VICTORIAN ASPECTS OF THE NAASRA ROADS STUDY

Graeme BOTH
Assistant Advance Planning Engineer
Country Roads Board of Victoria

ABSTRACT: *The objectives of the NAASRA Roads Study are to measure the nature and condition of the Australian road system, provide a basis for assessing changes in it, assess the effects of alternatives for the management of the system, and illustrate the physical effect on the system (and the cost of transport on it) of various levels of funds. The study is examining the system in three investigations: rural arterials, urban arterials and local roads. The methods are described and some preliminary Victorian rural arterial results presented. Progress with the urban arterial and local road investigation is described.*

VICTORIAN ASPECTS OF THE NAASRA ROADS STUDY

INTRODUCTION

Content of paper

This paper describes the work currently being undertaken by the Country Roads Board (CRB) for the NAASRA Roads Study (NRS). The study is examining the road system in three separate investigations: rural arterials, urban arterials and local roads. At present an analysis has been undertaken for rural arterial roads, excluding National Highways, and some preliminary results are reported. In coming months the rural arterial analysis will be finalised and National Highways analysed. The other two investigations have only reached the stage where the basic methodologies have been defined and data collection has commenced. These are briefly described in the latter sections of the paper.

Earlier road need studies

The first road needs study in Victoria was carried out by the CRB in 1937. It examined road needs for the declared State highway system for the following decade. In 1948 another study was undertaken, this time in co-operation with municipal engineers. It also covered unclassified roads outside cities. A similar survey was performed in 1954.

In 1960 and 1964 the National Association of Australian State Road Authorities (NAASRA) carried out Australia-wide studies of road needs for the periods 1960 to 1970 and 1964 to 1974 respectively. The 1960 studies were limited to rural roads, whereas the 1964 studies covered both rural and urban roads. The two studies lacked uniformity between States because there was no formal specification for data collection, road deficiency assessment standards or improvement project design standards.

In 1967-68 the then recently formed Commonwealth Bureau of Roads (CBRds) carried out a comprehensive study of the entire Australian road system for the period 1969-1979 using data on the physical condition of Australian roads collected by the State Road Authorities (SRAs), in accordance with specifications agreed by the CBRds and NAASRA. A similar study was conducted in 1971-72 and a minimal amount of updating undertaken two years later.

In 1977, an update survey was done for National Highways and rural arterial roads and reported by the Bureau of Transport Economics (BTE) in 1979.

NAASRA Roads Study

In May 1980, the National Association of Australian State Road Authorities decided to carry out a comprehensive study covering all classes of roads on an Australian-wide basis. The Study, known as the NAASRA Roads Study, is scheduled for completion by early 1984. Details of the background to the NRS, its scope, organisation and management are given in Underwood (1982).

The objectives of the NRS are:

(i) To provide a clear picture, in measurable terms, of the nature and condition of the Australian Road System;

(ii) To provide a basis (along with earlier surveys and continuing surveys) for assessing changes in (and the rate of change of) the nature and condition of the Australian Road System;

(iii) To provide a basis for assessing the effects of alternatives for management of the road system;

(iv) To illustrate the physical effect on the Australian Road System, and on the cost of transport on it, of various levels of funding;

(v) To present the findings in a manner that can be readily understood by all.

Differences from previous national road surveys

The inventory information assembled during the rural and urban arterial investigations will be stored in NAASRA Data Bank System (NDBS) format. This system, described in Linsten (1978), incorporates a locational system utilising permanent reference points, and will provide a basis for comparison with future inventories, thus satisfying NRS objective (ii). The NRS is the first survey to provide a precise definition of the network of roads studied, thus enabling future changes to the network to be clearly identified.

Previous surveys have determined the cost of bringing the system up to specified engineering standards, and in the more recent surveys calculated the economically warranted expenditure on projects on part of the network. The NRS approach is to reverse the process by considering a range of funding levels and determining the condition of the entire system after 10 years under each funding assumption. It is the first survey to do so.

The major concern of the NRS reports themselves will be to provide factual and understandable information. They will not be concerned with making a case for increased road funding by any particular level of government, nor of influencing particular funding decisions. However others may wish to use the figures for such purposes.

Unlike the various Commonwealth surveys the NRS must be conducted by a consensus approach where each aspect of the resulting methodology is effectively determined by the magnitude of the effort that can be expended by each and every SRA.

The resources being devoted to the NRS are considerably less than in previous surveys. The central Study Team contains only 3 engineers, each working on one of the 3 investigations. With the exception of the inventory data updating, which is required for CRB purposes anyway, the Victorian rural arterial analysis and reporting will take less than half a person year, the urban arterial possibly one person year and the local road study about half a person year. There will be some minor additional work by technical support staff. Victoria has also contributed perhaps 1 person year in assisting the Study Team in developing and adapting methodology.

Any criticism of the NRS methodology or usefulness should bear in mind the above points, particularly the necessity for a consensus approach and the limited level of resources.

RURAL ARTERIALS

The general procedure was given in Cleeland and Both (1982) although many of the details have since been modified.

The roads studied were the primary arterial (NAASRA functional classes 1, 2 and 6) and secondary arterial (classes 3 and 7) roads in rural and outer urban areas.

The existing physical inventory was described as at 30 June 1981 and the initial travel (vehicle-kilometres) was for 1980/81. The analysis period for future funding levels and management strategies was the 10 years from 1981/82 to 1990/91 inclusive. The description of the future inventory was for June 1991.

All costs were in 1980/81 prices. The funding levels analysed were the "current" funding level (average of the 1979/80 and 1980/81 expenditure) and levels +50%, +25% and -25% from that level. These were abbreviated as F100, F150, F125 and F75.

Description of Road Stock and Performance

The detailed description of the 1981 inventory was accomplished by cross-tabulations from the inventory showing:

(a) length and travel for 12 road categories (combinations of surface type, width and number of carriageways) and 14 traffic volume (AADT) ranges,

(b) number of horizontal curves for sealed roads by 4 terrain classes and 8 design speed ranges,

(c) ditto for vertical crest curves but with 7 speed ranges,

(d) length of grade in 5 gradient ranges and the 14 traffic volume ranges,

(e) length of sealed roads by roughness, in 14 ranges of NAASRA Roughness Meter (NRM) readings (the characteristics and use of the NAASRA Roughness Meter are described in NAASRA (1981)),

(f) number of bridges, either timber or otherwise, in 4 categories of load capacity,

(g) number of bridges, in 7 ranges of width by the 14 traffic volume ranges,

(h) number of level crossings by type of protection.

Because of their size and complexity the tables will not be reported in this paper, however some key statistics for Victorian rural arterials are:

(i)	Length	:	15,414 km of which 97% is sealed.
(ii)	Travel	:	7,200 m vehicle-kilometres.
(iii)	Width	:	178 km divided, 7,760 km wide (6m nominal) two lane, 6,500 km narrow (7m nominal) two lane and 550 km one lane seal.
(iv)	Roughness	:	1,236 km has a roughness greater than 120 counts/km.
(v)	Bridges	:	1,373 of which 130 are timber and about 250 have a rated capacity less than the current legal load limit.

Measuring the effect of various funding levels and strategies

The NRS specification required that the estimate of future effects be undertaken using a computer model, NIMPAC, which simulated the total cost of travel, including vehicle operating costs and the costs of maintaining and improving the road network with different standards for deficiency assessment and project design. NIMPAC is described in Cleeland and Both (1982) and the NIMPAC documentation (NAASRA 1978).

The effects were demonstrated by changes in:

(a) road inventory characteristics between 1981 and 1991,

(b) length and cost of various categories of roadworks over the 10 year period together with road user costs,

(c) assessment standards (which determine the initiation of projects), design standards (scale of projects) and project timing rules.

Choice of a modelling approach

The use of NIMPAC could be questioned on the ground that the model relationships or data input may be unreliable for a particular calculation or a specific section of road. However the NRS objectives could not have been addressed by all States in a relatively consistent manner within the time limits and resource constraints of the NRS without some form of computer modelling.

Though some elements of NIMPAC have not previously been used in a national road survey the road user submodel has been used in a number of State and federal studies over the past decade. BTE and the Australian Road Research Board have both reviewed the vehicle operating cost components of that submodel, but at this stage it appears to give an adequate representation of change in road user costs at a macro (i.e. State or road category) level. The judgement of most users so far has been that it hasn't been worth the research effort to improve the basis of the calculations, and by implication their reliability.

Important NIMPAC assumptions and data

The most important assumption in the model is that pavement roughness, as measured by the NAASRA Roughness Meter, is suitable as a measure of pavement condition over time and as a means of determining the timing of reconstruction. NIMPAC incorporates a roughness-pavement age relationship which can be varied by the analyst on an area and road functional class basis.

The relationship given in Stevenson (1976) for Victorian functional class 2 roads, i.e.,

$$\text{Roughness (counts/km)} = 0.11\ (\text{Age})^2 - 0.43\ \text{Age} + 44$$

was assumed, for simplicity, to apply to all rural arterial roads. At an age of 20 years this gives a roughness of about 80 counts/km and at 30 years 130 counts/km. Unfortunately pavement age data was only available for less than one quarter of the sealed length (State highways only) and in the time available it was not possible to confirm the validity or otherwise of the ERVIS relationship from 1981 roughness measurements.

The roughness value which initiated reconstruction was adjusted until there was a match between the average annual amount of reconstruction work generated by NIMPAC and that estimated to have been undertaken in 1980/81. In that sense the model could be said to have been calibrated, although whether the various simulated 1991 roughness distributions can validly be compared with the 1981 measured roughness distribution only time will tell. It is however felt that the comparisons between the various 1991 simulated roughness distributions are valid.

For each link of the network an estimate was made of AADT and its recent rate of growth. Overall this produced a growth of 25% in vehicle kilometres over the decade 1981-1991. This is equivalent to a compound growth rate of about 2.2%, which is considerably below the 3.6% estimated for the period 1971-1979 from the ABS Motor Vehicle Usage Surveys. The data therefore may underestimate total future travel, but this is unlikely to significantly affect the NRS results.

An important simplification was that for rural arterials the traffic composition on each link over the whole period was 71% cars, 13% light commercials and 16% trucks.

Strategies input to the model

Design standards for the F100 analysis were selected to reflect current policies. Design speeds for primary arterials ranged from 110 km/hr to 80 km/hr depending on terrain (the range for secondary arterials was 100 km/hr to 40 km/hr). The warrant for sealing was 60 veh/day whilst duplication was undertaken when the traffic reached 8,000 veh/day. Maximum pavement roughness was set at 120 counts/km for roads in functional classes 1 and 2 and 140 for those in functional class 3. No widening was permitted prior to reconstruction or rehabilitation.

For the F75 analysis maximum pavement roughness was increased by 20 counts/km and realignment of secondary arterials prevented.

For the F125 and F150 analyses widening was permitted for roads smoother than 60 counts/km. The warrant for duplication was reduced for each budget as was the volume warrant for overtaking lanes. At F150 maximum pavement roughness was reduced by 10 counts/km and design speeds for secondary arterials raised to be only 10 km/hr below those for primary arterials.

The key inputs are summarised in Table 1.

Change in Inventory 1981-1991

For each funding increase the length of wide two lane sealed roads (greater than 6 and duplicated roads increased while the length of narrow two lane seals, one lane seals and gravel roads declined. The higher the budget the greater was the effect. As shown in Figure 1 this phenomenon was particularly noticeable when only roads carrying in excess of 6,000 veh/day were considered.

Figure 2 shows that the length of very smooth road increased but the length in the range 60-100 counts/km increased as NIMPAC enforced the strict cutoff at maximum pavement roughness rather than allowing the current more subjective approach to determining time of reconstruction.

Table 2 gives a simplified comparison of the 1981 and estimated 1991 inventories. The proportion of duplicated road in the network would increase from the 1981 value of 1.1% to between 1.4% (F75) and 3.5% (F150). Concurrently usage of duplicated roads would increase from 11.3% of system travel to between 15.4% (F75) and 29.6% (F150). The proportion of total travel on one lane and narrow two lane seals would also decrease very significantly.

Improvements over 10 year period

The length of projects, the total road authority cost and the total road user cost are summarised in Table 3.

(a) New Seal

Total length of new seal was constant at 300 km reflecting the very small proportion of the network currently unsealed (2.8%) and the fixed assessment standard of 60 veh/day before sealing was considered. At F75 and F100 almost 30% of new seal was single lane, however at F125 and F150 design standards were altered so that only two lane seal was constructed.

(b) Widening of one lane seals

Conversion of one lane seals to two lanes progressed slowly from 123 km at F75 and 164 km at F100 before accelerating to a plateau value of 360-370 km at F125 and F150.

TABLE 1 Rural Arterials - Assessment and Design Standards and Project Timing Rules by Budget Level

STANDARDS AND RULES	F75	F100	F125	F150
ASSESSMENT STANDARDS (Initiation of Projects)				
Max. pavement roughness (counts/km)	140/160*	120/140	120/140	110/130
Min. bridge strength - (% T44)**	74/55	74/55	74/55	74/55
DESIGN STANDARDS (Scale of Projects)				
Curve speed - Flat terrain - (km/h)	110/0	110/100	110/100	110/100
" " - Undulating terrain-(km/h)	100/0	100/80	100/80	100/90
" " - Hilly terrain - (km/h)	90/0	90/60	90/60	90/80
" " - Mountainous terrain - (km/h)	80/0	80/40	80/40	80/70
Max. traffic on 1 Lane seal - 4 m (v.p.d.)	150	150	0	0
" " 2 Lane seal - 6 m (v.p.d.)	1500	1500	1500	1000
" " 2 Lane seal - 7 m (v.p.d.)	8000	8000	7000	6000
" " 4 Lane divided - 14 m (v.p.d.)	30000	30000	30000	20000
Add overtaking lanes on 3% grade if traffic exceeds (v.p.d.)	5000	5000	3666	2333
" " " " 6% " " " " "	3000	3000	2333	1333
PROJECT TIMING RULES				
Widen pavements smoother than (counts/km) -	-	-	60/70	60/70

* indicates primary / secondary arterial values

** %T44 is the ratio of the bending moment for the weakest girder, modified for present physical condition, for the design load over that for the NAASRA T44 design truck loading.

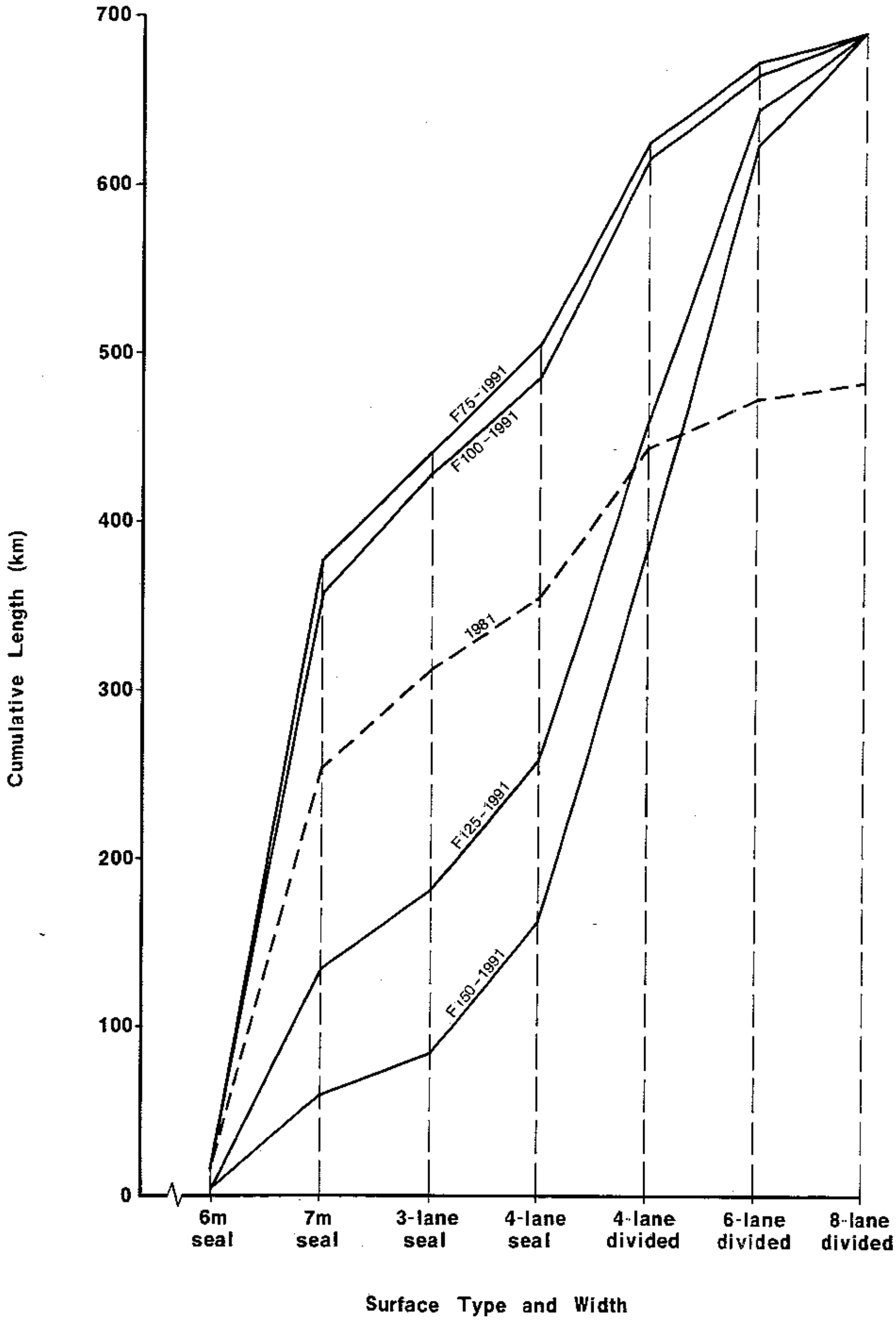

Figure 1. LENGTH OF RURAL ARTERIAL ROAD CARRYING IN EXCESS OF 6000 VEHICLES PER DAY.

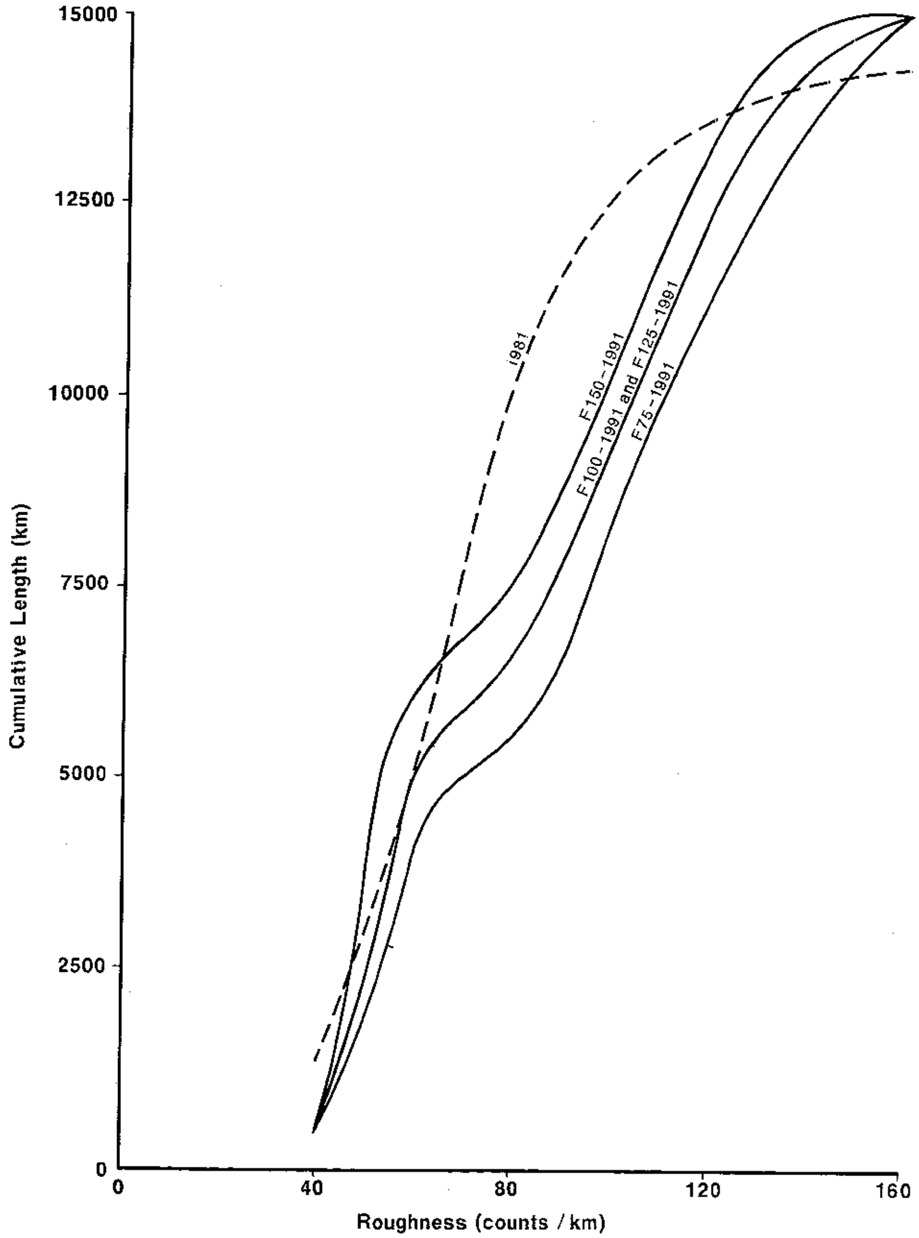

Figure 2. ROUGHNESS DISTRIBUTION FOR SEALED RURAL ARTERIAL ROADS.

TABLE 2. Rural Arterials - Comparison of 1981 and 1991 Inventories (route km).

ROAD CATEGORY	1981	1991			
		F75	F100	F125	F150
Unsealed	425	137	137	137	137
1 Lane Seal	548	491	456	162	139
Narrow 2 Lane (6m)	6502	6300	5738	5083	3840
2 Lane (7m)	7267	7751	8315	8994	9909
3 and 4 Lane	483	515	531	574	827
4 Lane Divided	122	140	149	222	242
Other Divided	56	80	87	241	319

TABLE 3. Rural Arterials - 1981/90 Project lengths and costs by budget level.

ITEM	F75	F100	F125	F150
PROJECT LENGTH (km)				
Widening to 6 or 8 lanes	47	59	308	401
Duplication	49	79	309	410
Overtaking Lanes	51	72	188	459
Realign and widen 2 lanes	84	529	555	975
Realign existing width	158	524	427	482
Rehabilitate and widen 2 lanes	581	972	1921	2570
Rehabilitate existing width	1146	970	1500	1545
Widen 1 to 2 lanes	123	164	358	370
New 2 lane seal	213	213	298	298
New 1 lane seal	86	86	0	0
Gravel resheet	137	137	142	145
Bridges on new duplications (Number)	4	6	46	54
Bridges widened (Number)	137	203	276	361
Bridges replaced (Number)	132	137	135	136
Resurfacing	10121	10528	10512	9878
COSTS ($ million - 1980/81)				
Total Road Authority Cost	605	789	1011	1283
Vehicle operating cost	14637	14448	14396	14201
Accident cost	1233	1230	1144	1125
Travel time cost	10439	10329	9344	9151
Total Road User Cost	26309	26007	24884	24477

(c) Widening of two lane seals

Under all funding levels there was a large length of widening undertaken. It increased linearly from 665 km at F75 to 3545 km at F150.

(d) Realignment and Rehabilitation

The total length of reconstruction (both realignment and rehabilitation) increased linearly from 1969 km at F75 to 5572 km. The length of realignment jumped from 242 km at F75 to around 1,000 km at F100 and F125 as secondary arterial realignment was permitted; and to 1457 km at F150 when design speeds were increased. Rehabilitation showed a small increase from F75 to F100 (1727 km to 1942 km) then two large jumps to 3421 km at F125 and 4115 km at F150.

(e) Overtaking lanes

51 km and 72 km of overtaking lanes were constructed at F75 and F100 respectively. The relaxation of the warrants for overtaking lanes at F125 and F150 met with large increases in construction (to 188 km and 459 km).

(f) Duplication

As with most types of project there was only a small increase from F75 to F100 (49 km and 79 km) when compared with F100 to F125 and F125 to F150. At the two upper levels 309 km and 410 km of duplication would be built.

(g) Bridgeworks

The value of bridgeworks increased from $58 million at F75 to $94 million at F150. Around 135 bridges were replaced to overcome load capacity restraints at each level but the number of bridges on duplications and the number of bridges widened also increased significantly. Four and 6 bridges were duplicated at F75 and F100 and 46 and 54 at F125 and F150. One hundred and thirty seven bridges were widened at F75, 203 at F100, 276 at F125 and 361 at F150. Much of this work was necessary because of the widening of the adjacent roadway.

Road User Costs

Each increase in funding produced a decrease in three components of road user cost; vehicle operating cost, accident cost and travel time cost. The rate of decrease was not constant; overall, there was a drop of $302 million from F75 to F100, $1123 million from F100 to F125 and $407 million from F125 to F150. In percentage terms, the greatest drop from F75 to F150 occurred for travel time cost (12%). This was followed by accident cost with a 9% decrease and vehicle operating cost which was down 3%. In all cases an incremental increase in road infrastructure costs was more than outweighed by a reduction in road user costs.

INNER URBAN ARTERIALS

The proposed procedures are described in Cullinan (1982). They comprise:

(i) The analysis and description of the 1981 situation in terms of -

(a) the overall urban planning context,

(b) physical characteristics and condition of the road stock,

(c) traffic service provided by the road system

(d) major traffic problems

(e) relevant Government policies and strategies,

(f) levels of road expenditure and work output.

(ii) Development of three future funding levels for which traffic service and other effects are to be estimated -

(a) 1980/81 level continued, in constant values (F1)

(b) less 50% (F2)

(c) plus 50% (F3)

Within these overall levels funding values are to be determined for servicing and operating work; rehabilitation; minor improvement works; and major improvements and additions.

(iii) Estimation of traffic service effects for major improvements (greater than $1 million) from 1991 traffic assignments and for minor improvement works from:

(a) tabulation of "1991" inventory data values and other derived parameters serving as "proxy" traffic service measures; and

(b) the sum of estimated typical effects of various types of minor improvements.

The study encompasses all arterial roads in the built-up areas of Melbourne, Geelong, Ballarat and Bendigo. Inner urban Melbourne comprises all Cities within the statistical division plus the Shire of Diamond Valley.

Network performance measures from assignments

The road system performance measures to be derived from the 1981 and 1991 F1, F2 and F3 network assignment output are:

(i) Travel time, measured by network vehicle hours,

(ii) Travel distance, network vehicle kilometres,

(iii) Speed, ie (ii) divided by (i),

(iv) Travel cost,

(v) Congestion, measured by volume/capacity ratio,

(vi) Accidents,

(vii) Fuel consumption.

Most of the above measures will be reported for approximately 9 sub-regions as well as the Melbourne regional total.

In the case of speed the presentation will include graphs showing the distribution of % length and % travel by speed and tables showing the speed at which 15%, 50% and 85% of the road length and travel operates. A similar presentation is envisaged for congestion, using volume/capacity ratio benchmarks of 0.2, 0.4, 0.6, 0.8, 1.0 and 1.2.

Unlike earlier surveys the NRS emphasis will not be on a comparison of individual cities (or States) in terms of absolute quantities for a particular (deficiency) benchmark but in terms of the relative changes between 1981 and the three 1991 assignments for an individual city.

Traffic Service Measures

The type of traffic service measures which will be used to describe the 1981 inventory and the simulated 1991 inventory after the coding in of minor traffic improvements (less than $1 million) include:

(i) Road length and travel, at regional level, for 4 major road categories based on number of carriageways and access control, with sub-categories based on number of lanes, existence of service roads and availability of peak period parking.

(ii) Number of arterial/arterial and arterial/non-arterial intersections and corresponding throughput (vehicles entering per day) by type of intersection control.

(iii) Number and percentage of intersections with traffic signals, separately for linked or unlinked signals.

(iv) Number of intersections and throughput by number of approach lanes and traffic volume for signalised arterial/arterial intersections.

(v) Number and area of bridges by function, length, width, area, superstructure material.

(vi) Number of bridges by traffic volume by width.

(vii) Number of railway level crossings by warning device by traffic volume.

In many of the above cases the presentation will include graphs showing the distributions of, for example:

(a) length, travel and corresponding percentages by AADT or AADT/lanes.

(b) number and percentage of intersections by sum of vehicles entering, sum of vehicles entering divided by sum of lanes, product of AADTs, etc.

Progress to date

At the time of writing the NRS Study Team had defined the basic methodology and almost completed the detailed specification. The descriptive treatment of the 1981 situation for Melbourne has now been completed and work is under way on the three sets of 1991 traffic assignments. The assembly of up-to-date inventory data for Melbourne has commenced and a pilot study begun to test the feasibility of the method for minor improvements. Inventory collection is due to be completed by April 1983, analysis of minor improvements by September-October 1983 and all reporting finished by the end of 1983. No results are yet available.

LOCAL ROADS

Local roads, both urban and rural, are being investigated in a program of three studies; Stage 1, pilot study for Stage 2, and Stage 2.

The Stage 1 study, which was completed in November 1982, brought together Australian Bureau of Statistics data on unclassified roads (a proxy for local roads) aggregated at a Local Government Area (LGA) level. The pilot study for Stage 2, and subsequently Stage 2, will collect and analyse a much more detailed data set in selected LGAs.

The Stage 1 study of local roads enabled definitions of 5 categories of LGA to be established. The basis for the categories was:

1. Urban - proportion of urban population greater than 97%.

2. Part Urban Part Rural - proportion of urban population between 75% and 97%.

3. Dense Rural - remaining LGAs with a population density over 3.0 persons/sq km.

4. Medium Rural - remaining LGAs with a population density of from 0.3 to 3.0 persons/sq. km.

5. Sparse Rural - population density less than 0.3 persons/sq. km.

In Victoria the data has shown strong relationships between average values of population, area, road length and expenditure characteristics in the first four categories. (Omeo Shire is the only category 5 LGA in Victoria.) Further, the categories have been shown to be statistically different. A summary of the characteristics is given in Table 4. More details are contained in CRB (1982).

The Stage 2 pilot study is being undertaken in 6 LGAs, one of which is in Victoria, the Shire of Kaniva, primarily because the Shire Engineer is on the Working Party on Local Roads, a group with members from a number of States which assists the Study Team in developing methodology. Kaniva is in the medium rural category. The results of the pilot study are not yet available.

Stage 2 in Victoria requires the participation of a sample of 20 LGAs in Victoria. A random sample of LGAs was selected and the Victorian Local Government Technical Committee has agreed that the sample is representative. Those LGAs chosen are:

TABLE 4. Some Characteristics of Victorian L G A's

L G A Category	Number of L G A's	Percent State Area	Percent State Population	Expenditure in Category			Percent State Local Road Length	Percent Category Length Sealed
				%	$ / km	$ / capita		
Urban	74	1	70	45	5920	35	10	89
Urban / Rural	21	3	15	13	2550	51	7	46
Dense Rural	55	20	9	22	1260	116	25	26
Medium Rural	62	73	6	20	570	163	57	19
Sparse Rural	1	3	0*	0*	605	219	1	16

* negligible percentage

URBAN (7 out of 74) Keilor, Malvern, Newtown, Northcote, Shepparton and South Barwon Cities and Stawell Town.

PART URBAN PART RURAL (2 out of 21) Berwick City, Eaglehawk Borough.

DENSE RURAL (5 out of 55) Bass, Daylesford and Glenlyon, Heytesbury, Myrtleford and Rutherglen Shires.

MEDIUM RURAL (6 out of 62) Alexandra, Kara Kara, Leigh, Mount Rouse, Portland and Rosedale Shires.

The work content of Stage 2 includes:

(i) inventory of a sample of roads within the selected LGAs (1000 road segments will be inventoried throughout the State),

(ii) description of bridge statistics within each LGA with a random sample of waterway crossings subject to data collection,

(iii) reporting of work output and expenditure statistics and of LGA road management practices.

The specification for Stage 2 provides for each inventoried road segment to be allocated to one of three assessment groups : urban, rural or sparse rural. The basis is adjacent land use, and in the case of non-urban roads whether the LGA is in the sparse rural category (not relevant in Victoria). If the land use is urban then the inventoried length is 200 metres, otherwise it is 1 km.

The analysis period will be 10 years from 1981 to 1991. The funding levels to be assessed will be:

(i) the 1980/81 level, in constant prices

(ii) plus 25%

(iii) minus 25%.

Analysis of urban local roads

The analysis for this assessment group is based on the assumption that the first priority on funding for urban local roads is to operation and maintenance. Once this aspect of the network management has been satisfied, funds are directed towards reconstruction of the older streets. Reconstruction in this context generally means some sort of combined rehabilitation and improvement involving pavement remedial work and re-surfacing together with improvement of the cross section (and possibly drainage) to a contemporary standard.

The analysis procedure will involve quantification of current expenditure on, and rate of carrying out, this type of reconstruction. The effects of changes in the level of funding will be expressed in terms of:

(a) the changed rate of performing such reconstruction; and

(b) the change in the proportions of the network in various road states from the beginning to the end of the analysis period. The road states will be defined in terms of width, cross section and surface types.

Analysis of rural local roads

This group of roads will be assessed by both the method described for urban local roads and by using NIMPAC operating in a constrained way on a restricted inventory. The constraints on NIMPAC will consist of suppressing the alignment improvements and vehicle operating cost calculations and restricting the pavement reconstruction/rehabilitation and maintenance strategy calculations. The model will operate normally to generate new paving, new sealing and widening projects.

The restricted model will operate on limited real input data but be calibrated to produce realistic reconstruction, rehabilitation and maintenance projects and costs. A synthetic road life curve and threshold values of roughness will be used to generate rehabilitation projects at the appropriate time intervals. A value of pavement serviceability rating (PSR) converted to roughness or actual NRM reading will be used to initiate the process on each randomly sampled road section within each sampled LGA. At this stage it is unknown whether this proposed modelling approach for rural local roads will produce satisfactory results.

In Victoria it is possible that an additional analysis will be undertaken, using NIMPAC, on the more than 6,000 km of declared Main roads which are in the local road category. This will both supplement the results for unclassified roads and provide at least some indication of the effect of the two different methods used for rural arterial and local roads.

Expansion of results

Expansion of results from the sample to the population of Local roads will be undertaken on the basis of the physical characteristics (in terms of proportion of total length) determined from the sampled road section. Control totals on the length of local roads, according to surface type, for each LGA, category of LGA and road assessment group will be obtained by adjusting the road length data obtained in Stage 1 (unclassified roads) to represent NAASRA Local roads classifications.

Progress

At the time of writing the 20 sample LGAs had just been informed of their selection. Inventory data collection, including NAASRA roughness meter measurements for rural roads, will be undertaken by CRB staff in the first half of 1983, with analysis and reporting at Victorian level in the third quarter of 1983. The NRS Study Team will prepare the national report by the end of 1983.

CONCLUDING REMARKS

The first major Australian steps into the field of computerised national road management information and decision-making systems were undertaken by the CBRds only a decade and a half ago. This compares with a documented world history of road building stretching back two millennia. The NRS should be seen as a major step forward in the area of road inventory systems and computer modelling which will significantly assist the decision-makers and road managers of the 1980s.

The impetus given to the assembly of inventory data and detailed description of expenditure and work output by the need to meet the tight timetable for the NRS has provided an up to date information base for CRB planning investigations quicker than would otherwise have eventuated. The information produced and the techniques developed or refined as part of the NRS will also be extremely useful for the CRB's own management of Victoria's declared road system. These benefits are quite apart from the use to NAASRA (and the CRB) of the formal NRS reports.

ACKNOWLEDGEMENT

This paper is presented with the permission of Mr T H Russell, Chairman, Country Roads Board, Victoria. The views in the paper are those of the author and do not necessarily represent those of the Country Roads Board.

REFERENCES

Cleeland, J.E. and Both, G.J. (1982) "Rural Arterial Roads. Issues and Framework for Assessment", Proc. 11th ARRB Conf. Road Studies Workshop pp 35-53.

Country Roads Board (1982) "NAASRA Roads Study : Local Roads - Stage 1 : Report for Victoria" Advance Planning Division.

Cullinan, M.F., Krosch, A.D. and Bunton, R.B. (1982) "Urban Arterial Road Studies : Issues and Framework for Assessment", Proc. 11th ARRB Conf. Road Studies Workshop, pp 55-76.

Linsten, D. (1978) "The NAASRA Data Bank System Study" Proc. 9th ARRB Conf.

NAASRA (1978) "NAASRA Road Planning Model-NIMPAC", Documentation initially prepared by COMMED Associates and subsequent update by the NAASRA Data Bank Maintenance Group.

NAASRA (1981) Standard Operating Instructions for the NAASRA Roughness Meter and Guide for the Present Serviceability Rating of Road Pavements.

Stevenson, J. McL. (1976) "Pavements" NAASRA Economics of Road Vehicle Limits Study. Technical Report T4.

Underwood, R.T. (1982) "The NAASRA Roads Study" Proc. 11th ARRB Conf. Road Studies Workshop, pp 1-13.

Vincent, E.N. (1982) "Local Road Studies : Issues and Framework for Assessment" Proc. 11th ARRB Conf. Road Studies Workshop, pp 77-89.