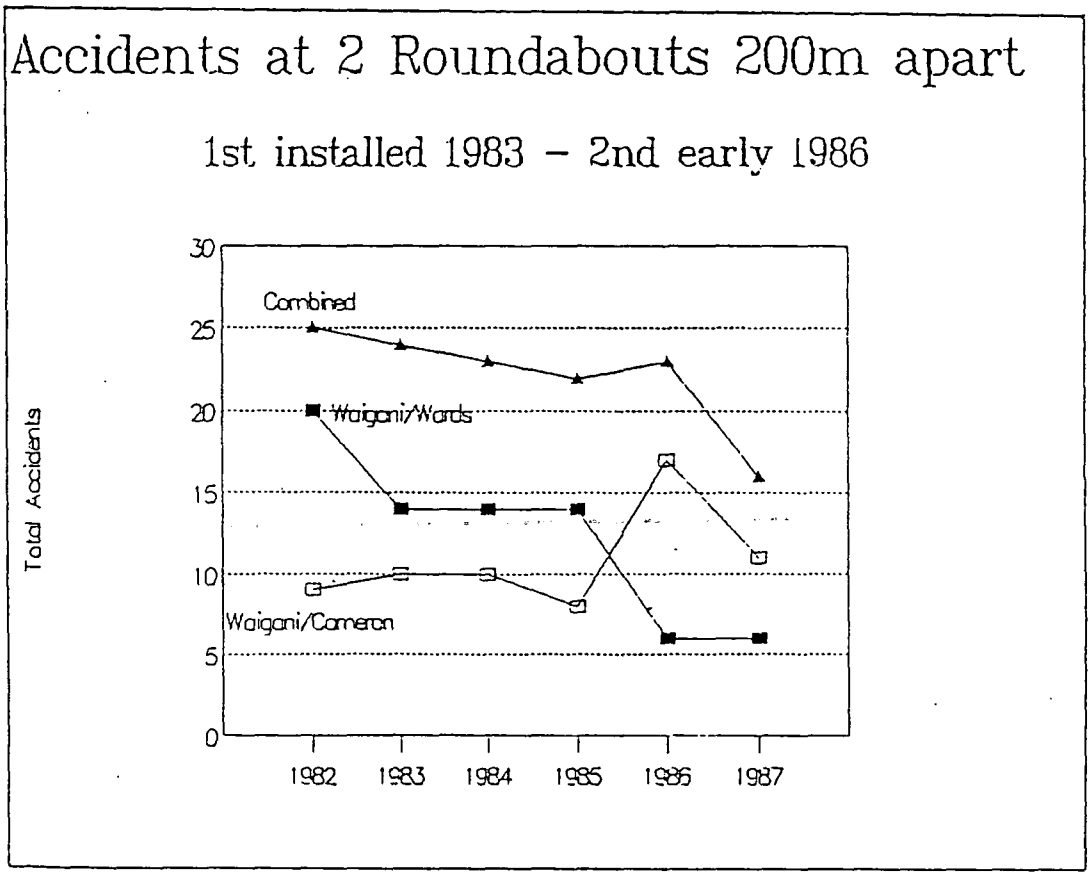


Figure 9

analysed to confirm this. Figure 9 shows the apparent crossover effect, with the combined data showing an overall decline in accidents.

Sites	Number of accidents per year			
	Injury accidents		Damage only accidents	
	Before	After	Before	After
1. Waigani Drive/Wards Road	2.0	0.5	15.0	9.5
2. Waigani Drive/Cameron Road	1.0	1.5	9.25	14.0
3. Waigani Drive/Koura Way	1.25	0.5	11.75	7.0
4. Waigani Drive/Goro Keaga Road	1.25	1.0	4.25	3.0
5. Angau Drive/Lahara Avenue	1.25	0.0	8.5	6.0
6. Bisini Parade/Kaubebe Street	0.25	0.5	2.75	2.5
Average rates for 6 sites	1.17	0.67	8.58	7.0

TABLE 1 Accident rates per year at intersections before and after roundabouts were installed

Rural Footpaths - Goroka

25. A major area of neglect throughout the Developing World is the provision of pedestrian footpaths alongside major rural high- ways. On some of these highways, large numbers of pedestrians can be observed but it is clear that highway designers have not taken their needs into consideration. Indeed, the authors know of no surveys that have ever been carried out to establish potential pedestrian needs when a major rural highway has been constructed or upgraded in a developing country.

26. The Highlands Highway in PNG is one such highway. It is the major rural highway of the country with very heavy pedestrian usage in the Highlands regions. Analyses of the accident data confirmed that rural pedestrian casualties were a major problem on the highway. One of the major blackspots was on the approaches to the Eastern Highland's Provicial Capital, Goroka. Pedestrians were making their own tracks in many places to get away from the traffic - in one extreme case, they were prepared to walk on slopes of 45 degrees to achieve this. In another case, pedestrians use embankment benching as a footpath. (This could be adopted as a formal design in many such situations).

27. As an initial trial, the Department of Transport is half- funding 13 kilometres of footpath, one metre wide, to be hand-dug alongside the drainage ditch from Goroka towards Asaro (Figure 10). Approximately 5 km has so far been constructed. It is generally being used by a large proportion of the pedestrians, but there remains a residual number who continue to walk along the highway itself. More studies of its use are required, particularly to establish whether its use is increasing or decreasing, and if decreasing, why this is so. It may need to be widened

to handle the volume of pedestrians or change long established habits (Figure 11).

Chevron Boards

28. Chevron boards have been erected so far on two accident- prone sections of rural highways containing difficult curves: (i) from Goroka to Kamaliki Creek on the Highlands Highway (Figure 12); and (ii) on the Buruni Coast Road in the National Capital District. Analyses of their effectiveness will have to wait a further twelve months for the 1988 accident data to be completed.

Accident Blackspot at Gusap Bridge, Ramu Highway

29. From December 1988 to April 1989 there were three fatal accidents and several injury accidents at the Gusap and Bora River bridges, which are a short distance apart on the Ramu Highway some 3 kms from the Ramu Sugar factory. The road carries only about 200 vehicles/day.

30. The bridges are on a recently sealed section of the Highway. This section of the road is very straight, and therefore fast, from Wataris to the Gusap Bridge, where the road then does a greater than 90 degree bend to cross the Gusap River - a classic accident producing situation. Before the beginning of the bend, there was a 40 kph speed limit sign at approximately 150m and a 'dangerous curves' symbolic warning sign at approximately 50m. There were no other advance warnings of the bends nor any chevron boards at the bends. When first sealed, there were apparently more signs but a number were stolen. There is no background to the Gusap River bend, just open sky, which gives no visual clue to the approaching drivers.

31. Before the road was sealed, there were only a few accidents at the bridges; it has been suggested that this was due to the large potholes on the approaches to the bridges.

32. The Ramu Sugar Company had constructed a temporary, unreflectorised, chevron board for erection at the Gusap River bend. Speed measurements made before and after its erection showed that this had little effect on entry speeds to the bend. A serious night-time accident occurred after its erection. Recently, a bar pattern (originally developed at TRRL) covering some 100m has been painted on the road (see Figure 13). Four reflectorised chevron boards will also be erected on the bend and the bar pattern extended to 200m before the bridge. Measurements of approach speeds following the installation of the chevron boards and bar pattern will be carried out in the near future and future accidents closely monitored. Eventually, it is planned to re-align the road in the vicinity of Gusap Bridge. This accident blackspot emphasises the need to anticipate potential new problems when a road is upgraded, and the need to "over-design" warning devices to alert drivers of the impending problem.

Figure 10 Hand-dug pedestrian footpath constructed alongside the Highlands Highway near Goroka

Figure 11 Pedestrians on Highlands Highway near Goroka

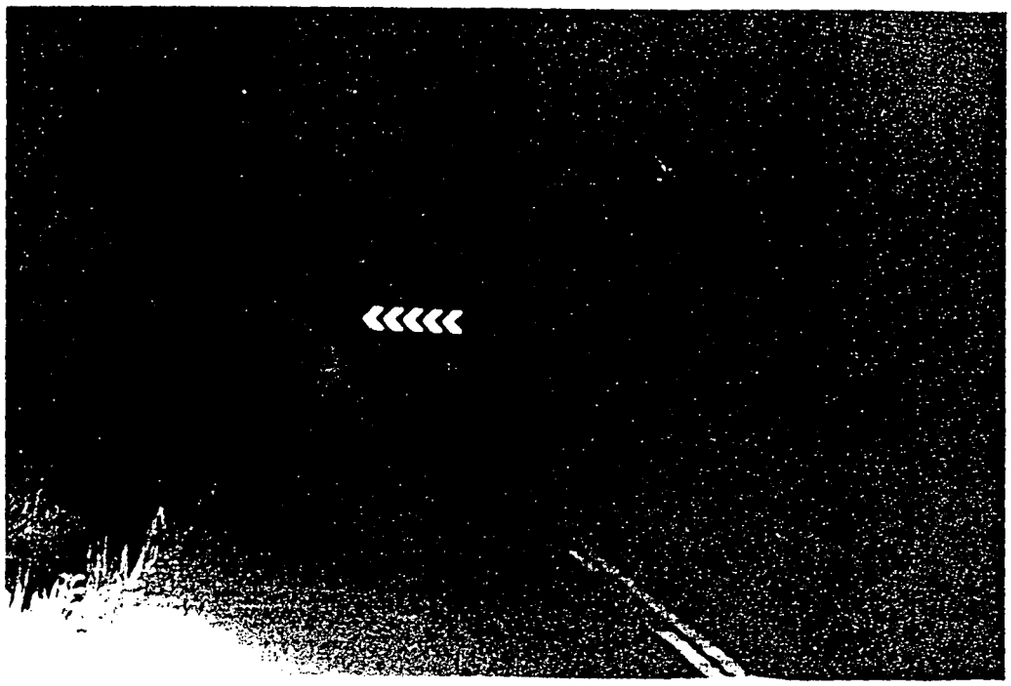


Figure 12 One of a series of Chevron Boards erected on the Highlands Highway near Goroka

Figure 13 TRRL bar pattern on approach to Gusap Bridge

33. If successful, it is planned to paint the TRRL bar pattern on the approaches to all single lane bridges on the Highlands Highway.

GEOMETRIC DESIGN STANDARDS OF RURAL ROADS AND ACCIDENT RATES

34. The research projects identified above have been concerned with accident reduction i.e. reducing existing accident problems. Research into the relationship between geometric design and road accidents is concerned with accident prevention through good design standards.

35. As indicated in paragraph 2, there has been very little research into the relationships between accident rates and the elements of geometric design in developing countries. An attempt will be made to establish the effects on accident rates of road width, shoulder width, horizontal and vertical curvature, gradient, sight distance and drainage ditch/side slope profile.

36. Research began using the 1979 PNG Highway Inventory and the available accident data. This initial research found that of the limited number of factors analysed, gradient was the one that most strongly correlated with accident rates (see Figure 14).

37. A survey of the Highlands Highway has just been carried out in a collaborative study between the TRRL, the Department of Transport and the Civil Engineering Department of the University of Technology, Lae, under Dr Chandran. The device shown in Figure 15 was specially developed for measuring side slope profiles.

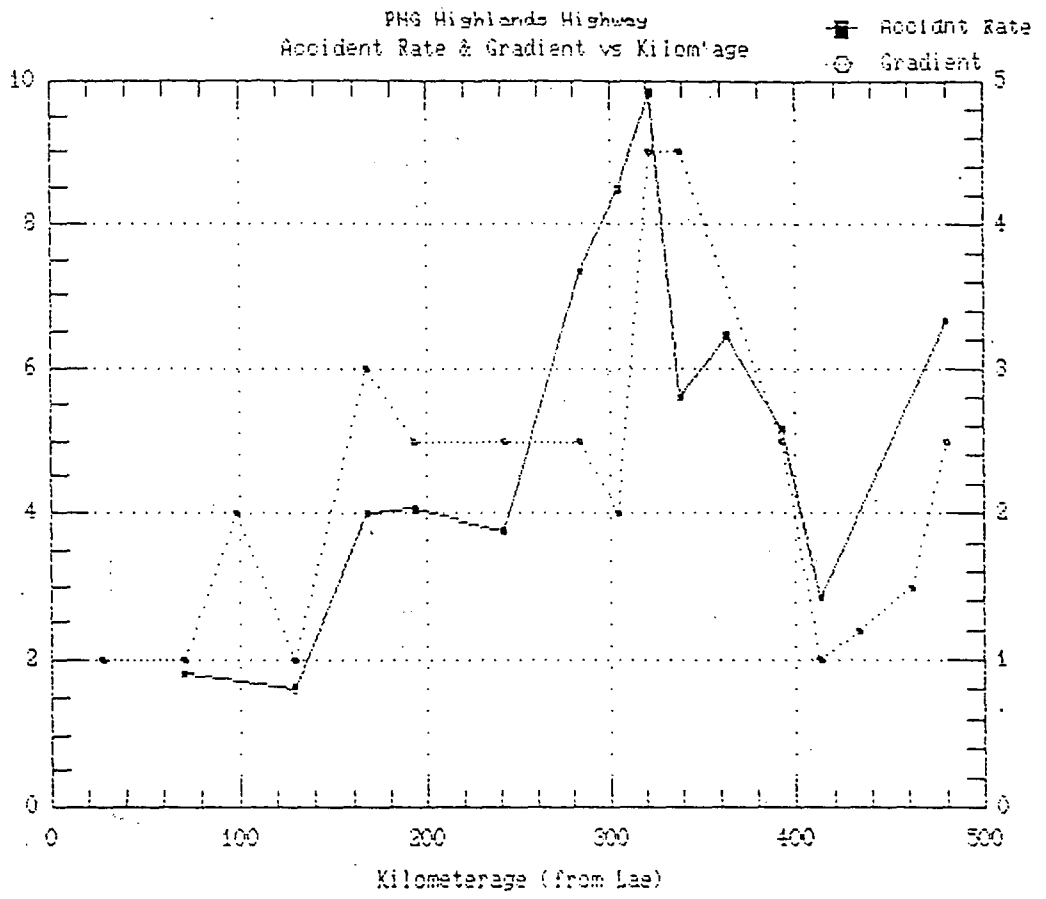
38. A second project will evaluate the effects of the progressive sealing of the Highland Highway both on traffic volumes and accident rates.

39. The deep concrete-surfaced drainage ditches just 1m from the carriageway on the Highland Highway, particularly in the region of Goroka, are a cause for concern from a safety viewpoint, and a special study of these will be made. It is believed these are one of the significant factors contributing to the high incidence of single vehicle accidents (paragraph 14).

ALCOHOL RESEARCH

The Alcohol Roadside Survey

40. Drink and driving is undoubtedly a major problem in PNG (paragraph 14). The effects of alcohol are probably compounded by the effects of betal nut chewing. It is planned to establish a project in which the drivers of all injury and fatal accidents in the NCD are requested on a voluntary basis to have an alcohol breath or blood test for a trial period. Over the same time period, roadside surveys of drivers' alcohol levels will



Regression Analysis - Linear model: Y = a+bX

Dependent variable: PNGTOT.AccPerVhKm SE Independent variable: PNGTOT.Gradient

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	1.58554	1.42993	1.10882	0.293461
Slope	1.42873	0.528789	2.7019	0.0222409

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	31.086970	1	31.086970	7.300242	.02224
Error	42.583479	10	4.258348		
Total (Corr.)	73.670449	11			

Correlation Coefficient = 0.649595 R-squared = 42.20 percent
Stnd. Error of Est. = 2.06358

Figure 14 Relationship between gradient and accident rate on Highlands Highway

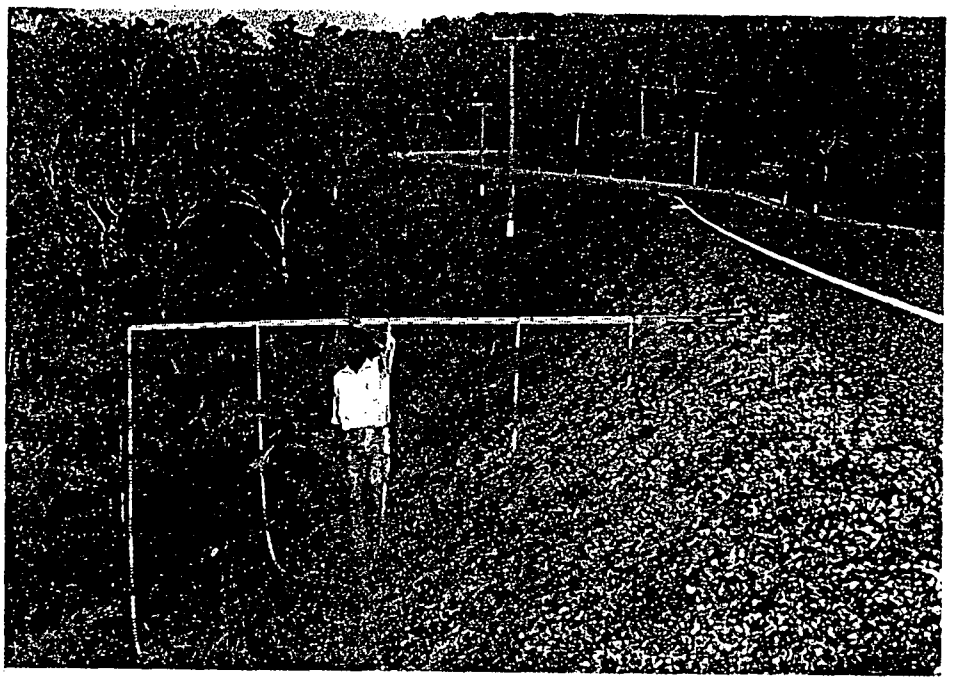


Figure 15 Device developed to measure side slope profiles in Geometric Design study

be carried out using breathalysers, again on a voluntary basis. It is also hoped that the Port Moresby General Hospital will be able to collaborate in measuring the blood alcohol levels of road accident casualties.

Attitude Survey

41. The Department of Transport with the support of the Department of Health has commissioned a national survey of 'Awareness of Alcochol Abuse in PNG', with particular reference to attitudes to drinking and driving. It was carried out by PNG-based consultants, First Market Research.

42. Two types of survey were carried out: (i) a qualitative survey involving informal discussion groups to explore ideas, attitudes and perceptions related to drinking; and (ii) a quantitative questionnaire survey using interviews in the home, in the street and at work.

43. The qualitative survey involved four groups of 8-10 participants in each of three contrasting areas of Papua New Guinea ie twelve discussion groups involving a total of about 100 people. The quantitative survey interviewed 200 people in each of the three areas.

44. The surveys were carried out with a view to the design of marketing material to be included in future road safety and anti-drink campaigns. The general conclusions relevant to this marketing approach were:

(i) Women appear to be more concerned and are more motivated to prevent alcohol abuse than men.

(ii) Women do not have the habitual drinking problems nor the social pressures associated with drinking to which men are subjected.

(iii) Women are influential in changing behaviour, especially within the family.

(iv) Younger people had more insight into and a greater fear of the consequences of alcohol than older people.

(v) Almost all drinkers who also drove indulged to a greater or lesser extent in drunk driving.

(vi) There is a general consensus that drunk driving can be lethal and that the consequences are far reaching.

(vii) There is a general consensus that the breathalyser should be introduced in PNG

(viii) There is little or no perception of safe drink driving limits.

(ix) There is a very distorted perception of how much it takes to get drunk.

SPECIAL STUDY: Injuries to Passengers in the rear of Pick-ups

45. As indicated in paragraph 14, a high proportion of injuries occur to the occupants of pick-ups in PNG. This is believed to be associated with the fact that very many passengers travel in the back of pick-ups, where they are thought to be very vulnerable. Table 2 compares the injurity severity of the occupants travelling inside the cab with that of passengers travelling in the open back of the pick-ups involved in accidents.

	Percentage of casualties who DIED or WERE HOSPITALISED	
Type of Pick-Up Accident	Inside Vehicle	Outside Vehicle
All	51% (320/628)	64% (457/710)
Urban	44% (67/151)	64% (68/106)
Rural	52% (252/476)	64% (389/604)
NCD	37% (17/46)	60% (25/42)
HIGHLANDS	59% (144/245)	67% (245/368)
Rollover	45% (101/225)	67% (204/305)
Hit object off road	59% (76/129)	77% (101/131)
Head On	58% (53/91)	47% (39/82)
Rear End	57% (17/30)	50% (9/18)
Right Angle	45% (18/40)	56% (10/18)
Side Swipe	40% (22/55)	47% (37/78)

TABLE 2 The severity of injuries in Pick-Up accidents

46. It can be seen from this table that, overall, 51% of casualties inside the vehicle were fatally or seriously injured whereas the figure was 64% for casualties outside (in the rear) of the vehicle. This is rather less an increase in severity than might have been expected given the apparent vulnerability of passengers in the rear. It could be argued that if all rear passengers in pick-ups had been enclosed in the vehicle in 1987, 362 (51% of 710) rather than 457 passengers would have been killed or severely injured - a saving of 95, perhaps rather less than might have been hoped. This assumes that passengers in the rear of (enclosed) vehicles were as vulnerable as those at the front, which is not normally the case; thus, the saving would probably have been rather greater than 95. A small difference is seen for outside passengers comparing the NCD and Highlands provinces.

47. The comparison of Urban and Rural accidents in Table 2 shows that there was no difference in the severity of injuries for passengers outside the vehicle (both 64%), again a rather surprising result, given the generally higher speeds

of rural accidents. The expected increase in severity is, however, seen for casualties inside the vehicle.

48. A comparison of the effects of various collision types on severity of injuries shows that 77% of outside passenger injuries were fatal or serious in 'hit object off road' collisions, and 67% in the case of 'rollover' accidents. It can be seen that for 'head on' and 'rear end' accidents, passengers inside the vehicle, presumably because they were at the front, were more severely injured than those outside the vehicle.

CONCLUSIONS

49. The wide range of schemes that have been or are being implemented has been listed in Figure 8. These schemes, combined with the availability of sound historical accident data provide an invaluable opportunity for research.

50. At this point in time, the research programme is reaching the half-way stage. Many of the accident remedial measures have only recently been implemented and others are yet to come. It is therefore too early to present general conclusions relating to the effectiveness or otherwise of the countermeasures. However, in the case of roundabouts, evidence is presented which suggests that they have been effective in reducing accidents.

51. One of the first activities under the research programme was the preparation and publication of the report "Road Accidents Papua New Guinea 1987". This has made a significant contribution to understanding the nature of the road safety problem in Papua New Guinea. It has provided a sound base on which to plan the future road safety programme and has suggested areas on which research is required e.g. the special study on the injuries to passengers in the rear of pick-ups.

52. This report also highlighted the fact that 75% of all in- juries are the result of accidents involving only one vehicle and this has already lead to further investigative work in this area. Some aspects of these accidents e.g. overloading of open pick-ups, pedestrian involvement and drink-driving have been selected for presentation on commercial TV as programme fillers as part of a general road safety education programme.

53. The survey of the Highlands Highway, as part of the geometric design study, has only just been completed (at the time of writing) and the data remain to be analysed. However, the survey has already been useful in terms of developing quick, easy and accurate methods of measurement over an extensive survey site (500 kms at 1km intervals).

54. A good start has been made to the alcohol research with the two surveys already carried out. As well as identifying the best approach for future publicity campaigns on alcohol abuse, the quantitative results together with the additional surveys planned could lead to a better understanding of the drink-driving problem and the development of appropriate countermeasures.

55. Special studies planned for the future include the application of the TRRL bar pattern to the approaches of all one-lane bridges on the Highlands Highway, the introduction of parking bays on the Highway and trials with high skid-resistance surfaces in the National Capital District.

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