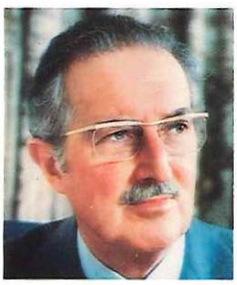
Country Roads Board
Victoria

Sixty-fifth Annual Report
for year ended 30th June, 1978

Presented to both Houses of Parliament
pursuant to Act No. 6229

The CRB is the State Road Authority of Victoria. The CRB's aim is to create an efficient road system within the context of the overall transportation needs of the community.
There are about 160,000 kilometres of public roads in Victoria, of which 23,697 km comprise the CRB's network of the State's principal roads.
The lengths of roads declared or proclaimed under the Country Roads Act are State Highways 7,030 km, freeways 284 km, main roads 14,555 km, tourists' roads 797 km, forest roads 1,031 km.

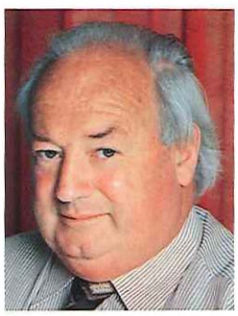


R E V Donaldson
Chairman

T H Russell
Deputy Chairman

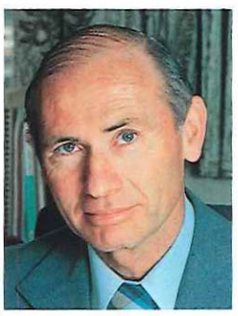
W S Brake
Member

Principal Officers
as at 30th June, 1978



Dr K G Moody
Engineer in Chief

N S Guerin
Deputy Engineer in Chief



N L Allanson
Secretary

G K Cox
Deputy Secretary

R G Cooper
Chief Accountant

R J C Bulman
Deputy Chief Accountant

Divisional Engineers and Regional Divisional Offices

A N Jephcott
Bairnsdale

T M Glazebrook
Bendigo

J W Heid
Horsham

F G Lodge
Warrnambool

E T Oppy
Ballarat

S H Hodgson
Dandenong

Vacant
Metropolitan

R R Patterson
Benalla

G W Marshallsea
Geelong

Dr D T Currie
Traralgon

Contents

Rural bridges — some of the new and one of the old.

1. A foggy day at the old bridge over the Buchan River in Buchan on the Bruthen-Buchan Road, Shire of Tambo. One of the more than 2,500 timber bridges in Victoria, many of which, like this one, have load limits to minimise deterioration.

2. Almost complete, a new bridge carrying the Bonang-Gelantipy Road across Stockyard Creek, Shire of Orbost.

3. Dusk at a new bridge carrying the Stawell-Warracknabeal Road over the Wimmera River at Glenorchy, Shire of Stawell.

4. Driving cattle across a new bridge carrying the Wy Yung-Calulu Road across Boggy Creek, Shire of Bairnsdale.

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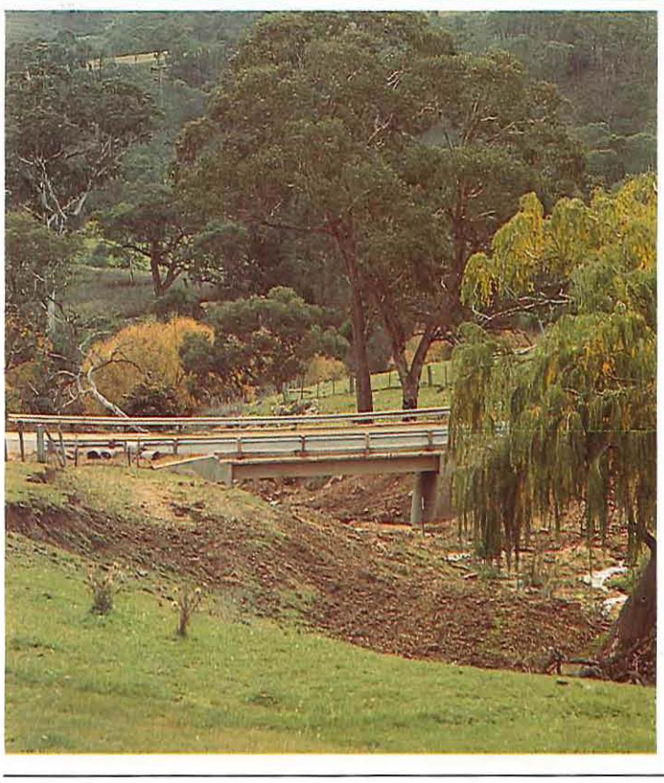

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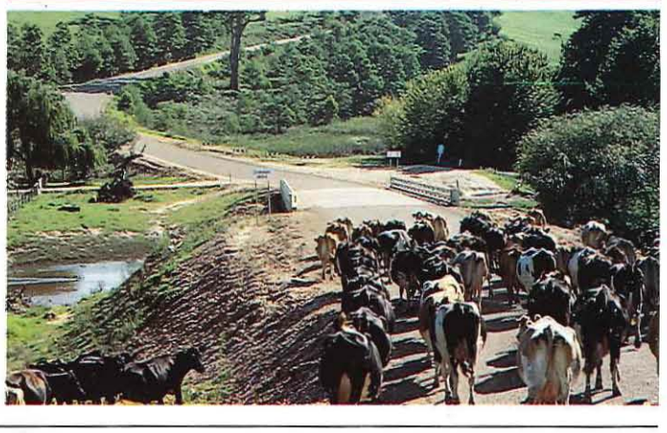


Review

Retardation of road programme

The Board has become increasingly concerned that work on many essential projects in urban and rural areas will not be commenced or will be retarded because of lack of sufficient funds. A shortfall in funds of $48 million is evident in financial year 1978/79.

Table 1 opposite lists the projects under the Board's direct control which will be affected and Table 2 gives an indication of the shortfall on municipal works for which the Board considers funds should be made available.

The rural state highway system

In rural Victoria there are more than 6,000 km of State highways, most of which have a sprayed bituminous seal surface over a pavement of natural roadmaking materials. In order to construct as much length of roads as possible with the available funds, such pavements were built using the principles of staged construction, with a minimum pavement depth to withstand the traffic loadings expected in the first decade or so of the life of the pavements.

To maintain the system in a satisfactory condition under increasing traffic volumes, it is imperative that each year approximately 3 to 4% of the system be reconstructed and approximately 12% be resealed. In 1977/78 and 1978/79 the Board was able to allocate sufficient funds to enable only approximately 1% to be reconstructed and only 10% to be resealed.

Unless substantially increased funds can be made available to enable a viable programme of reconstruction together with maintaining an adequate resealing programme on the rural State highway system, serious deterioration of long lengths of rural State highways could occur.

Rural bridge replacement programmes

There are approximately 8,500 bridges and major culverts in the rural road system in Victoria. More than half of these are over 30 years old and were not constructed for heavy, high speed traffic. Between 2,500 and 3,000 of these bridges are of timber construction and subject to deterioration from a number of causes. To replace the timber bridges alone would cost approximately $180 million and at present rates of expenditure would take more than 50 years. In this period many of the bridges would have collapsed or have had severe load restrictions imposed unless additional maintenance costs to repair these bridges were incurred.

A structure which is deficient whether by physical deterioration or insufficient width is a serious hazard and could well be the cause of an accident costing the community more than the cost of replacing the structure. It is essential that additional funds be made available for expenditure to replace old timber bridges on the rural road system.

Declared roads system in Melbourne metropolitan area

The Board's expenditure on land acquisition, construction and reconstruction on the declared roads system in the Melbourne Metropolitan Planning Area has declined from $46.6 million in 1974/75 to $37.3 million in 1977/78 (in constant money terms at 1974/75 prices). The decline occurred on freeways (down $9.5 million) whilst State highways, main roads and tourists' roads increased by $0.2 million. Substantial increases in expenditure on the maintenance of the system will be needed and this will result in a corresponding reduction in the funds available for the development and improvement of the system. This decline in road construction funds is taking place in spite of the following facts:

(i) the 1976 Australian Bureau of Statistics Motor Vehicle Usage Survey indicates that total travel increased by approximately 5% per annum over the five years from 1971 to 1976;

(ii) recent travel time surveys by the RACV show that peak period travel times have increased by an average of 25% over a five year period;

(iii) peak period travel speeds have declined by about 5 km/h in the inner suburbs over the past five years.

Without additional major investment to improve these roads, increases in congestion will continue.

Requirements for land acquisition

A major problem facing the Board is the need to purchase properties for future road works. The announcement of new projects generates requests by owners for the Board to purchase properties and the inclusion of projects in planning schemes brings obligations on the Board to purchase properties well in advance of road works.

The purchase of these properties places a severe drain on the Board's resources and reduces the funds for expenditure on construction and reconstruction works. The indications are that in 1978/79 the Board will be faced with claims totalling $33 million for land acquisition compared with expenditure of $22.53 million in 1977/78.

Roads under municipal control

Municipal councils are concerned at their inability to maintain roads in a satisfactory condition due to the low level of the Board's allocations.

The following table shows the comparison between applications for funds received from municipal councils and the allocations made by the Board for main roads and unclassified roads.

	Municipal applications for funds		Allocations to municipalities		
Year	Actual	1974/75 constant money value	Final Alloc.	1974/75 constant money value	% of allocation to application
	$000s	$000s	$000s	$000s	
1974/75	112,571	112,571	54,641	54,641	48.5
1975/76	146,092	125,293	64,513	55,328	44.2
1976/77	163,477	123,940	76,093	57,690	46.5
1977/78	160,781	112,828	77,980	54,722	48.5
1978/79	174,774	113,859	79,625*	51,873	45.6

*Original allocation

Alternative sources of finance

The Board recognises that loan funds would be appropriate to finance land acquisition and major construction works but has been denied access to this source of finance for many years. The Board made a submission to the Government on the desirability of this source of finance being made available to the Board.

The only alternative sources of increased funds available to the Board are from traditional Commonwealth or State Government sources.

The Commonwealth Government has shown no indication of raising its contribution to the maintenance and development of the State's roads, and as the table below indicates, Victorian motorists are receiving back less than half their investment in fuel taxes in the form of road grants.

The most readily available additional funds for the Board would be an increase in State motor vehicle and trailer registration fees. In the Board's opinion, an increase in registration fees by at least 40% should be implemented as soon as possible.

Comparison of fuel taxes and road grants

The proportion which Commonwealth road grants to Victoria have borne to the amount of customs and excise duty on fuels collected in the Victorian marketing area is as follows:

Year	Customs and excise duty paid in Vic. market area	C'wealth grants for roads (inc. Planning and Research)	Proportion grant duty
1974/75	$195.6 m	$77.09 m	39.4%
1975/76	$199.0 m	$89.30 m	44.9%
1976/77	$206.0 m	$92.50 m	44.9%
1977/78	$218.0 m (est)	$101.04 m	46.3%

Table 1: projects under CRB direct control

Significant projects which will not be commenced or will be retarded in 1978/79 due to lack of funds.

Urban projects

Project	Description of work	Amount of shortfall
		$000s
West Gate Freeway	Construction of the eastern section from Graham Street to St Kilda Road	1,800
Route E6	Construction of new route Eastern Freeway to Harp Road	1,400
Eastern Freeway	Extension of freeway from Thompsons Road-Doncaster Road	2,600
Princes Freeway	Berwick Bypass	300
Mornington Peninsula Freeway	Construction of freeway carriageways along Wells Road between Springvale Road and Eel Race Road	1,000
Mornington Peninsula Freeway	Construction freeway from Moorooduc Road to Dromana	1,000
Burwood Highway	Provide additional lanes between Springvale Road and Wantirna-Sassafras Road	800
Mulgrave Freeway	Construction between Warrigal Road and Forster Road	1,500
Princes Highway West	Duplication from Princes Freeway to Werribee including intersection treatment at Hoppers Crossing	400
Princes Highway West	Board's proportion of Latrobe Terrace level crossing abolition project, Geelong	500
Latrobe Terrace	Reconstruction between Hope Street and Fyans Street, Geelong	500
Tullamarine Freeway	Construction between Calder Freeway and Lancefield Road	500
Calder Freeway	Keilor Bypass	2,150
West Gate Freeway	Construction of eastern and western approach roads	2,000
Nepean Highway	Widening of highway between Elsternwick and Moorabbin	6,000
Total Urban Works:		22,450

Rural projects

Project	Description of work	Amount of shortfall
		$000s
Princes Highway East Section 1	Extend duplication east of Pakenham	1,040
Princes Freeway	Construct bypass of Drouin	1,020
Princes Freeway	Construct duplicate carriageway and Watsons Road interchange	650
Princes Highway East Section 6	Reconstruct failed pavement (Rankins to Wingan River)	350
Princes Freeway	Asphalt strengthening (Little River to Hovells Creek)	500
Princes Highway West Section 3	Construct deviation on improved alignment at Cudgee	220
Calder Highway Section 2	Reconstruct at Ravenswood including new bridges at Bullock and Buckeye Creeks	300
Cann Valley Highway	Reconstruct beyond Fiddlers Creek including new bridge	200
Omeo Highway Section 1	Replace road over rail bridge in Bruthen	250
Omeo Highway Section 3	Reconstruct narrow section beyond Omeo	300
Murray Valley Highway Section 2	Reconstruct through Rutherglen	300
Murray Valley Highway Section 2	Complete reconstruction east of Strathmerton	200
Murray Valley Highway Section 4	Reconstruct west of Wood Wood	250
Northern Highway	Reconstruction north of Pyalong	300
Maroondah Highway	Reconstruct Acheron to Breakaway Road including new bridge at Connellys Creek	350
Ovens Highway	Replace bridge over Ovens River at Porepunkah (including approaches)	470
Glenelg Highway	New bridge and approaches at Mt Emu Creek, Skipton	250
Pyrenees Highway	Reconstruct at Shepherds Hill east of Carisbrook	230
Pyrenees Highway	Reconstruct at Mooneys Gap	300
Henty Highway Section 1	Reconstruct south of Branxholme	240
Henty Highway Section 1	Reconstruct (including duplication) in Hamilton	400
Hamilton Highway	Reconstruct (above flood level) west of Inverleigh	400
Ocean Road Section 3	Reconstruct (Otway Lighthouse Road to Calder River)	400
Goulburn Valley Section 2	Reconstruct South of Seymour	110
Midland Highway Section 5	Reconstruction north of Swanpool	210
Total Rural Works		9,240
Total Direct Works		31,690

Undercover bus stop at Doncaster Shopping Town.

Table 2: municipal works

Division	Municipalities affected	No. of projects	Total amount of shortfall
			$100s
Bairnsdale	7	10	0.495
Ballarat	6	6	0.604
Benalla	12	17	0.714
Bendigo	8	11	1.821
Dandenong	16	25	2.799
Geelong	6	10	1.054
Horsham	7	7	0.404
Metropolitan	10	14	4.909
Traralgon	6	12	2.462
Warrnambool	14	29	1.138
Total	92	141	16.400

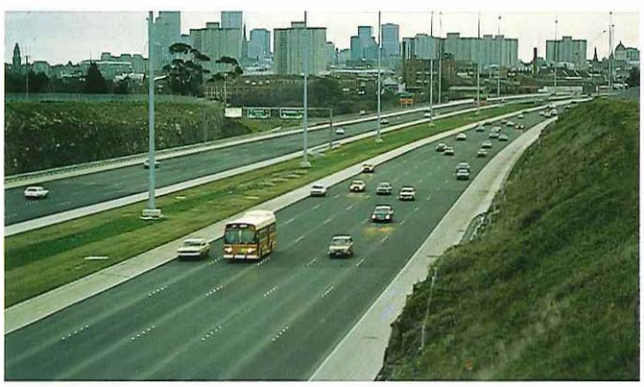
Rubber-tyred public transport

There is a growing awareness in the community that various forms of transport are needed to satisfy the travel requirements of those who live in any urban area. Within tne Melbourne metropolitan area, the most concentrated movement of passengers is to and from the Central Business District — and this is appropriately handled by the existing fixed rail system. However, this movement to and from the Central Business District is only a small part of the total travel in the metropolitan area.

The majority of travel in the metropolitan area is inter-suburban travel for work, shopping, schooling, recreation and other purposes. This type of travel has widely dispersed origins and destinations, and it cannot be efficiently or economically served by train or tram. Instead, it is very appropriately handled by buses and taxis.

In peak periods, the efficiency of road based public transport is frequently impaired by private cars, but there are several types of traffic engineering measures which can be taken to improve this situation. Traffic lights can be adjusted to give preference to buses or trams, provision can be made for buses to make turns which are banned to other vehicles and provision can be made for exclusive use by buses of particular sections of road.

Although there are currently no roads in Melbourne which have sufficient density of buses (more than 40 per hour) to justify long lengths of exclusive bus lanes, there are instances where short lengths of exclusive bus lane are justified. For example, in Punt Road immediately south of Swan Street and on the Eastern Freeway on the exit lane to Hoddle Street, there are such short lengths to enable buses to pass cars at traffic lights. It can be expected that this measure will be used at other locations in the future.



Eastern Freeway public and private transport flowing freely during evening peak.

Bus services in urban areas can provide a flexible route coverage particularly in serving developing areas where demand is low. The services can be extended later as demand grows. A further advantage is increased accessibility to the buses and reduced walking distances for patrons.

In rural areas, buses can provide a viable, effective service for levels of patronage which would be uneconomic for trains. Country school buses (although not strictly public transport) have enabled country children to enjoy a type of education which would not otherwise have been possible.

The Board makes provision for the operation of public transport on new roads and freeways where this is needed. The design and construction of the Eastern Freeway was heavily influenced by the Government's decision to provide for the proposed East Doncaster railway line in the median. At present, express buses are using the freeway.

The design and construction of main roads and State highways regularly include the provision of bus bays for the safe transfer of passengers. In this regard, the Government's decision to abandon the earlier proposed Frankston to Dandenong railway line in favour of a bus service along the Dandenong-Frankston Road will have an influence on the Board's construction programme. The conversion of this road to a dual carriageway road will further progress as funds permit and provision will be made for the effective operation of the bus service.

In the future, the Board will be placing increased emphasis on the provision for rubber-tyred public transport in the planning, design, construction and management of roads.

Eastern Freeway — exclusive bus lane on exit ramp at Hoddle Street.

Eastern Freeway

During December 1977, the Eastern Freeway between Collingwood and Bulleen was opened to traffic in three stages, from Hoddle Street, Collingwood to Chandler Highway, Kew; Chandler Highway to Burke Road, Kew; and Burke Road to Bulleen Road, Bulleen.

The construction of the freeway commenced under the control of the Melbourne and Metropolitan Board of Works in 1971. In July 1974 the responsibility for the project was transferred to the CRB when the metropolitan roading responsibilities of the Melbourne and Metropolitan Board of Works were transferred to the CRB.

The project involved four million tonnes of earthworks, the construction of 16 bridges and the asphalting of 9 km of road pavement. The freeway generally consists of four lanes in each direction (8-lane capacity) with five lanes in each direction (10-lane capacity) between Hoddle Street and the Chandler Highway.

The freeway was designed to provide an aesthetic travelling environment for the motorist. It follows the line of the Yarra River Valley, bordering the Yarra Bend Park and three golf courses. Extensive landscaping was carried out on the freeway reserve.

During the past seven years trees, shrubs and ground cover were planted progressively as earthworks were completed, and much of the vegetation is now well established. Some further landscaping work is still proceeding.

The new freeway provides significant benefits for motorists, and adds vital additional road capacity in the area.

Residential streets, as well as existing arterial roads, in Collingwood, Kew and Balwyn will benefit as much of the through traffic will use the Eastern Freeway. This will result in greater freedom of movement for local traffic, pedestrians and shoppers; reduced hazards and accidents; and improvements to the local residential environment.

In February and March 1978 traffic counts on and adjacent to the Eastern Freeway recorded volumes on the freeway of 51,600 vehicles per 24 hour day; on Eastern Highway (Alexandra Parade) between Wellington Street and Smith Street, 29,100 vpd (10,400 vpd 1977); on Hoddle Street north of Johnston Street 52,600 vpd (40,600 vpd 1977); on Johnston Street at the Yarra River, 25,100 vpd (40,800 vpd 1977); on Heidelberg Road at the Merri Creek, 33,800 vpd (52,400 vpd 1977).

Regretfully, anti freeway groups and representatives of the Collingwood and Fitzroy City Councils actively opposed the opening of the freeway. This opposition unfortunately led to violent confrontations, involving police.

In October 1977, Alexandra Parade between Gold Street and Nicholson Street was declared a State highway (the Eastern Highway) under the provisions of the Country Roads Act.

The Board expresses its appreciation for the manner in which its personnel carried out their duties and commends the Victoria Police on their efficient and responsible action in what was a most difficult situation.

Hume Freeway, Wallan-Broadford Section

The Hume Freeway (Wallan-Broadford Section) project involved the construction of 34.5 km of rural four lane dual carriageway freeway to replace an existing single carriageway highway following a different alignment. Work commenced in 1971 and the project was opened to traffic in May 1976.

Following pavement problems on the freeway the Government decided to retain the services of Dr David Croney, OBE, BSc, PhD, FICE, FInst HE, the recently retired head of the Pavement Design Division of the Transport and Road Research Laboratory, Great Britain, to advise generally on the suitability of the pavement to accept the final asphalt overlay provided for in the pavement design. Dr Croney's terms of reference were "to report upon the design and construction of the Hume Freeway, Wallan to Broadford Section and the suitability of all the pavement and substructure (including drainage facilities) for the addition of the final asphalt overlay".

Dr Croney carried out his task during January 1978 and reported his findings to the Honorable the Minister of Transport in a report dated 1st February, 1978.

Dr Croney submitted the following summary of conclusions and recommendations:

"(1) An investigation of the present condition of the pavement of the Hume Freeway has shown that the thickness of the base and sub-base layers as designed was quite adequate for the soil foundation condition and the traffic being carried.

(2) The foundation is sound and well drained: no additional subsoil drainage is necessary.

(3) The standard of construction and supervision as indicated by the uniformity of the layers and their thicknesses is regarded as excellent.

(4) The primary cause of the failures in the Glenelgin Interchange area, soon after the road was opened to traffic, was the use in that area of a cementitious additive which was intended to improve the grading of the crushed stone base. This rendered the material both brittle and difficult to compact. As a consequence the surface disintegrated under traffic stresses.

(5) Had a substantial part of the bituminous surfacing, required by the design, been added at the time of construction, the failures of the base might have been avoided or their effects been delayed for a considerable time. (The practice of delaying the placing of bituminous surfacings on pavements with compacted stone bases is economically sound for lightly trafficked roads, but it cannot be recommended for major roads carrying high speed commercial traffic.)

(6) The rapid deterioration of bituminous patches intended to repair the original failures was primarily due to the use of an unsatisfactory asphalt mixture containing a large proportion of soft degraded aggregate."

Dr Croney made the following recommendations:

"(1) The defective areas of patching should be removed and replaced with bituminous material made from sound aggregate and to a specification set out in Appendix 4 of the Report.

(2) The whole pavement should be overlaid by a two-course bituminous surfacing of total thickness 95 mm and to a specification set out in Appendix 5 of the Report.

(3) Both of these recommendations should be implemented as soon as possible to avoid further damage during next winter."

Dr Croney made the following additional comments:

"The application of valid long-term experience gained on less heavily trafficked roads, to high speed freeways which attract long haul heavy vehicles, has resulted in widespread and expensive pavement failures in every country where industrial freeways have been constructed.

Viewed in this context the problems on the Hume Freeway must be regarded as minor."

The Board regards Dr Croney's recommendations as confirming its view that the pavement was sound and suitable to receive an asphalt overlay.

Contracts were let during the year for the application of the asphalt overlay between Wallan and Big Hill. Work was suspended in early June because of poor weather conditions.

The application of the final asphalt overlay over the complete section of freeway between Wallan and Broadford is expected to be completed before Christmas 1978.

Hume Freeway — asphalt paving south of Wandong.

West Gate Freeway, South Melbourne Section

The West Gate Freeway formerly known as the F9 Freeway will provide a continuation from the eastern approaches to the West Gate Bridge at Graham Street, Port Melbourne to Grant Street, South Melbourne. The freeway is needed to cater for West Gate Bridge and Johnson Street Bridge traffic and will provide a southerly bypass of the city centre resulting in a vastly improved road connection between the western and south-eastern suburbs.

Eight traffic lanes at ground level will be provided from Graham Street to Johnson Street. From Johnson Street, the freeway will be elevated to east of Kings Way with a basic six-lane configuration. Beyond Kings Way an arterial road connection will be provided along Grant Street to St Kilda Road.

Interchanges will be provided at Graham Street, Port Melbourne and at Johnson Street and Kings Way in South Melbourne. Connections to Sturt Street and Power Street will provide access to Alexandra Avenue.

During the year the Board's major activity on the project concerned the purchase of property, the demolition of buildings along the freeway route and the necessary design work.

As at 30th June, 1978, 57 properties had been purchased and 40 demolished.

The necessary alterations to the existing freeway between Graham Street and Rogers Street to cater for traffic from the West Gate Bridge, when open for traffic, proceeded satisfactorily during the year.

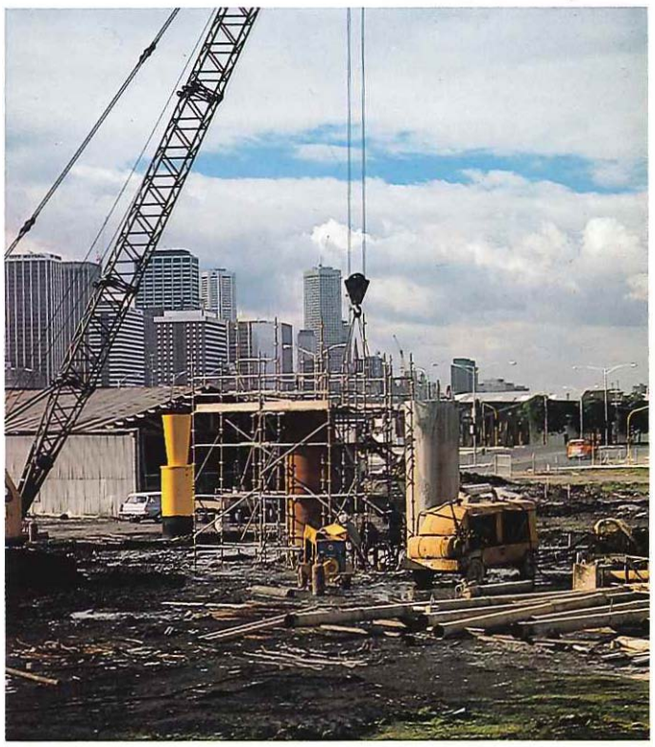
Work started in March 1978 on the sinking of the first piles for the elevated section of the freeway. Approximately 380 piles varying in width and depth, will be required for the construction of two parallel bridges each 1900 m long, making them the longest bridges in the State after the West Gate Bridge.

An extensive study into the short term and long term measures necessary to cater for traffic in the South Melbourne and Port Melbourne areas was carried out by the Board with the co-operation of the Councils. The following reports were completed as part of the study to assist in the design of the freeway and in developing short term improvements for traffic.

Volume 1: Land Use and Environment Survey.
Volume 2: Traffic Survey.
Volume 3: Short Term Traffic Management.
Summary of Short Term Improvements.
Volume 4: Long Term Traffic Management.
Volume 5: F9 (West Gate Freeway) Corridor Development.
Volume 6: F9 (West Gate Freeway) Impacts.

The West Gate Freeway, South Melbourne Section is estimated to cost $80 million in 1978 prices and is programmed for completion by late 1983.

The provision of additional funds by the Government of $19.1 million over the next four years beyond those presently budgeted would enable the whole project to be completed in November 1982 with the at grade section to Johnson Street being ready for traffic in June 1981 and the northern carriageway of the elevated structure being ready for traffic in April 1982.



West Gate Freeway — first piles near Johnson Street bridge for elevated structure.

Western Freeway, Ballan Section

The Western Freeway, Ballan Section, was opened to traffic late in the financial year and declared complete by the Hon J A Rafferty, Minister of Transport at a ceremony held at Ballan on 15th June, 1978.

Western Freeway, Ballan Section — Completion Ceremony.

The project involved the construction of 8.4 km of divided carriageways providing two lanes for traffic in each direction and the construction of 9 bridge structures. Full diamond interchanges are provided at the eastern end of the project and at Daylesford Road. Overpasses are available at Greendale Road and Racecourse Road and bridges have been constructed over the Werribee River and Eastern Moorabool River. Construction commenced in January 1976 and was completed at a cost of approximately $9.8 million.

The new freeway bypasses the township of Ballan to the north, and links the already completed Pykes Creek and Gordon Sections of the Western Freeway. Other sections of the Western Freeway completed in previous years are Pykes Creek (7.1 km) 1969, Gordon (9.3 km) 1972, Bacchus Marsh (9 km) 1972, Pentland Hills (5.6 km) 1973, and Myrniong (5.9 km) in 1975. Preliminary work began during the year on the Western Freeway bypasses of Wallace and Bungaree. When this 11.2 kilometre section is completed in approximately 1981 motorists will be provided with a continuous four lane road from the outskirts of Melbourne to Ballarat, a distance of 100 kilometres.

Western Freeway, Ballan Section

Corridor traffic control by traffic signal co-ordination

In recent years the Board has been involved to an increasing extent in planning and implementing traffic management measures in conjunction with road improvements of all kinds on the Board's declared road system.

The involvement has been necessary to achieve the greatest efficiency of traffic movement on the existing road system, to facilitate the maximum relief of "traffic pressures" on residential and other sensitive areas and to provide for the more efficient movement of on-street public transport vehicles.

One of the most significant traffic management measures is the co-ordination of traffic signals. Such co-ordinated systems have already been implemented at St Kilda Junction, in Hoddle Street from the Eastern Freeway to Albert Street, and in Kings Way (in association with Melbourne City Council).

Further systems are being or will be installed on the Johnson Street Bridge project, along the Eastern Highway (Alexandra Parade) and on the Maroondah Highway in Ringwood. Planning and design work is also proceeding on systems for the Burwood Highway (in association with the tramway extension) and on the Nepean Highway between Elsternwick and Moorabbin.

Co-ordinated systems will be developed progressively according to the needs of traffic and the availability of funds, initially on State highways and other declared roads, but the systems will have the potential for extension to include other arterial roads where found to be desirable and where suitable arrangements can be made with relevant municipal councils.

The Board considers traffic signal co-ordination to be an important and integral part of its road improvement programme and proposes to allocate funds for such works on a continuing basis as part of its annual works programmes.

In developing these concepts, and the existing operational systems, the Board's engineers have maintained liaison and consultation with engineers of the Road Safety and Traffic Authority.

Flooding in Eastern Victoria

Extensive flooding in Eastern Victoria during June 1978, caused widespread damage to roads, road closures and hazards to traffic, particularly over the Queen's Birthday holiday weekend.

The South Gippsland Highway between Sale and Longford and the Cann Valley Highway in East Gippsland were closed by flood waters for most of June. The major State highway in Eastern Victoria, the Princes Highway East, was closed briefly on two occasions, east of Bairnsdale at Broadlands.

Other State highways closed were the Midland Highway, south of Morwell and the Bonang Highway. Many other roads in the Board's Bairnsdale and Traralgon Divisions were also closed and severely damaged during the month. Preliminary estimates indicated that restoration costs would exceed $2 million.

The elevated freeway bypass of Orbost, with major new bridges constructed over the Snowy River and the adjacent flood plains and completed in December 1977, provided access to Orbost, while the old highway route was under water during the peak period of the flood.

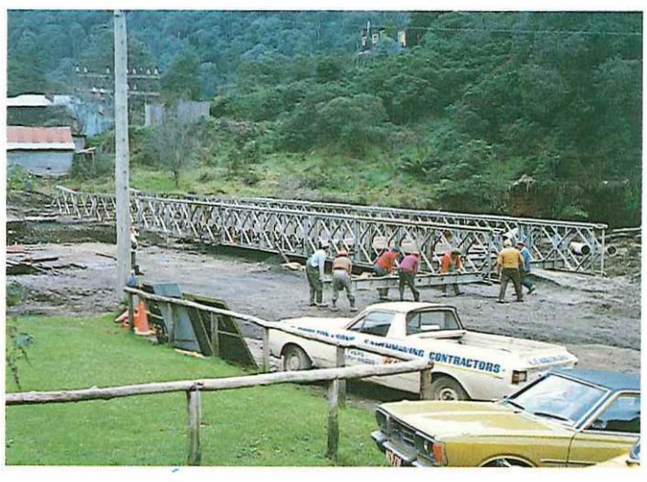
Grants for the restoration of roads and bridges damaged by floods are made by the State Government in accordance with the terms of the Commonwealth/State agreement for natural disasters. Under this agreement the State Government meets the first $3.5 million of restoration costs and the Commonwealth Government meets any additional amounts required.

Assistance to individual authorities is available up to 75% of total restoration costs, but where the total cost is more than $100,000, assistance is available to within $25,000 of the total.

Assistance is not available for any expenditure incurred in restoring assets beyond the standards which existed prior to the disaster.

Applications from councils for funds to restore roads and bridges damaged by floods are referred to the Board for investigation and recommendation to the Treasurer.

Erection of a Bailey bridge across Stringer's Creek, Walhalla, following a washout of the old bridge during the flooding in the south east of the State.



The road system

State highways

State highways are the principal arteries forming interstate connections and links between the larger centres of population in the State. Some State highways in Victoria form part of the National Route system of highways with uniform route numbering throughout Australia. The Board bears the full cost of both construction and maintenance works required to meet the needs of through traffic. The total length of State highways was 7,030 km, as at 30th June, 1978.

Significant works completed or substantially completed during the financial year are listed in the Road Construction and Maintenance section of the report.

The Hume Highway /Freeway and the Western Highway /Freeway have been declared by the Commonwealth Minister for Transport as national highways under the provisions of the States Grants (Roads) Act 1977. These declarations permitted funds made available by the Commonwealth to be spent on the Hume Highway/Freeway and the Western Highway /Freeway.

Freeways

A freeway is a road having dual carriageways with no direct access from adjoining properties and side roads. All crossings of a freeway are by means of overpass or underpass bridges, and traffic enters or leaves the freeway carriageways by means of carefully designed ramps. The Board bears the total cost of all work on freeways.

Significant works completed or substantially completed during the financial year are listed in the Road Construction and Maintenance section of this report.

Tourists' roads

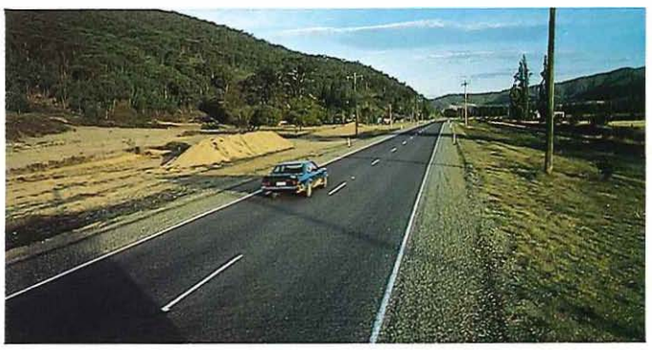
Tourists' roads proclaimed under the provisions of the Country Roads Act provide access to places of special interest to tourists, both in summer and winter. The Board bears the full cost of works required to cater for the needs of through traffic. In general the works are carried out under the direct supervision of the Board's staff.

Significant works completed or substantially completed during the financial year are listed in the Road Construction and Maintenance section of this report.

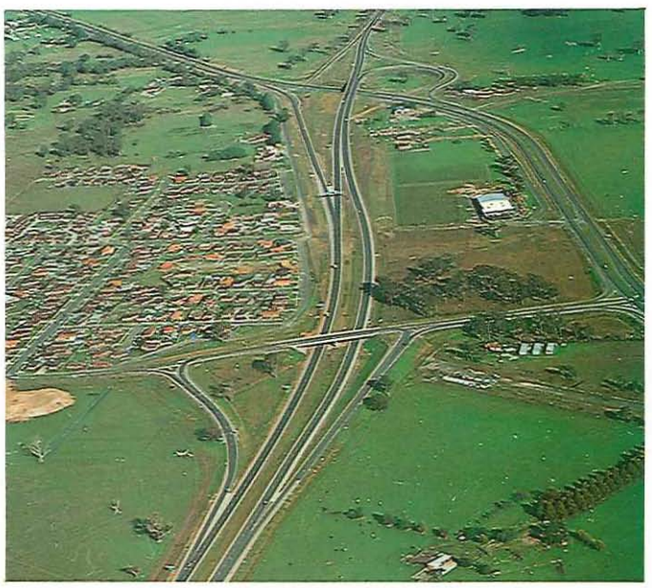
Forest roads

Forest roads proclaimed under the provisions of the Country Roads Act are situated within or adjacent to any State forest or in areas which are considered by the Board to be timbered, mountainous or undeveloped. The Board bears the full cost of works required to cater for the needs of through traffic, with approximately half the work carried out on these roads being undertaken by municipal councils on behalf of the Board.

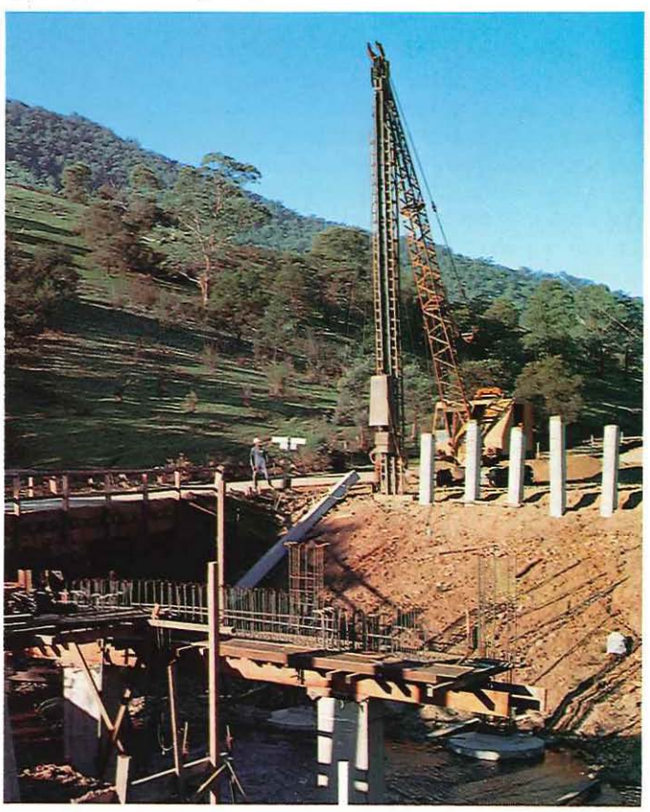
Significant works completed or substantially completed during the financial year are listed in the Road Construction and Maintenance section of this report.



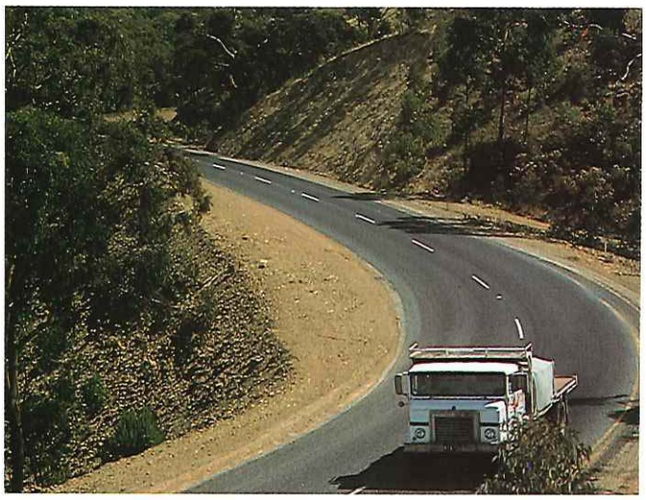
Ovens Highway reconstruction completed between Ovens and Eurobin.



South Gippsland Freeway, Hampton Park.



Dargo Forest Road, Shire of Bright, construction of new bridge across Castleburn Creek.



Whittlesea-Yea Road, Shire of Yea, reconstruction completed at Junction Hill.

Main roads

Main roads are roads linking centres of population with other centres or with areas of industry, commerce, or settlement. Generally main roads are constructed and maintained by municipal councils to the satisfaction of, and with financial assistance from, the Board. In some cases, at the request of the council and with the approval of the Minister, works are carried out under the direct supervision of the Board's staff. A summary of the more important work on main roads completed or substantially completed during the year is given in the Municipal section of this report.

The total length of roads declared or proclaimed in Victoria under the Country Roads Act was 23,697 km as at 30th June 1978.

The Declared road system

'000s km	0 2 4 6 8 10 12 14 16 18 20 22 24
State Highways	7,030
Freeways	284
Tourists' Roads	797
Forest Roads	1,031
Main Roads	14,555
Total length of declared road system	23,697

Unclassified roads

Roads which are not included in the Board's declared and proclaimed road system are referred to as unclassified roads. These roads are the responsibility of municipal councils, but each year the Board provides financial assistance towards the cost of construction and maintenance works, generally in accordance with priorities allotted by municipal councils. Municipal contributions are determined at the time the allocation is made, and are based on many factors including the nature, extent and location of the particular work and the financial position of the municipal council concerned.

A summary of the more significant works on unclassified roads completed or substantially completed during the year with financial assistance from the Board appears in the Municipal section of this report.

The amount of money spent on each type of road is outlined in the Finance Section of this Report.

Lengths of State highways, Freeways, Tourists' roads and Forests roads

As at 30th June, 1978

State Highways — declared as at 30.6.78

Name	Route	Length (kilometres)
Bass	Lang Lang-Inverloch	60.6
Bellarine	Geelong-Queenscliff	31.6
Bonang	Orbost-NSW border near Delegate	113.1
Borung	Dimboola-Charlton	123.3
Burwood	Burwood-Ferntree Gully	20.4
Calder*	Melbourne-Mildura	560.1
Cann Valley	Cann River-NSW border	44.9
Eastern*	Nicholson Street-Gold Street	1.2
Glenelg	Ballarat-SA border near Mt Gambier	282.2
Goulburn Valley	Eildon-Strathmerton	223.8
Hamilton	Geelong-Hamilton	231.0
Henty	Portland-Lascelles	346.1
Hume*	Melbourne-NSW border near Albury	210.5
Kiewa Valley	Bandiana-Mt Beauty	78.7
Loddon Valley	Bendigo-Kerang	123.7
Maroondah	Melbourne-Mansfield	184.6
McIvor	Heathcote-Bendigo	44.2
Midland*	Geelong-Ballarat	
	Bendigo-Shepparton	
	Benalla-Mansfield	414.7
	Morwell-Port Welshpool	78.9
Murray Valley	Corryong-Hattah	737.0
Nepean	Melbourne-Portsea	91.1
Northern	Kilmore-Echuca	161.9
Omeo	Bairnsdale-Tallangatta	282.2
Ouyen	Ouyen-SA border near Pinnaroo	130.7
Ovens	Wangaratta-Bright	76.2
Princes (East)*	Melbourne-NSW border near Genoa	482.2
Princes (West)*	Melbourne-SA border near Mt Gambier	401.9
Pyrenees	Elphinstone-Ararat	147.0
South Gippsland*	Dandenong-Yarram-Sale	254.4
Sturt	Mildura-SA border near Renmark	113.6
Sunraysia	Ballarat-Calder Highway	340.0
Warburton	Lilydale-Warburton	34.6
Western*	Melbourne-Serviceton	381.2
Wimmera	Apsley-St Arnaud	222.2

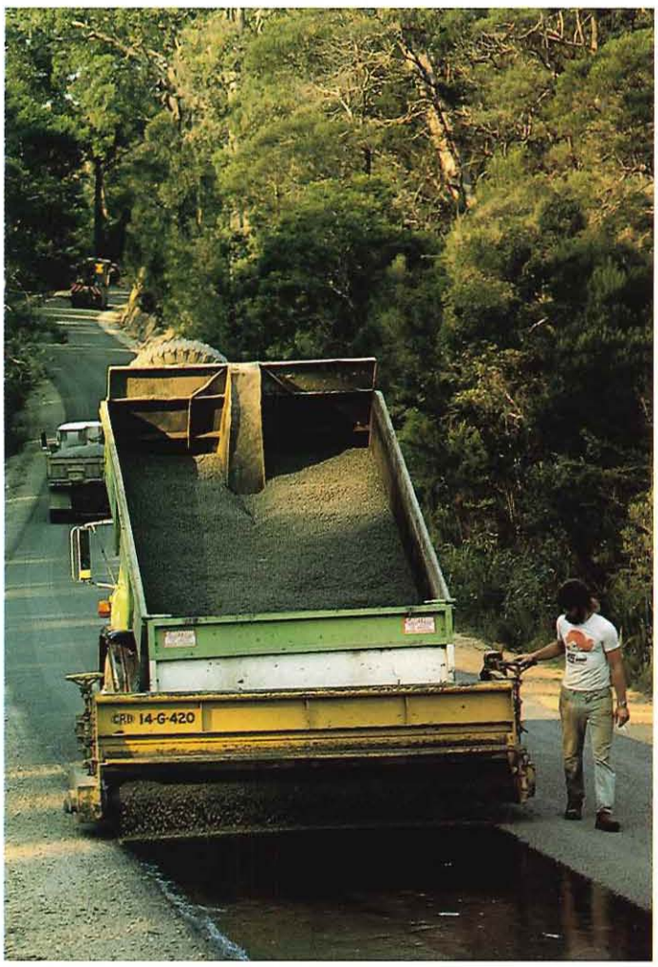
*Lengths quoted do not include freeway sections.

Kangertong-Glenleeson Road, Shire of Minhamite, reconstruction.

Work on Tourists' Roads for the benefit of recreational travel.

1. Mallacoota Road — resurfacing.
2. Mallacoota Road — construction of new bridge across Halls Creek.
3. Bogong High Plains Road — reconstruction between Mt Beauty and the Gatehouse.
4. Mt Buller Road — reconstruction at Glenroy Road intersection.

1



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2

Freeways — as at 30.6.78

Name	Section	Length (kilometres)
Calder	Keilor	2.8
	Elphinstone	2.8
Eastern	Hoddle Street to Bulleen Road	9.0
Frankston	Eel Race Drain to Beach Street	7.0
Hume	Craigieburn to Kalkallo	8.3
	Beveridge	3.2
	Wallan-Broadford	34.8
	Broadford to Tallarook	15.6
	Chiltern	21.3
Lower Yarra	Bertie Street to Graham Street	0.3
	Williamstown Road to Princes F'way	5.1
Midland	Yinnar	9.6
Mornington Peninsula	Dromana to Rosebud	8.4
Princes	Mulgrave	15.7
	Moe and Haunted Hills	19.7
	Laverton	12.8
	Lara	24.4
	Maltby	10.2
	Dartmoor	3.0
South Eastern	Anderson Street to Tooronga Road	6.8
South Gippsland	Whitelaw	3.8
	Princes Freeway to Pound Road	5.6
Tullamarine	Flemington Bridge to Melbourne Airport	20.9
Western	Deer Park to Melton	13.3
	Bacchus Marsh	8.7
	Pentland Hills	9.5
	Pykes Creek	7.3
	Ballan	7.8
	Gordon	9.4

Forest roads — declared as at 30.6.78

Name	Municipalities	Length (kilometres)
Bairnsdale-Dargo	Avon and Bairnsdale Shires	20.8
Bealiba-Moliagul	Bet Bet Shire	9.0
Beech Forest-Mt. Sabine	Otway Shire	12.6
Benambra-Corryong	Omeo, Tallangatta and Upper Murray Shires	76.5
Benambra-Limestone	OmeoShire	14.3
Bendoc-Orbost	Orbost Shire	20.9
Brookville	OmeoShire	15.9
Bruthen-Buchan	TamboShire	36.5
Buchan-Ensay	Tambo Shire	19.8
Bullumwaal-Tabberabbera	Bairnsdale Shire	30.3
Carrajung-Woodside	Alberton Shire	17.7
Dargo	Avon Shire	74.8
Deans Marsh-Lorne	Winchelsea Shire	22.9
Drummond-Vaughan	Daylesford and Glenlyon and Newstead Shires	20.9
Epsom-Fosterville	Huntly Shire	21.2
Forrest-Apollo Bay	Otway Shire	19.7
Greendale-Trentham	Ballan and Kyneton Shires	23.8

Forest roads — declared as at 30.6.78 (cont)

Name	Municipalities	Length (kilometres)
Heyfield-Jamieson	Mansfield and Maffra Shires	145.5
Inglewood-Rheola	Korong Shire	17.3
Kimbolton	Strathfieldsaye Shire	13.5
Lavers Hill-Cobden	Heytesbury and Otway Shires	42.7
Meredith-Steiglitz-Maude	Bannockburn Shire	20.7
Murrungower	Orbost Shire	21.3
Portland-Nelson	Portland Shire	38.6
Red Knob	Tambo Shire	7.2
Tatong-Tolmie	Benalla Shire	36.3
Walhalla	Narracan, Mansfield and Upper Yarra Shires	110.7
Warburton-Woods Point	Healesville, Upper Yarra and Mansfield Shires	103.4
Warrowitue	McIvor Shire	16.5

Tourists' roads — declared as at 30.6.78

Name	Municipalities	Length (kilometres)
Acheron Way	Healesville and Upper Yarra Shires	35.4
Alpine	Bright and Omeo Shires	83.0
Arthur's Seat	Flinders Shire	8.1
Bogong High Plains	Bright and Omeo Shires	66.7
Cameron Drive	Gisborne and Newham and Woodend Shires	4.3
Donna Buang	Healesville and Upper Yarra Shires	34.0
Gipsy Point	Orbost Shire	2.4
Grampians	Ararat, Dundas and Stawell Shires and Stawell Town	69.5
Great Ocean Road	Barrabool, Winchelsea, Otway, Heytesbury and Warrnambool Shires	207.2
Mallacoota	Orbost Shire	22.5
Mount Abrupt	Ararat and Mount Rouse Shires	24.8
Mount Buffalo	Bright Shire	39.0
Mount Buller	Mansfield Shire	27.0
Mount Dandenong	Sherbrooke and Lillydale Shires	21.8
Mount Victory	Arapiles, Stawell and Wimmera Shires	30.7
Marysville-Woods Point	Healesville Shire	18.9
Otway Lighthouse	Otway Shire	12.9
Phillip Island	Bass and Phillip Island Shires	23.4
Silverband	Stawell Shire	9.1
Sydenham Inlet	Orbost Shire	21.6
Wartook	Wimmera Shire	3.5
Wilson's Promontory	South Gippsland Shire	31.0

Road construction and maintenance

Major projects

During the year the Board continued work on 18 projects, each having an estimated cost of at least $4 million. Many of the major projects included the construction of divided roads which as a result of work completed during the year have increased the total length of dual carriageways on freeways, State highways and main roads throughout the State to 752 km. The more important major projects in progress during the year included:

URBAN

Mulgrave Freeway

Work continued on the construction of the 3.7 km extension of the freeway from Forster Road to Warrigal Road, Oakleigh. Earthworks and the relocation of services progressed satisfactorily and construction began on the Huntingdale Road overpass.

The freeway is expected to be opened to Huntingdale Road late in 1979, and to Warrigal Road in 1981.

The extension is estimated to cost $12 million at 1978 prices.

West Gate Freeway

Work began on the 3.6 km West Gate Freeway, between Graham Street, Port Melbourne and Grant Street, South Melbourne. The freeway will be elevated for 2 km between Johnson Street and Kings Way, and eight of the 380 pile foundations required for the elevated structure were constructed as test piles to provide information for the remaining pile foundations.

Alterations to services and demolition of property were also commenced.

The freeway, estimated to cost $80 million, is programmed for completion by late 1983.

A more detailed description of this project is included on page 9 of this report.

Eastern Freeway

The 9 km Eastern Freeway, between Hoddle Street, Collingwood and Bulleen Road, Bulleen, was opened to traffic during December, 1977. This section of the freeway is generally of eight lane capacity, with 10 lanes between Merri Creek and the Chandler Highway interchange. The central median is designed to cater for a fixed rail public transport system to serve the East Doncaster area.

The total cost of this section of the Eastern Freeway including associated works in Hoddle Street was approximately $84.5 million. A more detailed description of the project is included on page 7 of this report.

Planning and design for the easterly extension of the Eastern Freeway from Bulleen Road to Doncaster Road, North Balwyn continued during the year.

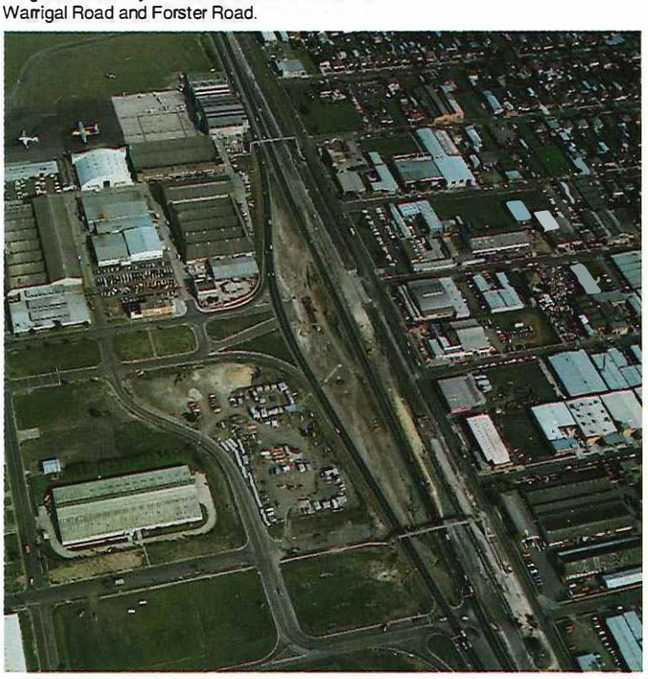
Tullamarine Freeway

Work continued during the year on the upgrading of Lancefield Road, adjacent to the Essendon Airport, to freeway standard. Construction of an interchange at English Street to provide access to the Essendon Airport progressed satisfactorily. The project is expected to be completed in late 1979 at an estimated cost of $6 million.

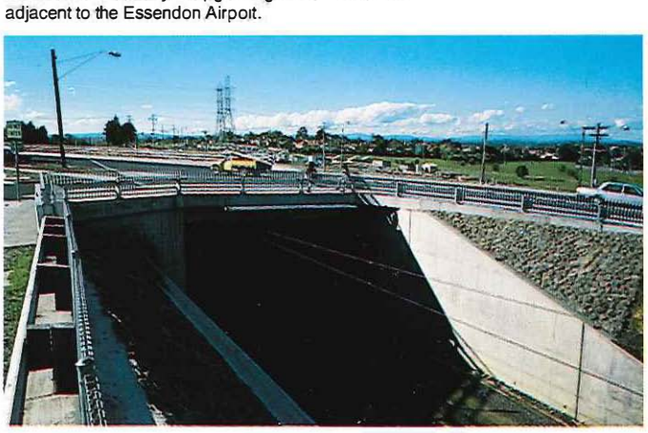
Greensborough Freeway

Lowering and duplication of the Melbourne-Hurstbridge railway line and the construction of road over rail overpasses at Watsonia Road and Grimshaw Street were completed during the year. The work cost approximately $5.7 million.

Mulgrave Freeway — under construction between Warrigal Road and Forster Road.



Tullamarine Freeway — upgrading Lancefield Road adjacent to the Essendon Airport.



Greensborough Freeway — Watsonia Road overpass.

Johnson Street Bridge
Work on the Johnson Street Bridge over the Yarra River to link the West Gate Freeway with Footscray Road was in its final stages at the end of the financial year. The bridge is scheduled to open early in the second half of 1978. Four lanes will be provided for traffic in each direction and the project is estimated to cost $30 million.

Mornington Peninsula Freeway
Construction continued on the 6.7 km section of the Mornington Peninsula Freeway between Springvale Road, Keysborough and Eel Race Drain, Seaford. Work included earthworks in the vicinity of Thompson Road and the Patterson River, construction of the Patterson River bridges and the Thompson Road interchange.
The freeway is estimated to cost $11.7 million and is scheduled for completion in late 1980.

Nepean Highway
Work continued on the widening of 6 km of the Nepean Highway between Cochrane Street, Elsternwick and South Road, Moorabbin. Demolition of properties on the first section between Cochrane Street and Hampton Street, and pre-construction tree planting were well advanced.
The project is estimated to cost $32 million at 1978 costs and is scheduled for completion in 1983.

Calder Freeway
Work began during the year on the 5 km Calder Freeway, Keilor Section, between Erebus Street and the Keilor-Melton Road, with the diversion of the Maribyrnong River being completed.
The project is estimated to cost $16.6 million at 1978 prices and is scheduled for completion in 1983.

South Gippsland Freeway
Work was completed on the freeway interchange with the South Gippsland Highway and on the northbound freeway carriageway between the South Gippsland Highway and Pound Road. The approximate cost of the project was $10 million.

RURAL

Hume Highway/Freeway
Seymour to Avenel
Work continued over the 20 km section from the Goulburn Valley Highway north of Seymour, to north of Avenel.
Bridgeworks proceeded at Hughes Creek, Avenel, and at the freeway crossing of the North Eastern Railway/Hume Highway, south of Mangalore.
The project is estimated to cost $35 million at 1978 prices and is scheduled for completion in 1983.
Avenel to Tubbs Hill
Duplication work on the 12 km section of the existing Hume Highway continued during the year.
This section is estimated to cost $7.5 million at 1978 prices and is scheduled for completion in mid 1979.
Bypass of Violet Town
Work continued on the construction of a 6.1 km freeway bypass of Violet Town including the construction of twin freeway bridges across Honeysuckle Creek.
The project is estimated to cost $6.5 million at 1978 prices and is scheduled for completion late in 1979.

Western Freeway
Ballan Section
The 8.4 km freeway bypass of Ballan was completed in June 1978. The project involved the construction of dual carriageways and nine bridges.
The project cost was approximately $9.8 million.
A more detailed description is included on page of this report.
Wallace-Bungaree Section
Preliminary work began on the 11.2 km freeway section bypassing the townships of Wallace and Bungaree. The Ballarat Water Commission started work on the relocation of a water channel and pipe line.
The project is estimated to cost $11 million at 1978 prices and is scheduled for completion in late 1983.

Princes Highway East
Morwell-Traralgon
Construction of 12 km of divided highway between Morwell and Traralgon continued during the year. Work on the last 2 km section is scheduled for completion in August, 1978, and the project is estimated to cost $4 million.

Princes Freeway
Drouin to Warragul
Earthworks and bridgeworks on the 7 km Drouin Section of the project continued during the year.
The estimated cost of the project is $31 million at 1978 prices.
The Drouin Section is scheduled for completion in 1982 and the Warragul Section in 1984.
Orbost
Work was completed on a project to provide an 8.4 km flood free crossing of the Snowy River flood plain and a bypass of Orbost. The project was completed in December, 1977 at an approximate cost of $9.9 million


Hume Freeway, Seymour to Avenel Section — bridges over Hughes Creek.


Hume Freeway, Violet Town Bypass — bridge over Honeysuckle Creek.

Contracts

Contracts under the Board's direct supervision

Details of the types and numbers of contracts entered into showing respective values, together with a comparison with those of financial year 1976/77 are shown in the following table:

	1976/77		1977/78	
Type of contract	No. of contracts	Value $	No. of contracts	Value $
Road construction—				
1. Over $1M	1	3,074,845	3	3,985,130
2. $100,000 to $1M	3	884,798	2	422,411
3. Under $100,000	1	26,884	4	178,540
Supply of roadmaking materials	112	5,173,648	134	7,927,294
Bituminous treatment and supply of materials	54	11,130,377	85	10,944,708
Bridge construction—				
1. Over $1M	—	—	—	—
2. $100,000 to $1M	9	2,640,745	3	595,336
3. Under $100,000	8	412,790	12	614,816
Components and fabricated steel	19	1,260,821	28	1,742,111
Construction equipment	19	1,389,507	18	678,811
Divisional facilities	1	64,489	3	193,383
Miscellaneous stores	2	520,000	5	2,660,375
Miscellaneous services	53	2,174,613	46	1,398,312
Total	282	28,753,517	343	31,341,227

Bituminous surfacing

Bituminous surfacing forms an important part of road construction and maintenance work.

A total amount of $28.7 million was spent in surfacing 5,088 km of road during the financial year. Approximately 96 per cent of the total length of bituminous surfacing done was of the sprayed seal type. The balance was of asphalt surfacing which is plant mixed and spread in a layer with a mechanical paver.

The sprayed seal process involves the spraying of a thin hot bituminous layer on to the road surface, followed by spreading a layer of aggregate which is rolled into the bitumen by pneumatic tyred rollers and controlled traffic. It is an economical surfacing process which provides a safe, skid resistant surface and for these reasons is used widely throughout the world.

For a successful sprayed seal to be obtained it is necessary for some loose aggregate to be left on the road surface on completion. The Board is conscious of the need to prevent windscreen damage caused by loose aggregate and provides appropriate warning signs, requesting motorists to travel slowly during the first few days after sealing. Traffic controlmen are also on duty while the work is in progress.

During the year the Board purchased a special Highway Suction Cleaner at a cost of approximately $113,000. This item of specialised plant is the first of its kind in Australia and was designed especially for removing loose aggregate from new seals on roads under traffic. It has been used mainly on the highly trafficked roads in the Melbourne Metropolitan area.

The Board's 17 mobile bituminous surfacing units, together with plant owned by municipal councils and contractors, completed 4,562 km of sprayed work at a cost of approximately $18,980,000.

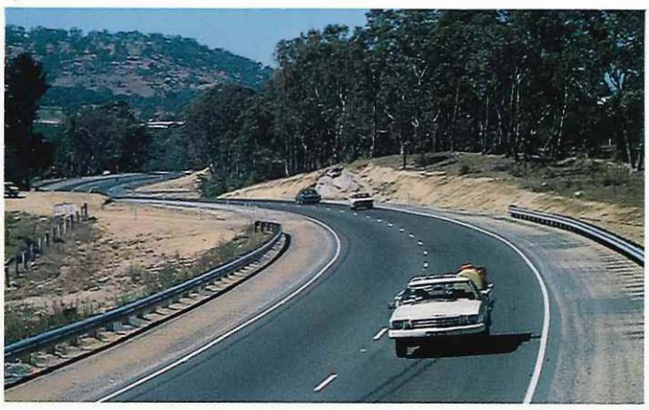
Contractors operating from fixed asphalt plants completed 194 km of plant mix work on densely trafficked roads at a cost of approximately $9.7 million using 400,230 tonnes of asphalt.

The lengths of the various types of work completed during the year were:

202 km of sealing widened pavements,
39 km of initial sealing on dual carriageways,
653 km of restoration of sealed coats on reconstructed sections,
520 km of final sealing on initial treatments,
2761 km of maintenance retreatments,
332 km sealed on behalf of other State and municipal authorities, and
581 km of extensions to the bituminous sealed road system of the State including 65 km of roads declared or proclaimed under the Country Roads Act.

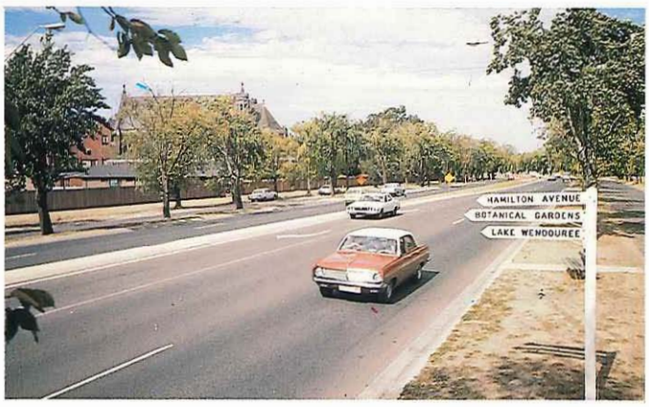
The following quantities of materials were used by the Board or by contractors during the year on bituminous surfacing works:

Material	Quantity
Bitumen for sprayed work	33,891 tonnes
Bitumen for asphalt	20,800 tonnes
Aggregate for sprayed work	302,000 cubic metres
Aggregate for asphalt	275,000 cubic metres
Other bituminous materials for sprayed work and maintenance	9,000 tonnes



Calder Highway — reconstruction north of Harcourt.

Princes Highway, Geelong.



Western Highway (Sturt Street) — duplication between Russell and Pleasant Streets, Ballarat.

Glenelg Highway, Hamilton.

State highways and Freeways

Significant works completed or substantially completed during financial year 1977-78.

Bellarine Highway
Bellarine Shire
Construction of twin cell culvert at Fenwick's Gully, and duplication of 2.5 km between Bawtree and Swan Roads.
Geelong City
Reconstruction of 2 sections between Moorabool Street and Yarra Street, and Swanston Street and Fitzroy Street.

Calder Highway
Keilor City
Widening to provide short-term improvements through Keilor township.
Metcalfe Shire
Reconstruction of 1.9 km north of Harcourt.
Walpeup Shire
Reconstruction of the intersection of the Calder Highway and Sunraysia Highway.
Walpeup Shire
Reconstruction of 2.1 km north of Kiamil.

Glenelg Highway
Glenelg Shire
Reconstruction and widening of 8.3 km east of Strathdownie.
Hamilton City
Stabilisation of pavement and realignment of kerbs between Grange Burn bridge and Cox Street.

Hamilton Highway
Leigh Shire
Reconstruction of 2 km west of Inverleigh.

Henty Highway
Portland Shire
Reconstruction of 2.1 km at Myamyn.

Hume Freeway
Violet Town Shire
Construction of 10 km of duplicate carriageway between Violet Town and Baddaginnie.

Midland Highway
Benalla Shire
Reconstruction of 2.6 km south of Swanpool, including the widening of a bridge at Swanpool.
Buninyong Shire
Reconstruction and realignment, including new climbing lanes, of 2.5 km at Buninyong Hill.

Murray Valley Highway
Cobram Shire
Reconstruction of 4.8 km west of Cobram.
Rochester Shire
Reconstruction of 2.6 km east of Gunbower.
Swan Hill City
Reconstruction with special parking, landscaping and pedestrian treatment, in Swan Hill township.

Ovens Highway
Bright Shire
Reconstruction of 0.4 km (Gavan Street) between Morses Creek and west of Anderson Street.

1

Improving the Princes Highway east of Melbourne.

1. Reconstruction east of Wingan River.
2. Bypass of Drouin and Warragul — earthworks on Drouin Section.
3. Duplication between Morwell and Traralgon.
4. Duplication at Pakenham.

3

4

2

Ovens Highway
Myrtleford Shire
Reconstruction and widening of 1.4 km between Ovens and Eurobin.

Princes Highway East
Buln Buln Shire
Construction of passing lanes at intersection with Longwarry-Labertouche Road.
Morwell Shire
Reconstruction of Jane Street intersection.
Orbost Shire
Widening and reconstruction of 3.3 km east of Reed Bed Creek.
Orbost Shire
Reconstruction of 1.5 km east of Wingan River.
Pakenham Shire
Duplication of 5.5 km between Officer and Pakenham.
Pakenham Shire
Construction of climbing lanes west of Bunyip River.
Warragul Shire
Duplication of 0.7 km west of Warragul.

Princes Highway West
Corio Shire
Widening of 2.9 km from 4 to 6 lanes.
Hampden Shire
Reconstruction of 2.9 km west of Camperdown.
Hampden Shire
Reconstruction of 2 km east of Garvoc.
Werribee Shire
Duplication of 0.8 km between Princes Freeway and Hoppers Crossing.

South Gippsland Highway
Cranbourne Shire
Reconstruction of intersection with Baxter-Tooradin Road.

Warburton Highway
Lillydale Shire
Construction of climbing lanes for westbound traffic at Wandin.

Western Highway
Ballaarat City
Reconstruction and duplication of 1.2 km (Sturt Street) between Pleasant Street and Russell Street.
Dimboola Shire
Construction of roundabout at intersection of the Western Highway and Borung Highway.
Horsham City
Construction of roundabout at the northern end of the duplicated carriageway on the southern approach to Horsham.

Wimmera Highway
Dunmunkle Shire
Reconstruction and widening of 10 km at Lallat Plains.

Tourists' roads

Significant works completed or substantially completed during financial year 1977/78.

Bogong High Plains Road
Bright Shire
Reconstruction and widening of 1 km between Mt. Beauty and the Gate House.

Forest roads

Significant works completed or substantially completed during financial year 1977/78.

Bealiba-Moliagul Road
Bet Bet Shire
Construction of 4 span bridge across Whitehead's Creek.

Walhalla Road
Narracan Shire
Reconstruction of 1 km south of Erica.

Land purchase

During the year the Board paid compensation and associated costs totalling $22.53 million for land required for the construction of new roads, the widening of existing roads or deviations from existing roads.

The expenditure incurred included $6,440,000 for the widening of the Nepean Highway from Elsternwick to Moorabbin and $3,949,000 for properties affected by the West Gate Freeway project.

The table below shows the road classification on which expenditure occurred.

	Commonwealth road category						
CRB road classification	National highways	Urban arterial roads	Urban local roads	Rural arterial roads	Rural local roads	Export roads	Total
	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Freeways	1,773	8,636	—	300	—	—	10,709
State highways	15	6,780	—	385	—	—	7,180
Tourists' roads	—	1	—	59	10	—	70
Forest roads	—	—	—	1	6	—	7
Main roads	—	2,774	—	172	76	—	3,022
Unclassified roads	—	1,114	202	1	203	17	1,537
Totals	1,788	19,305	202	918	295	17	22,525

The table below shows the number of land purchase transactions completed and the amount of compensation and associated costs paid by the Board over the five years.

	1973/74	1974/75	1975/76	1976/77	1977/78
Number of land purchase cases settled	864	923	661	671	786
Compensation and associated costs paid by the Board	$11.71m	$19.34m	$16.02m	$20.97m	$22.53m
Land purchase expenditure on unclassified roads under council supervision	$0.88m	$0.53m	$0.73m	$0.74m	$1.26m

Of the $22.53 million expended during the year, $8.07 million was spent in purchasing properties from owners who demonstrated that they were incurring hardship due to the Board's future road proposals.

The Board received $1,569,782 from 754 rented residential or commercial properties and 150 separate areas of vacant land.

During the year 64 separate areas of surplus land were sold for $1,296,587, 5 residential properties surplus to requirements were sold for $119,000 and 35 houses were sold for removal for $126,930.

The Board's objective in the payment of compensation is to ensure as far as possible that the owner is placed in the same financial position after the purchase of land as prior to the purchase.

A pamphlet entitled "Your property your roads" was issued during the year in an attempt to assist property owners in their dealings with the Board. Information contained in the pamphlet covers such matters as, negotiating the sale, property owners' entitlements, interest free loans, living in the property after compensation is paid, special cases of hardship and the actual payment of the compensation.

Bridges

Construction of new bridges

A total of 94 new bridges estimated to cost $12,545,000 were commenced during 1977/78.

The following table gives a comparison between the number and estimated cost of bridge projects commenced in 1977/78 and those for the preceding financial year.

Description	1976/77		1977/78	
	No.	Est. cost	No.	Est. cost
New bridges commenced under the supervision of the Board's staff	56	$12,670,000	42	$9,265,000
New bridges commenced under municipal supervision with financial assistance from the Board	55	$3,787,000	52	$3,120,000
Miscellaneous — Sign structures, poles, footings, stone beaching and block facing				$160,000
Total bridges commenced	111	$16,457,000	94	$12,545,000

Major bridges completed in rural areas

Some of the major bridges completed in rural areas during the year under the direct supervision of the Board's staff included:

Western Freeway, Ballan Section

☐ Eastern Interchange — two span concrete box girder structure, 100 m long and 9.8 m between kerbs.

☐ Werribee River — twin bridges, each three span prestressed reinforced concrete structure, 44.05 m long and 11.6 m between kerbs.

☐ Ballan-Daylesford Road Interchange — two span concrete box girder structure, 89 m long and 9.8 m between kerbs.

☐ Racecourse Road — twin bridges prestressed and reinforced concrete, each three span, 23 m long and 11.6 m between kerbs.

☐ Eastern Moorabool River — twin bridges of prestressed and reinforced concrete, 37 m long and 11.6 m between kerbs.

Princes Freeway, Drouin Section

☐ Buln Buln Road — three span prestressed and concrete structure, 36.9 m long and 11.6 m between kerbs.

Tambo Shire

☐ Nowa Nowa Main Road, road over rail overpass — three span prestressed concrete slab and reinforced concrete structure, 29.9 m long and 8.5 m between kerbs, plus 1.5 m footway.

Some of the larger bridges completed during the year under municipal supervision, with financial assistance from the Board were:

Stawell Shire

☐ Stawell-Warracknabeal Road, over the Wimmera River at Glenorchy, 10 span prestressed beams, 155 m long and 9.8 m between kerbs.

Avon Shire

☐ Bengworden Road, over the Avon River at Stratford, seven span, prestressed "I" beams, 129.8 m long and 8.6 m between kerbs.

Bulla Shire

☐ Sunbury Road, over Jacksons Creek, two span, prestressed concrete beam and slab, 48.1 m long and 8.6 m between kerbs.

Metropolitan bridges and overpasses

Among the larger bridges in the metropolitan area completed during the year under the direct supervision of the Board's staff were:

Eastern Freeway

☐ Yarra River Bridges — twin, five span reinforced concrete, prestressed and post-tensioned beams each 140 m long and 20.5 m between kerbs.

☐ Merri Creek Bridges — twin bridges each two span cast in situ continuous post-tensioned multi cell block, each 67.0 m long and 24.3 m between kerbs.

Mulgrave Freeway

☐ Scotchman's Creek Culvert — four cell precast concrete box culvert, 347.2 m long and 18 m wide.

Mulgrave Freeway — Scotchman's Creek Culvert.

Grade separated pedestrian crossings

The Board is involved in the construction of grade separated pedestrian crossings as outlined below:

1. The construction of pedestrian overpasses over freeways or other important arterial roads to improve pedestrian access to areas on either side of the road.
2. The replacement of at-grade school crossings on heavily trafficked roads with pedestrian overpasses or underpasses, under the scheme introduced by the Victorian Government in 1965. The scheme provides for:

☐ Applications for subsidies to be submitted to the Board by municipal councils;

☐ Priorities to be decided by the Board and the Road Safety and Traffic Authority, taking into account traffic volume, average speed, number and age range of children crossing, and the type of road;

☐ The total costs of approved crossings to be shared equally between the State Government (Treasury), the Transport Fund and the municipal council.

3. Assistance to municipal councils on request in the preparation of plans and specifications and supervision of construction in cases where the council pays the whole cost of construction.
The following crossings were constructed by the Board during the year:

Restoration of pedestrian access
☐ Greensborough Freeway, Watsonia Road Pedestrian Overpass — two span composite steel beam and reinforced concrete, 42 m long and 2.75 m wide, with two ramps each 15 m long.
☐ Greensborough Freeway, Grimshaw Street Pedestrian Overpass — single span post tensioned beam and RC structure, 26.17 m long.
☐ Eastern Freeway, Trennery Crescent Pedestrian Overpass — eight span pedestrian bridge of four post-tensioned and four reinforced concrete beams, 218.5 m long and 2.1 m wide.

Grade-separated crossings to serve schools
☐ Princes Highway, Dandenong, Dandenong High School Pedestrian Overpass — six span post-tensioned and reinforced concrete structure, 157 m long and 2 m wide.
Twenty structures have now been constructed under the Victorian Government scheme.

Elimination of railway level crossings

In 1954 the State Government established the Level Crossings Fund with a view to providing finance to assist with the elimination of dangerous railway level crossings. Contributions were made by the Board and the Victorian Railways towards the cost of the projects. Since then 64 road overpasses, or underpasses, at a cost of more than $42 million have been constructed to eliminate railway level crossings.
Since 1st July, 1974, the total cost of this work has been charged to the Transport Fund.
The following projects were substantially completed by the CRB during the year.
☐ Princes Highway West, road over rail overpass at Weerite — three span prestressed concrete and reinforced concrete 41.97 m long and 9.76 m between kerbs.
☐ Camp Road, road over rail overpass, Broadmeadows — five span prestressed and reinforced concrete structure, 118.2 m long and 21.7 m between kerbs including two 8.5 m carriageways and three span off-ramp, 6 m wide.

Concrete Award

The overpass carrying Yarra Bend Park Road over the Eastern Freeway received a certificate of merit from the Concrete Institute of Australia in its 1977 Excellence in Concrete Awards. The Institute made the award, one of six merit certificates from 40 entries of buildings and structures, for the "excellent way in which the concrete was used in this project".
The bridge was designed by the consulting firm Macdonald Wagner and Priddle Pty Ltd for the Planning and Highways Branch of the MMBW. It was constructed by Central Constructions Pty Ltd, which has since become part of Leighton Contractors Pty Ltd.
The overpass is a single span, portal frame, cast in situ prestressed concrete box structure, 91 metres long and 7.3 metres between kerbs.
The overpass was completed in August 1975, at a cost of $400,000 and was one of the projects under construction when the roading responsibilities of the MMBW were taken over by the CRB on 1st July, 1974.


Princes Highway — pedestrian overpass near Dandenong High School.


Princes Highway — road over rail overpass under construction at Weerite.


Camp Road, Broadmeadows — elimination of railway level crossing.


Award winning bridge.

Road planning

Road planning studies

The road planning function of the Board is an essential and highly sophisticated operation, involving all of the many diverse skills required to reach a compatible balance between the community's desire for mobility and its various other needs. The staff of the Board's Planning Sub-branch brings together engineering, sociological, economic, environmental and town planning expertise in formulating and evaluating future road proposals. Specially trained officers in the Board's service, together with specialised equipment, are also able to provide technical advice on noise and air pollution, landscaping and general environmental matters.

Significant planning studies in which the Board was involved during the year are described below.

Outer ring corridor study

In July 1977, the recommendations from the Outer Ring Corridor Study were forwarded to the Government. The study was under the control of the Road Planning Liaison Committee, consisting of representatives of the Ministry of Transport, the Melbourne and Metropolitan Board of Works and the Board, and examined the strategic significance of a new transport route around the main built up area of Melbourne.

The main recommendations from the final study report were:

(a) that action be taken to preserve the opportunity to construct an Outer Ring road;

(b) that for the longer term development of an Outer Ring road, planning should proceed in conjunction with local Councils and with appropriate public participation on the basis of an ultimate six lane freeway;

(c) that special attention should be given to the section between Diamond Creek and Ringwood due to the nature of the area, the absence of a Melbourne Metropolitan Planning Scheme reservation and the imminent development of the area in some sections.

Outer ring, Diamond Creek to Ringwood study

In adopting the recommendations of the Outer Ring Corridor Study, the Government announced its decision to proceed with a study for the section of the Outer Ring road, Diamond Creek to Ringwood.

As with the earlier Outer Ring Corridor Study, the Road Planning Liaison Committee is responsible to the Government for directing the current investigation and recommending a course of action.

The aim of the study is to determine the most appropriate future road system in the area between Diamond Creek and Ringwood which will enable the Melbourne Metropolitan Planning Scheme to be amended to preserve the option of future development of the road system, if required.

The detailed work of the study is being carried out by the Joint Road Planning Group, comprised of officers from the Melbourne and Metropolitan Board of Works and the Board.

Other authorities and organisations will also be consulted, including the Ministry for Conservation, the Middle Yarra Advisory Council, the State Electricity Commission and the Town and Country Planning Board.

The local municipal councils will be kept informed on the progress of the study and are being invited to contribute.

The major steps of the investigation are to:

☐ Develop a range of alternatives and make these available to the councils and the community for comment.

☐ Discuss the alternatives with the councils and the community and modify or refine where necessary in response to local suggestions.

☐ Prepare and publish an "Environment Effects Statement".

☐ Receive final council and community comments.

☐ Arrange for independent assessment of the statement and comments from the Ministry for Conservation.

☐ Make recommendations to the Government for a decision in principle.

Depending on the approved course of action any necessary amendment to the Melbourne Metropolitan Planning Scheme will then be sought.

Omeo Highway between Omeo and Mitta Mitta

During the year the Board carried out a further investigation into the alternatives of either upgrading the existing Omeo Highway between Omeo and Mitta Mitta or constructing a new low level deviation of the highway.

The further investigation followed a previous study, the results of which were conveyed to the municipal councils concerned in January 1974. Since then, the State Co-ordination Council has been evaluating the alternatives with the objective of providing an improved road link between the north-east and eastern areas of the State.

The investigation involved the preparation of base data from topographical maps, aerial photographs, existing survey data, road inventory data, and field measurements. Geological maps and stream catchments were examined in detail. Horizontal and vertical alignment plans were produced for each route.

The design standards adopted were similar to previous studies with some reduction where topographical conditions were so severe as to make desirable standards very difficult and costly to attain.

The design standards adopted were:

Design speed	60-70 km/h 40 km/h	(generally) (minimum)
Curve radius	130 m + 50 m	(generally) (minimum)
Superelevation	1 in 10	(maximum)
Grade (desirable)	6-7% 8%	(ruling) (general maximum)
Formation width	8.6 m + 0.9 m (drain) + 0.6 m (widening for guide posts)	
Pavement width	8.6 m	
Sealed width	6.2 m with 7.4 m (on curves)	

An examination of snow, ice and fog conditions was carried out in conjunction with an officer from the Bureau of Meteorology. The general conclusions were:

☐ Snow is certain to occur more often on the existing Omeo Highway but the days on which snow is deep enough to close the highway are few and snow clearing can rapidly correct this situation.

☐ Ice can occur on either alternative and depends for its formation on a complex set of factors including the presence of water, air temperature, vegetation, aspect and air currents. On balance, it would appear that icing would be a greater problem on a low level deviation of the highway.

☐ Fog is unpredictable in its occurrence. It is not possible to conclude that either alternative has an advantage in this respect.

Comparison of alternatives
The following comparison was formulated between the two alternatives:

		Upgraded Omeo Highway	New Low Level Deviation
(1)	Length between common points	103 km	108 km
(2)	Maximum elevation	1380 m	900 m
(3)	Length in km above 900 m	30 km	—
(4)	Horizontal alignment—		
	(a) number of curves in the design speed range of		
	40-50 km/h	67	79
	50-70 km/h	94	93
	over 70 km/h	71	79
	(b) total number of curves	232	251
(5)	Vertical alignment — Length in km (excluding section common to both alternatives)		
	(a) 8%-10% grade	4.0 km	8.5 km*
	(b) 10%-12% grade	2.5 km	—
	(c) 12%	0.5 km	— (*Max. grade 8.8%)
(6)	Estimated construction costs in $ (June 1978)	$29.5m	$44.5m
(7)	Estimated maintenance costs for a 30 year period at June 1978 prices	$4.9m	$4.4m (Plus maintenance of existing Omeo Highway of $3.7m)
(8)	Estimated travel time for a truck	Similar	

Environmental effects
As a new low level deviation would be constructed in virgin bushland and would require considerable lengths of major cuttings and embankments involving the likelihood of erosion, there would be a major effect on the environment.
In the process of upgrading the existing Omeo Highway there would be some environmental disturbance. However, this would be minimal, as the progressive nature of the upgrading would allow re-establishment of vegetation and keep disturbance to relatively minor lengths. Also, the disturbance would be confined to a relatively narrow band along the highway.

Advantages of new low level deviation
The advantages of a new low level deviation were concluded to be:
(1) rare likelihood of closure due to snow;
(2) generally flatter grades.

Disadvantages of new low level deviation
The disadvantages of a new low level deviation were concluded to be:
(1) increased construction cost;
(2) greater overall maintenance costs;
(3) lack of opportunity for staging of construction, and hence of expenditure;
(4) possible icing problems;
(5) greater environmental impact; and
(6) slightly more tortuous route.

Conclusion
The investigations indicate that both the upgraded Omeo Highway and the low level route are essentially all weather routes. On the relatively small number of times when snow is of sufficient depth to impede traffic on the upgraded Omeo Highway route, effective snow clearing operations would be mounted without difficulty and keep the highway open.
The Board concluded and has so recommended that the only practical course of action is to upgrade the existing Omeo Highway.

Gardiners Creek Valley Study
The Board continued to be involved in the Gardiners Creek Valley Study, which investigated the need to link the South Eastern and Mulgrave Freeways.
The Government set up this corridor study involving the Ministry for Planning, Ministry of Transport, Ministry for Conservation, Melbourne and Metropolitan Board of Works, Town and Country Planning Board, Malvern, Camberwell and Hawthorn City Councils and the Country Roads Board to investigate and recommend a course of action on the future allocation of space in the Gardiners Creek Valley for transport, drainage, recreation, and other community uses.
The Steering Committee appointed to carry out the study forwarded its report and recommendations to the Government in January, 1978.
During the study, the community was kept fully informed of progress by the release of five bulletins, each with a distribution of about 25,000 in the Study Area. In addition, detailed technical reports prepared by the six study teams were also available for examination.
People were encouraged to respond and set out their ideas and views via group discussions, questionnaires, letters, phone calls and personal contact. All letters were individually answered and their contents summarised and classified as input to the Steering Committee and the Government. A display and mobile information centre were also arranged.
Three main issues were paramount throughout the study:
☐ increasing traffic and its intrusion into local streets, with its inherent adverse effects on the quality of the local environment;
☐ the importance of parks, creeks and open space, and
☐ the concerns of home owners of whose properties could be affected by any road proposals.
Consideration of these issues led the Steering Committee to reach the following basic conclusions:
1. The existing road system is unsuitable for carrying existing and expected future traffic.
2. There is a strongly expressed community view that the South Eastern and Mulgrave Freeways should be linked.
3. The significance of the Gardiners Creek Valley as a local and regional open space facility justifies provision for replacement of existing open space and sporting facilities which would be lost by making provision for the road reservation.
4. The section of Gardiners Creek between High Street and Scotchmans Creek is of such environmental importance to justify the selection of a route outside the existing reservation so as to avoid impact on this feature.
The Steering Committee recommended route "C3" which follows the Main Road Reservation in the Metropolitan Planning Scheme between Toorak and Burke Roads, then swings across to follow along the north side of the Glen Waverley railway line from High Street to East Malvern, then along Scotchmans Creek to the Mulgrave Freeway.
The Steering Committee reported that it recognised that the choice of route "C3" would undoubtedly conflict with the widely

expressed belief that any new road should be built within the existing Planning Scheme Main Road Reservation. However, the Committee considered that the choice of "C3" represents a compromise in favour of the needs of posterity in terms of the environment, recreation and traffic demand.
At the time of writing this Report a final decision on the Steering Committee's recommendation was still under consideration by the Government.
In addition to the above studies the Board continued its investigations on other road planning studies throughout the State, including the following:

Urban

☐ The Bell Street-Banksia Street connection, Heidelberg.
☐ The Eastern Freeway, Bulleen to Ringwood.
☐ A local bypass of Lilydale.
☐ The North-South Arterial Road Route, Sunshine.
☐ The Northern Arterial Road, Reynolds Road, Donvale, to Maroondah Highway at Croydon North.

Rural

☐ The Calder Freeway, Keilor to Diggers Rest Section.
☐ The Calder Freeway, Porcupine Hill to Big Hill Section.
☐ The Hume Freeway, Baddaginnie to Bowser Section.
☐ The Hume Freeway, Euroa Bypass.
☐ The Princes Freeway, Morwell Section.
☐ The Princes Freeway, Pakenham Section.
☐ The Princes Freeway, Tynong Section.
☐ The Princes Freeway, Geelong Bypass (in association with the Geelong Regional Commission).
☐ The Western Freeway, Ballarat Bypass.

Increasing traffic volumes in the developing outer areas of Melbourne

Traffic volumes in the developing outer areas of Melbourne have increased significantly over the last 10 years placing a heavier burden on many already over crowded roads and highlighting the need for road improvements.
Traffic counts conducted throughout Melbourne between 1968 and 1977 show traffic volume increases ranging up to 207%.
The map opposite illustrates the changes in traffic volume across a number of screenlines in the metropolitan area expressed as percentage increases from 1968 to 1977.
The percentage increases were obtained by counting the number of vehicles crossing an imaginary line in a nominated area, thus indicating the movement of vehicles in that area.
Traffic volume counts have also shown that on some major roads Sunday traffic volumes exceed the week-day volumes principally because of recreational trips. Some examples are shown in the following table:

Road	Location of Count	Traffic volumes, 24 hours two-way Week-day	Sunday
Maroondah Hwy	at Coldstream	Jan 1976	Jan 1976
		8,100	14,000
		July 1976	July 1976
		7,900	14,000
Sth Gippsland Fwy	at Princes Hwy East	Jan 1977	Jan 1977
		7,500	10,000
		July 1977	July 1977
		8,900	11,600
Princes Fwy	at Lara	July 1975	July 1975
		14,300	22,400
		Jan 1976	Jan 1976
		22,200	27,600

1977 Australian Roads Survey

On several occasions in recent years the member authorities of the National Association of Australian State Road Authorities have conducted surveys of the road system to assist the Commonwealth Bureau of Roads and later the Bureau of Transport Economics in its task of providing advice to the Commonwealth Government on the framing of road legislation.
A major survey, termed the Australian Roads Survey 1969-74, was conducted in 1971/72. Since then, two limited surveys have been carried out, one in 1975 and the other in 1977.
The 1977 survey was restricted to National highways and the arterial road system in both rural and urban areas.
The main phases of this survey were:

(i) collection of inventory data on roads and bridges,
(ii) identification of deficiencies,
(iii) generating and estimating the cost of improvement projects, and the preparation of maintenance estimates,
(iv) economic evaluation of improvement projects,
(v) selection of financial programmes allowing for restrictions on finance and other resources.

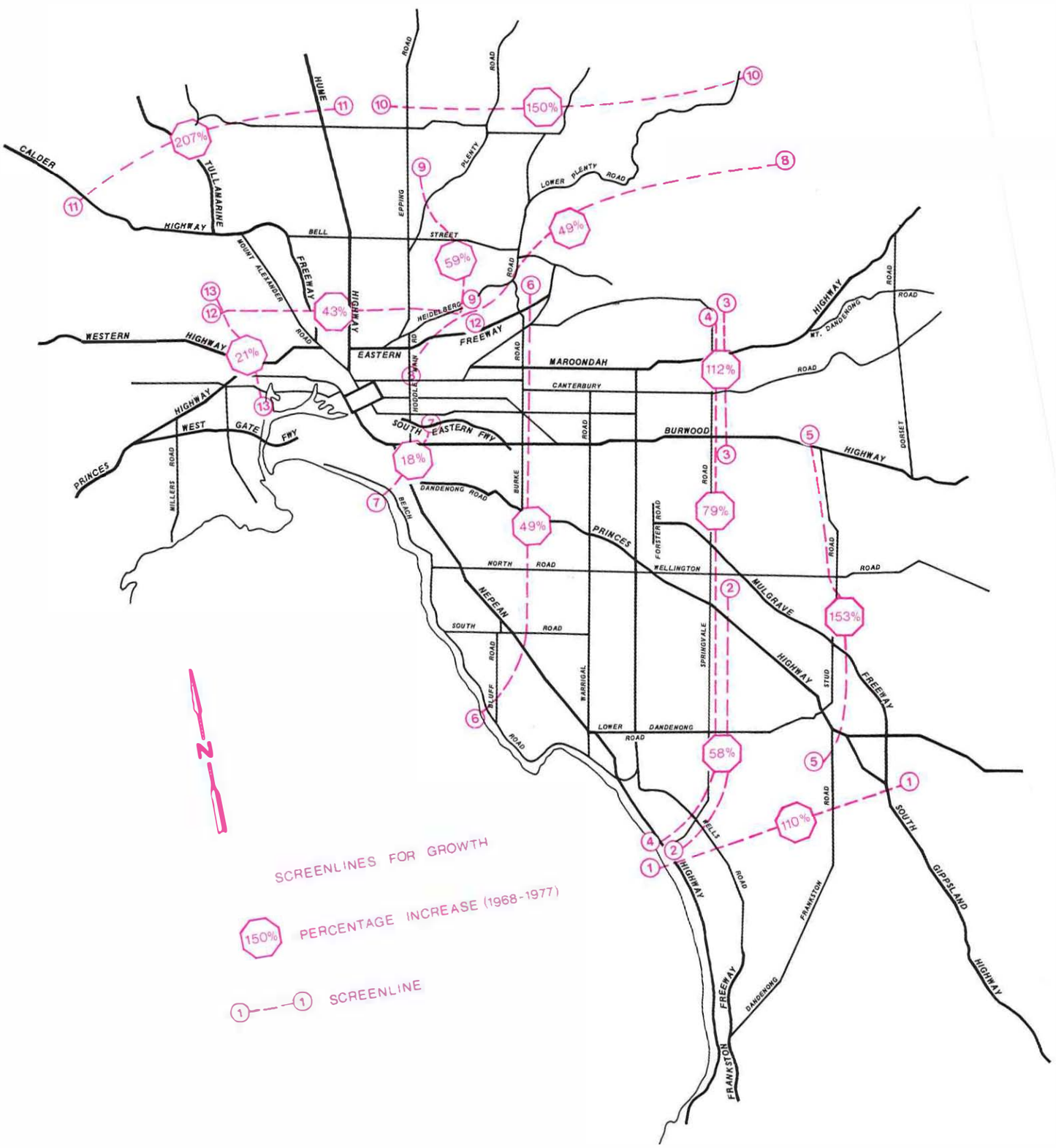
The first phase of the survey was carried out by the State Road Authorities and the other four phases largely by the Bureau of Transport Economics.
As a member of the National Association of Australian State Road Authorities, the Board undertook the survey in Victoria. During the year, the checking and revision of the Board's basic road and bridge inventory data was completed.
The objective of the 1977 survey was to obtain more up-to-date information about the Australian road system to assist the Bureau of Transport Economics in the preparation of its report to the Commonwealth Government about financial assistance for roads by the Commonwealth to the States. The report will be used in the preparation of legislation to replace the States Grants (Roads) Act 1977 which expires on 30th June, 1980.

Improvements to the rural road system

In order to cater for the increasing demand for travel in a safe and efficient manner, there is a need to progressively upgrade State highways to divided highway or rural freeway standards.

Rural road improvement criteria

The Board adopted the following criteria in the development of road improvements in the rural areas of the State:
☐ the planning, design, construction and management of a network of arterial roads to be co-ordinated on a State-wide basis;
☐ the first priority to be a satisfactory programme of maintaining the existing road system including routine reconstruction and resealing;
☐ a system of divided roads and freeways, including town bypasses, on the more heavily trafficked routes to be stage developed;
☐ an adequate system of arterial roads to be developed in provincial cities and towns;
☐ existing roads, intersections and roadsides to be improved to reduce the number and severity of traffic accidents;
☐ bridges that are narrow, structurally deficient or of inadequate waterway to be improved or replaced;
☐ recreational and tourist traffic to be adequately provided for by the maintenance and development of roads of tourist interest, including the provision of a system of wayside stopping places and rest areas on all classes of roads;
☐ roadsides to be developed by the establishment and maintenance of plantations, minimising the removal of existing vegetation and control of advertising hoardings;


CALDER
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BELL
STREET
HEIDELBERG
ROAD
EASTERN
FREEWAY
WESTERN
HIGHWAY
HOODLE STREET
SOUTH EASTERN FWY
MAROONDAH
ROAD
CANTERBURY
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BURWOOD
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MILLERS
ROAD
DANDENONG ROAD
BURKE
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BEACH
PRINCES
FORSTER ROAD
WELLINGTON
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NORTH
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NEPEAN
SOUTH
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BLUFF
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WARRIGAL
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SPRINGVALE
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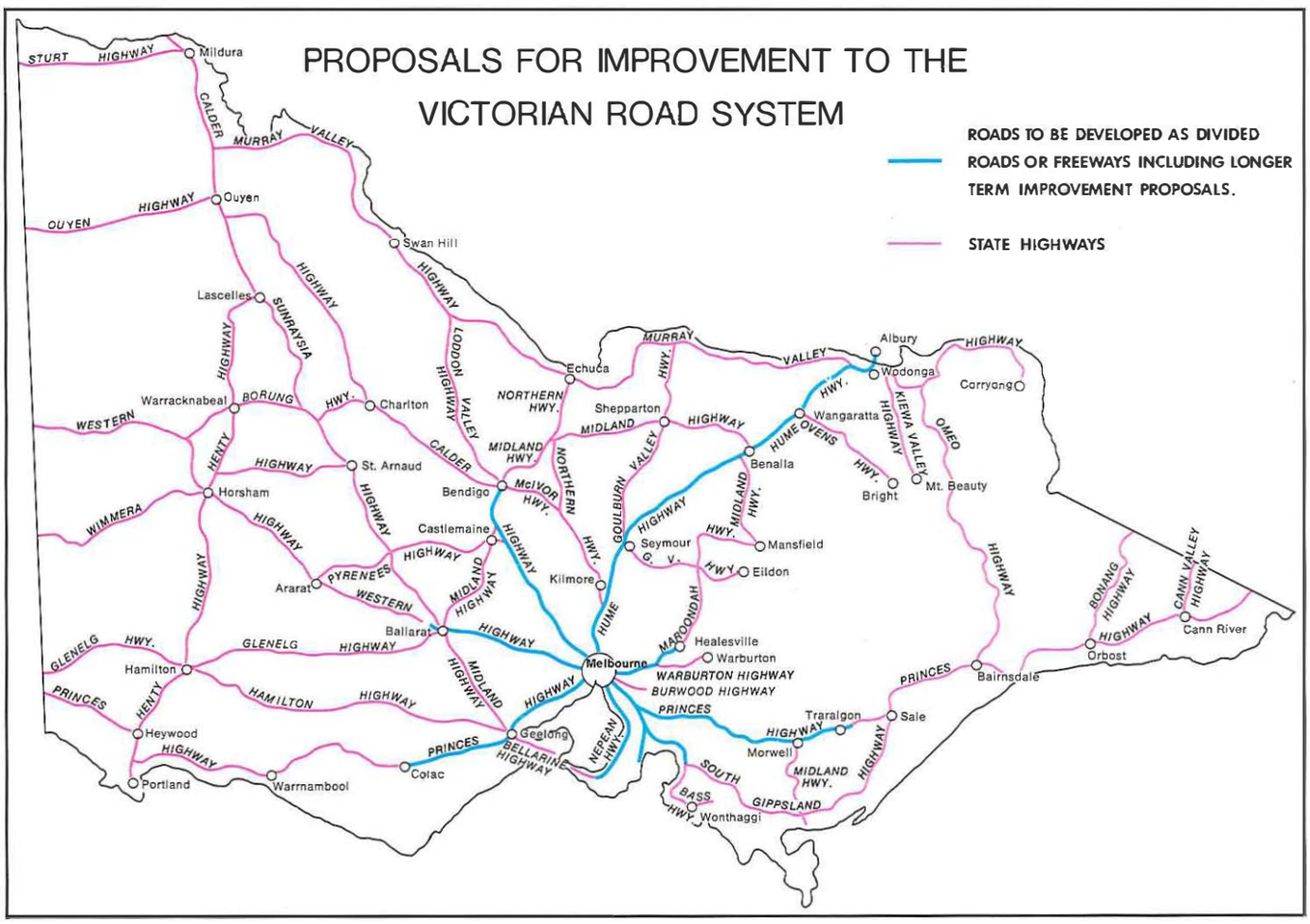
49%
59%
43%
21%
112%
18%
49%
79%
153%
58%
110%
N
SCREENLINES FOR GROWTH
150% PERCENTAGE INCREASE (1968-1977)
1 1 SCREENLINE

☐ in the areas that are subject to development, a conscious policy to be followed to set aside land for future road needs, thus enabling development to proceed with assurance;
☐ all works to be implemented within the guidelines set out in the Government's Statement of Planning Policy No. 5 "Highway Areas".
The map below illustrates the major rural highways that are proposed for progressive development as divided roads or freeways.

Vehicle travel in Victoria

During 1976 the Australian Bureau of Statistics conducted its third survey of motor vehicle usage and the results were published in August 1977. Previous surveys were conducted in 1963 and 1971.
In Victoria, the major changes which have occurred in the five year period from 1971 to 1976 were:
☐ Total registered motor vehicles increased by 29% to nearly 1.8 million.
☐ Total travel increased by 28% from 22,700 million vehicle kilometres to 29,000 million vehicle kilometres.
☐ The amount of road freight moved, as measured by tonne-kilometres of commercial vehicle travel, increased by 22% from 6691 million to 8190 million and is now nearly three times the amount carried by rail.
☐ Average annual distance travelled by individual cars and station wagons decreased from 16,400 to 15,900 km, mainly as a result of the large increase in households owning more than one car. The average for all motor vehicles (including motor cycles) decreased from 16,400 to 16,100 km.
☐ The number of vehicles per head of population has increased from 1 vehicle per 2.5 persons to 1 vehicle per 2.1 persons.



Traffic services

Linemarking

During the 1977/78 financial year the Board spent $1,605,592 maintaining Statcon markings and extending and maintaining linemarking and pavement markers throughout the State.

The length of linemarking maintained by the Board's linemarking machines was as follows:

- State highways and freeways — 7,789 km or 36,229 km of equivalent standard stripe
- Other CRB declared or proclaimed roads — 5,924 or 17,597 km of equivalent standard stripe
- Unclassified roads — 1,645 or 5,423 km of equivalent standard stripe.

The term 'equivalent standard stripe' means a 3 m stripe and a 10 m gap.

The cost of this work was

- $23/km of standard stripe
- $47/km of 75 mm wide

The cost of extending and maintaining the system of raised reflective pavement markers on declared roads was $121,307; 56,432 reflective markers were laid.

Control of overdimensional and overweight vehicles

In order to maintain safe conditions for road users and also protect both bridges and road surfaces from damage, limits are imposed by law on the width, height, length and weight of vehicles and their loads.

The Board has the responsibility under the provisions of the Motor Car Act, for issuing permits for the movement of overdimensional or heavy vehicles exceeding the legal weight, height, length and width —

(a) on roads declared or proclaimed under the provisions of the Country Roads Act, and

(b) for a journey which includes unclassified roads in two or more greater metropolitan municipalities as defined under the Motor Car Act.

The following table illustrates the number and types of permits issued during the year compared with those issued during financial year 1976/77.

	1976/77	1977/78
Single trip permits	20,075	21,021
Annual permits	3,526	3,061
NAASRA permits*	11,150	8,260
Total number of permits issued	34,751	32,342

* This figure represents the number of permits issued in accordance with the NAASRA recommendations from the study into the Economics of Road Vehicle Limits. The permits will be effective until such time as they are made redundant by new legislation.

The number of offences reported during the year by the Board's twenty-two traffic officers and the four police officers seconded to the Board amount to 8,383. These offences resulted in over $1 million in fines and costs which were paid into the Consolidated Fund.

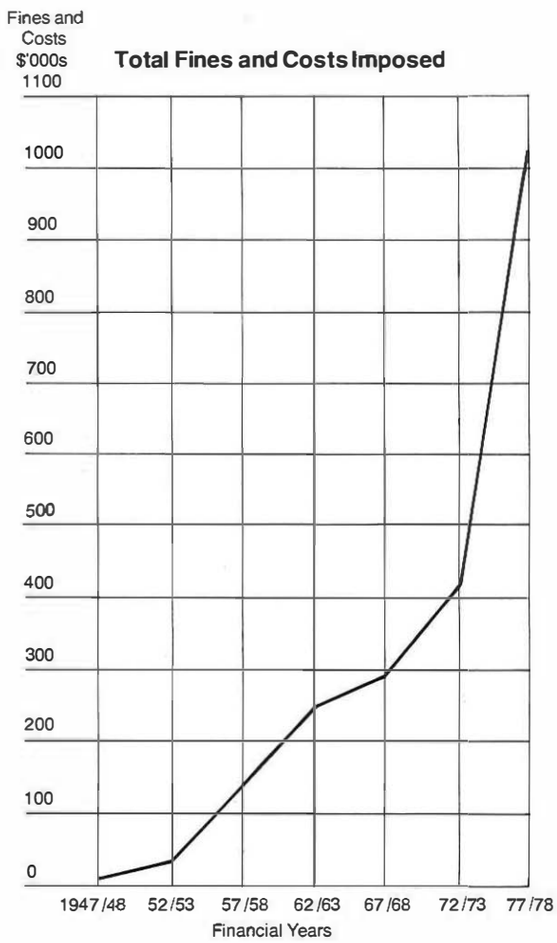
Traffic information services and driver education

The Board continued the practice of issuing regular bulletins to the media and the police, fire brigade and ambulance services to provide information on the location of the Board's and municipal works which would cause delays in traffic flow.

Regular weekly Motoring Bulletins were issued during the year by the Board's Public Relations Section. In addition, special snow and flood reports were issued as required, describing the road conditions.

The Board published the following brochures during the year, to assist drivers:

A Guide to Victoria's Rest Areas
Snow Driving, It's An Art (revised)
Fog Driving
Freeway Driving
Eastern Freeway Driver's Guide



Traffic management in South Melbourne

During the year a co-ordinating committee consisting of representatives of South Melbourne, Port Melbourne and St Kilda City Councils, the Road Safety and Traffic Authority and the Board investigated a series of traffic management measures to accommodate traffic flow expected after the opening of the West Gate and Johnson Street bridges.

One of the recommendations made by the committee to the Government was for an Advisory Truck Route through the northern section of the City of South Melbourne.

As detailed on the map below the route will facilitate the movement of heavy trucks between the new bridges and Kingsway and encourage the use of the Kingsway-Queens Road route.

Work on the route began in May 1978, and involves the installation of new and improved traffic signals and road improvements.

The Advisory Truck Route was one of a series of traffic management measures recommended to the Government by the committee. The recommendations are listed below:

☐ Action should be taken to accelerate the progress of work on the widening and short term improvements on the Nepean Highway between Gardenvale and Moorabbin with a view to completion of the work at the earliest practical time and to obtain early benefit to traffic during the staging of construction.

☐ As much traffic as is practicable should be attracted to the Kingsway-Queens Road-St Kilda Road-Nepean Highway route. In this regard traffic management measures and improvements should be implemented to increase the capacity and attractiveness of the route.

☐ While it is realised that the Kings Way-Queens Road route can not cater for all north-south trips, measures should be introduced to discourage and prevent if possible, any increase in the volumes of traffic using Canterbury Road and Beaconsfield Parade.

☐ Restrictions and/or bans should be introduced on the use of Beach Main Road, Canterbury Road and Graham Street south of Williamstown Road by heavy vehicles.

☐ Measures should be implemented urgently to discourage, and, or prevent through traffic from using local access streets in residential areas including any necessary closures and facilities required to maintain accessibility.

West Gate and Johnson Street Bridges
Advisory Truck Route

1. Lorimer Street/Rogers Street/Boundary Street
Intersection treatment and install traffic signals.

2. Lorimer Street (in progress)
Road widening, Hartley Street to Gittus Street.

3. Lorimer Street/Johnson Street
Adapt traffic signals.

4. Footscray Road to Lorimer Street
Link traffic signals over Johnson Street bridge.

5. Lorimer Street/Normanby Road
Minor channelisation and install traffic signals.

6. Normanby Road/Clarendon Street
Intersection treatment — roundabout.

7. Clarendon Street/City Road
Improve traffic signals.

8. Clarendon Street/Grant Street
Install traffic signals.

Installation of Advisory Truck Route traffic signals at corner of Clarendon and Grant Streets, South Melbourne.

9. Market Street and York Street
Conversion to one way pair. Pavement strengthening and alterations to parking — Clarendon Street to Kings Way.

10. Market Street/Moray Street
Install traffic signals.

11. Market Street/Kings Way
Provide median break and install traffic signals.

12. York Street/Moray Street
Install traffic signals.

13. York Street/Clarendon Street
Install traffic signals.

14. Clarendon Street, Market Street, York Street and Kings Way
Link traffic signals from City Road to and including Kings Way radio controlled system.

15. Union Street
Resurfacing between Queens Road and St Kilda Road.

16. Queens Road and Union Street
Link existing signals between Lorne Street and St Kilda Road.

17. Market Street/Grant Street
Conversion to one way pair. Modifications to intersections and traffic signals at City Road/Market Street and City Road/Grant Street.

Note — 12 hour clearways to be implemented for Clarendon Street, sections of Kings Way and Queens Road. Advisory signing to be located along truck route and approaches.

Snow clearing

Snow clearing of roads to snow resorts was carried out in 1977/78 on the Alpine Road (Mt Hotham), Mt Buffalo Road (Mt Buffalo), Mt Buller Road (Mt Buller) and Bogong High Plains Road (Falls Creek).

Snow falls were generally light during the 1977 winter with most of the snow falling in late July. Snow clearing started in late May and finished in mid September.

Night snow clearing was carried out at Mt Hotham on Friday and Saturday nights during the season, and financed by a special Treasury Grant.

Snow clearing of car parks was carried out at the resorts as a charge against the respective administering authorities or special Country Roads Board/National Parks Service grants in the case of Mt Buffalo. The heavy falls of snow in late July created problems in car park clearing at all resorts.

Schmidt snow clearing equipment attached to a Mercedes-Benz Unimog prime mover and purchased in 1976/77, was put into service at Falls Creek with satisfactory results.

Trials of a M.A.N. 4-wheel drive truck and plough blade were conducted at Mt Buller and Mt Hotham during the latter part of the winter. Further trials will be necessary during the 1978 snow season to assess the vehicle as a possible replacement for the 4-wheel drive snowploughs currently in use.

Details of snowfall recorded during the 1977 winter by the Board's snow clearing gangs are shown in the following table:

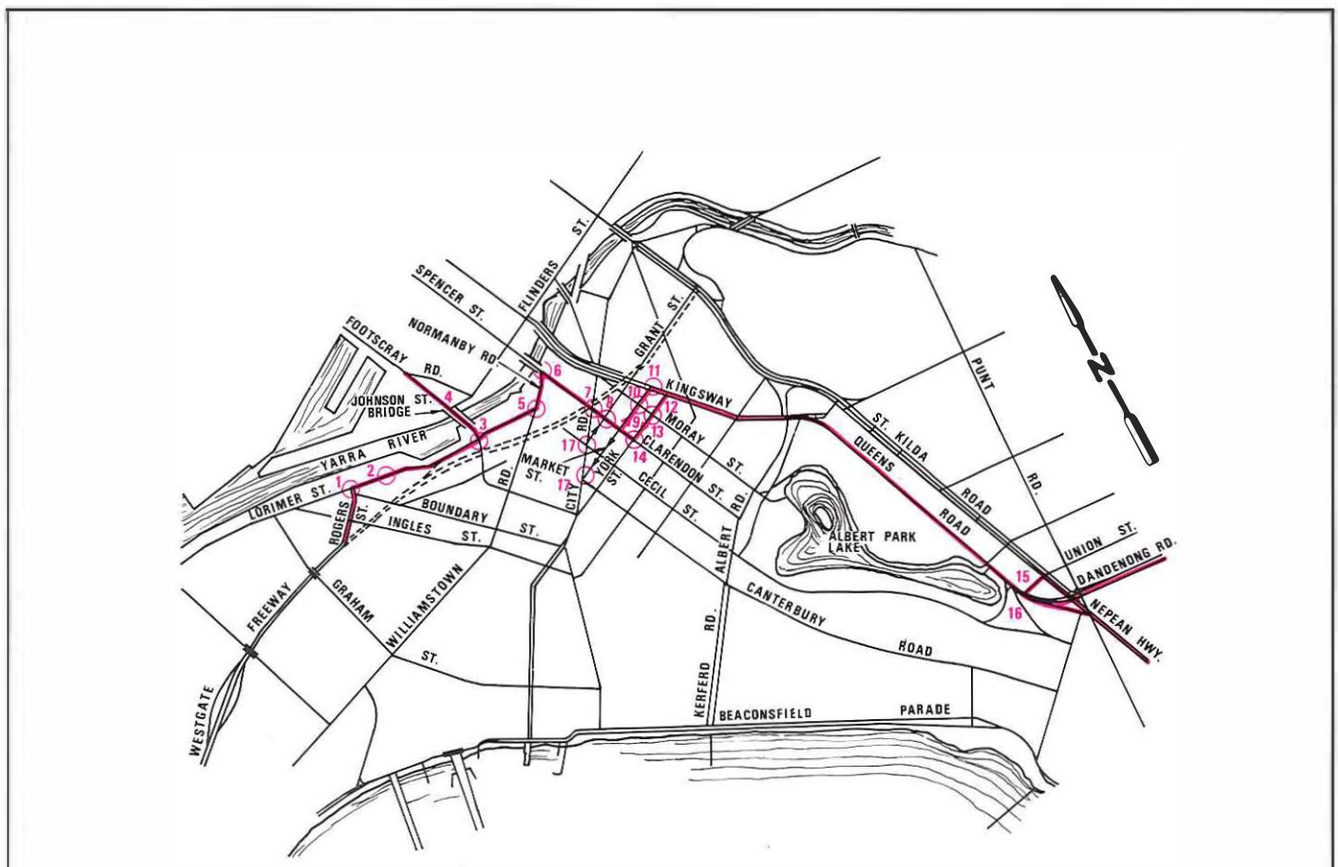
Road	Resort	Earliest snowfall 1977	Latest snowfall 1977	No. of snow days	Max. daily snowfall (mm)	Average snowfall depth (mm)	Average length of road cleared (km)	Est. Cost 1977 season $000
Alpine Tourists'	Mt Hotham	24 May	14 Sept	47	700	137	43	213.5
Mt Buffalo Tourists'	Mt Buffalo	30 May	13 Sept	28	250	108	17	41.3
Mt Buller Tourists'	Mt Buller	24 May	14 Sept	42	450	121	10.5	41.6
Bogong High Plains Tourists'	Falls Creek	24 May	13 Sept	34	400	143	11	43.3

Costs do not include:

(a) clearing of car parks for Committees of Management;

(b) night clearing at Mt Hotham financed by a State Treasury Grant of $35,000;

(c) 20% of the total cost of snow clearing on the Bogong High Plains Road, contributed by the State Electricity Commission of Victoria.



West Gate and Johnson Street Bridges
Advisory Truck Route

Emergency services

The Board provides a free emergency telephone service and assistance to drivers of immobilized vehicles on six major metropolitan traffic routes. The routes concerned are:

Eastern Freeway
Kings Bridge
Mulgrave Freeway/South Gippsland Freeway
Tullamarine Freeway
South Eastern Freeway
Westgate Freeway

The emergency service extends for 24 hours per day and includes providing assistance with minor mechanical problems, the sale of sufficient petrol to enable the vehicle to be restarted and driven clear of the freeway and also a towing service so that the vehicles can be cleared from the freeway.

The number of calls to the Board's Emergency Service Centre at Head Office has increased steadily from 4,800 calls in the first year of operation in 1975 to approximately 8,000 calls during financial year 1977/78.

Emergency telephones were installed on the Eastern Freeway in March 1978 and the installations on the Mulgrave Freeway and the South Gippsland Freeway between Forster Road, Mt Waverley, and Somerville Road, Hampton Park, were well advanced at the end of the financial year.

The Emergency Service Centre also permits continuous radio communication with the Board's road maintenance personnel and Traffic Officers outside normal working hours. The Emergency Services Officers are also able to provide up to date information outside normal working hours relating to road conditions especially during floods or bush fires.

The following table shows the distribution and types of calls received during financial year 1977/78.

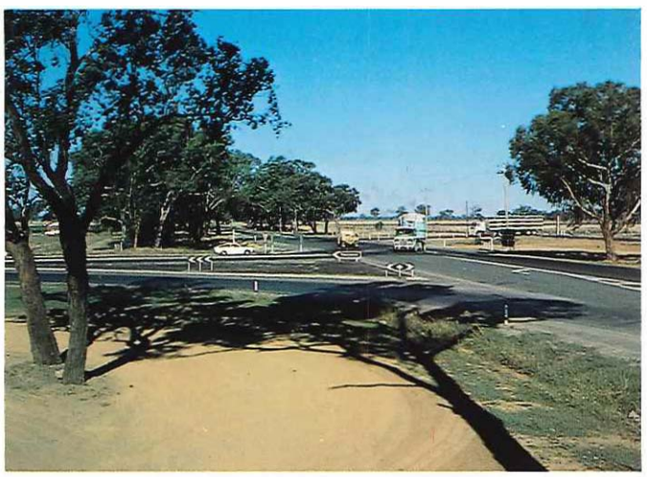
Emergency Services — call analysis

Fault	Total	% of all calls	% of breakdowns
Petrol	1,516	19.3	25.8
Tyres	442	5.6	7.5
Radiator	552	7.0	9.3
Mechanical	2,516	32.0	42.8
Accident	224	2.8	3.8
Hoax	141	1.8	2.4
Hazard	408	5.2	6.9
Other	86	1.1	1.5
Sub Total	5,885	74.8	100.0
Other	1,980	25.2	—
Total	7,865	100.0	—

Emergency Services — freeway analysis

Freeway	No. of calls	%
Tullamarine	2,792	47.4
Eastern*	795	13.5
South Eastern	1,554	26.4
West Gate	530	9.0
Kings Bridge	214	3.7
Mulgrave	—	—
Total	5,885	100.0

*Half year only



Murray Valley Highway — Benalla-Tocumwal Road intersection.

Duplication of Bellarine Highway.

Roads and the environment

The environmental studies section

The Board has long been aware of the need to incorporate environmental considerations into its road planning studies, and as early as 1972 the first specialists in this area were appointed. In that year an economist, town planner and sociologist joined the staff of the then Freeway Planning Division where they worked as the "Community Impact Study Group". In 1976 the Board decided to constitute the group as a separate section, within the Planning Sub-branch, responsible to the Chief Planning Engineer. A group leader was appointed and the group was re-named the Environmental Studies Section. Over the years the Section has grown in number and now has the following officers:

Leader
Town Planner
Assistant Town Planner
Economist
Sociologist
Assistant Sociologist
Landscape Architect
Engineering Assistant
Draftsman
Typist/Clerk

The role of the Environmental Studies Section is to ensure that the non-engineering aspects of road proposals are properly assessed within the framework of a multi-disciplinary approach, and presented along with engineering and financial considerations so that balanced decisions can be made.

The main functions of the Section are:

☐ To undertake environmental studies for planning investigations ranging through corridor studies, route location investigations and traffic management studies.

☐ To give specialist advice when required such as in the review or development of guidelines, standards and policies or regulations which may apply to the Board's activities.

☐ To ensure that the environmental study techniques and procedures used are in line with current practice.

☐ To initiate applied research into problem areas or on special topics which might advance the field of understanding of environmental issues.

The Environmental Studies Section assisted in the preparation of two Environment Effects Statements during the year.

In the City of Heidelberg a possible road connection between Bell Street and Banksia Street was investigated. The main objective of the proposed connection is to remove large volumes of through traffic from Burgundy Street which is an important shopping area and to relieve the dangerous traffic situation arising from the steep grade in Burgundy Street. Such a road connection would require the acquisition of houses and parkland and the Ministry for conservation requested that a full environmental assessment be prepared. The views of the public were obtained from a series of group discussions with local residents organised by the Environmental Studies Section. Comprehensive studies of the potential noise effects of a connecting road were also carried out to assess the effectiveness of remedial measures.

The second Environment Effects Statement concerned the Hume Freeway Bypass of Euroa. A Social Survey was undertaken in Euroa involving interviews with affected property owners, residents and business people in the town, in order to assess preferences for the various alternative routes.

The Environmental Studies Section also conducts an annual review of the Board's proposed works programme in conjunction with officers of the Ministry for Conservation. These reviews were implemented following the Commonwealth Department of Transport's request that the Board provide environmental clearances of its proposed works programmes.

Landscaping and roads

Landscaping of the roadsides plays an important role in providing a better travelling environment for the motorist. The landscaping treatment of a road takes into account the needs of the road users, in terms of driver safety as well as visual appeal, and the needs of people living adjacent to the road.

The Board is responsible for the management of the roadsides of State highways, freeways, tourists' and forest roads.

During 1977/78, the Board planted a total 139,062 trees and shrubs at a total cost of $49,016.

The table below shows the breakup of these figures by Board divisions and projects.

In planning road improvements — new freeways and widening and duplication of existing roads — the landscaping treatment is considered as part of the planning process.

When a new road is planned

During the planning and design stages of a new road, an analysis is carried out of the corridor through which the road will pass.

Among the factors that are evaluated are land form, land use, drainage and existing vegetation.

These factors are then examined together with the functional demands of the road. The design of the road will determine the landscaping treatment to be used.

A new freeway that will carry a high proportion of large trucks is designed with long gentle curves and flat grades. The landscaping treatment is planned to integrate the freeway with the countryside, and where possible vegetation that is native to the area is used.

Improvements to an existing road

When improvements to an existing road are needed, care is taken to preserve as much of the vegetation on the road reserve as possible.

Trees and shrubs are only removed where it is necessary to allow safe and efficient use of the road.

For major improvements, such as a major duplication of a State highway, the Board investigates purchasing additional land for the second carriageway so that trees and shrubs already growing in the road reserve can be retained.

During earthwork, the topsoil is generally removed and stored for use in the final restoration and planting.

Landscaping to improve safety to motorists

The main safety function of landscaping the median between duplicate carriageways is to screen the headlight glare of oncoming vehicles.

Trees and shrubs planted in the median can also help to prevent motorists making illegal U-turns across the median.

Loddon Valley Highway, Bendigo.

Landscaping principles can be utilised to improve the safety and efficiency of roads, as follows:

☐ Concentrated plantings near cross roads, especially in undulating country, can help to warn motorists of the location of an intersection. Plantings of this type must not restrict visibility at intersections.

☐ Linear plantings within the road reserve in undulating terrain can be used to define the route of the road ahead.

☐ Trees can be grouped into separate stands along a road to complement the surrounding landscape, and provide variety and contrast for the motorist.

☐ By planning the most suitable treatment for roadside vegetation, the monotonous effect of a line of trees at a constant distance from the road can be avoided.

☐ A band of trees along a road can be formed to follow a wave effect which varies in distance from the road to provide a more interesting travelling route.

☐ In many rural areas, the roadside vegetation provides a pleasant travelling environment through country that is dominated by large, cleared grazing areas and land under cultivation.

☐ Roadside rest areas and wayside stops also contribute to the motorists' travelling environment.

While trees and shrubs are planted to provide an interesting travelling environment, careful planning is necessary so that they do not constitute a hazard in themselves.

Controls

Fire

The vegetation in road reserves requires regular maintenance and management — cleaning up, thinning and under controlled conditions, burning off in cool weather — to minimise the likelihood of fires being started in roadside areas as a result of cigarette butts or matches being thrown from passing vehicles. In this way, the fire hazard risk is reduced while the attractiveness of the roadside is retained.

During maintenance work, the Board avoids wherever possible a conflict between the fire prevention measures and the demands of conservation.

Roads are frequently used as fire-breaks by fire control authorities.

Noxious weeds

Noxious weeds are a problem on roadside reserves. Wind carries the weed seeds on to medians and batters, and they quickly spread to endanger the vegetation.

As every gardener knows, repeated clearing of noxious weeds is an irksome, time-consuming task and adds to the costs of maintenance of the roadside.

Preserving local flora and fauna

The Board plants indigenous trees and shrubs in roadside reserves wherever possible. In this way, roadside reserves play an important role in helping to preserve a region's native vegetation. For example, much of the distinctive character of the Mallee farmlands is derived from the native vegetation on the road reserves. The value of this vegetation for landscape preservation and conservation is especially high in the eastern and southern Mallee, where roadside vegetation often comprises the only remaining stands of indigenous flora in the area.

Native animals use reserves for their habitat, and birds use the trees and shrubs for nests and sources of food.

The continuation of an indigenous species in an area may also prove useful for land studies, as it permits the original pattern of the vegetation to be studied.

However, there are a number of situations where the planting of indigenous species is not possible. For example, major new roadworks may alter drainage patterns and affect water tables, or the micro-climate may be changed so that the indigenous species would not survive.

In such cases there is often a need to choose other planting material. Often only specially selected species will grow in the harsher environment of a roadside.

Engineering factors, such as the type of delineation and the width of the median, may result in non-indigenous plants being selected for an area.

Numbers and cost of trees and shrubs planted during the 1977/78 financial year

Divisions	Trees and shrubs	Purchase cost
Bairnsdale	1,902	1,026
Ballarat	3,210	1,408
Benalla	3,060	1,521
Bendigo	3,160	1,270
Dandenong	40,737	13,176
Geelong	16,618	6,915
Horsham	7,200	3,200
Metropolitan	17,825	5,776
Traralgon	2,600	880
Warrnambool	4,800	1,327
Projects		
Eastern Freeway	13,300	4,655
Hume Freeway	5,100	1,700
Johnson Street Bridge	2,200	770
Mulgrave Freeway	17,000	5,270
West Gate Freeway	350	122
Total	**139,062**	**$49,016**
1976/77	129,246	$46,813

Municipal

Municipal allocations

Victoria's 212 municipal councils have been allocated $79,625,000 for road works on main and unclassified roads for 1978-79.

This represents $2,239,000 more than for 1977/78. However, in real terms the 1978/79 allocations will result in less work being carried out than in 1977/78 due to rising costs.

The total amount of the applications for funds for 1978/79 received from councils was $174,774,000 but the Board was able to allocate only approximately 46% of this amount.

The table below shows the applications and allocations of funds to municipal councils for 1977/78 and 1978/79.

	1977/78		1978/79	
	Applications	Original allocations	Applications	Allocations
	$000s	$000s	$000s	$000s
Main roads	61,942	36,898	67,910	38,015
Unclassified roads	98,839	40,488	106,864	41,610
	$160,781	$77,386	$174,774	$79,625

New procedures in allocation of funds to municipal councils

To allow councils greater flexibility in the use of the Board's funds and to reduce administrative work in municipal offices, the Board introduced for the 1977/78 financial year, a system of bulk allocations with associated simplification of financial and administrative procedures for works on unclassified roads.

Simplified financial and administrative procedures were also instituted in respect to allocations for main roads.

Discussions with municipal officers have indicated that the new procedures have been favourably received and have generally achieved the desired objectives.

There has been a substantial reduction in the amount of paperwork passing between the Board and councils and in the clerical workload associated with the reimbursement of councils' expenditure.

The new procedures have also allowed councils greater flexibility and autonomy in the performance of works programmes and have encouraged closer liaison between the Board's and councils' officers.

34th Conference of Municipal Engineers

The 34th Conference of Municipal Engineers, convened by the Board in conjunction with the Local Government Engineers Association of Victoria was held at the Board's Head Office on 3rd and 4th April, 1978, concluding with a technical tour on 7th April, 1978.

The conference was officially opened by the Chairman, Mr R E V Donaldson, on behalf of the Hon J A Rafferty, MP, Minister of Transport.

The general theme of the conference was Continuing Education for the Engineer. The opening paper was a keynote address — "Overall Strategy Planning" presented by Mr K D Green, OBE, ED, Secretary, Premier's Department. Mr Green's address was well received by conference participants and set the pattern for a highly informative and successful conference. Approximately 250 local government and CRB engineers attended with representatives from some State Instrumentalities and Departments.

Following the key-note address, the papers presented and their authors were as follows:

Industrial Parks and Trends in Industrial Uses — Mr M J Pawsey, City Engineer, Berwick.

The Views of an Arbitrator on Engineering Contract Management — Mr J H Standish.

Developments in Pavement Design — Mr P W Lowe, Materials Research Engineer, CRB.

Use of Crushed Rock as a Pavement Material — Mr M L Williams, Major Projects Engineer, CRB.

Fixed Roadside Hazards — Mr E V Barton, Traffic Engineer, CRB.

CRB Approach to Traffic Noise Studies — Mr G W Jameson, Scientific Officer, CRB.

Use of Computers — Mr M V Jones, National Executive Engineer, Association for Computer Aided Design Limited.

Control of Local Road Intersections under the STATCON Programme — Mr A T Fry, Deputy Chairman, Road Safety and Traffic Authority.

Panel discussions on environmental considerations:

(i) Environmental Considerations in Road Planning: Mr R E H Saunders, Leader Environmental Studies Section, CRB.

(ii) The Public Involvement Programme for West Coast Highway: Swanbourne Area Study (WA) — Mr B M Robbins, Associate Director, Scott and Furphy, Engineers.

(iii) Landscape Concepts: Mr A Kelly, Landscape Architect, CRB.

(iv) Restoration of Areas after Roadworks: Mr D N Durant, Project Engineer, Mulgrave Freeway, CRB.

(v) Selection of Trees and Shrubs for Roadsides: Mr H L Gray, Roadside Development Engineer, CRB.

(vi) Control of Erosion on Roadworks: Mr T Richmond, Engineer, Geelong Division, CRB.

SEC/CRB Code of Practice for Tree Clearing and Trimming: Mr E T Oppy, Divisional Engineer, Ballarat, CRB; Mr K W Pocknee, Field Practices Engineer, SEC; Mr J A McKerrow, Shire Engineer, Bulla.

Commonwealth Road Legislation and CRB Allocations Procedures:

(i) Funds for Roads — A Municipal Viewpoint: Mr K J Dowling, City Engineer, Malvern.

(ii) Funds for Roads — Recent Developments: Mr N S Guerin, Deputy Engineer in Chief, CRB.

(iii) Road Funding — Application and Allocation: Mr K C Langdon, Shire Engineer, Warrigal.

(iv) New Financial and Administrative Procedures relating to the Allocation of Funds to Municipal Councils: Mr R G Cooper, Chief Accountant, CRB.

ARRB — An Overview: Dr M G Lay, Executive Director, ARRB.

Use of Rubber in Bituminous Surfacing Including Experimental Use of Scrap Rubber from Old Vehicle Tyres: Mr J D Bethune, Asphalt Engineer, CRB.

Developing the Civic Environment — The Streetscape: Mr P S Parkinson, Shire Engineer, Flinders.

Current Practices in Bridge Construction: Mr G D Black, Assistant Bridge Construction Engineer, CRB.

Review of Procedures for Preparation of Plans and Specifications for Municipal Bridgeworks: Mr B Addis, Bridge Design Engineer, CRB.

Plant and Equipment Innovations: Mr L J McKenzie, Shire Engineer, Ararat. Mr A G Thompson, City Engineer, Waverley. Mr A R Keam, Shire Engineer, Dimboola. Mr N J Arbuthnot, Shire Engineer, Mildura. Mr M E John, Shire Engineer, Wycheproof. Mr P M Jeffreys, Chief Mechanical Engineer, CRB.

Municipal road works (opposite page).

1. (full page) Reconstruction of 1.8 km of road south-east of Shepparton, Shire of Shepparton.
2. Reconstruction on the Warrnambool-Penshurst Road, Shire of Minhamite.
3. Widening of Stud Road, City of Dandenong.
4. Deviation of Bairnsdale-Paynesville Road at Eagle Point, Shire of Bairnsdale.
5. Reconstruction on the Rosebud-Flinders Road near Picnic Point, Shire of Flinders.

The technical tour on Friday morning, 7th April, included an inspection of construction work on the English Street Interchange, Lancefield Road (conversion to freeway standard); the Johnson Street Bridge and preliminary work for the West Gate Freeway, South Melbourne Section.

The Board extends its thanks and appreciation to the Local Government Engineers Association of Victoria for assistance in planning the conference, to Mr K D Green and to all engineers, particularly those who presented papers, for contributing to the success of the conference.

Visits to municipalities

Each year the Board members make official visits to a number of municipalities throughout the State. This has been the practice since 1913 when the first Board members toured the State to decide which roads should be main roads. Most of the municipalities in Victoria are visited at approximately six yearly intervals. These visits include a tour of the municipality's roads, in company with councillors and council officers, and discussions on local road problems, thus providing the Board members with first hand information about road conditions and developments.

During the year the Board made official visits to 31 municipalities: the Cities of Ararat, Box Hill, Brunswick, Camberwell, Coburg, Echuca, Mildura, Preston, South Barwon, Waverley; the Shires of Ararat, Barrabool, Bass, Bellarine, Bright, Cranbourne, Deakin, Grenville, Heytesbury, Kara Kara, Korumburra, Lexton, Lillydale, Mansfield, Mildura, Myrtleford, Omeo, Rutherglen, St Arnaud, Yarrawonga and the Borough of Queenscliffe.

The Board places on record its appreciation of the assistance given by all Councillors and municipal officers during these visits.

Deputations

The Board is always prepared to discuss matters of common interest with representatives of councils or other official bodies. These discussions provide a useful channel of communication between the Board and local administration. During the year the Board received deputations from the following councils:

The Cities of Box Hill, Camberwell, Collingwood, Fitzroy, Horsham, Melbourne and Mildura; the Shires of Buln Buln, Eltham and Morwell and the Borough of Wonthaggi.

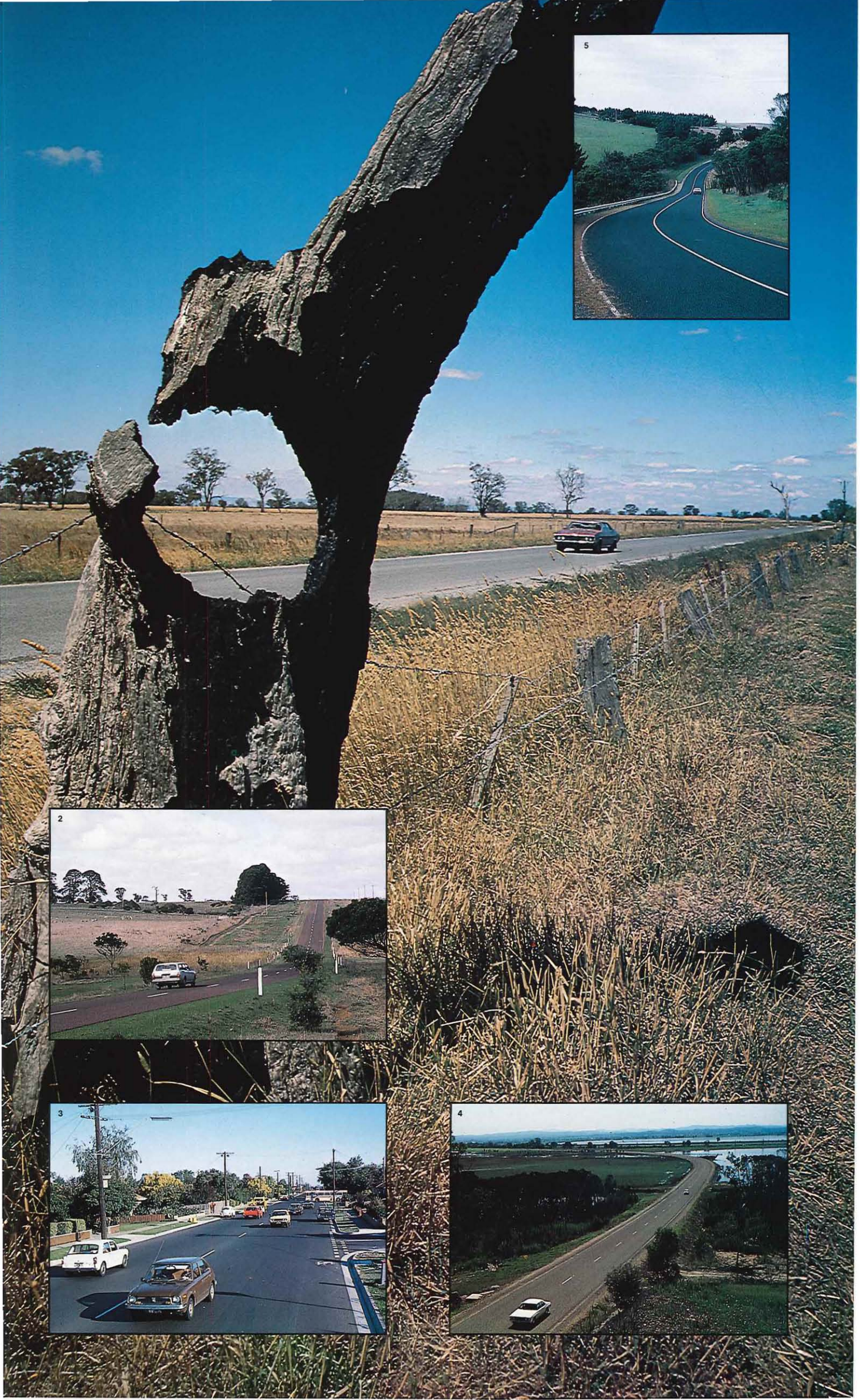
The main topics were the general inadequacy of road grants to meet the State's road needs, the allocation of road funds to municipal councils by the Board, freeway planning and road construction.

Municipalities Forest Roads Improvement Fund

The Municipalities Forest Roads Improvement Fund was established in the State Treasury in 1955 for the purpose of assisting municipal councils in the improvement and protection of roads adjacent to State Forest areas and to facilitate the extraction of forest produce. An amount of $150,000 was authorised to be paid into the fund by the State Government during the year, increasing the authorised contributions to $1,010,000.

The Board's Divisional Engineers combined with the appropriate Forests Commission Officers to determine the priorities of eligible works. Allocations for particular works were made by the Board with the agreement of the Forests Commission, but the limited funds available from the fund only enabled grants to be made for the most urgent works.

However, because of increases over the past two years in the authorised contributions to the Fund, outstanding current applications have been reduced from over $300,000 to approximately $190,000.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Significant works on main and unclassified roads

Main roads

Significant works completed or substantially completed during financial year 1977-78.

Avon Shire
Bengworden Road
Construction of a seven span bridge across the Avon River—130 m long and 8.6 m between kerbs.

Bairnsdale Shire
Bairnsdale-Paynesville Road
Realignment of 4.3 km through McLeod Morass at Eagle Point.

Broadmeadows City
Pascoe Vale Road
Asphalt resurfacing between Chapman Avenue and Grandview Street, and Douglas Street and Devon Road.

Bendigo City
Strathfieldsaye Road
Reconstruction of 0.2 km between Pall Mall and Queen Street.

Broadford Shire and Yea Shire
King Parrot Creek Road
Construction of a four span bridge across King Parrot Creek and approach roads.

Camberwell City
Canterbury Road
Reconstruction between Elgar Road and Station Street.
Doncaster Road
Reconstruction between Wentworth Avenue and Keats Street.

Cobram Shire
Benalla-Tocumwal Road
Reconstruction of 3.2 km north of Katamatite.

Cranbourne Shire
Cranbourne-Frankston Road
Reconstruction and duplication between South Gippsland Highway and Monohans Road.
Reconstruction between Dandenong-Hastings Road and Pearcedale Road.

Creswick Shire
Clunes-Creswick Road
Reconstruction of 3.9 km north of Creswick.

Croydon City
Canterbury Road
Reconstruction of Dorset Road intersection.

Dandenong City
Stud Road
Reconstruction between Clow Street and David Street.

Deakin Shire, Kyabram Shire and Rodney Shire
Kyabram-Rochester Road
Reconstruction of 2 km.

Dunmunkle Shire
Donald-Minyip Road
Reconstruction of 4 km east of Minyip.
Murtoa-Minyip Road
Reconstruction of 8 km west of Munyip.

Eltham Shire
Eltham-Yarra Glen Road
Reconstruction between Reynolds Road and Hurstbridge.

Essendon City
Mt Alexander Road
Asphalt resurfacing between Buckley Street and Kellaway Avenue.

Hampden Shire
Gnarpurt Road
Reconstruction of 1.7 km near Lake Gnarpurt.

Heidelberg City
Heidelberg-Eltham Road
Construction of a roundabout at McArthur Road intersection.

Healesville Shire
Eltham-Yarra Glen Road
Reconstruction and realignment of 1.4 km of road.

Heytesbury Shire
Cobden-Port Campbell Road
Reconstruction of 1.4 km north of Port Campbell.
Cobden-Warrnambool Road
Reconstruction of 1.8 km east of Elingamite.

Kerang Shire
Koroop Road
Reconstruction and realignment of 2 km.

Knox City
Stud Road
Duplication between Burwood Highway and High Street Road.

Mansfield Shire
Mansfield Road
Construction of two cell culvert and approaches across Timbertop Creek.
Reconstruction and realignment at Glenroy Road intersection.

Marong Shire
Bridgewater-Maldon Road
Construction of a three span bridge across Bradford Creek and construction of approach roads.

Melton Shire
Diggers Rest-Coimadai Road
Reconstruction and widening of 1.6 km.

Metcalfe Shire
Bendigo-Sutton Grange Road
Reconstruction and realignment of 1.6 km.

Minhamite Shire
Warrnambool-Penshurst Road
Reconstruction of 3.4 km north of Hawkesdale.

Moorabbin City
Doncaster-Mordialloc Road
Reconstruction and widening between Leslie Road and Kingston Road.
Warrigal Road
Reconstruction of Kingston Road intersection.

Mortlake Shire
Terang-Framlingham Road
Reconstruction and realignment of 2 km east of Framlingham.

Oakleigh City
Doncaster-Mordialloc Road
Reconstruction of Centre Road intersection.

Cobden-Port Campbell Road, Shire of Heytesbury
— construction of bridge across Curdies River.

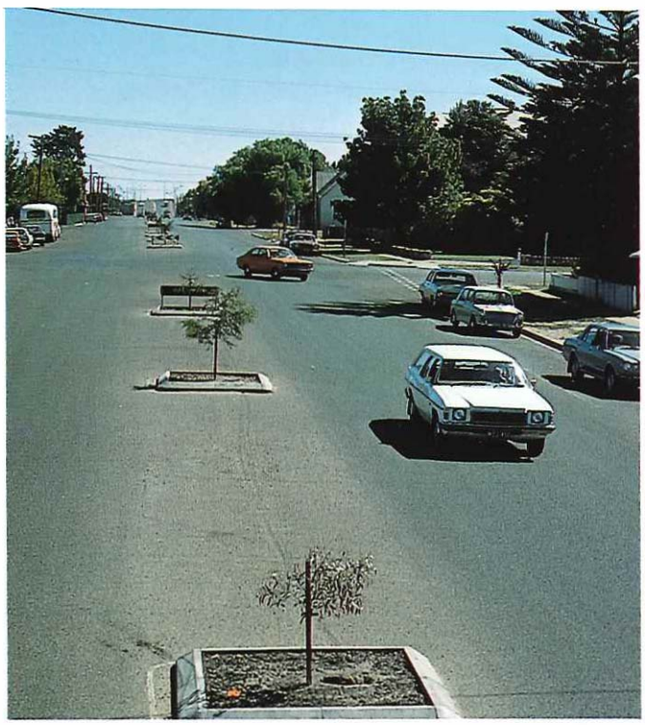
Preston City
Epping Road
Widening and reconstruction between Kenilworth Street and Mahoneys Road.
Gilbert Road
Reconstruction between Miller Street and Jacka Street.
Shepparton Shire
Violet Town-Dookie Road
Construction of 4 span bridge across the Broken River at Nalinga.
Springvale City
Cheltenham Road
Widening between Chandler Road and Corrigan Road.
Widening between Springvale Road and Howard Road.
St Kilda City
Beach Road
Reconstruction between Byrne Avenue and Kingsley Street.
Improvements to Head Street intersection.
Stawell Shire
Stawell-Warracknabeal Road
Construction of 10 span bridge across the Wimmera River at Glenorchy and construction of approaches.
Tallangatta Shire
Talgarno Road
Reconstruction and realignment of 2.8 km.
Tullaroop Shire
Maryborough-Dunolly Road
Reconstruction of 1.5 km at Bet Bet.
Wangaratta Shire
Wangaratta-Yarrawonga Road
Reconstruction of 1.5 km.
Warrnambool Shire
Allansford-Peterborough Road
Reconstruction of 2.5 km.
Waverley City
Doncaster-Mordialloc Road
Intersection treatment at Waverley Road.
Ferntree Gully Road
Reconstruction between Springvale Road and Cootamundra Drive.
High Street
Reconstruction between Gallaghers Road and Dandenong Creek.
Yea Shire
Whittlesea-Yea Road
Reconstruction and realignment of 7.7 km at Junction Hill.
Yea-Yarra Glen Road
Reconstruction and realignment of 0.8 km north of Glenburn at Devlins Bridge.

Unclassified roads

Significant works completed or substantially completed during financial year 1977-78.

Altona City and Werribee Shire
Merton Street
Reconstruction between Queen Street and North Avenue.
Bairnsdale Shire
Wy Yung-Calulu Road
Construction of a three span bridge across Boggy Creek.
Ballaarat City
Drummond Street North
Reconstruction of 0.8 km between Webster Street and Duncan Street.
Little Bridge Street
Construction of 0.2 km between Peel Street and Main Road.
Berwick City
Narre Warren North-Cranbourne Road
Reconstruction between Pound Road and City Road.
Box Hill City
Station Street
Reconstruction and widening between Canterbury Road and Piedmont Street.
Bright Shire
Wobonga Lane
Construction of three span bridge across the Ovens River.
Brunswick City
Blyth Street
Reconstruction between Staley Street and Burchett Street.
Victoria Street
Reconstruction between Sydney Road and Burchett Street.
Camberwell City
Balwyn Road
Reconstruction and widening between Belmore Road and Doncaster Road.
Caulfield City
Orrong Road
Asphalt re-surfacing between Glen Eira Road and Blackburn Road.
Coburg City
Cumberland Road
Reconstruction between Bell Street and Gafney Street.
Corio Shire
Sandy Creek Road
Construction of 1.8 km north west of the You Yangs Road.
Windermere Road
Reconstruction of 2.3 km between Geelong-Ballan Road and Kees Road.
Dandenong City
Heatherton Road
Reconstruction between Namur Street and Chandler Road.
Deakin Shire
Watson Road
Reconstruction of 3.5 km south from Echuca-Kyabram Road.
Doncaster and Templestowe City
Thompsons Road South
Reconstruction between Manningham Road and the Koonung Creek.
East Loddon Shire
Pyramid-Yarraberb Road
Reconstruction of 8 km.
Flinders Shire
Canterbury Jetty Road
Construction between Fairsea Grove and Melbourne Road.

Footscray City
Whitehall Street
Reconstruction between Napier Street and Hopkins Street.
Heidelberg City
Banksia Street
Reconstruction and widening through the Lower Heidelberg Road and Dora Street intersections.
Upper Heidelberg Road
Reconstruction between Montgomery Street and Altona Street.
Horsham City
Urquhart Street
Reconstruction and widening between Hamilton Street and O'Callaghans Parade (Western Highway).



Widening of Urquhart Street, City of Horsham.

Knox City
Boronia Road
Intersection treatment at Scoresby Road.
Forest Road
Reconstruction between The Glen and Burwood Highway.
Lillydale Shire
Hull Road
Reconstruction between Croydondale Road and Greenhills Road.
Mansfield Shire
Mansfield-Howes Creek Road
Reconstruction of 1.4 km.
School Lane
Reconstruction of 1.6 km near Merrijig.
Melton Shire
Coburns Road
Reconstruction between Western Highway and Centenary Avenue.
Holden Street
Construction of new bridge over Kororiot Creek and constructic of approaches.
Minhamite Shire
Kangertong-Glengleeson Road
Reconstruction of 4 km.
Moorabbin City
Charman Road
Reconstruction between Glebe Avenue and LaTrobe Street.
Mordialloc City and Moorabbin City
Charman Road
Reconstruction between Balcombe Road and LaTrobe Street.
Mordialloc City
Service Road (Nepean Highway)
Construction of service road between Eighth Street and Warrigal Road.
White Street
Reconstruction and widening between Bradshaw Street and Boundary Road.
Mortlake Shire
Occupation Lane
Reconstruction of 3 km.
Numurkah Shire
Rockliff's Road
Reconstruction and realignment of 3.2 km between Fuzzards Road and Centre Road.
Nunawading City
Main Street
Reconstruction between South Parade and Canterbury Road.
Orbost Shire
Bonang-Gelantipy Road
Construction of single span bridge across Stockyard Creek.
Oxley Shire
Benalla-Whitfield Road
Reconstruction and realignment of 1.3 km including the construction of a three span bridge across Fifteen Mile Creek.
Portland Shire
Winnap-Drik Drik Road
Reconstruction of 2.1 km at Drik Drik.
Preston/Broadmeadows Cities and Whittlesea Shire
Mahoneys Road
Reconstruction and duplication of Mahoneys Road between the Hume Highway and High Street.
Ringwood City
Loughnan Road
Reconstruction between Heatherside Court and Ringwood Street.
Springvale City
Heatherton Road
Reconstruction between Westall Road and Springvale Road.
Tambo Shire
Snowy River Road
Construction of two span bridge across Wulgulmerang Creek.
Upper Murray Shire
Briggs Gap Road
Reconstruction and realignment of 2.6 km from the Tallangatta-Corryong Road.
Thougla Road
Reconstruction and realignment of 2.9 km from the junction with the Murray Valley Highway.
Waverley City
Blackburn Road
Reconstruction between Normanby Road and Duerdin Street.
Werribee Shire
Nerowie Road
Construction of 2.2 km west from Exford Road.
Whittlesea Shire
Settlement Road
Reconstruction east of High Street.

Other projects and activities

National Park roads

The State Government again provided loan funds repayable by the Board, amounting to $100,000, for expenditure on roads and associated purposes in or near National Parks.

Allocations were made by the Board after consultation with the National Parks Service for maintenance and for other works in or near the following National Parks:

Brisbane Ranges National Park	Bannockburn and Corio Shires
Bulga National Park	Alberton Shire
Cape Schanck National Park	Flinders Shire
Captain James Cook National Park	Orbost Shire
Ferntree Gully National Park	Sherbrooke Shire
Fraser National Park	Alexandra Shire
Glenaladale National Park	Bairnsdale Shire
Hattah Lakes National Park	Mildura Shire
Kinglake National Park	Eltham and Whittlesea Shires
Lind National Park	Orbost Shire
Little Desert National Park	Dimboola Shire
Morwell National Park	Morwell Shire
Mount Buffalo National Park	Bright Shire
Mount Burrowa Pine National Park	Tallangatta Shire
Mount Eccles National Park	Minhamite Shire
Mount Richmond National Park	Portland Shire
Mount Samaria National Park	Mansfield Shire
Organ Pipes National Park	Keilor City and Bulla Shire
Port Campbell National Park	Heytesbury Shire
Tarra Valley National Park	Alberton Shire
The Lakes National Park	Rosedale Shire
Warby Ranges National Park	Wangaratta Shire
Warrandyte National Park	Doncaster and Templestowe City
Wilsons Promontory National Park	South Gippsland Shire
Wingan Inlet National Park	Orbost Shire
Wyperfeld National Park	Karkarooc Shire

The works consisted of the construction and sealing of access roads to National Parks and roads and parking areas within National Parks, together with the maintenance of roads already constructed. The works were carried out either by the Board, the local municipal council concerned or the National Parks Service. The Government has made loan funds totalling $1,497,000 available for these purposes since 1st July, 1963.

Roads of tourist interest

The State Government provided loan funds totalling $225,000 in 1977/78 for expenditure on roads of a tourist nature other than roads proclaimed as tourists' roads under the provisions of the Country Roads Act. The loan funds are repayable by the Board.

Allocations for particular projects were made by the Board after consultation with the Ministry of Tourism. The total amount made available by the Government since 1960 is $3,669,000. Applications for financial assistance from these funds are well in excess of the amount available for expenditure.

The Board is required to make an annual payment into the Tourist Fund amounting to two per cent of the amount credited to the Country Roads Board Fund in the previous year from receipts under the Motor Car Act. An amount of $1,216,027 was paid during the year. The Tourist Fund is administered by the Ministry of Tourism.

National Association of Australian State Road Authorities

The National Association of Australian State Road Authorities (NAASRA) is an organisation of the Road Authorities of the six States and the Commonwealth Department of Construction, the members of NAASRA being the heads of the various authorities. The aims of NAASRA may be briefly stated as providing uniformity of practice in road and bridge design, construction, maintenance and operation, improved construction methods and the production and updating of technical manuals to establish standard practices throughout Australia.

The Association also collects and disseminates statistical information relating to traffic, the types and standards of roads and road finance. The information collected is used in the formulation of the national road policies.

The technical work of NAASRA is performed by the Principal Technical Committee (consisting of the chief engineering officers of the authorities) and a number of supporting standing and ad hoc committees on which the Board is represented.

NAASRA's views on such matters as the Commonwealth's controls on road finance, and Commonwealth participation in works programming, road design and construction standards are presented to the Australian Transport Advisory Council Road Advisers Group of which the Board's Chairman, Mr R E V Donaldson, is a member. This group advises ATAC, the meeting of Ministers of Transport which determines policy.

The following NAASRA meetings were held during the year:

☐ 58th (Annual Meeting) Perth, 21st and 22nd November, 1977, attended by Mr T H Russell, Deputy Chairman.

☐ 59th (Intermediate Meeting) Melbourne, 9th May, 1978, attended by Mr R E V Donaldson, Chairman; Mr T H Russell, Deputy Chairman; and Mr W S Brake, Member.

Items considered by NAASRA during the year included:

1 Commonwealth road funds legislation.
2 State roads legislation.
3 Australian Road Surveys.
4 Road vehicle limits:
— implementation of ERVL Study recommendations
— operation of large combination vehicles.
5 NAASRA study of road maintenance standards, costing and management.
6 Environmental matters.
7 Principal national routes.
8 Productivity measures in the road construction industry.
9 NAASRA Data Bank System Study.
10 Uniform Road Statistics.
11 Reports of Australian Committee on Road Devices (ACORD) and Australian Transport Advisory Council (Road Advisors Group).
12 Truck Hire Rates.
13 Co-ordination of Road Research.
14 International Training Courses.
15 Draft Guidelines for Compensation for Properties affected by Road Proposals.
16 NAASRA Publications.

Australian Road Research Board

The Australian Road Research Board was established in 1960. The Board of Directors includes the heads of the State Road Authorities, the secretary of the Commonwealth Department of Construction, the secretary of the Commonwealth Department of Transport and the Executive Director of ARRB.

Up to 10% of the ARRB's annual expenditure is borne by the Commonwealth Department of Construction. The remainder is shared by the six State road authorities on the percentage basis

adopted by the Commonwealth Government in making grants to the States under the States Grants (Roads) Act 1977 and the Transport Planning and Research (Financial Assistance) Act 1977.

The objective of the Board is to co-ordinate, encourage and arrange continuing research into problems associated with road and traffic in Australia, i.e. research into road planning, location, design, construction and maintenance, traffic operation and road safety.

The Directors of the Australian Road Research Board meet twice a year to consider management and policy matters and to review the progress of research projects.

Mr T H Russell, Deputy Chairman, attended the 35th Directors Meeting of ARRB at the Main Roads Department, Perth on 23rd November, 1977, while the Chairman, Mr R E V Donaldson who is also the Deputy Chairman of ARRB, attended the half yearly meeting held at the Australian Road Research Centre, Vermont on 10th and 11th May, 1978.

Technical conferences for the wider dissemination of the results of research and the exchange of knowledge are held biennially. Several CRB engineers are members of ARRB Technical or Specialist Committees.

As examples of the research projects being undertaken by ARRB, Dr M G Lay, Executive Director, ARRB, referred to the following projects in a paper presented at the 34th Conference of Municipal Engineers.

"Dynamic Truck Suspension Performance": a study of the forces that different types of truck suspensions apply to the road;

"Weighing Vehicles in Motion": a new weighing device called EMU (Electronic Mass Unit) has been developed. EMU not only measures the weight of the moving axle, but also measures the speed of the truck and the axle spacing and then assesses the type of truck;

"Speeds on Curves": an assessment of advisory speeds;

"Quality Control — Dimensions in Construction";

"Quality Control — Materials in Construction";

"Approval of Transport Planning Techniques";

"Design of Bituminous Plant Mixes": ARRB and the CRB are actively involved on field trials of some new asphalt mixes, especially designed for residential streets.

Co-operation with Army Reserve

During the year the Board joined other State Government instrumentalities and employers in supporting the "Employer Policy Statement" of the State Committee for Support of the Reserve Forces.

The policy statement encourages enlistment in the Reserves, as a significant and economical method of providing defence forces in peacetime as well as being a valuable addition to employee development within an organisation.

The Board with other State Government instrumentalities, sponsors Royal Australian Engineers Supplementary Reserve units in the Australian Army Reserve. The units sponsored by the Board are the Headquarters 22 Construction Regiment and the 107 Plant Squadron (Heavy). Members of these units are drawn from Board personnel throughout the State and have an obligation to attend an annual 14 day training camp. Additional training courses for promotion and acquisition of specialist skills are conducted at other times during the year.

The 1977 annual camp was held at Puckapunyal where training in demolitions, water supply, infantry minor tactics and range shooting was undertaken.

During March 1978 members of the Plant Squadron applied their skills to practical advantage by dismantling a 30.5 m long Bailey Bridge spanning the Broken River near Swanpool in north-eastern Victoria. This bridging, part of stocks held by the Board for emergency purposes, was erected following floods in 1974 which washed away the existing bridge. With the construction of the permanent concrete replacement bridge completed, the dismantling was carried out over a weekend and provided valuable community assistance as well as training benefit to unit members.

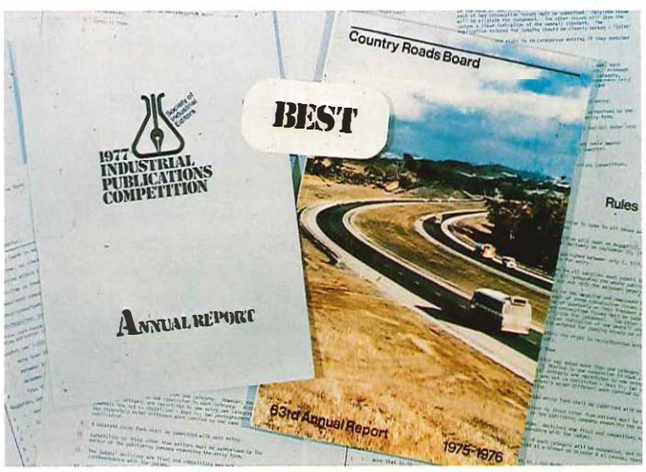
The Commanding Officer of the regiment is Lieutenant Colonel G R Hunt, ED, the Board's Project Engineer for the Eastern Freeway and the plant squadron is commanded by Major P M Hosking, ED, the Board's Property Officer. At 30th June, 1978, fifteen members of the Board's staff were officers of 22 Construction Regiment.

Public relations

The Board continued to pursue the policy of informing the public of its functions and works. The Public Relations Officer and his staff prepared news releases and publications for public issue and arranged for audio-visual productions and displays relating to the Board's activities.

Publications

In November, the annual national awards of the Society of Industrial Editors were announced. The Board received the First Award in the Annual Report Section for its 1975/76 Annual Report and the First Award in the magazine section for the 35th edition of CRB News, published in May 1977. This edition of CRB News contained the feature article, titled "Your Property . . . Your Roads" for which the Board received a commendation in the Awards.



During the year, the Board issued the following publications or pamphlets:
CRB News, Nos 36, 37, 38.
Roadside Rest Areas
CRB Colouring Book (for children)
The Princes Freeway, Drouin-Warrigul Sections
The Hume Freeway, Violet Town Bypass
Snow Driving . . . It's An Art (revised)
The Western Freeway, Melbourne to Ballarat
Pedestrian Overpasses and Underpasses
Driver's Guide to the Eastern Freeway
The Eastern Freeway
Fog Driving
Freeway Driving
Financial Facts, February 1978

Audio visual productions
During the year five short video productions were made for public exhibition:
The Hume Challenge (revised)
The Bypass of Euroa
Western Roads
The Widening of Nepean Highway
Freeway Driving

Anti-litter campaign
During the summer of 1977/78, the Board carried out a major public education campaign relating to the problem of roadside litter.
The main feature of the campaign was the production and distribution of 140,000 car tidy bags, and a number of colour posters which highlighted the Board's annual litter collection costs, currently estimated at $600,000.
The campaign gained wide community support, and the Board wishes to express its thanks to the community groups, individuals, companies and the media who assisted in the campaign.

Personnel

The Board's personnel strength as at 30th June, 1978 was as follows:

Technological staff (professional)	615
Technical staff	519
Administrative staff	762
Supervisory staff — Field	176
— Depot	77
Clerk of works	83
Construction and maintenance personnel	2163
Workshop and depot personnel	630
Total	5025

For the first time in several years, the Board recruited a group of young civil engineers and technical staff during the year as part of its manpower planning programme. The group consisted of 19 civil engineers, 12 draftsmen and 8 survey assistants.
The Board engaged 50 young people during the year as part of the Commonwealth Government initiated Special Youth Employment Training Programme. This programme encourages the development of job skills in young persons between the ages of 15-24 years who have been unemployed for six months. The young persons engaged were given on-the-job training for a maximum period of six months. The State Government encouraged its departments and instrumentalities to participate in the programme and gave financial support.

Forty school students also gained some work experience under the Work Experience Act. The Act was introduced by the State Government in January 1975 to provide work experience for up to twelve days in any one term for students over thirteen years of age. The State Education Department reimbursed the Board the salaries paid to the students.
The flexible working hours scheme introduced last year at Head Office was extended to regional Divisional Offices and the office at the Board's Mechanical Sub-branch at Syndal.

Workers compensation
Arising out of the engagement of an Occupational Health Specialist as the Board's part-time Medical Officer and the appointment of an experienced Workers Compensation Officer significant improvements were achieved in dealing with workers compensation claims. A Workers Compensation Administration Committee was established to examine all aspects of workers compensation claims received from personnel throughout the Board's organisation. Action taken by this committee together with a greater awareness of accident prevention measures throughout the Board led to a reduction in absences due to workers compensation. Valuable assistance was also provided to the Board's insurers resulting in speedier compensation payments to claimants.

Apprenticeships

Thirty-eight new apprentices were employed during the year in the trades of motor mechanics (25), carpentry and joinery (6), structural steel fabrication (2), cooking (1), gardening (1), painting and decorating (1), lithographic printing (1) and plumbing and gasfitting (1).

The total number of apprentices in training at the 30th June 1978, was:

Motor mechanics	74
Structural steel fabrication	5
Carpentry and joinery	9
Painting and decorating	4
Electrical mechanics	3
Cooking	1
Automotive electrics	2
Gardening	3
Lithographic printing	2
Instrument making and repairing	1
Fitting and machining	1
Plumbing and gasfitting	2
Total	107

Industrial relations

During the year the Board participated in several hearings before the Australian Conciliation and Arbitration Commission. Three cases in particular, involving the important A.W.U. Construction and Maintenance Award, were of direct significance to the Board.

The first case concerned wage and condition changes for employees engaged by certain companies in asphalting operations. A strike by some of these employees occurred, causing delays in the surfacing of the Eastern Freeway. As a result of this case the wage rates of the employees concerned were increased on the basis of work value.

The second case involved wage claims on behalf of the Board's employees engaged in roadmaking operations. The decision resulted in the wage rates of these employees being incorporated into the Award without any increase.

The third case, not determined at 30th June, concerned conditions attaching to the payment of wages during inclement weather at construction sites.

The Board's work was also affected by a strike when employees of one of the Board's contractors engaged on resurfacing work on the Hume Freeway (Wallan to Broadford Section) stopped work in support of improvements in conditions. This strike lasted for one week, after which the parties were able to be brought together to confer on a number of on-site problems.

Fortunately, the very serious strike of State Electricity Commission maintenance employees late in 1977, which had devastating effects in some areas, ended before it adversely affected the Board's operations.

The Board decided in principle to issue safety footwear to its field and workshop employees. Stocks are expected to be available for issue early in the new financial year.

Generally, the Board's relationships with the trade unions and staff associations continued to be satisfactory. Two single day industrial relations training courses for job representatives of two staff associations — The Municipal Officers' Association of Australia and the Association of Architects, Engineers, Surveyors and Draughtsmen of Australia — were held at the Board's Head Office under the auspices of the Trade Union Training Authority. The Board's Personnel Manager, Industrial Relations Officer and Personnel Officer presented papers to the courses.

Details of Awards to which the Board is a respondent party and the number of its personnel covered by these Awards are as follows:

Award	
Australian Workers Union Construction and Maintenance	1807
Building Construction Employees and Builders Labourers	139
Carpenters and Joiners	18
Engine Drivers and Firemen	5
National Building Trades Construction	78
Metal Trades	319
Transport Workers (General)	254
Municipal Officers (Country Roads Board)	1815
Municipal Officers (Country Roads Board) Senior Officers	19
Professional Engineers (Country Roads Board, Victoria)	527
Professional Engineers (Country Roads Board, Victoria) Senior Engineers	21

The remaining employees are covered by Victorian Wages Board Determinations.

Training and development

As in previous years the Board's internal training and development programme was designed to meet the needs of apprentices, field and workshop personnel, supervisory staff, technical staff, administrative staff and professional staff.

Training courses were conducted covering legislation affecting the Board's work, pre-retirement planning, supervision, project management, and many technical aspects of the Board's activities. The personal development of young engineers and draftsmen was assisted by work experience rotation schemes and the Study Leave Scheme.

During the year the Board had the responsibility of conducting the International Training Course in Road and Bridge Engineering for 19 African and Asian Engineers. This three month course is conducted annually by the National Association of State Road Authorities in association with the Australian Development Assistance Bureau, and is rotated between the various State Road Authorities each year.

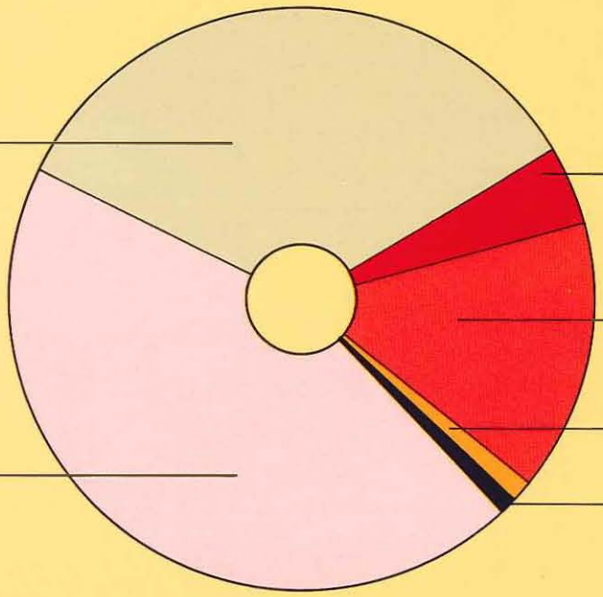
Retirements
During the year the following personnel retired after substantial service with the Board:

Name	Position	Location	Length of service (years)
Taylor, C R	Patrolman	Dandenong Division	47
Liddell, C C	Deputy Secretary	Secretary's Branch	42
Smith, R S T	Superintendent of Works	Benalla Division	40
Macdonald, C T	Cleaner/Gardener	Bairnsdale Division	37
Nolan, D J	Articulated Vehicle Driver	Mechanical Sub-Branch	37
Fowler, A K	Patrolman	Benalla Division	36
Drury, (Miss) W G	Senior Receptionist/Typist	Office Services Section	35
Perry, A F	Overseer	Warrnambool	35
Lilley, R	Supervising Draftsman	Materials Research Division	33
Upton, L P	Workshop Supervisor	Ballarat Division	33
Malcolmson, K	Ganger	Bridge Sub-Branch	32
Sanders, A T	Ganger	Benalla Division	31
*Wilby, L G	Superintendent of Works	Urban Projects Sub-Branch	31
*Cooper, H W	Construction and Maintenance Worker	Benalla Division	30
Everard, H C	Traffic Officer	Bendigo Division	30
Palm, R O	Painter	Mechanical Sub-Branch	30
Pevitt, A G	Patrol Assistant	Warmambool Division	30
Ronald, J W A	Divisional Accounts Clerk	Geelong Division	30
Acreman, G F	Fitter Leading Hand	Mechanical Sub-Branch	29
Alexander, E W	Foreman	Mechanical Sub-Branch	29
Brayshaw, H D	Workshop Foreman	Traralgon Division	29
Howlett, E C	Assistant Secretary	Secretary's Branch	29
Andree, W A G	Divisional Engineer's Clerk	Mechanical Sub-Branch	28
Coppleman, L G	Clerk of Works	Major Projects Division	28
Hardy, R S A	Truck Driver	Traralgon Division	28
*Anderson, J L	Owner/Truck Driver	Traralgon Division	27
Carey, D	Patrolman	Ballarat Division	27
*Wilson, L R	Traffic Officer	Warrnambool Division	27
Daly, C J	Patrolman	Benalla Division	26
McCarthy, J P	Fitter	Ballarat Division	26
Napaduik, D	Pipelayer	Traralgon Division	26
Gibb, J McD	Clerk of Works	Benalla Division	25
Jones, W E	Senior Prosecutions Officer	Traffic Section	25
McLeod, E E	Engineering Assistant	Bairnsdale Division	25
Renn, W S	Overseer	Urban Projects Sub-Branch	25
Rodwell, J S	Engineering Assistant	Bairnsdale Division	25
Rylow, P	Traffic Controller	Traralgon Division	25
Whitelaw, K N	Construction and Maintenance Worker	Bairnsdale Division	25
Mauger, (Mrs) M M	Senior Machine Operator	Mechanical Sub-Branch	24
*Dell, G C	Patrolman	Dandenong Division	23
Garland, K L	Patrolman	Bairnsdale Division	23
Worland, P	Patrol Assistant	Benalla Division	23
Bronkhorst, A	Depot Clerk	Warrnambool Division	22
Lyberis, J	Construction Carpenter	Bridge Sub-Branch	22
Shiel, (Miss) M E	Clerical Assistant	Correspondence Registry	22
Trickey, D J	Carpenter	Horsham Division	22
Whitechurch, C G	Traffic Officer	Traffic Section	22
Barton, G M	Cost Clerk	Geelong Division	21
*Seager, O K	Carpenter	Bridge Sub-Branch	21
King, H	Mobile Crane Driver	Ballarat Division	20
*Nancarrow, L W	Roadmaster	Horsham Division	20
*Wos, J	Mechanical Plant Operator	Dandenong Division	20

*Deceased

Finance

Receipts 1977-78



Registration fees, drivers' licence fees etc.
33.93% $75,978,000

Tonne kilometre tax
4.38% $9,818,000

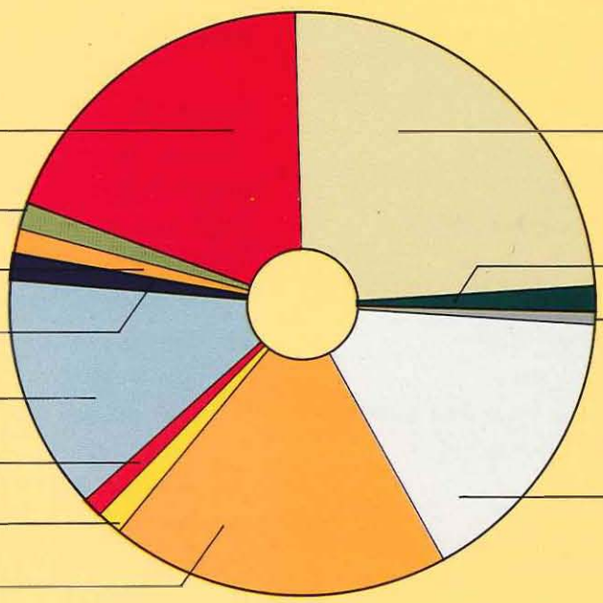
Allocation from Roads (Special Projects) Fund
14.94% $33,456,000

Municipal repayments
1.29% $2,891,000

Other
1.26% $2,830,000

Commonwealth Grants
44.20% $98,980,000

Payments 1977-78



State highways
18.95% $42,253,000

Freeways
24.43% $54,463,000

Other
1.33% $2,972,000

Planning and research
1.26% $2,817,000

Tourists' roads
1.45% $3,227,000

Forest roads
.73% $1,617,000

Capital
1.4% $3,122,000

Management and operating
13.05% $29,102,000

Statutory payments
1.09% $2,422,000

Main roads
16.05% $35,785,000

Interest and sinking fund
1.34% $2,993,000

Unclassified roads
18.92% $42,170,000

Receipts

The Board's receipts were obtained from the following main sources:

After deducting the cost of collecting revenue received under the Motor Car Act, the total funds available to the Board during the year, including the allocation from the Roads (Special Projects) Fund, was $224,745 844. The funds were derived from:

State sources	124,972,830
Commonwealth sources	98,980,094
Balance brought forward from year 1976/77	792,920
	$224,745,844

State sources:

☐ Motor registration fees:
Fees payable on the registration and re-registration of motor vehicles and trailers less the costs of collecting the fees (excluding metropolitan omnibus registration fees and the specified proportion of registration fees paid to the Roads (Special Projects) Fund.

☐ Registration number plate fees:
Fees payable for the provision and/or replacement of number plates less the costs of providing the plates and collecting the fees.

☐ Examiners' licence fees:
Fees payable by persons licensed to conduct motor car road-worthiness examinations, less cost of collection of the fees.

☐ Authorized log book fees:
Fees payable for the purchase of log books less the cost of providing the books and collecting the fees.

☐ Learner driver permit fees:
Seven-eighths of the permit fee and the permit extension fee payable by applicants for and/or holders of learner driver permits less seven-eighths of the cost of collection of the fees (one-eighth less one-eighth cost of collection is paid to the Drivers' Licence Suspense Account).

☐ Drivers' licence testing fees:
Seven-eighths of $4 of the fee payable for the test of proficiency of candidates for motor car drivers' licences less seven-eighths of the cost of conducting the test and collecting the fee (one-eighth of $4 less one-eighth cost of collection is paid to the Drivers' Licence Suspense Account) and the amount of each fee above $4 is paid to the Consolidated Fund.

☐ Motor car drivers' licence fees and tractor drivers' licence fees:
One-eighth of the fees payable for the issue of drivers' licences less one-eighth of the cost of collecting the fees (one-half, less one-half cost of collection, is paid to the Consolidated Fund; one-quarter, less one-quarter cost of collection, is paid to the Municipalities Assistance Fund; one-eighth, less one-eighth cost of collection, is paid to the Drivers' Licence Suspense Account).

☐ Motor driving instructors' appointment and testing fees: Fees payable by candidates for motor driving instructors' licences, less cost of collection of the fees.

☐ Motor driving instructors' licence fees:
One-quarter of the fees payable for the issue of motor driving instructors' licences less one-quarter of the costs of collection of the fees (one-half, less one-half cost of collection, is paid to the Consolidated Fund; one-quarter, less one-quarter cost of collection, is paid to the Municipalities Assistance Fund).

☐ Unregistered vehicle permit fee:
A fee for the issue of a permit to use an unregistered motor car or trailer on a highway for a period of not more than 7 days, less the costs of collection of the fee.

☐ Proprietorship notification fee:
A fee payable with notification by a proprietor of a motor car or trailer of repossession of the item under a hire purchase agreement, bill of sale or like instrument, less the costs of collection of the fee.

☐ Fines imposed under the provisions of the Country Roads Act.

☐ All moneys received under Part II of the Commercial Goods Vehicles Act (tonne kilometre tax).

☐ Municipal payments on account of main road works.

☐ Special moneys appropriated by Parliament.

☐ Loan money.

☐ Allocation from Roads (Special Projects) Fund.

Appendix 1

Special projects

Projects financed in whole or part from the Roads (Special Projects) Fund, during the financial year.

Project No.	Name and Descriptions
24	Eastern Freeway — Construction of a multi-lane freeway from Alexandra Parade, Collingwood to Thompsons Road, Bulleen.
33	Princes Freeway — Construction of a new bridge over the Snowy River at Orbost and realignment of approaches.
40	Princes Freeway — Construction of a second carriageway between Moe and Hernes Oak.
41	Princes Freeway/Princes Highway — Construction of dual carriageways between Morwell and Traralgon.
43	Princes Freeway — Bypass of Drouin and Warragul.
44	Tullamarine Freeway — Construction of interchange at Essendon Airport and conversion of Lancefield Road to Freeway.
46	Omeo Highway — Improvements between Omeo and Mitta Mitta.
47	Calder Highway — Improvements between Harcourt and Bendigo.
48	Princes Highway East — Duplication through Pakenham and improvement of Army Road intersection.
50	STATCON — The installation of stop signs, give way signs and traffic signals throughout the State.
51	Bellarine Highway — Construction of duplicate carriageways and new bridge at Fenwick Gully, Wallington.
52	Great Ocean Road — Reconstruction from Marengo to Calder River.
54	South Gippsland Freeway — Construction of road and bridge at Hampton Park.
55	Eastern Freeway — Construction of multi-lane freeway between Thompsons Road, Bulleen and Doncaster Road, Balwyn North.
56	Latrobe Terrace — Construction of multi-lane highway between Hope Street and Settlement Road, Geelong.
57	Mornington Peninsula Freeway — Construction of multi-lane freeway between Eel Race Drain, Seaford and Springvale Road, Keysborough.
58	Nepean Highway — Construction of multi-lane highway between Cochrane Street, Elsternwick and South Road, Moorabbin.
59	Calder Freeway — Bypass of Keilor between Erebus Street and west of Keilor-Melton Road.
60	Princes Highway East — Construction of multi-lane highway between Hawthorn Road and Waverley Road, Malvern.
61	Western Highway — Construction of four-lane highway between Princes Highway and Ashley Street, Sunshine.
62	Princes Freeway — Construction of bypass of Berwick.
63	Princes Highway East — Improvements between Tonghi Creek and Bluenose Creek, Shire of Orbost.
64	Princes Highway East — Improvements between Rankins and east of Jones Creek Road, Shire of Orbost.
65	Omeo Highway — Improvements between Sarsfield and Bruthen.
66	Cann Valley Highway — Improvements between Weeragua and NSW border.
67	Mallacoota Tourists' Road — Improvements between Halls Creek and Mangans Lane.
68	Sunraysia Highway — Improvements between Bet Bet Creek and Lamplough.
69	Murray Valley Highway — Improvements at Killara and construction of bridges over Kiewa River.
70	Midland Highway — Improvements between Reef Hills and Barjarg south of Benalla.
71	Murray Valley Highway — Improvements between Wood Wood and Piangil.
72	Phillip Island Tourists' Road — Improvements between Anderson and the Nobbies.
73	Hamilton Highway — Improvements between Bruce Creek and west of Inverleigh.
74	Wimmera Highway — Improvements between Rupanyup and west of Marnoo.
75	Henty Highway — Princes Highway West — Improvements between Portland North and Bolwarra deviation.
76	Henty Highway — Improvements between Heywood and Branxholme.

Appendix 2

Motor Registrations

Registrations under the Motor Car Act during the year 1977/78 totalled 2,274,465 an increase of 5.8% over the total for the previous year.

Vehicle	Financial year 1976/77		Financial year 1977/78		Increase	Decrease
Private						
New	125,504		121,125			
Secondhand:						
Re-registered	52,355		58,915			
Renewed	1,393,199	1,571,058	1,489,284	1,669,324	98,266	
Commercial and hire						
New	18,092		16,579			
Secondhand:						
Re-registered	5,407		5,823			
Renewed	129,323	152,822	135,221	157,623	4,801	
Primary producers' trucks and tractors						
New	3,521		4,168			
Secondhand:						
Re-registered	2,716		2,864			
Renewed	77,934	84,171†	80,773	87,805*	3,634	
Licences under the Motor Omnibus Act		820		871	51	
Trailers		295,230		311,997	16,767	
Motorcycles		45,602		46,845	1,243	
Totals		2,149,703		2,274,465	124,762	

† Includes 42,577 no-fee tractors
* Includes 43,512 no-fee tractors

Appendix 3

Statement of receipts and payments

for year ended 30th June 1978 (Adjusted to nearest dollar)

Country Roads Board

		Country Roads Board Fund Act 6229	Act 6222 road maint. A/c
Receipts			
Balance as at 1st July 1977		792,920	
Motor Car Act 1958 (No. 6325)			
Motor Car Registration Fees	83,597,194		
Drivers Licence Fees	1,632,113		
Drivers Licence Testing Fees	489,657		
Trailer Registration Fees	2,460,737		
Learner Drivers Permit Fees	234,943		
Examiners Licence Fees	8,742		
Sale of Log Books	14,928		
Motor Driving Instructors Licence — Appointment and Testing Fees	3,620		
Motor Driving Instructors Licence Fees	5,510		
	88,447,444		
Less: Cost of Collection	12,469,291	75,978,153	
Municipalities Contributions			
Permanent Works — Main Roads	128,805		
Maintenance Works — Main Roads	2,761,731	2,890,536	
Fees — Commercial Goods Vehicles Act No. 6222 — Road Maintenance A/C			9,817,988
Public Works and Services Act No. 9068		581,000	
Fines — Country Roads Act No. 6229		8,154	
General Receipts		1,915,706	
State Loan Funds — Act No. 6229			
Allocation — Roads (Special Projects) Fund			
Commonwealth Grants			
States Grants (Roads) Act 1977			
Transport Plan. & Res. (Fin. Asstnce.) Act 1977			
Transport (Planning & Research) Act 1974			
Adjustment of Grants for year ended 30th June 1977			
Traffic & Road Safety Improvement			
		$82,166,469	9,817,988
Payments			
Road Expenditure			
Main Roads — Construction and Reconstruction		12,400,590	
Maintenance		6,307,584	6,445,884
State Highways — Construction and Reconstruction		2,167,777	
Maintenance		10,466,606	2,638,727
Freeways — Construction and Reconstruction		11,207,510	
Maintenance		1,123,179	733,377
Tourists' Roads — Construction and Reconstruction		629,611	
Maintenance		1,781,132	
Forest Roads — Construction and Reconstruction		686,474	
Maintenance		930,385	
Unclassified Roads — Construction and Reconstruction		10,549,342	
Maintenance		1,104,206	
Contribution to Melbourne & Metropolitan Tramways Board			
Tram Tracks Reconstruction		355,837	
Rail/Road Bridges Protection		455,842	
State Intersection Control (STATCON) Programme			
Murray River Bridges and Punts		286,553	
Traffic Line Marking		1,605,592	
Statutory Payments			
Interest and Sinking Fund	2,993,051		
Traffic Authority Fund	608,014		
Tourist Fund	1,216,027		
Transport Regulation Fund	598,071	5,415,163	
Planning & Research		1,515,998	
Capital Expenditure			
Plant Replacement and Additions	2,058,636		
Buildings, Workshops, Etc.	1,063,133	3,121,769	
Management & Operating Expenditure		8,467,829	
		$80,578,979	9,817,988
Balance available to the Board as at 30th June 1978		$1,587,490	

Auditor General's Certificate

The accounts of the Country Roads Board for the year ended 30th June 1978 have been audited. In my opinion, the above Statement of Receipts and Payments fairly presents in summary form the transactions during that period.

B. J. Waldron, Auditor-General, 11th September 1978

Loan Funds	Roads (Special Projects) Fund	States Grants (Roads) Act 1974	Transport Plan & Res. (Fin. Asstnce.) Act 1977	Transport (Plan & Res.) Act 1974 Section 7	C'wealth Traffic & Road Safety Improvement Trust Account		Total
							792,920
						75,978,153	
						2,890,536	
						9,817,988	
						581,000	
						8,154	
						1,915,706	
325,000						325,000	
	33,456,293					33,456,293	124,972,830
		97,670,000				97,670,000	
			1,286,666			1,286,666	
				14,573		14,573	
					8,855	8,855	98,980,094
325,000	33,456,293	97,670,000	1,286,666	14,573	8,855		224,745,844
	1,443,848	9,186,316			564	23,031,318	
						12,753,468	35,784,786
325,000	13,995,938	11,105,196				27,593,911	
		1,553,503				14,658,836	42,252,747
	9,956,692	30,386,698				51,550,900	
		1,055,413				2,911,969	54,462,869
	756,549	59,435				1,445,595	
						1,781,132	3,226,727
						686,474	
						930,385	1,616,859
	49,251	24,082,784			8,291	34,689,668	
		6,020,000				7,124,206	
						355,837	42,169,711
							455,842
	624,995						624,995
							286,553
							1,605,592
							182,486,681
							5,415,163
			1,286,666	14,573			2,817,237
							3,121,769
	6,629,020	14,004,978					29,101,827
325,000	33,456,293	97,454,323	1,286,666	14,573	8,855		222,942,677
		215,677					$1,803,167

R. G. Cooper, Chief Accountant, 7th September 1978

Appendix 4

Loan liability

as at 30th June 1978

	Main roads etc.	Developmental roads	Total
	$	$	$
Permanent works			
Main roads	16,730,322.16		16,730,322.16
State highways	19,279,304.20		19,279,304.20
Freeways	3,000,000.00		3,000,000.00
Tourists' roads	227,316.44		227,316.44
Forest roads	2,167.89		2,167.89
Developmental roads		12,851,515.09	12,851,515.09
Discount and expenses	752,978.22	585,302.89	1,338,281.11
Total amount borrowed	39,992,088.91	13,436,817.98	53,428,906.89
Less redemption of loans			
Redemption funds	170,438.11	1,292,772.73	1,463,210.84
Main roads sinking fund	571,376.76		571,376.76
Developmental roads sinking fund		110,166.02	110,166.02
State loans repayment fund	3,621,057.87		3,621,057.87
National debt sinking fund	9,417,599.89	8,690,808.85	18,108,408.74
Consolidated fund	52,111.36		52,111.36
	13,832,583.99	10,093,747.60	23,926,331.59
Loan liability at 30th June 1978	26,159,504.92	3,343,070.38	29,502,575.30

Appendix 5

Works executed on behalf of Commonwealth and State Government Authorities

for the year ended 30th June 1978
(Adjusted to nearest dollar)

Departments	Description of works	Expenditure	
Commonwealth			
Department of Construction	Access roads to various Commonwealth establishments		7,395
Victoria			
Crown Lands & Survey Department	Reconstruction of Dunmoor Road, Glenelg	173	
Melbourne and Metropolitan Tramways Board	Construction of East Burwood Tram Extension	508,909	
Ministry of Tourism	Additional snow clearing on the Alpine Road to Mt Hotham	37,427	
Ministry of Tourism	Construction of Rest Area at Rennick on Princes Highway	6,280	
Ministry of Transport	Grade separated level crossing projects etc. charged to the Transport Fund	3,643,644	
	Grade separated pedestrian crossings charged to State Treasury, Municipalities and Transport Fund	359,545	
Premier's Department	Roadworks in connection with Wonderland and Sundial Roads, Stawell Shire	300	
Rural Finance & Settlement Commission	Roadworks in Commission land settlement areas throughout the State	3,673	4,559,951
State Treasury	Kings Bridge — sundry expenditure less proceeds of rental of properties acquired in connection with construction of Kings Bridge	14,496 Cr	
State Treasury	Improvements to various roads adjacent to State Forests to facilitate the extraction of timber and charged to Municipalities Forest Roads Improvement Fund	126,349	
State Treasury	Restoration works on roads and bridges damaged by floods and bushfires	410,946	522,799
			$5,090,145

Country Roads Board

Engineer in Chief's Report 1977-78

Country Roads Board
Melbourne

The Chairman

I submit herewith my Report for 1977 /78. The Report deals with those activities within the Engineer in Chief's Branch which are considered to be of general or specific technical interest.

K G Moody
Engineer in Chief

Index

Planning

Road planning by the Board is directed to the provision of an adequate and efficient road system within the State in accordance with and in the context of, the needs and aspirations of the community, as expressed by the political process.

Road planning processes include:

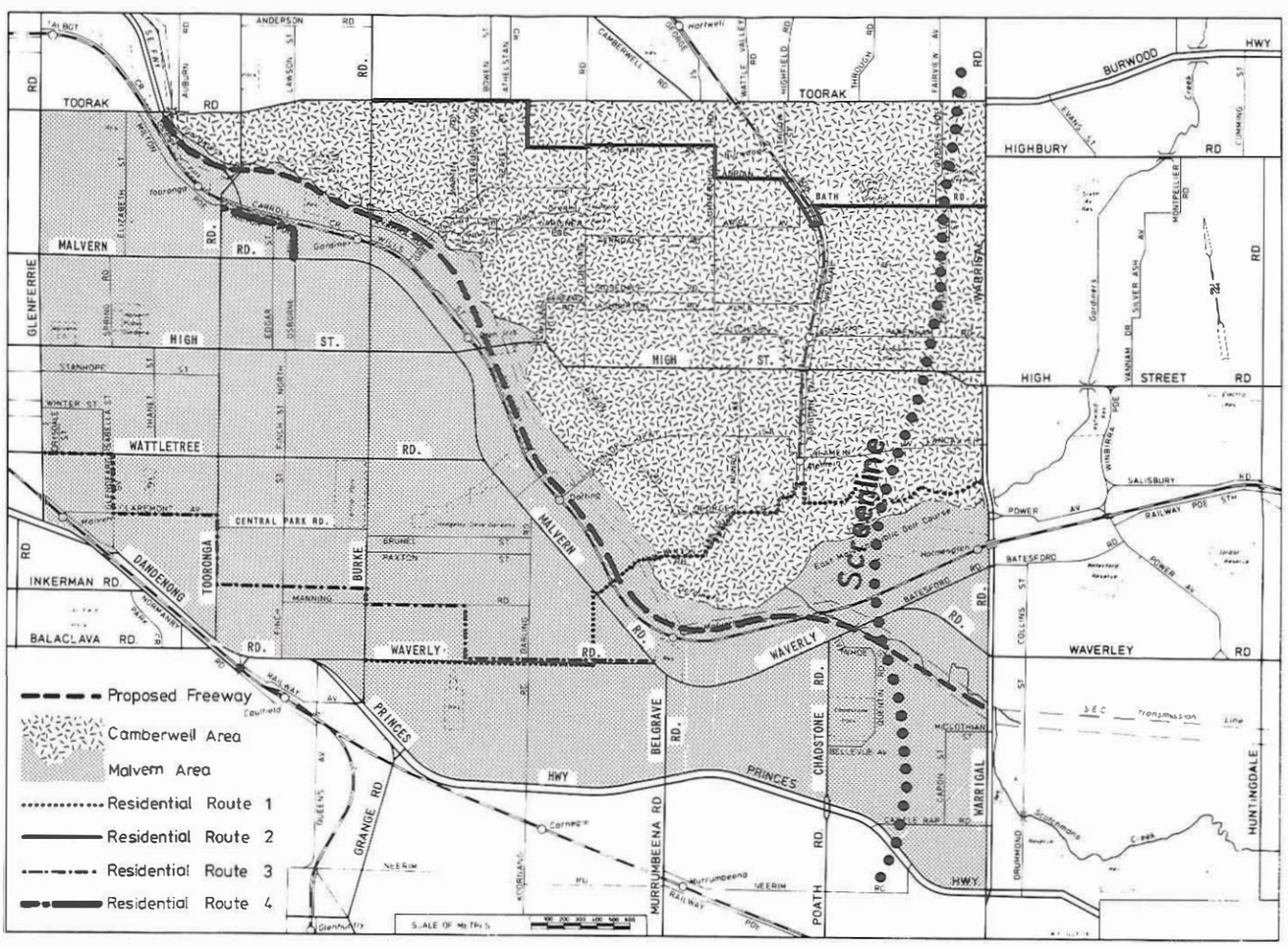
- ☐ Monitoring the performance of the road system.
- ☐ Identifying community needs and desires.
- ☐ Identifying deficiencies or problem areas.
- ☐ Examining a range of practicable alternative treatments to overcome or relieve deficiencies or problems.
- ☐ Evaluating environmental, sociological, economic and technical effects of alternatives and selecting the more suitable treatments.
- ☐ Examining the effect of selected treatments on the road system in the light of budgetary controls and staging options.
- ☐ Adopting a favoured solution.
- ☐ When required by the favoured solution, proceeding with the statutory procedures for amendment of planning schemes.

In recent years, the trend has been to directly involve a number of authorities in the studies and to encourage extensive community participation as part of the study.
On the more contentious or sensitive proposals, environmental and sociological aspects are given particular attention and in some cases either a Preliminary Environmental Report or an Environmental Effects Statement is prepared. If an Environmental Effects Statement is prepared, it is usual to exhibit the statement for a month and for public comment to be invited. The Statement, and the comment received, is then assessed by the Ministry for Conservation before final decisions are made.
Proposals are normally referred to the relevant municipal councils and other authorities and agencies, including planning authorities for comment and where necessary under statutory planning procedures for agreement.
As a result road planning studies are becoming more complex and costly, and require considerable time and resources to complete.

Through Traffic on Residential Streets

Because of the inadequacy of layout and the limited capacity of the existing arterial road system in many localities there is an increasing tendency for road traffic to seek relief by diverting to residential streets, which were not intended for this purpose.
As part of the Gardiners Creek Valley Study an investigation was undertaken to obtain information on the volumes of traffic using residential streets and the reasons for such intrusion. This information was then used to assess the likely intrusion of through traffic into the existing residential street network for each of the alternatives considered during the study.
The Camberwell section of the study area (see Figure 1) consists of large blocks of residential development bounded on 2 or 3 sides by arterial roads. There are a few highly utilised routes through these residential areas carrying volumes up to 5,000 veh/day (e.g. Bath Road 4,700 veh/day). The Malvern area (also see Figure 1) consists of small blocks of grid type residential development bounded on all 4 sides by arterial roads. There are many alternative routes through these residential areas carrying volumes up to 3,000 veh/day (e.g. Central Park Road 2,600 veh/day).
Investigations into the locally generated traffic volumes on each outlet from a residential area to an arterial road showed that 500-600 veh/day could be expected on these roads in the Camberwell area and 200-300 veh/day in the Malvern area. Traffic volumes on many residential street routes are considerably higher than these volumes and are therefore mainly through traffic.
The contribution of residential streets to the overall capacity of the road network was estimated by determining the volumes of through traffic on residential streets and comparing them with volumes on arterial roads crossing a screenline. Through traffic volumes on residential streets amount to 8-17 per cent of the volumes on arterial roads (e.g. 10 per cent for screenline shown) and therefore contribute significantly to the total capacity of the road network.
Travel time runs on selected residential street routes were carried out to enable comparison with travel times for equivalent trips on the arterial road network. Vehicles using residential street routes adopt speeds of up to 60 km/hr where possible, but average 35-40 km/hr due to the corners and intersections along the route. Vehicles using residential street routes

Figure 1: Through traffic routes in some local residential streets of Camberwell and Malvern.



encounter minor delays averaging 10 seconds at 25 per cent of the intersections with small streets (volumes less than 10,000 veh/day) and longer delays averaging 26 seconds at 75 per cent of the intersections with arterial roads (volumes greater than 10,000 veh/day).
The following reasons for diversion of through traffic to alternative residential routes (see Figure 1) were identified:

(a) The Inadequacy of the Arterial Road Network
The arterial network in the study area and in the Camberwell area in particular does not adequately cater for some movements, e.g. between the south-west and north-east corners of the study area. Vehicles desiring to make such trips adopt more direct residential routes, e.g. residential route 1 which is 10 per cent shorter in distance and offers a 25 per cent time saving in peak periods compared with routes using the arterial road network. The attractiveness of such routes in off peak periods is attested by the daily pattern of hourly traffic volumes — route 1 displays a typical arterial road type distribution in that the hourly volumes remain significantly outside peak periods and the 4 peak hour volumes accounting for only 34 per cent of the daily volume.

(b) Congestion on the Arterial Road Network
As travel times on the arterial roads increase due to excessive congestion some vehicles will seek alternative adjacent routes through residential areas. These residential routes are quicker even though they may be longer. Residential route 2 is 13 per cent longer but still 30 per cent quicker, during peak periods, than the alternative arterial route. Routes such as this are only attractive during peak periods when the arterial roads are heavily congested. The hourly traffic volume variation throughout the day on this route supports this conclusion as the volumes in off peak periods are less significant and the four peak hour volumes account for 52 per cent of the daily volume.

(c) Avoidance of Delay
Some drivers will not tolerate excessive delay (stopped time) and will seek alternative routes on residential streets which offer only marginal time saving but a relatively small delay.
Residential route 3 is similar in length to arterial routes and requires approximately the same travel time. However, it includes only 10 per cent delay time compared with 30 per cent delay time for the alternative arterial route, and is preferred by some drivers.

(d) Avoiding Congested Turning Movements
Large delays are often incurred by turning vehicles, especially vehicles turning to the right, at intersections on the arterial network. In many cases drivers can divert around such intersections by using nearby residential streets, e.g. residential route 4. In some cases residential streets are also used to transfer from one arterial with congested turning movements to an adjacent arterial with spare turning capacity.

The computer modelling process adopted to predict future traffic volumes for the different road concepts considered in this study was unable to account for the through traffic volumes using residential routes. To rationalize the computer assignments for 1991 traffic, it was necessary to manually reassign traffic from the arterial road network to the residential routes. This was done by assuming that the proportions of total traffic which would use residential streets in 1991 would be the same as exists under current conditions. Account was also taken of the expected congestion on the adjacent arterials and of the estimated capacity of the residential routes.
These studies indicated that, if existing conditions were retained, residential routes would continue to significantly contribute to the capacity of the road network. As congestion on the arterial roads causes lengthening of the peak periods, alternative residential routes would remain attractive for longer periods. The number of discernible peak hours per day on residential routes would increase from the present 3 to 5 by 1991.
However, construction of a new arterial road or freeway would reduce through intrusion into residential areas, especially for movements along the creek valley (i.e. parallel to the new facility). Movements across the valley on residential routes would only be marginally affected.

Hume Freeway
(a) Baddaginnie to Bowser
The planning investigation stage for the location of the Hume Freeway between Baddaginnie and Bowser is reaching its conclusion after nearly five years of work. This section of the Hume Freeway, which includes the by-passes of Benalla and Wangaratta, forms part of the National Highway between Melbourne and Wodonga.
Throughout the investigations there has been significant involvement with relevant councils and authorities as well as the community. Comments and suggestions from these sources were all considered in the establishment of a favoured route as described in Summary Report No 2 — February 1978 and comprised the Reef Hills, Winton, Airport and Wangaratta Lines.
The Board's favoured route was selected because it is considered to serve the best interests of the community, both locally and generally, as well as having significant advantages regarding access to the towns and cities along the route, greater flexibility with staging and fewer effects on the Laceby Flats flood plain. Comments received to date indicate that the favoured route is generally supported by most authorities and members of the local community.
The next stages of the project will be the final adoption of a route and detailed design. Construction, at an estimated cost of $134 million (1977 prices), is expected to commence in the early 1980s.

(b) Euroa Section
Following an extensive investigation of alternative routes, the Board published the results of its investigation indicating that it favoured adoption of a route to the south of Euroa township. The Board received comments from members of the public, the Euroa Shire Council and many other authorities, and members of the Board's staff attended meetings of the council and a public meeting to discuss the alternatives and seek information and comments. A Social Survey was conducted to further ascertain the views of the local community.
From these submissions and meetings, it was apparent that among other issues some members of the community and some authorities were concerned about particular aspects of the favoured route.
As a direct result of this process the alternatives were further considered and a modified route developed and circulated to all authorities.
An Environmental Effects Statement is being drafted and it is anticipated that this will be placed on exhibition by the Ministry for Conservation during 1978. Following the completion of the procedure for the receipt and assessment of comments, the Board will make recommendations to the Government on the route to be adopted.

Princes Freeway
Pakenham and Tynong Sections
Following a study of this section by consultants Wilbur Smith and Associates the Board approved a general freeway alignment to south of Pakenham and a zone of interest on the remaining section to Bunyip River. The zone of interest was approximately 1 km wide on the south side of the Princes Highway.
A more detailed study of the route commenced in April 1977. The main thrust of the investigation concentrated on the section between Pakenham and Bunyip River, and it soon became apparent that the alternatives generally following the highway alignment would be cheaper, more easily staged and less environmentally damaging than alignments deviating from the highway. A close examination of alternatives led to the conclusion that the existing highway should be converted to freeway conditions, with the existing highway pavement retained as the ultimate westbound freeway carriageway. A new eastbound freeway carriageway would be constructed generally on the north side of the existing carriageway. This would allow for stage construction of the freeway, the first stage being highway duplication from Pakenham to Bunyip River.

Calder Highway Corridor
Melbourne to Bendigo
As part of the Forward-Look Programme for Major Improvements to the rural State highway system an investigation of short and medium term improvements for the Calder Highway corridor between Melbourne and Bendigo was undertaken.

The investigation established priority schedules for minor or major improvements in the corridor based on the likely occurrence of deficiencies, economic analyses of improvements, and other relevant factors.
Various strategies for the development of the corridor at different rates of funding and at different levels of improvement were hypothesised.
The favoured strategy provides a short and medium term integrated plan to overcome the deficiencies in the corridor as well as a framework for the ultimate development of a freeway route to Bendigo.
Under this strategy, significant improvements are planned for the corridor over the next 3 years by concentrating action on the construction of the by-pass of Keilor and by the construction of a significant number of spot improvements.
Subject to the availability of funds, work would then proceed on the progressive development of a 4 lane route by the construction of town by-passes and progressive duplication and improvement of the sections of highway between towns.

NAASRA Data Bank System Study
In 1976, the National Association of Australian State Road Authorities (NAASRA) decided to proceed with a study into the development of computer-based systems for road and bridge inventory data for roads.
A small team of staff seconded from State Road Authorities was established to develop a computer-based road and bridge planning model, and design and implement a system for storing, validating and maintaining an up-to-date road and bridge inventory on a uniform basis in each State Road Authority.
The work of the study team resulted in the establishment of a computerised Data Bank System, comprising Standard Data Files with data validation and data updating sub-systems.
The inventory items included in the Data Bank provide for both rural and urban roads with single or dual carriageways. Additional items may be added to meet the individual requirements of each State Road Authority. Inventory items are to be permanently referenced using a Road Reference System developed by NAASRA.
The computer-based planning model NIMPAC (NAASRA Improved Model for Project Assessment and Costing) has been developed to provide State Road Authorities with improved means of planning road system improvements and assessing performance against planned objectives. The model is established for roads and bridges in rural and outer-urban areas and is developed in a manner which will permit modifications and extensions as required.
The systems developed during this study will provide all State Road Authorities with a valuable aid to road planning. They will minimise the cost of obtaining and processing road inventory data and provide road authorities with the information necessary for them to contribute on a sound basis to the formulation of national road policies.
The Board is also providing the facilities to maintain and update, on behalf of NAASRA, the computer programs developed by the study.

Commercial Vehicle Surveys
In early 1976, the NAASRA Economics of Road Vehicles Limits Study (ERVLS) recommended a set of mass limits for commercial vehicles which would allow heavier loads to be carried on most vehicles when operating on Victorian roads. The recommended limits also allowed for a slight increase in the length of articulated vehicles and in the height of line-haul commercial vehicles. Most of the recommended mass and dimension limits were put into operation in Victoria in November 1976 under an extension of the permit system.
In 1977/78 the Board conducted limited surveys on the Hume and Western Highways to monitor the effects of the new limits. The surveys have confirmed the trend for operators to use larger trucks, the proportion of these vehicles in the traffic stream having increased dramatically over the past 15 years. Although operators have taken advantage of the increased loads allowed under the permit system, significant increases in pavement damage do not appear to have resulted because the ERVLS recommendations encourage the use of vehicles with the less-damaging axle types. Operators have also made considerable use of the increased dimensional limits allowed by the permit system. Further surveys are required to verify whether these conclusions apply on a general basis.

Steel Trough Decking
A large number of timber decked bridges are still in service throughout Victoria, and in many areas it is becoming increasingly difficult to obtain suitable sawn timber for replacement decking. Increasing costs of material supply, and high maintenance charges resulting from the use of poorer grades of timber and increased wear and tear resulting from increasing vehicle loadings have encouraged investigation of alternative types of decking as a replacement for timber.
Steel trough decking has been used on several bridges over the past ten to twelve years, and with galvanized sections now being readily available, it is likely that this material will be more widely used in the future.
The material currently adopted is zinc coated Grade 250 steel 3.2 mm thick, cold rolled to a trough profile. It is available in lengths up to 12 metres, but longer lengths may be supplied where the available transport and handling facilities permit their use.
Trough decking already installed has been designed for H10 and H15 wheel loads, the H15 wheel load being approximately equivalent to the 'A' class loading for which many existing bridges were designed. Decking has been arranged to span longitudinally between crossbeams in some bridges, and transversely between stringers in others. Design stresses conform to the NAASRA Bridge Design Specification for Grade 250 steel, and checking of wheel load distribution to confirm the values adopted for design is under way.
Steel trough decking may be used with either timber or steel supporting members, and a variety of types of fixings are being investigated. With steel supporting members, plug or slot welding has been used as well as bolted connections; a simple and quick fixing may be obtained by using self tapping screws in pre-drilled holes. Where the supporting members are timber, bolted fixing brackets or bolts passing directly through the troughing and timber crossbeams are used. In both situations, penetration of water through the fastening is prevented by a mastic water seal.
End splices of troughing should be arranged over supporting members, and for square bridges, all end splices may be arranged at the same relative location. Side splices between troughing sections made by intermittent fillet welding or by self-drilling and tapping screws assist in live load distribution between adjacent sections.
The running surface is provided by premixed asphalt filling placed over the trough decking.

Examination of steel trough decking in service has shown the need for careful detailing and installation to ensure satisfactory long-term behaviour. Welded connections damage the zinc coating and corrosion may occur unless alleviated by applying a zinc-rich paint after welding. Corrosion is also evident at the side lap joints between sections of troughing and adjacent to deck joints, i.e. wherever water is able to penetrate through the bituminous pavement or deck joints.
As more use is made of steel trough decking, further improvements in design and detailing to improve service behaviour will evolve; possible changes which are presently envisaged include the use of thicker steel sections or high strength steel.

Johnson Street Bridge Project
The Johnson Street Bridge consists of twin structures, each having five main spans of approximately 33.5 metres and an approach span of 10.0 metres at the northern end. Each structure has an overall width of 19.1 metres and an overall length of 176.6 metres. The superstructure consists of precast prestressed concrete beams with an in-situ reinforced concrete deck slab made continuous over the piers. The piers and abutments are reinforced concrete supported on large diameter cylinder piles.
Interesting features of the bridge include the large diameter piles and the use of full depth exposed aggregate fascia panels:

(a) Cylinder Piles
Special attention was given to the foundations in both the design and construction stages because of the close proximity of the 990 mm inside diameter Melbourne Main Sewer, which was built around 1895. Consequently, a 12 metre easement was adopted within which no piles were to be founded.

Two vertical 1680 mm diameter reinforced concrete piles per pier and abutment were adopted, i.e. 24 piles in all. These piles were taken through the overlying Coode Island silts, Fishermen's Bend silt, and Moray Street gravels and socketed into the Silurian bedrock. In addition, four raker piles were installed for a possible future structure. The design load for the piles varies between 5930 kN to 9770 kN and is supported by a combination of end bearing (40 per cent) and shaft friction (60 per cent). An adhesion factor $\alpha = 0.2$ was used but after test loading a pile to 13,950 kN this was subsequently revised to $\alpha = 0.4$ provided the socket was excavated by hand and could be inspected "in the dry".

An outer steel casing 16 mm thick in the lower section and 13 mm thick in the upper sections was oscillated into Silurian mudstone (see Plate 1). Due to the possibility of damage to the sewer, percussion methods of installation were prohibited, except to ensure a seal in the final 600 mm of driving.

During the oscillation process, the pile was continually excavated using a mechanical grab device and, to minimize the risk of "blow-ins", the casing was kept full of water.

Although some sockets were formed under water using a combination of augering and airlifting, the contractor generally elected to de-water the casing and use hand mining techniques to excavate the socket below the toe of the casing.

Socket lengths varied between 1.8 metres and 17.6 metres in length and were based on core examination and testing and visual inspection of the socket excavation. The overall length of the piles varied between 40 and 55.6 metres. The base was founded on mudstone with an end bearing value of 1.72 MPa.

The unreinforced socket was cast under water using a tremie operation up to a level approximately 4.6 metres above the casing toe. The pile was then de-watered, reinforcing installed for the remaining length and the concreting operation completed. Cylinder pile concrete was sulphate resistant with a specified 28-day strength of 30 MPa.

In the case of the cylinder piles adjacent to the sewer, geophones and tiltmeters were used to monitor vibration and ground movement during pile installation.

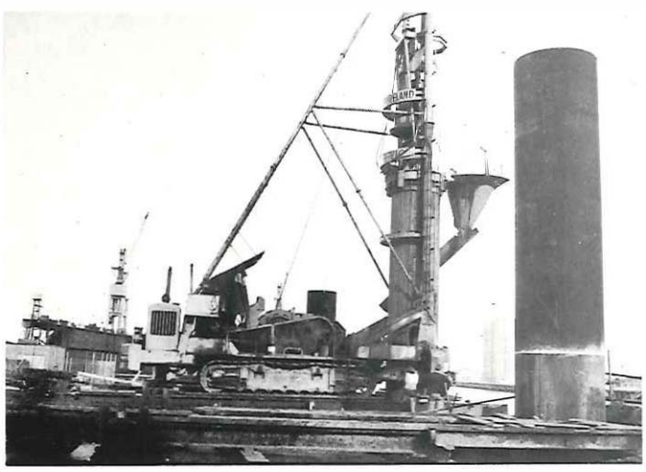


Plate 1: Installation of outer steel casings of piles for the Johnson Street Bridge

(b) Fascia Panels

As this bridge is to be one of the main bridges over the Yarra River on the edge of the Central Business District, considerable attention was given to its aesthetic qualities. As the structures were of typical beam and slab type, it was considered that architectural treatment of the bridge should aim to create the effect of a continuous ribbon across the river. To this end, an inclined full depth exposed aggregate panel was eventually adopted.

As the bridge is a low level crossing, consideration at the design stage had to be given to flood and debris loading.

Also, the tendency for thin sections to twist or warp due to differential shrinkage led to the adoption of a total thickness of the fascia panels of 114 mm, excluding the protrusion of the exposed aggregate. The panels were precast rather than cast in-situ because of easier installation, especially over the river. The final design required the use of 144 panels, 4.90 m long × 1.98 m deep (approximately) cast monolithically with a reinforced concrete edge beam. The panels were cast in a steel mould, using initially a standard concrete mix and finished with a 38 mm veneer of Harcourt Granite which was in turn screened, rolled and water washed. The panels were steam cured and acid etched with diluted hydrochloric acid to provide a clean, uniform finish. Each panel weighs approximately 4 tonnes.

Plate 2: Substantially completed Johnson Street Bridge showing fascia panels

Road Design and Construction

"Spur" — String Processing User Routines

The traditional survey method for highway design represents terrain as a series of cross-sections perpendicular to and at intervals along a line usually the centre line of the road. This technique is limited and inflexible in its ability to represent the terrain. It is also wasteful of survey effort in many circumstances.

An advance on this method is to represent the terrain as a sequential collection of related points (northing, easting and level) which are termed "strings". For example, the invert of a creek may be one string and its banks subsequent strings, all being defined independently by a series of points.

It is assumed that the terrain between any two points in a string or between any points in adjacent strings can be found by linear interpolation.

Plans and Surveys Division has adopted this technique using stadia methods and has developed the String Processing User Routines System (SPUR) to aid surveyors and road designers. The SPUR system is compatible with the "RIDGE" road design system.

In the field terrain information is entered into stadia books by the surveyor and submitted for card punching and reduction. With the information on file, it is a straightforward task to obtain plan diagrams and grade plots of the strings using "SPUR", and to obtain contour plans using the "RIDGE" system.

When the road designer has established a proposed design line, the string file is used to obtain cross-sections along a nominated line at any interval, and the traditional design process evolves by the use of the "RIDGE" system to obtain a Digital Roadway Model and subsequent cross-section design plots.

The system, although simple in concept, is a powerful design tool having many advantages and applications—

- ☐ Survey time in the field is reduced since less time is wasted in establishing centre lines.
- ☐ The string file is easily changed and the record of terrain is retained indefinitely.

In the design process—

- ☐ Manual plotting by the draftsman from field books is almost eliminated.
- ☐ Cross-sections are always normal to the design line.
- ☐ Horizontal and vertical plots of an area are easily and quickly obtained.

- ☐ The terrain surface can be easily transformed from one grid system to another (local to state grid).
- ☐ Terrain definition is the responsibility of the surveyor, not the draftsman.

Eastern Freeway

(a) Drainage

During the construction of the Eastern Freeway, it became apparent that the pavement profiles in the vicinity of the spiral to tangent to spiral (STS) transition areas could produce a surface drainage problem in terms of excessive depths of flow leading to possible vehicle aquaplaning. This problem, arising mainly from a combination of curvilinear alignment, minimal longitudinal grades and wide carriageways, could also be accentuated by construction inaccuracies in laying the pavement surfacing.

To alleviate this potential problem, revised pavement profiles were designed to reduce the depth of flow and minimize "ponding" in the transition areas.

In the original design, the maximum drainage path length was 102 metres and over a length of 90 metres the crossfall varied between 0 per cent and ± 0.5 per cent. At its flattest point the longitudinal grade was 0.3 per cent. By comparison, the revised pavement profiles obtained by progressively rotating the crossfall traffic lane by traffic lane produced a minimum drainage path length of 33.5 metres and a minimum crossfall of 1 per cent through the STS area (except in those areas of each individual lane under rotation).

Such a modified STS area therefore not only substantially reduced the drainage path length and consequently the depth of flow (calculated in this case to be from 9.94 mm to 5.06 mm, i.e. by 49 per cent), but also provided a payment profile that is far less critical in terms of the construction accuracy needed.

(b) Noise Attenuation

Noise attenuation barriers have been constructed at selected localities along the perimeter of the Eastern Freeway to reduce to acceptable levels the transmission of traffic noise to adjacent residential properties.

Barriers generally consist of earthen embankments alongside the freeway carriageways and surmounted, where the available toe width is restricted, by a timber wall to raise the barrier to the required height.

Alternative materials considered for the walls were precast concrete panelling, masonry blocks, conventional brick, crib walling and pressure-treated pine. Three test panels were erected, but pressure-treated pine was chosen following consideration of relative costs, effectiveness, appearance, and the views of local people.

The CSIRO Building Research Division provided valuable guidance in specifying the requirements of the pressure-treated pine. The nominal height of wall is 1.8 metres and the unit cost of erection, including supply and delivery of all materials, was approximately $66 per lineal metre.

In certain areas, the height of wall adopted was a compromise to retain distant views of the Yarra River valley from residences while providing some degree of noise attenuation. In another area, the majority of residents favoured planting of trees to visually screen the freeway rather than construction of a noise barrier. Following further representations since the freeway was opened, the Board has agreed to construct a noise barrier in this area, having ascertained that the L10 (18 hour) levels are unacceptably high.

For prediction of traffic noise levels, the Board currently uses the method prescribed in the HMSO publication "Calculation of Road Traffic Noise" (CORTN). This method has been found to correlate satisfactorily with actual measured values. Further, the Board has adopted an L10 (18 hour) value of 68 dB(A) as the predicted level at which corrective measures should be examined on new freeway facilities.

Since the freeway was opened, limited checking of noise levels using measured and predicted values has shown that the barriers are generally adequate.

Princes Highway East

From Orbost to the New South Wales border, the Princes Highway East generally comprises a 5.5-6 metre sealed pavement with a 8.5-9 metre formation.

The pavement was constructed using granitic sand and decomposed granite obtained at various locations along this section. This material is poorly graded and often of high plasticity and extensive failures have developed under current traffic.

The programme of improvement involves pavement resheeting on sections of adequate alignment standards and complete reconstruction to replace sections of low standard alignment.

Extensive investigations throughout the area have shown a paucity of naturally occurring pavement materials, and even deposits of rock suitable for production of crushed rock are few in number and very limited in extent.

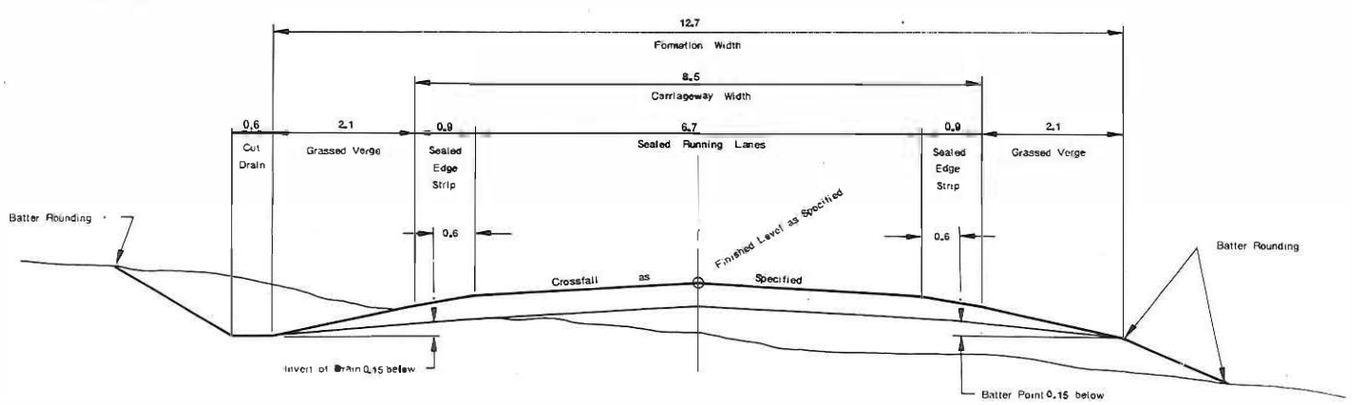
Because of these facts and the need to improve the shear strength, and reduce the moisture sensitivity of the available granitic sand, the initial projects in this overall programme have been constructed by in-situ cement stabilization of the upper 150 mm of pavement material.

The pavement cross-section (see Figure 2) represents a departure from established practice with the objective of improving the ability of the pavement to resist the ingress of moisture by penetration through the seal or by infiltration from the unsealed edges.

A seal 8.5 metres wide has been provided with edgelines 6.7 metres apart. The pavement extends over the full formation width and the subgrade crossfall is increased over the outer 2.4 metres width of formation. Subsoil drains with facilities to permit inspection will be provided in cuts beneath the verge.

The performance of the initial sections of pavement constructed according to these concepts will be closely monitored to assess their structural behaviour and maintenance requirements.

Figure 2: Pavement cross-section adopted for the Princes Highway East, Sections 5 and 6



Landscaping

(a) Hume Freeway (Wallan to Broadford)

The construction of new sections of freeway in hilly country has required careful selection of horizontal and vertical alignment in order to achieve desirable road design standards at reasonable cost. Even so, heavy cut and fill earthworks have been made, and for aesthetic and practical reasons a great deal of care has been exercised in shaping cut and fill batters, in controlling erosion, and in establishing vegetation.

This is particularly exemplified in the Wallan-Broadford Section of the Hume Freeway.

The greater part of the project length is in undulating country calling for major cuttings and embankments which, in many areas, were susceptible to erosion. Consequently, particular attention was given to the shaping and treatment of earthworks.

The primary object in earthworks treatment was to develop a roadside that fitted into the undulating and rounded nature of the countryside.

The following were some of the more significant features of the design:

☐ *Location and Alignment*

To avoid emphasizing the presence of deep box cuttings against the skyline, the alignment through such cuttings was curved wherever possible. Where this could not be achieved, particular attention was given to a slope design to achieve a natural appearance. Relatively simple three-dimensional cardboard cut-out models were used to check this feature.

In sidelong slopes and at some box cutting sites the horizontal and vertical alignments were adjusted to avoid leaving small arrises of cutting on the downhill side of the roadway. Alternatively, wherever it was reasonably economical, the design called for removal of these arrises to achieve an open appearance, capture the views of the surrounding countryside and give the impression that the roadway was located in side cutting.

☐ *Individual Slope Design*

Particular attention was given to the design of individual slopes, and each cutting and embankment was individually checked for appearance and erosion protection. In general, the method adopted was to warp the approach to each cutting (and the transition between cutting and embankment) by adopting a constant batter offset (or catchline) usually about 10 to 13 metres wide: in some cases, this was increased to correspond to the ruling offset for the particular cutting.

The maximum batter offset adopted in this treatment was approximately 50 metres.

Uniform slopes of 2:1 were maintained through the balance of deep cuts. Embankment slopes were generally 4:1 or 6:1 for embankments 4.5 m or less in height and 1.5:1 for higher embankments. Wherever economically justified, guard-fence was eliminated by adopting flatter and safer embankment slopes.

The largest cuttings were checked by contour design to ensure that the slopes blended fairly naturally into the existing land form.

The tops and toes of all embankments and cuttings were generously rounded. It was found that an approximately parabolic rounding of 6 m × 6 m removed the sharp edge at the limits of the earthworks and achieved a natural appearance in this location.

A combination of cross-sectional and sand fill models and contour designs were used to develop landscape treatments of complex slopes at interchange sites.

Erosion control measures on the Wallan to Broadford Section of the Hume Freeway called for treatment of bare and disturbed ground as quickly as possible following on completion of earthworks.

The steeper drainage lines were generally thatched with straw or hay to depths of 75 mm to 100 mm held in place with wire mesh. Batter faces were finished in a roughened condition prior to approximately 100 mm topsoil being placed. This enabled a mechanical interlock between the base material and topsoil and produced a situation in which grass roots could readily penetrate through the topsoil into the batter soils. Fertilizer and grass mixes used included rye grasses, bents, clovers and sub-clovers. In some instances "spray-on" treatments were used whilst on other ground agricultural equipment was utilized to spread fertilizer and sow seed.

To date over 30,000 trees and shrubs have been planted on verges, interchanges, medians and rest areas. In addition, steep slopes at overpass structures have been planted with ground cover plants. Shrubs have been established in the median to minimize headlight glare to opposing traffic. Native shrubs, including wattles, paperbarks and small eucalypts, constitute the bulk of the species used.

The verges have been treated using groupings of tree species which occur along the length of the job. These include *Eucalyptus macrorhyncha* (Red Stringybark), *Eucalyptus melliodora* (Yellow Box), *Eucalyptus polyanthemos* (Red Box), *Eucalyptus obliqua* (Messmate), *Eucalyptus cypellocarpa* (Mountain Grey Gum), *Eucalyptus radiata* (Narrow Leaf Peppermint), *Eucalyptus microcarpa* (Grey Box), and *Acacia mearnsi* (Black Wattle). Planting along the verges so far has been designed to blend the freeway in with the natural vegetation. Some of the eucalypts have also been used in the two rest areas to eventually provide shade and shelter.

Natural conditions on the Divide provide great extremes of climate, and tree growth is largely governed by the seasonal conditions prevailing after planting. Generally spring or late winter provides the better condition for tree planting.

Further tree planting is yet to be carried out as initial planting becomes self sufficient.

(b) Eastern Freeway

The Eastern Freeway from Collingwood to Bulleen is located along the Yarra River valley and as such it was essential that the freeway be developed as a picturesque and scenic route in harmony with its natural setting. To achieve this it was necessary that considerable landscaping of the freeway be undertaken.

The location, alignment and levels of the freeway were controlled by factors exclusive of landscaping considerations, but considerable effort has been applied to achieve appropriate harmony and contrast in colour and texture in landscaped areas and rock cuttings, in screening of unsightly areas, in screening of the freeway from adjoining development, in attenuation of freeway traffic noise, and in the control of erosion.

The landscaping design provided for planting of native and exotic trees, shrubs and ground cover plants.

The trees used comprise the following varieties:

☐ seven varieties of eucalyptus, the principal species being *Eucalyptus camaldulensis* and *Eucalyptus citriodora*,

☐ four varieties of melaleuca, the principal species being *Melaleuca armillaris*,

☐ three varieties of acacia, the principal species being *Acacia baileyana* (or Cootamundra Wattle),

☐ varieties of hakea.

The ground cover and shrubs were selected to minimise maintenance and add variety and colour to flat areas and the batters of the freeway. The principal plants selected for this purpose were *Galenia secunda, Grevillea rosemarinifolia, Grevillea tridentifera, Rhagodia gaudichaudiana, Dimorphotheca ecklonis* (or South African Daisy of the Veldt) and *Hedera helix* (or ivy).

Materials and Research

Nuclear Density Gauge Testing of Asphalt

The method of testing the density of asphalt in the past has required the cutting of cores from the pavement using a diamond-tipped core cutter. In more recent times, use has been made of a nuclear density gauge for this purpose. This method of test has the advantage that it is non-destructive and results may be obtained almost as soon as field testing is completed. It has been found that, although the gauge does not give a reliable measure of the density of asphalt at a particular point, it is possible to obtain a reliable mean value for a given area of asphalt if measurements are taken at a sufficient number of points within the area under consideration. The method of assessment adopted has been to consider the asphalt placed in one location on one day as a lot or batch. The mean and standard deviation, and relative compaction, based on laboratory compacted specimens, are calculated from ten measurements and are used to estimate the proportion of the lot or batch which has been compacted to less than the specified minimum value.

The gauge is calibrated for each particular mix of asphalt by comparing the gauge counts at about twenty sites with the respective bulk density values of cores of asphalt cut from the same sites.

One serious problem in using the nuclear density gauge in the manner described results from the fact that the gauge readings are influenced by material within about 75 mm of the surface although material within about 40 mm of the surface has the major effect. As a consequence the results obtained on layers of asphalt less than about 50 mm thick may be unreliable.

Control of Stone Quality

Because of serious difficulties encountered in identifying unsound rock by visual methods, more thorough methods of inspection of source rock have been introduced into the Board's quality control procedures. These new procedures require regular sampling of all quarry faces in active use, and complete classification of the rock by appropriate laboratory testing. Type samples of material of the various quality classes are then established for use by plant inspection personnel in assessing quality of source rock and crushed rock products. While the practical assessment of quality still relies on the judgment of colour, texture and hardness by a trained inspector, the uncertainty of this process has been substantially reduced by the availability of type samples.

Raised Reflective Pavement Markers

A service test was carried out on the Maroondah Highway at Blackburn in order to compare the service performance of raised reflective pavement markers (RRPMs) complying with the Board's current specifications, with that of markers of other types and forms of construction.

Five different makes of RRPM marker of four different types of construction (see Plate 3) were included in the test. Eighty-eight sets of these five markers were placed during April and May 1977. The period over which the test was conducted was 421 days. Towards the end of the study a further thirty markers having a very low initial optical performance were laid, replacing markers which had been removed.

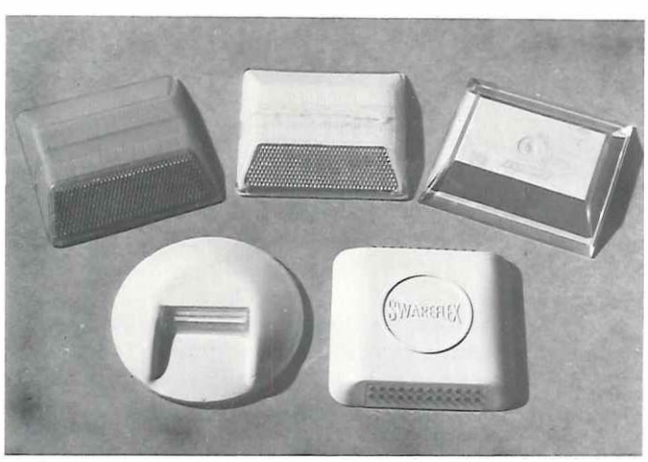


Plate 3: Raised reflective pavement markers (RRPMs) used in the Maroondah Highway service test:
Upper row — Makes 1, 2 and 3;
Lower row — Makes 4 and 5.

Prior to installation, the coefficient of luminous intensity (CIL) of each RRPM was measured. At intervals, groups of markers were removed for CIL measurements to be made in the laboratory, and for each marker the value was compared to the initial value. CIL values were also measured with the RRPMs wetted with a barber spray. The RRPMs were found to have CIL values when wet generally 3-10 times higher than when dry. This property of greater luminance when wet is extremely valuable to the motorist as it is in wet weather that RRPMs are most needed because of the decreased visibility of painted linemarking.

Reduction in CIL is caused by abrasive degradation of the exposed face of the reflective element, by entry of moisture, by loss of portion of the reflective element, or by build-up of traffic grime. In wet weather trafficking tends to clean the faces of the RRPMs, and the film of water on the face fills any pitting thereby increasing retro-reflection.

During the test, the different RRPMs suffered damage, as summarised below.

Makes 1 and 2, which are of similar construction, mainly suffered abrasive degradation, but some minor separation of the shells from the filler occurred with Make 2. This has been observed elsewhere with these RRPMs and the problem is believed to be aggravated slightly by exposure to ultra-violet light. Steps have been taken to rectify the problem.

Make 3 suffered breakdown of the weld joining the shell to the filler, allowing entry of water and mud, thereby obscuring the reflective element. In many cases the shell was lost.

Make 4 suffered failure of the adhesive holding the reflective element to the ceramic body, with either entry of water or complete loss of the element. A change in the type of adhesive used has been made.

Make 5 suffered mechanical damage to the individual glass reflectors. The reflectors do not extend as high above the pavement as the reflectors of the other types and the loss due to build-up of dirt at the markers-pavement junction is therefore greater. The improvement in performance in wet weather is not so noticeable with this marker. The glass reflecting element of this type of RRPM scratches and chips in contrast to the surface peening suffered by the acrylic types.

Towards the end of the study the carriageway was resealed, which provided an opportunity to observe the performance of the markers when subjected to greatly increased abrasion from loose stones. At the conclusion of the test, 147 days after the reseal, the dry CIL values of the various markers were generally of the order of 1 to 4 mcd/lx. It was noted that the use of self-adhesive covers over the markers during the resealing operation had been generally satisfactory.

The set of thirty low reading RRPMs which were placed late in the trial had a mean CIL of 120 mcd/lx initially. After 67 days under traffic the mean CIL had fallen to 8 mcd/lx. By comparison two RRPMs having initial CIL values of 344 and 313 mcd/lx were removed at 65 days and CIL values of 9 and 6 mcd/lx were recorded.

Although the CIL values measured for RRPMs in the as-removed condition were near the sensitivity limit of the CRB reflex photometer, observation under road conditions shows that a RRPM having a CIL in the range of 3 to 10 mcd/lx still provides useful delineation. For comparison, the luminance of a new reflectorized painted traffic stripe (80 mm × 3 mm) was measured with a Spectra-Pritchard photometer, and for viewing at a simulated distance of 30 m on the road, a CIL of about 0.5 mcd/lx was calculated. The equivalent figure for a non-reflective traffic stripe was of the order of 0.02 mcd/lx. In wet weather the difference between a painted reflectorized traffic stripe and a RRPM would probably increase by at least a further factor of 10.

Regular night inspections of the installations were made and a count taken of RRPMs which had been damaged. Damage was classified as "minor" when optical performance was not markedly affected, "considerable" when optical performance was completely lost, and "severe" when the major portion of a RRPM was missing. Field observations made 3 weeks before the markers were removed indicate that a marker with a CIL as low as 2 mcd/lx is still effective as a delineator.

In summary, it appears that the CIL values of a RRPM can fall rapidly in service to a level of performance which is from a tenth to a hundredth of its performance when new, and that this level

when compared among different marker types bears little relationship to their performance when new. Even so, the markers are ten to fifty times brighter than a painted reflectorized traffic stripe in dry conditions, and many more times brighter in the wet.
As a result of this study, an amended specification providing for acceptance of pavement markers to be based on performance after trafficking has been prepared.

Bituminous Surfacing

Extent of Work
Table 1 shows that 5,088 km of all types of bituminous surfacing work was completed in 1977/78 compared with 4,826 km in 1976/77. The length of roadway treated increased by 262 km and the area treated has increased by approximately 1,600,000 m².
In 1977/78 the length of sealed pavement on the Board's declared system was increased by 65 km and the length on unclassified roads by 516 km, as shown in Table 2.
Reconstruction of existing sealed pavements and the restoration of the seal coat amounted to 371 km of the declared system, 1.6 per cent of the sealed length, compared with 1.4 per cent in 1976/77.
Retreatment on declared roads amounted to 1,697 km, being 7.2 per cent of the sealed length compared to 7.0 per cent in 1976/77.

Table 1:
Bituminous surfacing work completed

Category of road and plant used	1976/77		1977/78	
		km		km
Work on roads to which the Board contributed funds:				
CRB declared roads				
Board's plant	2018		2179	
Municipal plant	136		119	
Contractor's plant	325		269	
		2479		2567
Unclassified roads				
Board's plant	1555		1731	
Municipal plant	213		243	
Contractor's plant	257		215	
		2025		2189
Sub-totals				
Work done for other Authorities by the Board's plant (no Board contributions for these works)				
Municipalities	310		322	
State instrumentalities	12		10	
Commonwealth works	0		0	
		322		332
Totals		4826		5088

Table 2:
Bituminous surfacing work on various road categories (on roads to which the Board contributed funds during 1977/78)

Type of work	State Highways	Freeways	Tourists' and forest roads	Main roads	Total Board's declared system	Unclassified roads	Totals
	km	km	km	km	km	km	km
Initial treatments:							
Extensions to sealed system							
Sprayed work	0.60	13.35	13.58	39.89	67.42	509.57	576.99
Plant mix work	—	1.17	—	—	1.17	6.26	7.43
Reconstruction of lengths of previously sealed pavements							
Sprayed work	114.24	—	8.40	229.71	352.35	259.82	612.17
Plant mix work	2.05	0.12	—	13.29	15.46	21.64	37.10
Widening of existing sealed pavements							
Sprayed work	59.71	3.91	7.41	60.61	131.64	61.10	192.74
Plant mix work	5.00	—	—	1.50	6.50	3.09	9.59
Duplication of existing sealed pavements							
Sprayed work	27.82	—	—	1.02	28.84	1.10	29.94
Plant mix work	—	—	—	5.11	5.11	3.61	8.72
Final seal							
Sprayed work	92.50	31.10	4.90	95.23	223.73	249.31	473.04
Plant mix work	3.24	21.10	—	12.75	37.09	9.68	46.77
Retreatments:							
Sprayed work	609.10	34.88	85.90	913.84	1643.72	1033.16	2676.88
Plant mix work	32.88	1.54	—	19.31	53.73	30.63	84.36
Totals	947.14	107.17	120.19	1392.26	2566.76	2188.97	4755.73

Types of Work
Sprayed work (initial treatments and retreatments) was again the principal type of work, amounting to 96 per cent of the total length of the work.
The plant mix work completed in 1977/78 was 194 km, i.e. 4 per cent of the total distance and 7 per cent of the total area.
The 1977/78 expenditure on plant mix works was equivalent to 34 per cent of the total expenditure on bituminous surfacing.
For the plant mix work a total of 400,230 tonnes was supplied and spread by contractors.

Cost of Work
The average unit costs for sprayed work done by the Board's seventeen bituminous surfacing units are shown in Table 3. The average overall cost of all types of sprayed work was 64 cents per square metre compared with 60 cents in 1976/77, an increase of 6 per cent. The average cost per tonne for asphalt supplied and laid was approximately $24.20 per tonne in the Melbourne and Geelong areas, and approximately $31.60 per tonne in other areas of the State. The average cost per tonne was $24.39, compared with $24.50 in 1976/77.

Table 3:
Average costs of sprayed bituminous surfacing done by the CRB plant
(on roads to which the Board contributed funds during 1977/78)
(Costs in cents per m²)

Item		Nature of work												
Square metres costed		ITP&S S.13 & over	ITP&S Size 10	ITP&S S.7 & sand	ITP&S 2 application seal	ITSO & reseal 2 appln.	Primer-seal	ITSO&ITFS & reseal S.16 & over	ITSO&ITFS & reseal Size 13	ITSO&ITFS & reseal Size 10	ITSO&ITFS & reseal S.7 & sand	BSRS Reseal Size 13	BSRS Reseal Size 10	Surface enrichment
		1350641	1088291	120583	26703	40641	1748860	1152	3963371	8527109	7224457	47963	259009	204972
Material														
	Cents	51.0	48.8	35.0	97.9	38.8	36.2	55.3	41.2	34.3	28.5	54.8	47.0	9.3
	%	51.4	53.5	56.0	57.1	60.0	55.8	55.5	55.3	55.9	56.1	50.8	46.9	46.7
Stores														
	Cents	4.2	2.4	1.5	6.2	2.6	1.8	2.3	2.4	2.0	1.6	2.3	3.3	0.5
	%	4.2	2.6	2.4	3.6	4.1	2.8	2.3	3.2	3.3	3.1	2.1	3.3	2.5
Plant Hire														
	Cents	17.4	15.6	9.8	26.9	8.8	10.3	17.8	11.7	9.6	8.0	21.1	18.3	3.7
	%	17.5	17.1	15.7	15.7	13.6	15.9	17.8	15.7	15.7	15.7	19.6	18.3	18.6
Labour														
	Cents	26.7	24.4	16.2	40.4	14.5	16.5	24.4	19.2	15.4	12.8	29.7	31.5	6.4
	%	26.9	26.8	25.9	23.6	22.3	25.5	24.4	25.8	25.1	25.1	27.5	31.5	32.2
Totals														
	Cents	99.3	91.2	62.5	171.4	64.7	64.8	99.8	74.5	61.3	50.9	107.9	100.1	19.9
	%	100	100	100	100	100	100	100	100	100	100	100	100	100

ITP&S indicates "Initial Treatment Prime & Seal" ITSO indicates "Initial Treatment Seal Only" ITFS indicates "Initial Treatment Final Seal"
BSRS indicates "Bitumen Scrap Rubber Seal".

Materials

(a) Aggregate

The total quantity of covering aggregate used was approximately 255,700 cubic metres on sprayed work undertaken by the Board, and 46,400 cubic metres on sprayed work undertaken by municipalities and contractors. Table 4 details the average prices of aggregates over the last five years and illustrates that the average price in 1977/78 was $0.50 per cubic metre higher than the average price in 1976/77.

Table 4
Average price of aggregate for bituminous surfacing
(in roadside stacks)

Material Prices/cubic metre	73/74	74/75	75/76	76/77	77/78
	$	$	$	$	$
Screenings	7.39	9.31	11.19	12.66	13.00
Gravel	6.53	9.24	11.36	12.55	11.97
Sand	3.68	3.06	5.23	4.89	6.40
Scoria	4.49	5.38	6.51	6.41	21.38
Average price all aggregate	7.08	9.13	11.01	12.42	12.92

(b) Bitumen

The Board purchased 33,891 tonnes of bitumen by contract with four suppliers at a cost of $4,360,000.

Scrap Rubber Asphalt

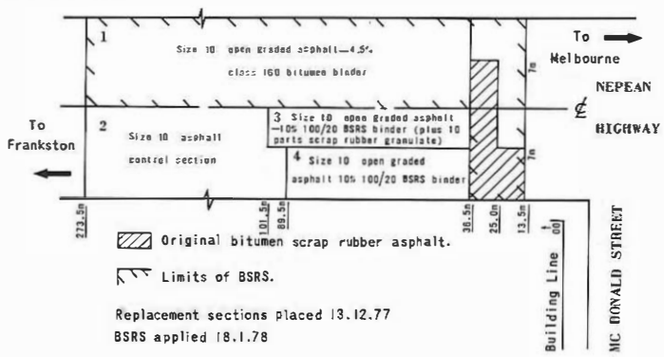
Trial sections of a coarse graded asphalt containing 3 per cent by mass of scrap rubber granulate (approximately 3 mm nominal size) placed in January 1977 in Kingsway, South Melbourne, and Nepean Highway, Mordialloc, were referred to in the 1976/77 Report. As reported, after approximately six weeks the scrap rubber asphalt at Kingsway, South Melbourne, was observed to be deteriorating with a general loss of cohesion and a migration of fines to the bottom of the layer. Failure ultimately occurred, and this material was removed and replaced in March 1977 with a standard dense graded asphalt.
A small quantity of coarse graded asphalt containing scrap rubber granulate was also used as a further trial. Lime filler was used in the aggregate portion of this mix to act as an anti-stripping agent and also to increase the density of the mix. The binder content was also increased slightly. This replacement material has been down for over thirteen months and is performing satisfactorily.
The experimental test sections placed on the Nepean Highway (see Figure 3) also subsequently failed and, with the exception of one short length, were removed. The replacement materials and treatments used were:

Section 1. Size 10 open graded asphalt with 4.5 per cent class 160 bitumen binder. This section and the small remaining original sections of scrap rubber asphalt were covered with a size 10 (BSRS) bitumen scrap rubber seal (100 parts of bitumen to 17 parts of scrap rubber) in January 1978.
Section 2. Size 10 normal asphalt (control section).
Section 3. Size 10 open graded asphalt with 10 per cent of bitumen scrap rubber binder (100 parts of bitumen to 20 parts of scrap rubber), plus 10 parts of rubber placed in the mix.
Section 4. Size 10 open graded asphalt with 10 per cent of bitumen scrap rubber binder (100 parts of bitumen to 20 parts of scrap rubber).

An inspection of the work at the end of April indicated that:

Section 1: Is in excellent condition with no evidence of any reflection cracks.
Section 2: Is already showing reflection cracks from the underlying Portland cement concrete pavement (cracks stop at join with BSRS).
Sections 3 and 4: No cracking of any consequence evident but some minor surface ravelling has occurred. These sections may require waterproofing with a sprayed seal to prevent any further deterioration.

Figure 3: Layout of experimental test sections on Nepean Highway, Mordialloc



Bitumen/Scrap Rubber Seals

As reported in 1976/77, bitumen scrap rubber seals (BSRS) show considerable promise as a thin flexible surfacing for use on cracked pavements.
During the 1977/78 bituminous surfacing season, Board sealing units placed a total of approximately 310,000 m² (equivalent to 42 km of 7.4 m wide two-lane road) of BSRS involving the mixing of approximately 80 tonnes of scrap rubber granulate into the bitumen binder. Scrap rubber added varied from 5 to 30 parts per 100 parts of bitumen by mass.

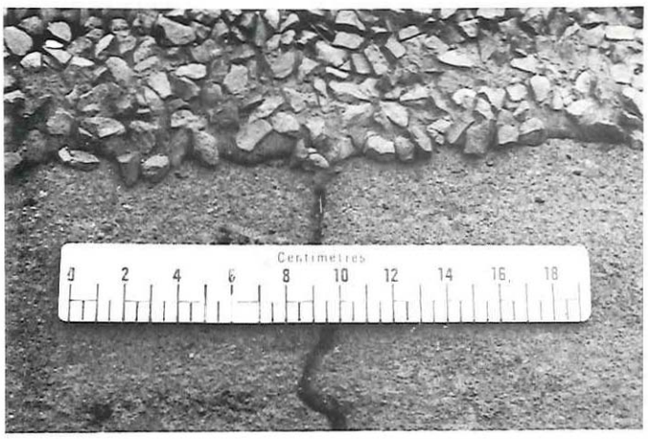


Plate 4: Bitumen scrap rubber seal over cracked asphalt

Bitumen Specification

Some minor problems occurred in late November/December 1977 in the north-western portion of the State during hot weather when bitumen supplied under the new Australian Standard AS 2008 — 1977 Residual Bitumen for Pavements was relatively slow to set up and minor flushing occurred in the sprayed seals. This was attributed to the class 160 bitumen being supplied during this period having viscosities at 60°C between 120 and 140 Pa.s. Although these values lie in the specified range of 120 to 200 Pa.s, suppliers were requested to adopt a minimum viscosity of 140 Pa.s for future supply in an endeavour to overcome the problem.

The viscosity values specified in AS 2008 will be modified for the 1978/79 bitumen supply contract as follows:

Class	Viscosity at 60°C, Pa.s	
	AS 2008	Proposed
80	60/100	70/100
160*	120/200	140/200
320	240/400	280/400
640	480/800	560/800

*Bitumen used for sprayed sealing work in class 160

The present standard allows a wider range of properties than was previously permitted as shown by Figures 4 and 5. Class 160 bitumen as graded by viscosity at 60°C allows a wide range of penetration at 25°C, e.g. 65-100 dmm (Figure 4) compared with the previous range of 85-100 (R90 bitumen) and an even wider range of penetration at the specified 15°C, e.g. 8 to 14 mm (= 80-140 dmm) (Figure 5). Bitumen manufacturers and users are currently gathering information on test properties and performance to aid in a review of the specification by the Standard Association of Australia which is to commence in early 1979.

The durability of bitumen is a most important factor in the life of sprayed seals and asphalt work. The current bitumen specification requires that bitumen shall take a minimum time of 10 days to reach critical viscosity when tested by the Australian Road Research Board Durability Test ATM No. 3. In this test, which is designed to identify bitumens which might give poor durability in service, thin films of bitumen are exposed at 100°C to air and the number of days required for the bitumen to reach the critical viscosity is determined. The critical viscosity is the viscosity at which the bitumen has hardened sufficiently to have reached the end of its effective life, and was found to be associated with the onset of cracking in sprayed seals. Trial sections of various bitumens have been laid for several years in hot climatic conditions in Victoria and other States. These sections are being sampled regularly to check viscosities and durability by the Australian Road Research Board as an ongoing research project.

During the 1977/78 bituminous surfacing season some difficulties were experienced in obtaining the minimum ten-day requirement. The durability of some bitumens used in recent years have had values in the order of five to seven days. Bitumen suppliers have now optimized their operations to produce the most durable bitumens practical using the existing refinery equipment and the currently available crudes. There is a definite trend to reduction in blowing temperatures in the refining process and to production of the required grade by blending materials having different viscosities, and this should lead to more durable bitumens. A minimum time of nine days to reach critical viscosity will be specified for the 1978/79 bitumen supply contract, and it is anticipated that all suppliers will meet this requirement.

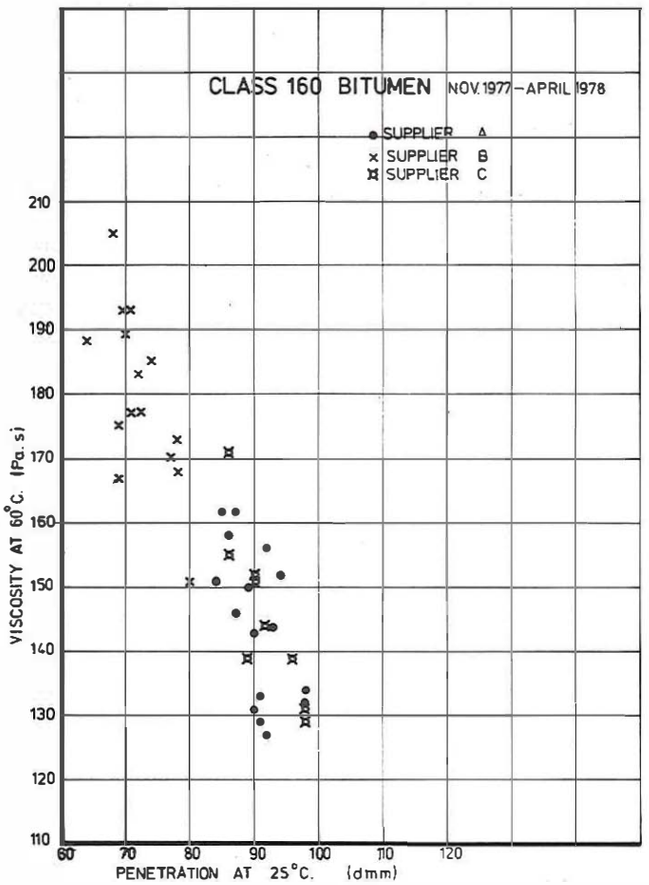
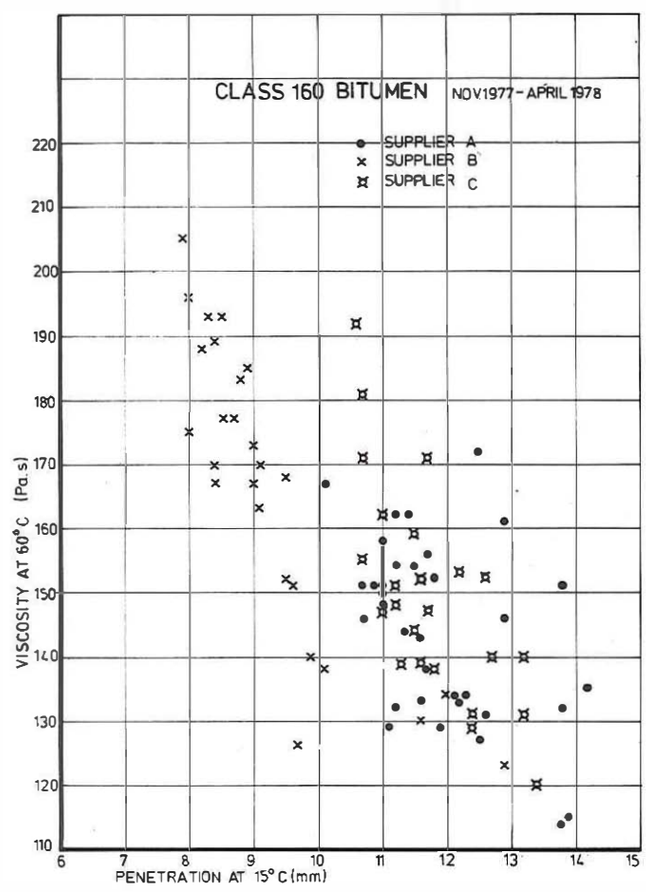


Figure 4

Figure 5



Quality Control of Bitumen

(a) Sprayed Seal Work

Expenditure on the Board's annual contract for the supply and delivery of bitumen is in the vicinity of $5,000,000.

It is important that bitumen supplied under the contract complies with the specification, and verification of compliance is an essential activity.

In the first instance, suppliers submit with their tenders samples of the bitumen proposed to be supplied under the contract.

During the contract period, the supplier informs the Board when a production tank is considered ready as a source of supply.

Each tank is then sampled and tested before bitumen is supplied for use.

Random samples of bitumen from rail tank cars and road vehicles are also taken throughout the contract period.

(b) Asphalt

Bitumen used for the production of asphalt is purchased by the asphalt producers directly from bitumen suppliers. When bitumen is being used in the production of asphalt for Board-funded works, it must comply with the Board's specification and can only be drawn from refinery tanks approved by the Board.

Samples of bitumen are taken daily from all asphalt plants. Normally, approximately 50 per cent of the samples are tested for viscosity. The balance of the samples are kept for reference and testing, if required.

Test results have shown that the bitumen held in storage at asphalt plants can be contaminated by oils and bitumen of other than the specified grade. Regular sampling and testing is essential to ensure the quality of bitumen.

Compaction of Asphalt

Emphasis has been placed on the importance of achieving adequate compaction during the laydown process to achieve a strong and durable asphalt pavement. Inadequate compaction leads to surfacing having decreased strength and durability.

Thin layers of asphalt cool rapidly making achievement of specified density difficult and, for this reason, asphalt work should be confined to warm weather conditions. The use of harder binders which are essential in heavy traffic situations requires higher mixing temperatures (5-10°C) and, again, their use should be confined to the warmer months (December to March.

Specifications for the larger and more important jobs now require sampling and testing of asphalt work on a lot basis, and judgement for compliance on statistically derived acceptance criteria. Other clauses make provision for retention of material which fails to comply with specified compaction standards at a reduced rate of payment.

Report on Previous Experimental Work

Table 5:

Road and location	Nature and reason for work	Date work done	Conclusion to date
Beaufort-Carngham Road	Adhesion trials using quartz aggregate.	Nov. 1967	Quartz aggregate, which has a poor affinity for bitumen, can be satisfactorily used as a cover aggregate for surface sealing provided that it is adequately precoated. The best results were achieved where the aggregate had been precoated with a light grade of tar.
			Cutback bitumen has also been successfully used as precoating material on aggregates which have poor adhesion values.
Maroondah Highway Blackburn	Skid-resistant evaluation of size 10 reseals using scoria, basalt and toscanite aggregate	Mar. 1971	All sections have performed satisfactorily over the past 7 years after being subject to the passage of an estimated 19 million vehicles. The Scrim testing in March 1977 gave the following comparative average SFC values: Scoria 72 Newer basalt 69 Toscanite 47 The scoria section on the approach to the traffic lights at Surrey Road had an average SFC value of 59. The texture depth on this section was less than half the depth on the other "straight through" sections. The SFC values on all sections using these aggregates meet the minimum requirement of 45 for urban arterial (category B) roads but only the scoria and newer basalt sections meet the minimum required value of 55 for approaches to traffic signals, etc. (category A).
Eramosa Road Shire of Hastings	To compare the relative life of a size 7 aggregate primerseal using a bitumen emulsion primerbinder and a proprietary cutback bitumen primerbinder	May 1975	The trials indicated that under the prevailing test conditions and the rates of application of the primerbinders adopted that: (1) the bitumen emulsion primerseal performed satisfactorily for a minimum period of 2 years and was quite serviceable for another 8 months under normal patrol maintenance work. (2) the cutback bitumen primerseal performed very satisfactorily for a minimum period of 2 years and 8 months and indications are that a life of 3 to 4 years could be expected.
Princes Highway West—Norlane	Evalution of the performance of a rubberized (natural rubber) asphalt in relation to reflection cracks from a concrete pavement	July 1974	Reflection cracks appeared through the nominal 38 mm depth of normal and rubberized asphalt within 18 months of placing. The trial indicated that the inclusion of 4 per cent natural rubber in the binder of the asphalt did not inhibit "reflection" cracking induced by differential vertical movement at joints in the concrete base.
Kangarton-Glengleeson Road Shire of Minhamite	Evaluation of the performance of 3 different proprietary primerbinders covered with a size 7 scoria and applied to a scoria-gravel mix pavement	Dec. 1974	All three primerbinders performed satisfactorily for at least three years. The primerseal using the modified primerbinder has performed marginally better than the other two primerbinders. The heavier rates of application of primerbinder did not significantly improve the performance of the primerseals.

Plant and Equipment

Highway Suction Sweeper

A suction sweeper has been purchased for use in removing surplus aggregate from newly sealed pavements and for normal sweeping operations.

The normal commercially-available street sweepers have been of only limited success when applied to sealing operations, because of their low capacity hoppers, low suction capacity and small effective cleaning width.

The suction sweeper which has been purchased (see Plate 5) is capable of removing excess aggregate over a 2.4 metre width of road surface at speeds of 8 to 12 km/hr. The suction unit is a centrifugal fan driven by a Cummins V555 — 110 kW auxiliary engine, capable of producing a suction of 12.45 kPa at 300,000 litres/min.

The high air velocity within the suction hood causes the unbonded aggregate to become airborne, allowing it to be drawn through a duct into a 3 m^3 hopper bin. The air stream passes through a high capacity filter system to effectively maintain dust control before exhausting into the atmosphere. The aggregate load is dumped through a rear door by tilting the hopper.

The suction unit is mounted on an International ACCOT 1830 diesel-powered prime mover which provides hydraulic power for tilting the hopper and operating the independent side brooms. The dual control driver's cab contains full instrumentation and controls for operating the suction sweeper, enabling the unit to be used for dual carriageway operations.

Plate 5: Highway suction sweeper

Hydraulic Power Tools for use in Road Maintenance

Over the past decade, hydraulic systems have been developed as a reliable, economical and efficient means of transmitting power, and over the past two years there has become available a range of hydraulically-powered construction tools, providing an alternative to compressed air and petrol engined tools.

Hydraulically-powered equipment has a high power to weight ratio and thus there is a considerable reduction in tool weight with resultant easier handling and operation. Hydraulic tools are significantly quieter than comparable compressed air or petrol engine driven units and provide more comfortable working conditions for the operator and less annoyance to the public.

A number of road patrols have been provided with the following equipment:

- ☐ Pavement breaker — 16 kg 22 mm hexagon steels, including points, chisel and spade bits.
- ☐ Tamper — 11 kg with a 150 mm round shoe and a 200 mm square shoe.
- ☐ Pole chain saw — 4 kg 300 mm bar, 2180 mm overall length. A very quiet unit and works extremely well. Useful for clearing overhanging branches from roadside trees as the operator can comfortably reach to a height of 4.5 m when working from the back of a patrol truck.
- ☐ Grass trimmer — 10 kg 2,057 mm overall length, rotating head contains four nylon "fishing line" cutters.

Hydraulic power for operating these tools is provided from the power takeoff of patrol trucks and tractors. The power takeoff and hydraulic pump, fitted to a truck to operate the hydraulic hoist, provide an adequate hydraulic power supply but the normal system must be modified by the addition of pipework and outlet/inlet couplings, oil filter, oil cooler, changeover valve and flow control valve. The cost of these modifications is approximately $1,400.

Patrol tractors are provided with hydraulic outlets at the rear of the unit. A flow control valve must be fitted into the system to restrict the outlet oil flow to a pre-set maximum to prevent damage to the hydraulic tools.

Power is transmitted to the tool by hydraulic hoses 8 m long. The normal operating requirements of the majority of hydraulic tools are 380 to 450 millilitres per second at about 12.4 MPa. This is well within the capacity of the hydraulic power sources fitted to patrol vehicles.

Other standard hydraulic tools currently available include heavy pavement breakers, drills, grinders, cut-off wheels, impact wrenches, chain saws, sump pumps, alternators and ventilating fans.

20,000 Litre Bitumen Road Tanker

A number of large bitumen sprayers of 4,500 litre capacity have been in use for several seasons and have resulted in improved output; however, to provide a more balanced and efficient bituminous surfacing spraying unit, the current policy is to provide for larger tender trucks and bitumen road tankers. Consequently, the Board commissioned the construction of a 20,000 litre bitumen road tanker (see Plate 6). In most instances, one 20,000 litre tankers load, plus one sprayer load, will provide the day's requirements for a bituminous surfacing unit. It is expected that ultimately 5 or 6 BS units will be equipped in this way.

The prime mover of this new tanker is a Volvo N1021 of 9.6 litres engine displacement, developing 190 kW (DIN). The transmission has 16 forward speeds. The trailer/tanker is a single compartment of 22,000 litres total capacity running on three trailing axles each equipped with an air-bag suspension. This suspension, which has been proved in service on an earlier tanker, has been chosen to minimize both tank maintenance and vehicle tare mass. To further reduce vehicles mass, the bitumen is heated by LP gas and the bitumen pump is driven by the prime mover power takeoff by hydraulic transmission, thus avoiding the need for an auxiliary engine.

The bitumen tanker incorporates a number of innovations such as the provision of burner tube expansion glands which ensure that the tank end is free from thermal stresses and consequent cracking.

Plate 6: New 20,000 litre capacity bitumen road tanker

West Gate Freeway Project

The West Gate Freeway, South Melbourne Section, will be constructed from the eastern approaches to the West Gate Bridge at Graham Street, Port Melbourne, to Grant Street, South Melbourne, at an estimated cost of $80 million (in 1978 prices). The freeway will provide eight traffic lanes from Graham Street to Johnson Street, and six lanes on the 1.9 km elevated section of freeway from Johnson Street to Kings Way. Interchanges will be provided at Graham Street, Johnson Street and Kings Way. The freeway is programmed for completion in late 1983.

Project Organization and Management System

The main objects in the execution of all Board projects are functional adequacy, safety, economy and good appearance of the finished work. These are of particular importance in the case of the West Gate Freeway project because of its magnitude, involving a very large expenditure of public funds, its location in a closely developed urban industrial area, crossing busy roads and railway lines, and the way in which it will dominate the area traversed to form a significant new feature in the landscape. An additional requirement imposed on this project is the early completion of the facility so as to provide access for large volumes of traffic to the West Gate Bridge, clear of the local road system. It is therefore seen as essential that special attention be given to the avoidance of problems that could arise from errors or faults occurring at any stage in the development and execution of the project.

The project will be executed as part of the work of the Urban Projects Sub-branch under the general administrative direction of the Chief Urban Projects Engineer. A Project Engineer has been appointed for project management, i.e. to develop the overall project programme, arrange the provision and management of funds, and provide co-ordination of the various phases of the project. The Project Engineer is responsible for all road construction, clearing right of way, alteration of services, traffic management, and the general management and direction of the project.

The Chief Bridge Engineer is responsible for all the technical aspects of the design and construction of the freeway bridges. He is represented at the site by the Resident Engineer (Bridgeworks) who has been appointed to head a team of experienced bridge construction personnel in the supervision and co-ordination of bridge construction. The Chief Bridge Engineer will be the "Engineer" for bridge construction contracts with the Resident Engineer (Bridgeworks) as the nominated "Superintending Officer". The Resident Engineer (Bridgeworks) will be responsible to the Chief Bridge Engineer for technical issues and contractural issues of a technical nature, and responsible to the Chief Urban Projects Engineer, through the Project Engineer, for administrative, financial and programming issues. The Chief Bridge Engineer and Chief Urban Projects Engineer will maintain close liaison.

The Project Engineer is responsible for ensuring that the activities of the various divisions engaged in project design and investigation activities are properly co-ordinated with the project works programme. To this end, a senior engineer in each specialist division has been appointed co-ordinator of the activities of that division relating to this project. The duty of each co-ordinator is to ensure that the activities of his division are co-ordinated with the project programme and appropriate programme control systems have been developed to ensure that this is done. A critical path network-based programme control system and an expenditure control system have been developed for the project and are now in operation. Progress of the project is reviewed fortnightly; expenditure is reviewed monthly.

The Bridge Sub-branch is responsible for the design and construction of the freeway bridges. The consultant firm Europe Etudes Gecti has been engaged for specialist advice in design and construction methods, and a firm of consultant structural engineers has been engaged for independent proof engineering of the design. A certification procedure has been established to ensure that all necessary checks have been carried out by engineers of the appropriate level of experience and competence, and all drawings, specifications and works instructions issued to the Resident Engineer (Bridgeworks) for construction purposes will require the approval of the Chief Bridge Engineer.

Construction of the freeway bridges will be carried out under a series of contracts co-ordinated and supervised by Board personnel. It is envisaged that the piled foundations will be subdivided into two or three contracts with further contracts for the piers and for the superstructure. Bearings, lighting and sign structures will be supplied under separate contracts.

West Gate Freeway Structures

(a) Segmental Concrete Box Superstructure Construction

The elevated section of the West Gate Freeway, South Melbourne Section, will compromise two parallel bridges, each 1.9 kilometres long, with associated structures carrying entry and exit ramps at Johnson Street and at Kings Way. With the exception of short lengths of structure at the approaches to the ramps and the freeway carriageways, the bridge superstructures will comprise prestressed concrete box girders constructed by the match-cast segmental cantilever method. The concrete segments will be cast in series, one against the other, following the order in which they will be finally assembled in the structure. The face of one segment will therefore serve as a mould against which the adjacent segment is "match-cast". Keys will be provided in the matching faces of segments to locate them positively in their correct relative positions, and joints will be waterproofed by the application of epoxy adhesive to the adjoining faces of the segments.

Each segment will be erected using the balanced cantilever technique, working in each direction from piers towards the centres of the adjacent spans, which will be completed by cast-in-situ concrete closing sections. Launching frames which progress from pier to pier along the bridges will be used for the erection of segments.

This form of construction has been adopted for the following reasons:

- the very deep foundations which extend over the whole of the job would lead to extremely high falsework costs if conventional methods of cast-in-situ or segmental construction were used.
- speed of construction is increased by limiting on-site work, and by the use of fast-setting adhesives which virtually eliminate the delays which normally occur while the concrete is setting and gaining strength.
- the problems associated with working over heavily trafficked surface streets, and railways are minimized because segments can be transported over the completed part of the structure to the work face, and the deck is complete as each segment is fixed in place.

The match-cast segmental cantilever method of construction is new to Australia, but has been used in Europe for some fifteen years. During that time, considerable expertise has been developed by some European consulting engineers with respect to the development of erection methods and equipment which are unique to this form of construction, and have an influence on the design of such structures. Bearing this in mind, the Board has engaged the services of the French consulting firm Europe Etudes Gecti to advise on these aspects and undertake the design of the main items of equipment to be used for the manufacture and erection of segments.

The structures are being designed by engineers of the Board's Bridge Design Division.

(b) Foundation Cylinders Lateral Load Test Programme

Foundation conditions on the greater part of the area traversed by the West Gate Freeway bridges comprise silurian bed rock beneath gravel and sand layers which are, in turn, overlain by very soft organic silty clays designated as Fishermen's Bend and Coode Island silts. The latter material, which is nearest the surface, is deposited in normally consolidated layers up to 30 metres deep, and is highly compressible.

The basement rock is weathered to varying degrees but, in general, it provides a satisfactory foundation material, suited to the construction of rock sockets to support bored concrete piles up to 1.5 metres in diameter.

The behaviour of the bored piles under transverse loading of both short-term and long-term duration has considerable influence on the design of the foundations of the structures for construction as well as service load conditions. At this stage, analytical predictions of the behaviour of the proposed foundation system have led to the conclusion that it will be effective in withstanding short-term construction and service

loads, but its performance under long-term and cyclic loading is difficult to assess.
Up to date, no investigations of the behaviour of prototype piles under lateral loading in soils typical of those encountered at the West Gate Freeway site have been done. A test programme has therefore been initiated in an attempt to verify the analytical procedures which have been used to predict the behaviour of the pile-soil system, and to confirm appropriate values for the soil properties used in those analyses. Time-dependent behaviour will also be studied.
Increased confidence in predicting the structural behaviour of the foundations of the West Gate Freeway structures will inevitably derive from the proposed testing programme: considerable savings in the overall cost of the structure may also be achieved as a result of greater understanding of that behaviour.

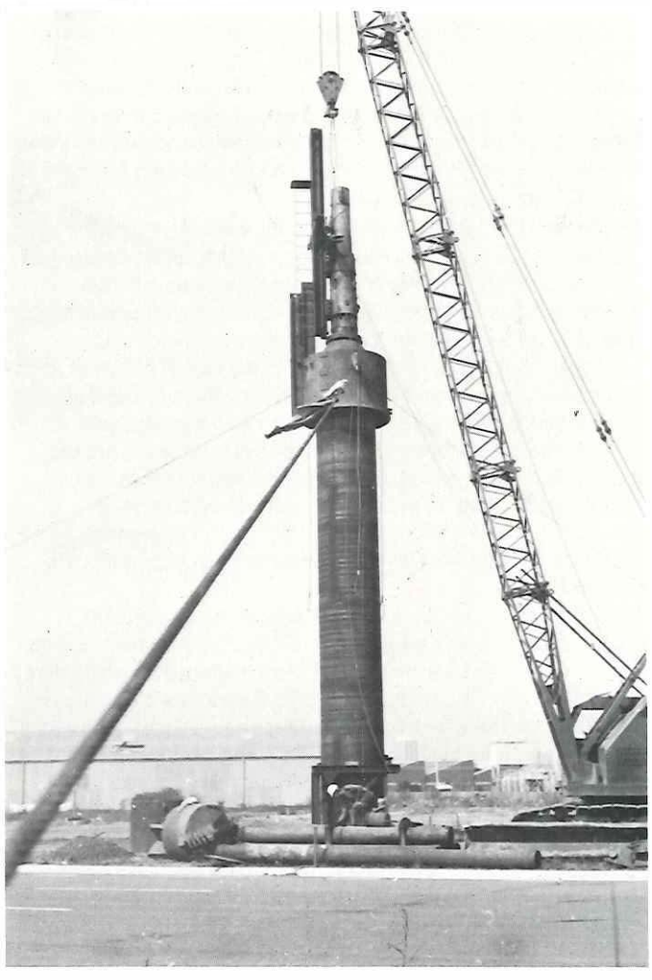
(c) Design of Rock Sockets

The design of the rock sockets is based upon recent research carried out by Board officers in conjunction with the Monash University School of Civil Engineering.
In keeping with conventional methods of pile design, the traditional approach to the design of rock sockets has been based upon assessment of ultimate load capacity. In early designs, base resistance only was taken into account in estimating vertical load capacity. More recently, shaft resistance has also been considered as acting in conjunction with base resistance, and working loads have been arrived at by applying suitable factors of safety to estimated ultimate base and shaft resistances, with checks being made on vertical settlement by elastic analysis.
Until recently, lack of information concerning the actual behaviour and the mechanism of failure of rock sockets has dictated a very conservative approach to design: base and shaft resistances commonly have been underestimated, and high factors of safety have been used to derive working loads because of the many uncertainties involved.
Nevertheless, over the last five years, a considerable amount of information concerning the performance of rock socketed piles in Melbourne mudstone has been assembled.
Analysis of this data has led to the establishment of empirical relationships between pile settlement and base and shaft resistance respectively. This will permit rock sockets to be designed to ensure that tolerable settlements will not be exceeded under working loads: reliable estimates can also be made of the total ultimate load capacity of sockets to confirm that the factors of safety used in conventional design procedures are maintained at acceptable levels.
Steps are being taken to validate the new design method by performing vertical load tests on the sockets of prototype piles which subsequently will be incorporated in the foundations of the freeway structures. A jacking device has been installed in a rock socket at the base of one 44 metre deep 1.5 metre diameter pile, and base and side shaft resistances and deformations have been measured independently under a range of loads up to the ultimate load condition. The results of the tests performed so far have compared closely with predicted values, thus producing a high level of confidence in the design method. The jacking device is recoverable, and it is proposed that subsequent tests will be performed in other representative locations. Further tests are also being done on sockets drilled into Melbourne mudstone at other sites where the rock is conveniently close to surface level. A major part of this work is being carried out in the floor of a quarry at East Burwood.
The new design method relies upon a thorough appraisal of the structure and the strength of the rock mass and, because the South Melbourne mudstones are extremely variable with respect to their weathering and jointing characteristics, it is essential that core drilling and sampling of the material be done at each pile location.
The strength of the rock is assessed by the following methods which are ranked in order of reliability:
1. Triaxial compression test — laboratory compression test of the core in a Hoek rock triaxial cell. The Board purchased this equipment to permit large numbers of tests to be done accurately and economically.
2. Moisture content/strength correlations — by comparing moisture content of all triaxial test samples, a correlation has been obtained for jointed or broken material not suitable for laboratory testing.
3. Visual logging by an experienced geotechnical engineer — experienced personnel can readily assess approximate rock strength by studying weathering, hardness, jointing, etc.
4. Point load index test — pieces of rock core are broken in a portable testing machine by point load applied by conical platens.
The approach to design is conservative in that the profile of rock strengths adopted in estimating base and shaft resistances is the lower bound of the envelope of measured strengths. Zero strength is assigned to zones in which the rock is extremely weathered, or from which no core is recovered during boring operations. No account is taken of the contribution to the overall load capacity which derives from the shaft resistance of the mudstone and the gravels and sand above the socket.
Application of this new method to the design of the pile foundations of the West Gate Freeway structures will lead to significant reductions in depths of rock sockets with corresponding savings in cost and construction time.

(d) Installation of Bored Piles

Seven bored piles have been installed in the median at Johnson Street, South Melbourne, as part of the West Gate Freeway project. Three of the piles were load tested to provide information for the design of the substructure for the freeway bridges, and the remaining four will be part of the bridges.
The piles are cast-in-situ reinforced concrete, 1500 mm diameter founded at depths ranging from 40-46 metres. The upper 33 to 37 metres of each pile was formed with a steel casing 12 mm thick through silty and sandy clays, sands, gravels and lightly weathered basalts. The lower 4.5 to 8 metres of each pile was socketed into the Silurian mudstone.
A Kobe K32 diesel hammer with an energy rating of 76,500 joules was used to drive the casings to refusal which occurred generally at a depth of about 23 metres (see Plate 7).
The soil within the casings and down to the top of the Silurian mudstone (at depths ranging from 33 to 37 metres) was excavated using a TG 200 rotary drilling machine capable of

Plate 7: Driving 1500 mm steel casings for bored piles at Johnson Street, South Melbourne



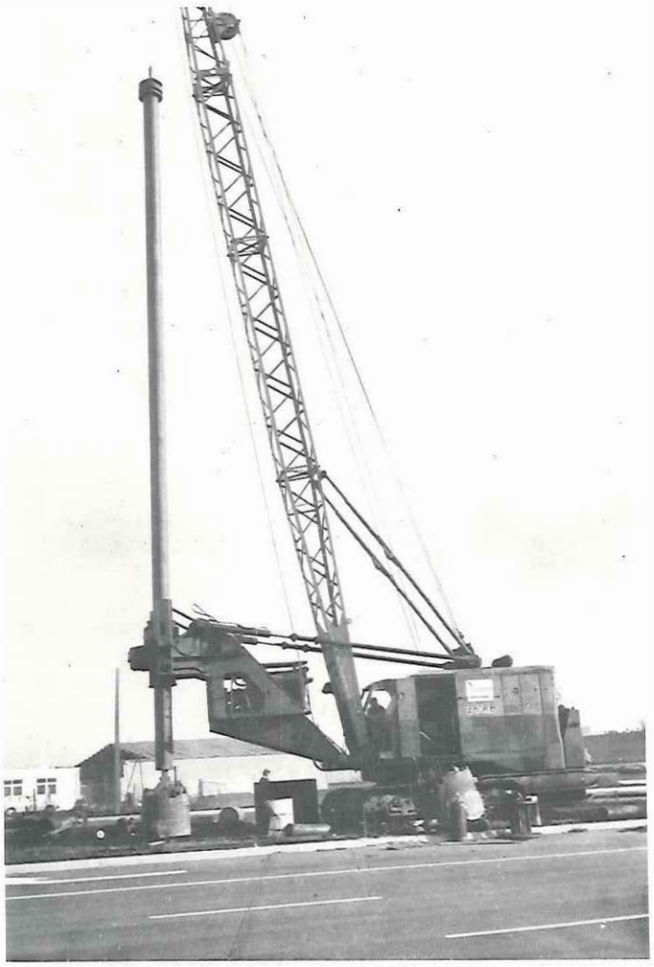


Plate 8: TG 200 rotary drilling rig used for the excavation of the steel casings

producing a maximum torque of 137,000 Nm (see Plate 8).
The casings were then extended and driven further until a minimum of 1 metre of casing penetrated into the mudstone prior to drilling and excavating the mudstone to provide the required socket lengths.
In this work, Bentonite was introduced into the hole after the excavation below the casing to ensure the stability of the sides of the excavation below the casing.
Following the completion of all excavation work the Bentonite was re-circulated to remove all detritus in suspension and in the pile socket.
After the excavation bore was "clean", the pile reinforcement was installed and concrete placed by tremie gradually displacing the Bentonite from the hole.
The quality of Bentonite used was constantly checked during excavation and prior to installation of the reinforcement cage and concreting. The following parameters were measured during the field checks, with typical values indicated:
Density: 1.15 gm/ml
Viscosity: 38 sec (Marsh Cone Test)
Filtration: 15 cm^3
Cake Formation: 1.5 mm
pH: 7.6
Sand Content: 2 per cent

Traffic Management

Investigations

Traffic Engineering Division has been heavily involved in investigations aimed at improving the flow of traffic using the road system in an area or corridor. In these investigations the aim has been to ensure a balance between the need for mobility and convenience, accessibility to local areas, and environmental protection.
The grouping of roads into functional classifications to identify arterial, sub-arterial and local components so as to form a hierarchy of roads is fundamental to the achievement of such a balance.

(a) Western Approaches to the Eastern Freeway

Although extensive studies and negotiations were carried out prior to the opening of the Eastern Freeway, no agreement was reached between the Board and the councils on traffic management measures to be implemented to meet the needs of all sections of the community.
Prior to the freeway opening, comprehensive "before" traffic counts and travel times were taken over an area ranging from Carlton to Ringwood. Since the freeway opened, many aspects of traffic operation have been investigated. Traffic counts were taken in February and March 1978 to measure changes in traffic volumes on adjacent streets. These counts indicate that there has been a small increase in the overall traffic in the corridor, as evidenced by the total traffic volumes on a screenline along the Yarra River from Heidelberg Road to Victoria Street, as shown below:

	24-hour Screenline Traffic Volumes
1975	133,150
1977 before freeway opening	128.000
Predicted — 1978 after freeway opening	145,000
Actual 1978	140,800

Further travel time and origin-destination studies will be carried out in August 1978. This information is needed in examining methods of improving traffic flow and to enable the preparation of local area traffic management plans.

(b) Eastern Approaches Area to West Gate Bridge

During 1976 a major traffic survey was carried out in South Melbourne and Port Melbourne to permit assessment of traffic conditions in those suburbs after the opening of Johnson Street and West Gate Bridges. The results of these studies were reported in a Short Term Traffic Management Report (May 1977) and the Long Term Traffic Management Report (November 1977).
Detailed traffic management studies have continued in order to arrive at solutions capable of meeting the objectives of environmental protection as well as facilitating traffic flow.
An Advisory Truck Route has been designated, and a series of measures to improve traffic flow along this advisory truck route has been agreed upon and is being implemented. The measures include traffic signal linking, maximisation of "green time" at traffic signals along the route, greater restrictions on parking, including some 12-hour clearways, turn bans at some signalized intersections and a roundabout at the southern end of Spencer Street Bridge.
The traffic management study has been widened to include consideration of measures along Beach Road and Nepean Highway as far south as South Road, Moorabbin, and along the Princes Highway as far as Clayton. These analyses have been largely based on travel time studies which also form part of a before and after study of the opening of the new bridges.
Measures such as traffic signal linking, turn bans, improved intersection layouts and increased restrictions on parking are being considered for the Princes and Nepean Highways to reduce travel times.

(c) Truck Management

The increased concern of the public with environmental issues such as noise has resulted in more attention being focused on the movement of trucks.
The Board has examined different strategies for the control of trucks in urban areas including:

- ☐ mandatory bans on local and collector streets within the arterial road network,
- ☐ mandatory bans on an area wide or corridor basis,
- ☐ use of advisory truck routes.

For area wide or corridor strategies the adoption of advisory truck routes is preferable to the use of mandatory bans, although the difficulty in route selection is still a major problem.
Since the economic consequences of introducing mandatory 24- hour regional bans on truck movements are significant, mandatory bans on trucks should only be introduced as a last resort if comprehensive analysis of the data on truck movements has indicated that alternative routes provide an adequate service and it can be demonstrated that environmental benefits are not achieved by either night-time

bans or an advisory route network or both.
Notwithstanding the many different problems which arise, the study showed the need for consistent standards so that truck drivers and operators can have a clear indication of the type of restriction to expect.
To summarise, truck bans on arterial roads should not be introduced without an assessment of truck route proposals, which must include consideration of:

- ☐ the appropriate type of truck management measure to implement, including hours of restriction, type of vehicle to be banned, etc.
- ☐ environmental effects resulting from truck redistribution on all streets where a significant change in the volume of trucks can be expected.
- ☐ adequacy of the routes available for truck movement from the truck operator's point of view, bearing in mind the need for efficient and economical transport services.

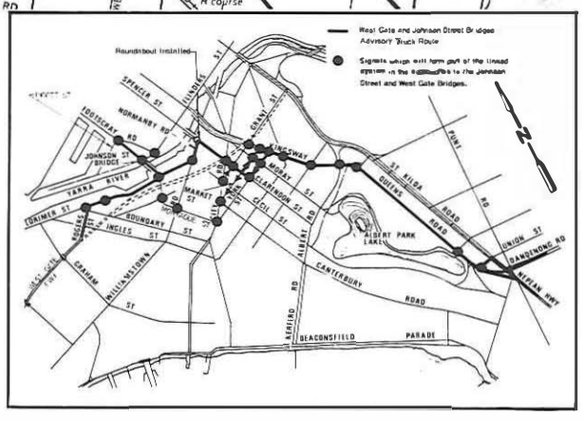
Area and Corridor Control by Traffic Signal Co-ordination
In recent years the Board has been involved to an increasing extent in planning and implementing traffic management measures in conjunction with road improvements of all kinds on the Board's declared road system to achieve more efficient traffic movement on the existing road system, to help relieve "traffic pressures" on residential and other sensitive areas, and to facilitate more efficient movement of on-street public transport vehicles.
These objectives will be facilitated by introducing traffic signal co-ordination along major arterial roads in association with other traffic management measures.

The following traffic signal co-ordination systems are already in operation:

- ☐ St Kilda Junction system
- ☐ Hoddle Street (Eastern Freeway to Albert Street)
- ☐ Kings Way (in association with Melbourne City Council)
- ☐ Eastern Highway (Alexandra Parade)
- ☐ Eastern Freeway Interchange Areas (along Chandler Highway, Burke Road and Bulleen Road)
- ☐ Johnson Street Bridge and advisory truck route
- ☐ Maroondah Highway at Ringwood

Planning and design work is also proceeding for systems along the Nepean Highway between Elsternwick and Moorabbin, and along Burwood Highway at East Burwood.
Investigations will be undertaken into the feasibility of linked signal systems on a corridor basis. Co-ordinated systems will be developed progressively according to the needs of traffic and the availability of funds, initially on State highways and other declared roads. The systems will have the potential for extension to include other arterial roads where desirable and where suitable arrangements can be made with relevant councils.
The Traffic Engineering Division will be responsible for the planning, design, specification, installation, commissioning and tuning of systems. These will be based on the mini-computer systems developed and operated by the NSW Department of Main Roads. The Department's system involves advanced control programmes which can co-ordinate the operation of up to 200 intersections, linked to a mini-computer by Telecom lines.

Figure 6: Existing and future linked traffic signal systems



Linked Signal Projects.

(a) Maroondah Highway, Ringwood

Work on this project commenced two years ago when a feasibility study indicated the potential improvements to traffic flow resulting from linking of signals. Controllers containing accurate electronic clocks are operated by a mains frequency "cable-less" linked system between New Street, Ringwood Street, Station Street and Warrandyte Road. The controllers have the capability of being linked to a mini-computer via Telecom lines. This system also has the capability of being extended along the Maroondah Highway and to other traffic signals in the area. The system will eventually be connected to the computer system being planned for this area.

(b) Burwood Highway, Burwood

Following the Government's decision to extend the tramline along the Burwood Highway, considerable design work has been involved in the remodelling of signals and the design of new intersection signals along the highway between Warrigal Road and Middleborough Road.

Initially, the controllers will operate via a mains frequency "cable-less" linked system which will provide the best possible progression for all vehicles. The system will have special provision for trams in that detectors will give advance information about trams so that priority tram phases can be introduced or extended for the peak travel direction. This system will be eventually connected to the computer system being planned for the area.

(c) Eastern Freeway Area

Traffic signals have been designed and installed for the Eastern Freeway, and commenced operating in December 1977. These signals control half diamond interchanges at Burke Road, Bulleen Road and Thompsons Road and a full diamond interchange at the Chandler Highway. The four sets of signals on the Chandler Highway in the interchange area are co-ordinated so that movements along Chandler Highway and the ramps operate with a minimum of delay.

In the western approaches area, the traffic signals along the Eastern Highway at Brunswick Street, Smith Street, Wellington Street, and the push button pedestrian signals at Gold Street are co-ordinated. There is also a linked signal system along Hoddle Street between the Eastern Freeway and Albert Street. The Chandler Highway and Eastern Highway signals are operating via a "cable-less" linked system until a master control system can be installed. The operation of this new equipment, based on microprocessor technology, is being evaluated as a stage in the move from isolated intersection control to a master control type system for several intersections.

(d) West Gate Freeway and Johnson Street Bridge Approaches

A number of traffic signals have been installed in South Melbourne as part of the traffic management measures for the area. The majority of these signals will operate as a part of the three separate co-ordinated systems being developed to aid management of traffic in this area.

The co-ordinated system for the Johnson Street Bridge approaches will be vehicle-responsive. The local controllers will act as slaves to the master controller which is a microprocessor type computer containing five time plans — the a.m. Peak Programme, the p.m. Peak Programme, the Midday Programme, the Midnight Programme, and the "Rest of the Day" Programme. Five strategic detectors will continually measure the traffic entering the system and the master controller will choose the time plan best suited to cope with the prevailing traffic conditions. Although the major time plan will be chosen by the master controller, each local controller can alter the phasing of the lights at its own intersection to cater for short-term fluctuations in traffic. Closed-circuit television and a master controller have been installed in the traffic control building in Blyth Street. The effect on traffic of any changes programmed into the master controller can be immediately viewed on the closed-circuit television which can film any of the intersections in the linked system. The television equipment will be particularly useful for fine-tuning the linked signal system when the Johnson Street Bridge is opened to traffic. This equipment can be moved to other sites and may therefore be used to fine tune future linked signal systems as they are installed.

Computer

(a) Computer Usage

In the 1977/78 year, the use of the Board's central computing facilities increased by approximately 50 per cent over the previous year's usage. To cope with this increased demand and the Board's first application system to be established under Information Management System (IMS), a substantial upgrading of equipment has been undertaken. An IBM 370/145 computer was installed in July 1977 as an interim measure prior to the availability of the faster 370/148 model. The 370/148 machine was subsequently installed during April 1978. Additional magnetic disc drives were also installed during the year. Data storage capacity was increased by 200 per unit.

The following table indicates the percentage use of the computer facilities by user for the period July 1977 to June 1978:

Mechanical Sub-branch	0.9
Bridge Sub-branch	10.2
Plans and Surveys Division	12.6
Title Survey Division	2.3
Traffic Engineering Division	7.3
Works Sub-branch (excluding Materials Research Division)	0.2
Materials Research Division	4.0
Advance Planning Division	5.0
Road Planning Division	16.6
Secretary's Branch/Chief Accountant's Branch	25.8
Computer Section and Miscellaneous	15.1
Total	100.0

(b) Information Management System (IMS)

IMS is a data base management system. "Data base" systems allow basic information from different sources (e.g. road and job descriptions, debits and credits) to be stored and maintained together, eliminating the need for each computer user to maintain his own copy of the data. The data is amended, added to and drawn on for computation by various users under pre-defined conditions. This contrasts with current computing methods where multiple copies of data must be maintained for various usages.

Application systems developed under IMS may also establish facilities to allow communications between terminals and the central computer system. These facilities may allow both the entry of data and the inquiry and reporting of data in the data bases from terminals at convenient locations.

A Data Base Administrator has been appointed to co-ordinate the use of IMS throughout the Board and to ensure the security and accuracy of data bases established in the future.

Safety

Details of the increases of accidents, the accident frequency rate and the days lost per million man-hours worked are shown in the following tables:

Table 6:

Accidents in the 1977/78 year compared with 1976/77:

Type of Injury	1976/77	1977/78	Decrease	Increase
Back strains	83	141	—	58
Burns and scalds	12	15	—	3
Burns to eyes	5	7	—	2
Fatal injuries	1	0	1	0
Foreign body in eyes	34	48	—	14
Fractures	28	19	9	—
Head injuries	16	14	2	—
Lacerations and wounds	63	70	—	7
Miscellaneous	68	73	—	5
Multiple injuries	—	1	—	1
Occupational diseases	20	21	—	1
Sprains and strains	81	66	15	—
	411	475	27	91

Table 7:
Trend in accident frequency rate and the days lost per million man-hours worked for (6) six-year period 1972/73-1977/78. (Fatal accidents are assessed in accordance with Australian Standard 1885-1976 as being equivalent to 6,000 days lost):

	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78
Total man-hours worked (million)	9.05	8.75	9.06	8.55	8.37	7.84
Lost-time accidents	335	315	380	397	411	475
Accident frequency rate per million man-hours	39	36	42	46	49	61
Days lost (including fatalities)	2,051	1,998	2,222	2,375	2,601	2,576
Resultant days lost per million man-hours (including fatalities)	226	228	245	277	310	329
Number of fatalities	0	0	1	0	1	0
Total days lost (including fatalities)	2,051	1,998	8,222	2,375	8,601	2,576
Total resultant days lost per million man-hours (including fatalities)	226	228	904	277	1,027	329

Publications

The following papers by officers of the Engineer in Chief's Branch were presented or published in the 1977/78 year.

"Some Aspects of Recent Trends in Australian Transport Investments"
G J Both, Transport Economist
K Bush, Economist
Presented at the International Road Federation, Australian Road Conference, Melbourne, April 1978

"Superplasticizing Admixtures in High Strength Concrete"
S B Bromham, Scientific Officer, Materials Research Division
Presented at the Institution of Engineers, Australia, Concrete Symposium, Brisbane, August 1977

"Some Materials Research Projects in the CRB"
D T Currie, Divisional Engineer, Traralgon
Presented at the Gippsland Group, Institution of Engineers, Australia, Victorian Division, Churchill, April 1977

"Pavement Materials — North Western Victoria Occurrence, Methods of Location and Properties"
B J Fielding, Scientific Officer, Materials Research Division
Presented at the North Western Region Extractive Industries Review Committee Field Day, Kerang, May 1978

"Ultrasonic Inspection of Welded Structures"
R S Gilmour, Assistant Materials Research Engineer
Presented at Joint Australasian Welding and Testing Conference, Perth, October 1977

"Shakedown as a Limit State"
P Grundy, Associate Professor of Civil Engineering, Monash University
F Tin Loi, Engineer, Bridge Design Division
Presented at the Sixth Australasian Conference on the Mechanics of Structures and Materials, Christchurch, New Zealand, August 1977

"Deflection Analysis of Strain Hardening Structures under Repeated Loading"
P Grundy, Associate Professor of Civil Engineering, Monash University
F Tin Loi, Engineer, Bridge Design Division
Published in International Journal of Mechanical Sciences, Vol 20, No 1, 1978

"Transport Victoria"
N S Guerin, Deputy Engineer in Chief
Presented at The Chartered Institute of Transport (Victorian Section) Annual Seminar, August 1977

"Initiation of Structural Change: The Evolution of Transport Planning"
N S Guerin, Deputy Engineer in Chief
Presented at the UNESCO Seminar on Urban Management Processes, Bridgewater, S A, August 1977

"The State Road Authority and Road Safety"
N S Guerin, Deputy Engineer in Chief
K C Hastings, Assistant Traffic Engineer
Presented at the International Road Federation, Australian Road Conference, Melbourne, April 1978

"Traffic Management in Urban Areas"
B J Negus, Senior Traffic Design Engineer
E V Barton, Traffic Engineer
Presented at the International Road Federation, Australian Road Conference, Melbourne, April 1978

"Notes on the History and Trends of Road Finance in Victoria"
J H Pittard, Advance Planning Engineer
Presented at the International Road Federation, Australian Road Conference, Melbourne, April 1978

"Notes on Planning"
A Pommers, Assistant Road Planning Engineer
Presented at a meeting of the Transportation Branch, Institution of Engineers, Australia, November 1977

"Road Planning — A Multidisciplinary Task"
A Pommers, Assistant Road Planning Engineer
K Bush, Economist
Presented at the International Road Federation, Australian Road Conference, Melbourne, April 1978

"Asphalt Mix Design and Quality Control Testing"
J J Rebbechi, Engineer, Asphalt Division
Presented at Australian Asphalt Pavement Association Supervisor Training Course, Melbourne, October 1977

"Traffic Accident Analysis and Road Design"
N Szwed, Engineer, Traffic Engineering Division
Presented at a Seminar to Final Year Civil Engineering Students, University of Melbourne, May 1978

"Deflection Stability of Work Hardening Structures"
F Tin Loi, Engineer, Bridge Design Division
P Grundy, Associate Professor of Civil Engineering, Monash University
Published in Journal of Structural Mechanics, Vol 6, No 3

"Design of the Orthotropic Deck for West Gate Bridge"
A R Toakley, Professor and Head School of Building, University of New South Wales
P J Balfe, Engineer, Bridge Construction Division
Presented at the Sixth Australasian Conference on the Mechanics of Structures and Materials, Christchurch, New Zealand, August 1977

"Some Aspects of the Planning of Urban Roads"
R T Underwood, Chief Planning Engineer
Presented at the International Road Federation, Eighth World Meeting, Tokyo, October 1977

"Some Sociological and Environmental Considerations in Urban Road Planning Studies"
R T Underwood, Chief Planning Engineer
Presented at the Annual Engineering Conference, Institution of Engineers, Australia, Melbourne, April 1978

"Japanese Expressways – Some Aspects of their Planning, Design and Operation"
R T Underwood, Chief Planning Engineer
Presented at the Civil Branch, Victoria Division, Institution of Engineers, Australia, Melbourne, May 1978

Other publications in 1977/78 were:
Engineering Note 116 — Additives to Crushed Rock
Engineering Note 117 — Additives to Crushed Rock

Staff

As at 30th June 1978 personnel in the Engineer in Chief's Branch numbered:

Technological Staff (Professional)	615
Technical Staff	519
Administrative Staff	381
Supervisor Staff — Field	176
— Depot	71
Clerks of Works	83
Construction and Maintenance Personnel	2,163
Workshop and Depot Personnel	599
	4,607

Design: Colin Adamson