COUNTRY ROADS BOARD

VICTORIA

SIXTIETH ANNUAL REPORT

FOR YEAR ENDED 30th JUNE, 1973

PRESENTED TO BOTH HOUSES OF PARLIAMENT
PURSUANT TO ACT No. 6229

COUNTRY ROADS BOARD

Chairman	**R. E. V. Donaldson**
Deputy Chairman	**J. D. Thorpe**
Member	**T. H. Russell**

PRINCIPAL OFFICERS AS AT 30th JUNE, 1973
HEAD OFFICE

Chief Engineer	**W. S. Brake**
Secretary	**N. L. Allanson**
Chief Accountant	**R. G. Cooper**
Deputy Chief Engineer	**Dr K. G. E. Moody**
Deputy Secretary	**C. C. Liddell**
Deputy Chief Accountant	**R. J. C. Bulman**

DIVISIONAL OFFICES

Division	*Divisional Engineer*
Bairnsdale	**W. H. Dolamore**
Ballarat	**E. T. Oppy**
Benalla	**R. R. Patterson**
Bendigo	**T. M. Glazebrook**
Dandenong	**F. W. Docking**
Geelong	**G. W. Marshallsea**
Horsham	**J. W. Heid**
Metropolitan	**L. M. Jones**
Traralgon	**A. Jacka**
Warrnambool	**F. G. Lodge**

60 Denmark Street
Kew

1st November, 1973

The Honorable E. R. Meagher, M.B.E., E.D., M.P.

Minister of Transport

100 Exhibition Street

Melbourne 3000

Sir,

In accordance with the requirements of Section 128 of the Country Roads Act 1958, No. 6229, the Board has the honour to submit to you for presentation to Parliament the report of its proceedings for the year ended 30th June, 1973.

The Board thanks you, Sir, for your support and interest in its activities and wishes to place on record its appreciation of the continued co-operation and assistance of other State Ministers, Government departments, State instrumentalities and municipal councils.

The Board also pays tribute to the continued loyal co-operation and work done by its stoff and employees throughout the year.

We have the honour to be,

Sir,

your obedient servants

R. E. V. DONALDSON, A.A.S.A. (Senior),
A.I.M.A., F.C.I.T., J.P.,
Chairman

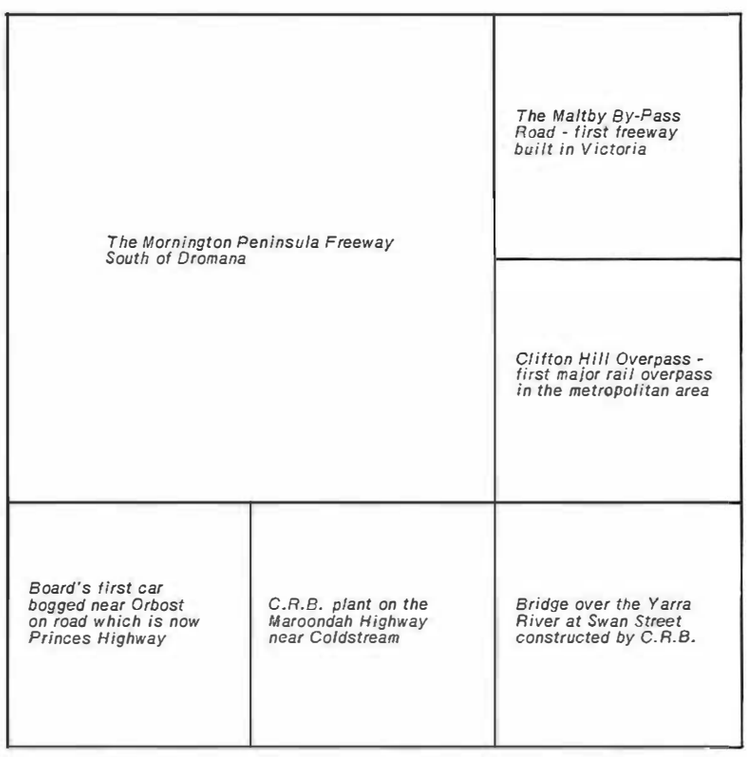
J. D. THORPE, C.E., F.I.E.Aust.,
M.I.T.E. (U.S.), F.C.I.T.,
Deputy Chairman

T. H. RUSSELL, M.Eng.Sc., B.C.E.,
Dip.C.E., C.E., F.I.E.Aust.,
Member

N. L. ALLANSON, A.A.S.A. (Senior), J.P.,
Secretary

CONTENTS

Cover:



The Mornington Peninsula Freeway South of Dromana

The Maltby By-Pass Road - first freeway built in Victoria

Clifton Hill Overpass - first major rail overpass in the metropolitan area

Board's first car bogged near Orbost on road which is now Princes Highway

C.R.B. plant on the Maroondah Highway near Coldstream

Bridge over the Yarra River at Swan Street constructed by C.R.B.

During 1972/73 the Board:

- **Expended $83,611,000 on new roads and bridges and the maintenance and improvement of existing roads and bridges.**
- **Expended $10,070,000 on the purchase of land for road purposes.**
- **Constructed 27 miles of additional dual carriageways.**
- **Sealed or resealed with bitumen 3,242 miles of road.**
- **Commenced the construction of 131 new bridges.**
- **Planted 80,000 trees and shrubs on road reserves.**
- **Allocated $48,536,000 for expenditure by municipalities on main and unclassified roads.**

ANNUAL REPORT 1972/73

REVIEW

1913-1973 SIXTY YEARS OF SERVICE — SHORTAGE OF FUNDS

In 1913, when the Country Roads Board first commenced its operations, roads in Victoria were generally in a deplorable condition. Many of them, particularly in hilly country, were little better than primitive tracks and even those which had been well constructed as the principal coach routes before the advent of railways had been allowed to deteriorate to a very serious extent.

In the Board's first Annual Report it was stated "the reasons for this deterioration in the standard of road construction are lack of funds and the absence of a systematic policy".

The Report went on to explain the practices adopted prior to the formation of the Country Roads Board. "In the desire to make available funds go as far as possible, the general practice is to annually vote a portion of the municipal funds to the construction of isolated patches of roads in sections seldom exceeding a quarter of a mile in length distributed throughout the Shire's ridings. Had these sections been designed to permanently improve the worst portions of the roads with a view to their being linked up in a systematic scheme of construction in the future, the policy would be sound enough, but frequently the work has been done in the cheapest possible manner, and without a complete survey of the whole road to ensure that the sections constructed would form suitable links in the completed chain."

Even though the Board takes pride in the improvements made to the State's road system during the past sixty years, its activities have always been hampered by a general shortage of funds. This shortage of funds has been more particularly marked in recent years. The level of funds available to the Board has fallen drastically short of that needed to be spent on developing Victoria's principal road system to meet the demands of industry, commerce, and the community generally. This shortage of funds is not only preventing much construction and reconstruction of heavily trafficked roads but is preventing the Board from declaring more main roads and State highways as the additional financial burden cannot be accepted.

Inflationary trends continue to outpace annual increments in revenue. In fact less actual road construction and maintenance work was possible during financial year 1972/73 than in the previous year, even though approximately $1,958,000 more was spent by the Board on this work.

The Board has already made a submission to the Victorian Government for an increase in the receipts paid into the Country Roads Board Fund for expenditure on Victoria's roads.

The following table shows the Board's expenditure each year from 1966/67 to 1972/73 expressed both as actual expenditure and in terms of 1966/67 money values:

C.R.B. EXPENDITURE(1) 1966/67-1972/73
TOTAL EXPENDITURE AND EXPENDITURE PER MOTOR VEHICLE
EXPRESSED IN 1966/67 VALUES

Financial Year	Actual Expenditure	Real Expenditure (2)	Index of Real Expenditure	Number of Motor Vehicles on Victorian Register (3)	Real Expenditure Per Motor Vehicle	Index of Real Expenditure Per Motor Vehicle
	$'000	$'000		'000	$	
1966/67	67,575	67,575	100.0	1,119	60.39	100.0
1967/68	72,443	69,213	102.4	1,174	58.95	97.6
1968/69	77,452	68,828	101.9	1,231	55.91	92.6
1969/70	87,115	73,702	109.1	1,295	56.91	94.2
1970/71	95,838	73,922	109.4	1,353	54.64	90.5
1971/72	99,685	71,031	105.1	1,407	50.48	83.6
1972/73	103,488	65,812	97.4	1,463 (est)	44.98	74.5

(1) Includes expenditure on Special Projects charged to Roads (Special Projects) Fund.

(2) Real expenditure is derived by deflation of actual expenditure by changes in ruling end-of-year prices.

(3) Number of motor vehicles on register as at 30th June each year — Commonwealth Series (adjusted for 1971 census results). Excludes motor cycles.

The Board's present financial position has caused many urgent works to be deferred. Examples of urgently needed municipal works in the metropolitan area which have not yet been implemented because of the Board's inability to provide the financial assistance necessary include:

Bridge Road, Richmond	— widen and provide dual carriageways between Hoddle Street and Church Street.
Canterbury Road	— provide dual carriageways between Heatherdale Road and Montrose.
Bell Street, Preston	— widen and provide dual carriageways between James Street and O'Keefe Street.
Stud Road	— provide dual carriageways between Bayswater and Mulgrave Freeway.
Epping Road, Preston	— provide road/rail grade-separation at the Reservoir railway level crossing.
Dandenong-Frankston Road	— provide dual carriageways between Dandenong and south of Carrum Downs, and road/rail grade-separation at the Skye Road railway level crossing.
Bell Street, Heidelberg	— development of an improved connection from Upper Heidelberg Road to Banksia Street.
Mount Dandenong Road	— provide dual carriageways between Croydon and Montrose.
Warrigal Road	— construct a new connection to Union Road including an overpass of the railway at Surrey Hills.

The above projects are only some examples of works which need to be carried out on roads under municipal control if adequate provision is to be made for freight, passenger, and private motoring purposes.

Further examples of major improvement works required on roods under the Board's direct control include:

Western Highway	— widening through Footscray.
Nepean Highway	— widening between Elsternwick and Moorabbin, and between Mordialloc and Seaford.
Maroondah Highway	— improvements between Elgar Road and Middleborough Road, and through Lilydale.
Princes Highway East	— widening and improvements through Caulfield.
Princes Highway West	— provision of dual carriageways between Lynch's Bridge and Racecourse Road.

In addition, entirely new arterial road routes are urgently required to relieve the present traffic congestion on such roads as:

Sydney Road	— between Brunswick Road and Bell Street.
Princes Highway East	— between Warrigal Road and Berwick.
Maroondah Highway	— through Ringwood.
Nepean Highway	— between Seaford and Dromana.
Calder Highway	— through Keilor.

The Board's annual traffic census figures reveal that in the Melbourne metropolitan area the volume of trucks and buses has increased by 42% since 1964 and that road traffic generally has increased by 72% in the same period.

As traffic increases, the cost of maintaining a length of road increases and the need to reconstruct a road arises more frequently. The reconstructed road requires a wider and thicker pavement. Increasing traffic eventually requires the provision of additional roads. Since 1970/71 the Board's financial ability to maintain and construct roads has fallen by 12%, yet travel on roads has increased by 12%.

Roads are an integral part of a planned transportation system. They are the main segment of the system which provides the flexibility for door to door transportation. Crowded roads result in loss of time, higher freight costs, and higher vehicle running costs.

The following table indicates the growth in five-year periods of the mileages of roads declared under the Country Roads Act, together with motor vehicle registrations in Victoria.

Year Ending 30th June	Motor Vehicle Registrations	Miles of Main Roads	Miles of State Highways	Miles of Tourists' Roads	Miles of Forest Roods	Miles of Freeways	Mileage of Declared Roads (Total)
1913 . . .	—	—	—	—	—	—	—
1918 . . .	14,121	2,950	—	—	—	—	2,950
1923 . . .	36,673	6,300	—	—	—	—	6,300
1928 . . .	126,328	6,300	1,474	—	—	—	7,774
1933 . . .	156,163	6,376	2,296	—	—	—	8,672
1938 . . .	223,122	6,685	2,308	350	—	—	9,343
1943 . . .	216,051	8,490	2,804	392	—	—	11,686
1948 . . .	290,153	9,806	3,846	402	241	—	14,295
1953 . . .	503,028	9,792	3,849	414	375	—	14,430
1958 . . .	720,030	9,754	3,845	415	378	—	14,392
1963 . . .	957,494	9,111	4,474	444	461	29	14,519
1968 . . .	1,222,563	9,097	4,460	483	461	40	14,541
1973 . . .	1,531,057	9,075	4,414	500	646	92	14,727

HIGHLIGHTS 1913-1973

Brief highlights of the Board's activities since its formation are:

1913 First Board meeting on 31st March.
1915 Completion of two years of investigation of road conditions throughout the State.
1918 Commencement of construction of developmental roads to give access from farming properties to railway stations or to a main road leading to a railway station.
1924 Legislation passed for the declaration of State highways, which became the direct responsibility of the C.R.B.
1925 District headquarters established at Benalla, Bendigo and Sale.
1926 Federal Aid Roads Agreement passed by the Commonwealth to provide funds from revenue on a systematic basis.
Stawell and Warrnambool Districts established with headquarters at Beaufort.
1928 District headquarters established at Warrnambool.
1930 C.R.B. compelled to reduce expenditure because of decline in motor registration
1935 Stawell District headquarters transferred to Stawell.
1936 The Tourists' Road Act passed, empowering the C.R.B. to recommend the proclamation of tourists' roads and to be responsible for the construction and maintenance of roads proclaimed as tourists' roads.
1939 World War II and the diversion of most resources to defence works.
1940 Dandenong and Geelong Divisions established.
1943 Forest Roads and Stock Routes Act passed.
1944 Traralgon Division established.
1945 Resumption of normal activities after war.
1948 Stawell district divided into Ballarat Division and Horsham Division. Metropolitan Division established.
1954 Level Crossings Fund established to accelerate replacement of railway level crossings with overpasses or underpasses.
1955 Dual carriageways on State highways commenced.
1956 Legislation passed giving the C.R.B. power to construct freeways.
1960 Present Head Office building at Kew completed.
1961 First freeway (Maltby By-pass Road) opened at Werribee.
1963 Dual carriageways on Princes Highway between Oakleigh and Dandenong completed.
1964 Scheme introduced for replacement of school crossings with pedestrian over-passes or underpasses on busy roads.
1965 Roads (Special Projects) Fund established to provide finance for special road projects throughout the State.
1966 C.R.B. appointed as the design and constructing authority for access roads to Lower Yarra Crossing project.
1968 Section of Tullamarine Freeway north of Essendon Airport opened.
1969 Arrangements made for transportation studies to be undertaken in the urban areas of Ballarat, Bendigo and Geelong. New Phillip Island bridge opened.
1970 Tullamarine Freeway south of Essendon Airport opened.
1971 Lower Yarra Freeway opened.
1972 Calder Freeway at Niddrie, Western Freeway at Bacchus Marsh and Gordon, and Mulgrave Freeway north of Dandenong opened.

COMMONWEALTH ASSISTANCE FOR ROADS

Since 1923 the Commonwealth Government has made grants available to the various States to assist their road programmes.

In 1926 the Commonwealth Government adopted the principle of road grants being made proportional to the use of petrol, the petrol tax being increased in that year and a definite amount per gallon being "hypothecated" for roads. This principle was retained for 33 years.

In 1959 the Commonwealth Aid Roads Act severed the connection between petrol tax and road grants and made provision for allocations from consolidated revenue for distribution to the States.

Generally, the cost of providing an adequate road system is borne by the owners and users of vehicles requiring the system. Local government bodies in Victoria devote a very high proportion of revenues to works on local roads giving direct access to properties. The State devotes most of the revenue derived from taxation of motor vehicles to road works or other closely related purposes.

Revenue most directly related to the usage of motor vehicles is raised by the Commonwealth Government in the form of excise duty on petrol and other motor fuels. In financial year 1972/73 the Commonwealth Government received $128.3 million in excise duty from the sale of motor fuels in Victoria. Under the terms of the Commonwealth Aid Roads Act 1969 a total of $57.24 million was made available to Victoria in the same year for expenditure on roads. This amount represents a return of 44.6% of the revenue raised in Victoria.

The Board's Fifty-ninth Annual Report began with an account of the shortage of funds at the Board's disposal to adequately finance essential road and bridge works throughout the State. The situation did not improve during financial year 1972/73.

Additional funds from the Commonwealth to provide a total contribution at least equal to the amount of petrol tax raised in Victoria would alleviate the present crisis.

AUSTRALIAN ROADS SURVEY 1969/74

The National Association of Australian State Road Authorities is undertaking a survey of roads in conjunction with the Commonwealth Bureau of Roads to provide information for consideration by the Commonwealth Government in framing legislation to replace the present Commonwealth Aid Roads Act which expires on 30th June, 1974.

The five main phases of the survey are:

(i) the collection of inventory data on roads and bridges;
(ii) the identification of deficiencies;
(iii) the selection and estimation of costs of improvement projects, and the preparation of maintenance estimates;
(iv) the economic evaluation of improvement projects;
(v) scheduling (listing of projects allowing for restrictions on finance and other resources).

The first three phases are being carried out mainly by the State Road Authorities and municipalities and the latter two phases largely by the Commonwealth Bureau of Roads.

As a member of the National Association of Australian State Road Authorities, the Board is undertaking the survey in Victoria with the assistance of local government bodies.

During the year the collection of basic road and bridge inventory data was completed. Editing and checking of the information was carried out manually and with the aid of a computer. The inventory data of over six million items was stored on magnetic tape.

Deficiencies in the rural and outer urban road system were identified using a computer programme which compared inventory data with defined standards of acceptability for each section of road. For the inner urban areas comparisons were made between measured travel speeds and tolerable standard speeds.

All information from the C.R.B. involvement in the survey has been forwarded to the Commonwealth Bureau of Roads.

CONSTRUCTION OF FREEWAYS AND DUAL CARRIAGEWAY ROADS

During the year the Board completed the construction of 17.4 miles of dual carriageways on freeways and State highways. Approximately 9.7 miles of declared main roads roads were also converted to dual carriageways by municipal councils with financial assistance from the Board. This increased the total mileage of dual carriageways on freeways, State highways, and main roads to 334 miles.

Dual carriageways constructed on the Murray Valley Highway at Bandiana.

The more important dual carriageway projects completed, in progress, or in the planning stage during the year are briefly described below:

Mulgrave Freeway and Eumemmerring Freeway

The construction of 3½ miles of the Mulgrave Freeway and the Eumemmerring Freeway from the Princes Highway at Hallam to Stud Road, Dandenong North, was completed during the year at a total cost of $6.8 million. This section was opened by His Excellency the Governor of Victoria at a ceremony held on 21st November, 1972.

The project involved the construction of 3½ miles of dual carriageways together with interchanges at Stud Road, Heatherton Road and the Princes Highway. Access for local traffic was provided by bridges over or under the freeway at Power Road, Kidds Road and Florence Street.

Provision was also made for a future freeway interchange north of Eumemmerring Creek to connect the present freeway to a future freeway extending easterly towards Gippsland.

All freeway bridges have been designed to allow for the future provision of additional freeway lanes on the median side of both carriageways.

Work continued on the adjoining section of Mulgrave Freeway from Stud Road to Springvale Road, Mulgrave, a distance of 4½ miles. This section is expected to be completed and opened to traffic in 1974, at an estimated cost of $12.9 million.

Detailed design, land acquisition, and alterations to services proceeded for the 4.4 miles of Mulgrave Freeway from Springvale Road to Warrigal Road, Chadstone.

Hume Freeway (Wallan to Broadford Section)

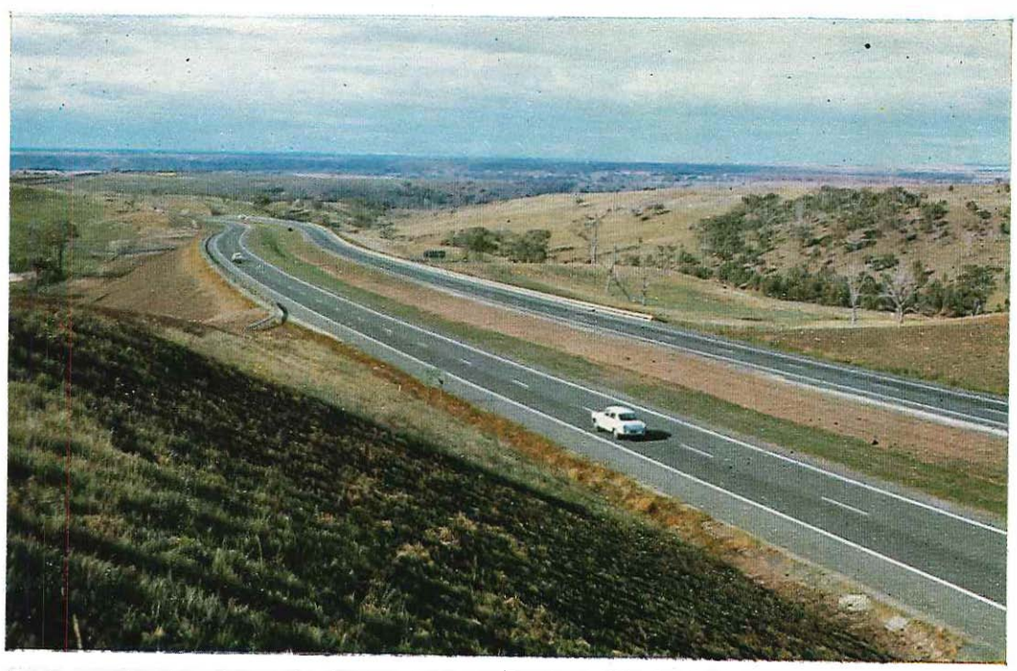
The construction of the southern section of 7.1 miles from Beveridge to Wandong continued during the year. During December 1972 a contract was let for the section between Wandong and Sunday Creek, a distance of 7.4 miles. In June, 1973, a contract was let for the remaining 6.8 miles from Sunday Creek north to Broadford.

The whole project of 21.3 miles of four-lane freeway is expected to be completed during financial year 1975/76 at an estimated cost in terms of 1972/73 prices of $21.0 million.

Western Freeway (Pentland Hills and Myrniong Sections)

Construction of the Pentland Hills section of 4 miles west from Bacchus Marsh continued during the year. A length of one mile from Korkuperrimul Creek to the Lion Park interchange was completed and opened to traffic. A further two miles is expected to be completed during August, 1973. Work on the remaining one mile will be completed in conjunction with the adjacent Myrniong section of the freeway.

Detailed plans were prepared for the Myrniong section of 3.6 miles with a view to commencing construction early in the 1973/74 financial year. Completion of this project will provide continuous freeway conditions from east of Bacchus Marsh to west of Pykes Creek Reservoir.



Newly completed section of the Western Freeway (Pentland Hills Section).

Calder Freeway

Work continued on the extension of the Calder Freeway from The Avenue, Niddrie, to Erebus Street, Keilor East, a distance of 1⅓ miles. The southern carriageway as far as Milleara Road was completed and opened to traffic. Work continued on the twin bridges across the railway, the northern freeway carriageway, and the Woorite Place interchange bridge.

The whole of this section is expected to be completed and opened to traffic early in 1974.

Mornington Peninsula Freeway

When completed the Mornington Peninsula Freeway will extend from the junction with the Frankston Freeway north of Frankston to Canterbury Jetty Road south of Sorrento.

A further one mile of freeway was opened to traffic in December, 1972, making a total of 2½ miles completed south-west from the Nepean Highway at Dromana. Work continued on the next 2½ mile section of the freeway to Jetty Road, Rosebud, which is expected to be opened by the end of 1973.

Frankston Freeway

This freeway commences at the junction with the Mornington Peninsula Freeway near Armstrongs Road, Seaford, and extends to the Frankston-Cranbourne Road at Frankston, a distance of 3.6 miles.

The section south of Klauer Street, Frankston North, was completed during 1971/72. During the year the construction of dual carriageways north from Klauer Street to Armstrongs Road, a distances of 1.5 miles, was completed, and grade-separated crossings of Klauer Street, Seaford Road and Austin Street will be completed in 1973/74.

The Mornington Peninsula Freeway south of Dromana.

Burwood Highway

The construction of one mile of dual carriageways from Austin Street to Acacia Road, Fern Tree Gully, at a cost of $650,000 was completed. This section was the final stage in the progressive development of dual carriageways on the Burwood Highway over its full length of 12.75 miles.

Princes Highway West

The construction of four miles of a second carriageway to provide dual carriageways between East Warrnambool and Allansford was completed.

Dual carriageways constructed on the Princes Highway West near Warrnambool.

COMMUNITY SURVEYS

The information obtained from community surveys conducted both before and after the construction of major road projects assists the Board's planners and designers in ensuring as far as possible that the completed project satisfies the needs of the community.

In the latter part of the financial year, the Board's Sociologist, Economist, Town Planner, and design engineers initiated and conducted a survey in the Niddrie Shopping Centre. The survey was designed to seek from shoppers, businessmen, and people involved in community services their reactions to a newly completed section of the Calder Freeway (Keilor Section).

The full analysis of the survey is still in progress, but the following comments summarise the responses made by the 550 people interviewed:

- the much quicker and safer trip to the city and other suburbs was readily appreciated;
- local streets had become safer and more pleasant because of reduced traffic;
- the shopping centre in Keilor Road was now a more attractive place to shop;
- it is now safer to cross Keilor Road because most through traffic now uses the freeway;
- the accessibility provided by the freeway was a significant factor in boosting development of the area;
- the pedestrian overpass of the freeway provided safe access to Niddrie Primary School and Niddrie High School.

The response to the survey was excellent and the Board is grateful to all who took part.

ROADSIDE DEVELOPMENT

The programme of planting trees and shrubs on road reserves throughout Victoria continued during the year. Eighty thousand seedling trees and shrubs were planted along medians, between pavements and road reserve boundaries, and the relatively open areas of freeway interchanges.

On the section of the Mulgrave Freeway from the Princes Highway to Stud Road a further 13,000 plants were used to supplement 2,000 earlier plantings. Particular attention was given to the placement of tall growing specimen trees in the open areas at interchanges, and the massing of acacias between the carriageways adjacent to freeway bridges.

In addition to the 4,600 plants placed last financial year a further 5,000 plants were placed along the Western Freeway (Bacchus Marsh Section), and 1,500 more plants were used on the Western Freeway (Gordon Section).

On the Western Highway at Ballarat East 2,700 mixed native and exotic trees and shrubs were planted to ensure a changing pattern of flowering and evergreen plants in most seasons.

The Northern Highway east of Elmore — a typical wayside stop.

NEW TEST VEHICLE

Early in 1973 the Board took delivery of a British-made test vehicle known as a Sideways-force Co-efficient Routine Investigation Machine. The machine is more commonly known as "SCRIM".

The purpose of the vehicle is to measure the skid resistance or "slipperiness" of road surfaces under wet conditions. A test wheel mounted at an angle of 20° to the direction of motion runs in contact with the road surface. A jet of water ahead of the wheel keeps the road surface wet. Forces acting on the wheel are measured and recorded in the vehicle's cabin. These readings accurately locate any sections of road where "slipperiness" exists or is increasing, and remedial action needs to be considered.

Following trials and instrument calibrations during March 1973, the vehicle was put into regular service to measure the skid resistance of various roads throughout the State. A more detailed account of this test vehicle is given in Appendix 11.

"SCRIM" undergoing trials and instrument calibrations.

MINISTRY OF TRANSPORT

Following the Victorian elections on 19th May 1973, and the subsequent changes in ministries the Hon. E. R. Meagher, MBE, ED, MP, Minister of Transport, was

designated as the responsible Minister of the Crown to accept responsibility in accordance with the terms of the Country Roads Act.
Immediately prior to that time the Board had operated under the jurisdiction of the Minister for Local Government.

The Board looks forward to continuing progress under Mr Meagher's guidance.

VICE-REGAL INSPECTION OF C.R.B. ACTIVITIES IN WESTERN VICTORIA

His Excellency, the Governor of Victoria, Major-General Sir Rohan Delacombe, KCMG, KCVO, KBE, CB, DSO, K.St.J., accompanied by the Board's Chairman, Mr R. E .V. Donaldson, spent three days in June, 1973, inspecting road works and meeting more than 150 of the Board's personnel in the western half of Victoria.

Leaving Melbourne on 27th June the party called at the Hume Freeway project between Wallan and Broadford. Later in the day several maintenance patrol gangs and a road construction unit were met along the Northern Highway and the Murray Valley Highway west of Echuca.

A feature of the second day of the tour was travelling along the Big Desert Road between Murrayville and Nhill, passing through the unique sand hill undulations and plant cover in this very isolated part of the State.

The third day of the tour was spent mainly on the Great Ocean Road.

It was evident that His Excellency's gracious manner, easy informality, and interest in the task being carried out was greatly appreciated by all personnel presented to His Excellency on the tour.

His Excellency the Governor of Victoria meets a CRB construction gang at High Camp, Northern Highway.

FINANCE

After deducting the cost of collecting revenue received under the Motor Car Act, the total funds available for expenditure by the Board during the year, including the allocation from the Roads (Special Projects) Fund, was $105,383,405.

The funds available were derived from:

State sources	$55,466,278
Commonwealth Aid Roads Act	49,785,000
Balance brought forward from year 1971/72	132,127
Total	$105,383,405

RECEIPTS

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

1. Fees under the Motor Car Act:
   (a) Motor registration fees less cost of collection (metropolitan bus registration fees and the specified proportion of registration fees paid to the Roads (Special Projects) Fund are excluded).
   (b) Two-thirds of additional registration fees, less two-thirds cost of collection, levied on first registration and subsequent changes of ownership.
   (c) Trailer registration fees less cost of collection other than the amount paid to the Roads (Special Projects) Fund.
   (d) One-eighth drivers' licence fees less one-eighth cost of collection.
   (e) Seven-eighths drivers' licence testing fees less seven-eighths cost of collection.
   (f) One-quarter driving instructors' licence fees less one-quarter cost of collection.
   (g) Examiners' licence fees (motor car roadworthiness examination) less cost of collection.
   (h) Fees for the issue of authorized log books less cost of collection.
2. All moneys raised under Part II of the Commercial Goods Vehicles Act (ton mile tax).
3. Municipal contributions to expenditure on declared main roads as provided for in the Country Roads Act.
4. Special Government Grants.
5. Small amounts of loan money.
6. Allocations from the Roads (Special Projects) Fund.
7. Receipts under the Commonwealth Aid Roads Act.

The following table shows the funds available to the Board for the construction and maintenance of roads in 1972/73 compared with 1971/72.

STATE SOURCES	1971/72		1972/73	
	$	$	$	$
Fees under the Motor Car Act less cost of collection	34,295,617		35,427,771	
Less: Payment to				
(a) Interest and Sinking Fund	2,584,294		2,611,805	
(b) Traffic Authority Fund	328,946		342,956	
(c) Tourist Fund	657,891		685,912	
(d) Transport Regulation Fund	534,167		548,173	
		30,190,319		31,238,925
Commercial Goods Vehicles Act		9,136,206		9,744,729
Municipalities' Contributions		2,190,207		2,182,290
Loan Funds		400,000		400,000
Special Grant from State Treasury		982,500		1,333,000
General Receipts		712,970		702,997
Allocation from Roads (Special Projects) Fund*		6,721,172		5,675,491
Totals:		50,333,374		51,277,432

*One-third of the receipts paid into this fund are allocated to the Country Roads Board. Two-thirds of these receipts are allocated to the Melbourne and Metropolitan Board of Works.

COMMONWEALTH AID ROADS ACT	1971/72		1972/73	
	$	$	$	$
Urban Arterial Roads	30,300,000		36,170,000	
Less: Amount allocated to Melbourne & Metropolitan Board of Works	4,520,000	25,780,000	7,455,000	28,715,000
Rural Arterial Roads		3,440,000		4,110,000
Rural Roads other than Arterial		15,330,000		16,100,000
Planning and Research		750,000		860,000
		45,300,000		49,785,000
Balance B/F at 1st July		78,000		132,127
Total Funds Available for Expenditure by the Country Roads Board		95,711,374		101,194,559
Less: Expenditure on Planning and Research	1,282,643		1,157,324	
Capital Expenditure (Plant, Workshops, Offices, etc.)	2,391,416		2,406,574	
Salaries, Operating A/cs and Other Admin. Expend.	10,252,427	13,926,486	12,123,433	15,687,331
Funds available to the Country Roads Board for Construction and Maintenance of Roads and Bridges		$81,784,888		$85,507,228

EXPENDITURE

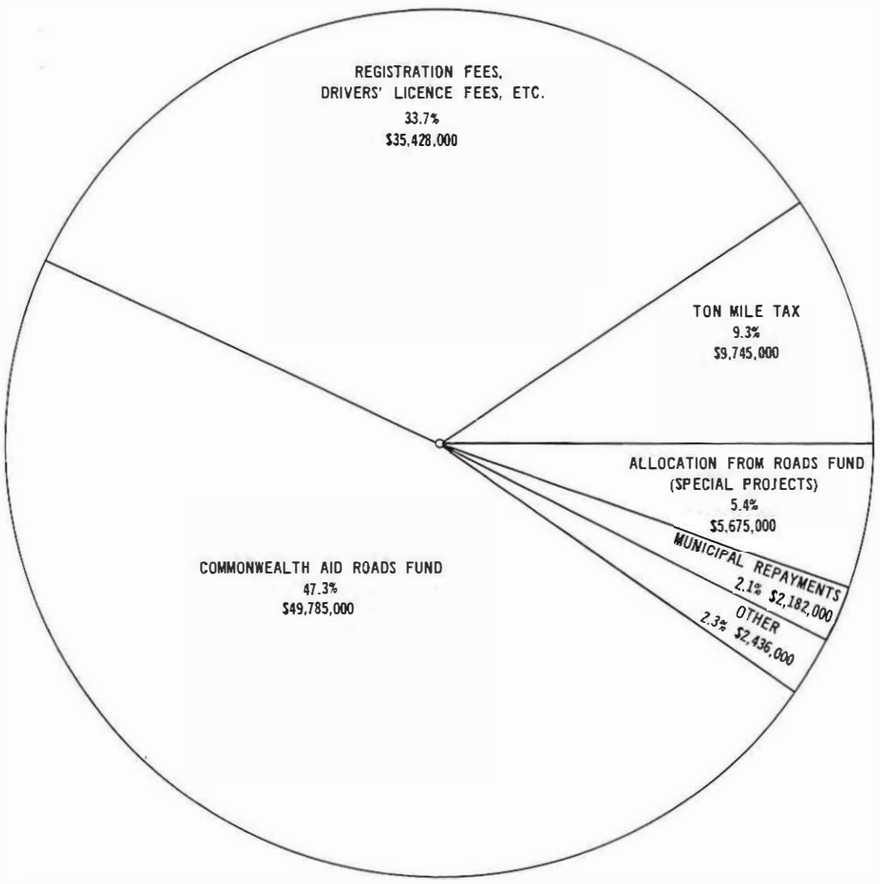
Expenditure in the form of cash payments during the financial year amounted to $103,487,601, leaving a cash balance of $1,895,804 to be carried forward into the financial year 1973-74. The Board's share of the grants to the State under the Commonwealth Aid Roads Act were fully expended.

The following table compares expenditure made, including that from the Roads (Special Projects) Fund, in the year 1972/73 with 1971/72.

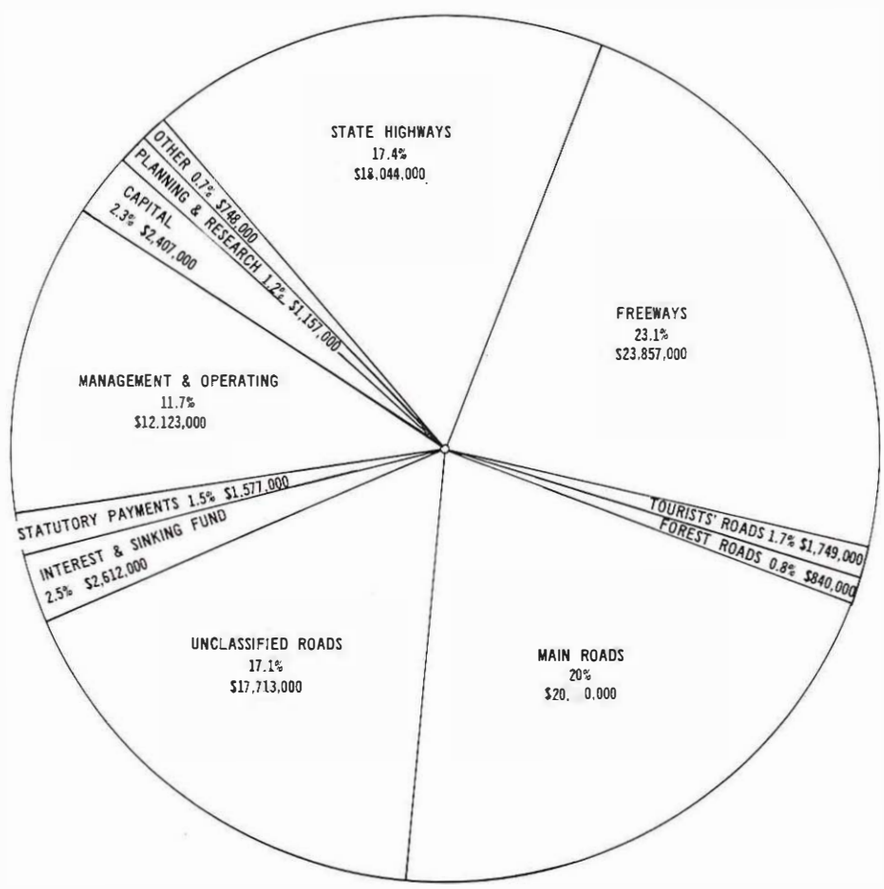
Item	1971/72	1972/73
	$	$
Construction and maintenance of roads and bridges	81,652,761	83,611,424
Capital expenditure (plant, workshops, offices, etc.)	2,391,416	2,406,574
Planning and Research	1,282,643	1,157,324
Salaries, operating accounts and other administrative expenditure	10,252,427	12,123,433
Statutory payments to Traffic Authority Fund, Tourist Fund and Transport Regulation Fund	1,521,004	1,577,041
Interest and Sinking Fund payments	2,584,294	2,611,805
Totals:	$99,684,545	$103,487,601

SHARING THE COSTS OF ROADWORKS

The Country Roads Act provides that no more than one-half of the amount expended from loan funds and one-third of the amount expended from the Country Roads Board Fund on main roads during the preceding financial year shall be apportioned between the various municipalities benefited thereby. The Act also provides that the amount apportioned to a council in respect of expenditure charged to the Country Roads Board Fund may be reduced where the cost of maintenance is excessive due to motor traffic not of local origin or to timber traffic. The revenue, valuation, and rating of the municipality and its financial obligations for loan expenditure on permanent works are taken into account in deciding the level of contribution by a council.



RECEIPTS 1972-73



EXPENDITURE 1972-73

In September 1972 expenditure on main roads in financial year 1971/72 was apportioned in accordance with the Country Roads Act, resulting in the following distribution of expenditure other than Loan Fund expenditure:

Expenditure from Country Roads Board Fund	$11,810,607
Expenditure from Commonwealth Aid Roads moneys	5,445,983
Expenditure from proceeds of ton/mile tax (Commercial Goods Vehicles Act)	3,102,569
Total:	$20,359,159
Amount of Country Roads Board Fund Expenditure apportioned to councils	$2,053,962

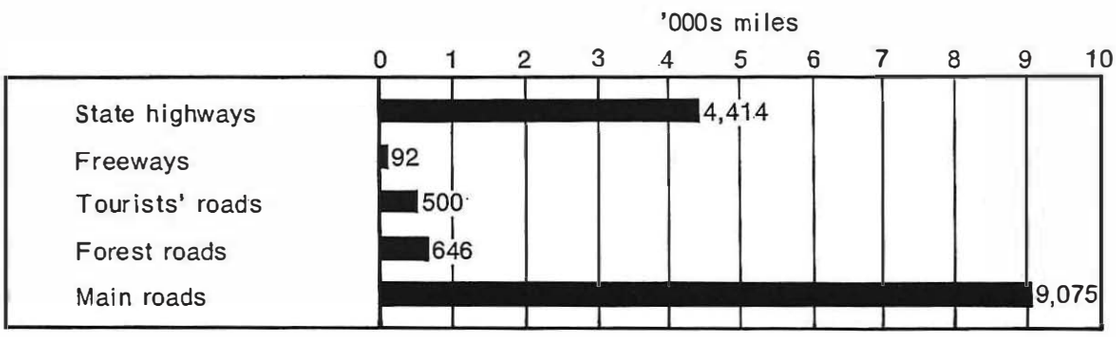
Within the limits of funds available, the Board made allocations to municipal councils for works on unclassified roads. The expenditure incurred from the allocations made by the Board in financial year 1972/73 compared with 1971/72 was as follows:

	1971/72		1972/73	
UNCLASSIFIED ROADS	C.R.B.	Council Contribution	C.R.B.	Council Contribution
	$	$	$	$
Construction and reconstruction	15,087,572	4,244,923	15,732,673	4,205,600
Patrol Maintenance	1,881,937	844,098	1,977,223	880,039
Total:	$16,969,509	$5,089,021	$17,709,896	$5,085,639

Municipal councils were not required to contribute towards the cost of works involving an expenditure during the year of $38,817,287 on State highways, freeways, tourists' roads and forest roads.

THE DECLARED ROAD SYSTEM

The total length of roads declared or proclaimed in Victoria under the Country Roads Act was 14,727 miles as at 30th June 1973.



It was not possible for the Board to increase the length of the declared road system during the year because of the additional financial responsibility which would be involved, and the inability of the Board's finances to permit further liabilities to be incurred.

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 expenditure of $18,044,000 on Victoria's 32 State highways during the year included an amount of $320,000 made available from the Roads (Special Projects) Fund.

By resolution dated 11th September 1972 following a Cabinet decision the Board renamed the North Western Highway and a section of the Henty Highway as the Sunraysia Highway between Ballarat and the junction with the Calder Highway south of Ouyen.

Appendix 1 includes a list of the State highways declared by the Board, and details of the more significant works completed during the year on State highways are given in Appendix 2.

FREEWAYS

Freeways are roads with dual carriageways having 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 by means of carefully designed ramps.

The Board bears the full cost of all works on freeways.

The total expenditure of $23,857,000 on freeways during the year included an amount of $5,353,000 made available from the Roads (Special Projects) Fund.

The major freeway project completed during the year was the first section of the Mulgrave Freeway, described on page 5 of this report. Other significant works completed during the year are included in Appendix 2.

The table in Appendix 1 lists the freeways constructed by the Board and opened to traffic.

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.

Details of the more significant works carried out on tourists' roads during the year are listed in Appendix 2.

The table in Appendix 1 lists the tourists' roads proclaimed under the provisions of the Country Roads Act.

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 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.

Appendix 3 lists the more important works completed during the year.

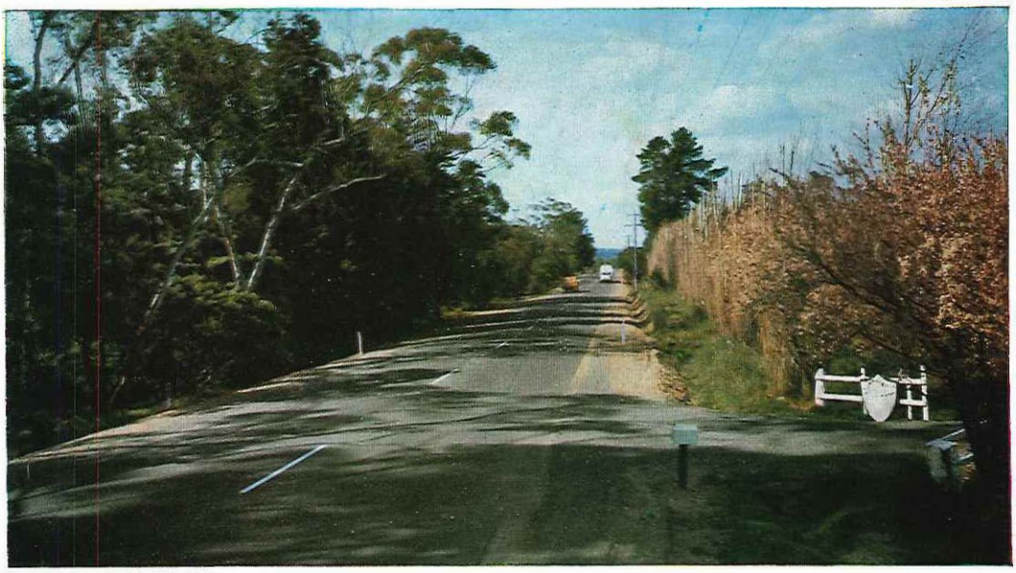
The table in Appendix 1 lists the forest roads proclaimed under the provisions of the Country Roads Act.

Walhalla Forest Road — reconstructed section north of Erica.

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 works are carried out under the direct supervision of the Board's staff.

A summary of the more important works on main roads completed during the year is given in Appendix 4.



Tyabb-Mornington Road — reconstructed section in Hastings Shire.

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 municipality concerned.

Reconstructed section of the Rosedale-Longford Road (unclassified), Rosedale Shire.

A list of the more significant works on unclassified roads carried out during the year with financial assistance from the Board appears in Appendix 5.

ARTERIAL ROADS

Under the provisions of the Commonwealth Aid Roads Act 1969 the Commonwealth Minister for Transport may declare certain roads to be urban arterial roads in the Melbourne Statistical Division and the urban areas of Geelong, Ballarat and Bendigo.

The urban arterial roads already declared by the Commonwealth Minister include all the Board's declared State highways and main roads in the Melbourne Statistical Division and the urban areas of Geelong, Ballarat and Bendigo.

The Minister has also declared as urban arterial roads certain unclassified roads which meet the Commonwealth Bureau of Roads' definitions of roads known as Class 6 and Class 7 roads. These definitions are:

Class 6 — arterial: those roads in urban areas whose main function is to perform as the principal arteries for massive "through" traffic movement or which are extensions into urban areas of Class 1 or Class 2 roads (Class 1 and Class 2 roads are in general "rural arterial roads").

Class 7 — sub-arterial: those roads in urban areas whose main function is to supplement the Class 6 roads in providing for "through" traffic movement or which distribute traffic between the Class 6 roads and the local street system.

During the year the Board advised municipal councils in the Melbourne Statistical Division and the urban areas of Geelong, Ballarat and Bendigo of the roads which had been declared as urban arterial roads and those roads for which application had been made to the Commonwealth Minister for declaration.

Application is made by the Board to the Commonwealth Minister for the declaration of unclassified roads as urban arterial roads if and when the Board is in a position to allocate funds for construction works on such roads.

ROAD CONSTRUCTION AND MAINTENANCE

Appendices 2 to 5 list the more significant works completed during the year with funds provided wholly or partly by the Board.

As mentioned elsewhere in this report the Board is most concerned that inflationary trends resulted in less roadwork being performed during the year than in the previous year.

The following table shows the miles of roads declared or proclaimed under the Country Roads Act as at 30th June 1973, and the expenditure incurred on such roads during the year.

The Princes Highway East — dual carriageways under construction at Traralgon.

Road	Declared or Proclaimed Miles	Road Expenditure (including Special Projects)		
		Patrol Maintenance	Other Maintenance	Construction and Reconstruction
		$	$	$
Freeways	91.6	434,000	81,000	23,342,000
State Highways	4,413.9	4,277,000	1,540,000	12,227,000
Tourists' roads	500.2	590,000	102,000	1,057,000
Forest roads	646.4	384,000	94,000	362,000
Main roads	9,074.9	4,398,000	1,794,000	14,468,000
Totals	14,727.0	10,083,000	3,611,000	51,456,000

SPECIAL PROJECTS

The Roads (Special Projects) Fund was established by the Government in 1965 from increased motor registration fees imposed as from 1st July 1965.

Works to be financed from the Roads (Special Projects) Fund must be approved by the Governor in Council on the recommendation of the Treasurer of Victoria. Two-thirds of the moneys credited to this fund are allocated by the Government to the Melbourne and Metropolitan Board of Works and the remainder to the Country Roads Board. Each financial year the Board submits recommendations through the Minister to the Treasurer for works to be carried out or commenced during the year as a charge against the fund.

Special Project No. 31 — realignment of the Calder Highway and a new road over rail overpass at Porcupine Hill.

Expenditure from the Roads (Special Projects) Fund by the Board on behalf of the State Government during the year was $5,675,491. Since the inception of the Special Projects scheme in 1965/66 the cost of work performed by the Board on Special Projects and charged to the Road (Special Projects) Fund totals $34,362,000.

Details of Special Projects on which work was carried out during the year are given in Appendix 6.

LAND PURCHASE

During the year the Board paid compensation and costs totalling $10,070,000 for land acquired or purchased for road purposes from 865 owners of land.

The following table shows the number of land purchase transactions completed and the amount of compensation paid over the last five years:

	1968/69	1969/70	1970/71	1971/72	1972/73
Number of land purchase cases settled	987	1,117	1,022	977	865
Compensation and associated costs paid by Board	$6.01 M	$5.29 M	$5.00 M	$5.14 M	$10.07 M
Reimbursement to councils for purchase of land for un-classified road works	$0.30 M	$0.18 M	$0.26 M	$0.33 M	$0.46 M

Many properties are purchased ahead of the time they are required for road construction purposes at the request of the owners prior to formal Notices of Acquisition being served and the precise dimensions of the land required being determined. This action by the Board assists owners who suffer hardship by not being able to sell the properties on the open market at a reasonable price because of the Board's road proposals.

Thirty-four houses owned by the Board and located on land required for imminent road construction purposes were sold by auction for a total amount of $78,700.

In some cases owners prefer the Board to purchase the whole of their properties where the portion required for road purposes has a significant effect on the continuing usage of the remainder of the property. The portion not required for road purposes can later be sold by the Board. During the year the Board sold 30 such areas of vacant land for $182,100 and five residential properties with dwellings for a total of $71,700.

TESTING OF MATERIALS AND RESEARCH

At its Head Office in Kew the Board has a modern well-equipped laboratory employing 160 personnel, including 34 qualified officers and 81 technicians.

The laboratory is administered by the Materials Research Engineer and is involved in routine testing and research connected with road building materials, including soils, rocks, gravels, concrete, steel, bitumen, asphalt, paints, rubber, reflective materials, lime and cement. This division carries out testing for the Board's regional divisions and also for municipalities. The research carried out is usually of a practical nature concerned with solving particular problems.

The work is carried out by the following specialist sections:

SECTION	BRIEF DESCRIPTION OF WORK OF SECTION
Chemistry and Bitumen Testing	Bituminous materials testing, inorganic chemistry analysis, reflective signs and delineation materials testing.
Asphalt and Plant Control	Special investigations such as skid resistance and special asphalt surfacings, routine asphalt design and testing, quality control of asphalt and crushed rock at the plant.
Technical Services	Electronics, workshop, equipment design and drafting, store and equipment supply, calibration of equipment.
Soils and Aggregates Laboratory Testing	Routine testing of soils and pavement materials.
Field Testing and Construction Quality Control	Pavement investigations, deflection testing of pavements, smoothness testing of pavements, construction control with field laboratories on major construction jobs in and near the metropolitan area.
Geology	Pavement material, seismic and resistivity survey investigations, petrographic analysis of rocks and quarry investigations, slip and water seepage problems.
Foundations	Field and laboratory work associated with bridge foundations and embankments, road settlement problems in soft areas.
Pavement Design	Design and recommendations regarding Portland cement rigid pavements, granular flexible pavements, full depth and deep strength asphalt pavements, recording test information on computer for future reference.
Concrete and Reinforced Steel Testing	Design and testing of concrete mixes, testing of reinforcing steel and bridge bearing pads.
Metallurgy	Testing of steel, ultrasonic testing of welds, advising on welding procedures and steels, building and testing a scale model of a particular bridge structure and research into stress corrosion of prestressing wire strands.
Special Research	Research into special projects such as compaction of coarse pavement materials, investigation of use of marginal pavement materials, shrinkage in concrete, and use of nuclear gauges to control density and moisture of pavement materials, research into penetrometers.

In addition to the laboratory at Head Office, the Board has well-equipped laboratories at the eight provincial regional divisions, each staffed by up to five technicians under the control of the Divisional Engineer. The divisional laboratories are engaged mainly on quality control of roadmaking materials within the respective divisions.

The following table lists the numbers and types of material tests and investigations which were conducted during 1972:

Type of Test or Investigation	Head Office Laboratories	Regional Laboratories
Samples of materials tested	8,610	11,710
Pavement investigations	54	170
Pavement deflection investigations	86	27
Density tests on roads	6,590	2,961
Concrete strength tests	9,350	4,654
Miscellaneous investigations	593	397

CONTRACTS

Contracts under the Board's Direct Supervision

Details of the types and numbers of contracts entered into and their respective values, together with a comparison with those of financial year 1971/72, are shown in the following table:

Type of Contract	1971/72		1972/73	
	Number of Contracts	$ Value	Number of Contracts	$ Value
Road Construction — Major Works (over $60,000)	10	6,396,948	5	8,067,409
Road Construction — Minor Works (under $60,000)	4	76,479	3	113,134
Supply of Roadmaking Materials	49	1,023,791	55	2,225,105
Bituminous Treatment and Supply of Materials	84	3,792,483	111	5,203,723
Bridge Construction	12	470,061	22	2,231,912
Manufacture of Bridge Components and Fabricated Steel	13	638,621	9	560,570
Supply of Reinforced Concrete Pipes and Box Culverts	1	96,190	20	1,152,970
Supply of Road and Bridge Construction Equipment	42	1,691,913	32	1,353,929
Divisional Facilities	6	207,027	—	—
Miscellaneous Services and Stores	32	1,941,943	27	1,248,073
Totals	253	$16,335,456	284	$22,156,825

The above details include contracts being financed from the Roads (Special Projects) Fund, which for the year 1971/72 amounted to 21 having a value of $6,329,000, and for 1972/73 amounted to 22 having a value of $9,568,665.

Contracts under Councils' Supervision

During the year the Board approved the acceptance by municipal councils of 234 tenders for a total amount of $5,742,823 for road and bridge works for which the Board allocated funds in whole or in part.

The Board also approved the use of 83 municipal contracts for the supply of materials for works partly financed from funds provided by the Board.

BITUMINOUS SURFACING

A bituminous surface protects road pavement materials from damage.

This surface may be provided by the application of a bituminous binder covered immediately with aggregate which is compacted by rolling. The binder is applied by spraying at a designated rate on to the pavement surface by a mobile bitumen sprayer. The aggregate is spread uniformly by a rotating belt spreader.

Alternatively the bituminous surface may be provided by spreading from a mechanical paver a carefully designed mixture of aggregate and bitumen produced from fixed mixing plants.

The total length of bituminous surfacing including both types completed during the year amounted to 3,242 miles at an approximate cost of $12,574,000.

The Board's seventeen mobile bituminous surfacing units together with plant owned by municipal councils and contractors completed 3,143 miles of sprayed work at a cost of approximately $8,790,000.

Contractors operating from fixed asphalt plants completed 99 miles of plant mix work on heavily trafficked roads at a cost of approximately $3,784,000 using 273,819 tons of bituminous concrete.

The lengths of various bituminous surfacing work completed during the year were:

204 miles of sealing widened pavement,
32 miles of initial sealing on dual carriageways,
488 miles of restoration of sealed coats on reconstructed sections,
280 miles of final sealing on initial treatments,
1,570 miles of maintenance retreatments,
92 miles sealed on behalf of other State and municipal authorities,
576 miles of extensions to the bituminous sealed road system of the State including 67 miles of roads declared or proclaimed under the Country Roads Act.

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

MATERIAL	QUANTITY
Bitumen for sprayed work	29,353 tons
Bitumen for bituminous concrete	15,200 tons
Aggregate for sprayed work	342,330 cubic yards
Aggregate for bituminous concrete	209,000 cubic yards
Other bituminous materials for sprayed work and maintenance	14,850 tons

The total length of sealed roads in the Board's declared or proclaimed road network is 13,363 miles or 91 per cent of the total length of declared or proclaimed roads.

LINEMARKING

Three large linemarking machines, five medium-sized machines and one small machine were engaged in pavement marking operations during the year.

The large units carried out the bulk of the work, including most new work and long distance striping.

Two of the medium sized machines under the control of the Divisional Engineers at Geelong and Bendigo, were used mainly on intersection markings and the restriping of short lengths as soon as possible after the retreatment of pavements. The other machines were located at Syndal and operated under the control of the Traffic Engineer.

Traffic lines and pavement markings on 8,291 route miles were maintained. The following table shows the route miles maintained compared with last financial year.

ROAD	1971/72	1972/73
State highways and freeways	4,209	4,215
Other declared or proclaimed roads under the Country Roads Act	3,132	3,230
Unclassified roads	787	846
Totals	8,128	8,291

The total length of linemarking expressed as miles of standard stripe (a 10 ft. line with 30 ft. gap) was 26,062 miles, a decrease of 9% over the previous year.

The reduction in length of equivalent standard stripe painted resulted from decreasing the frequency of linemarking from once in six months to once in nine months. This was done to conserve finance. The quality of line after nine months' service on rural highways appears to be acceptable.

Reflectorized markers were used, in conjunction with non-reflective ceramic buttons, on metropolitan freeways constructed by the Board to delineate lane lines and ramp edge lines. Reflective markers were also used at other selected locations, such as at sharp curves or at intersections to give improved delineation, especially under adverse weather conditions.

The cost of striping by the two large self-propelled linemarking machines was $19.83 per mile of equivalent standard stripe and $15.16 per mile for the striping by the large push trolley machine. The lower cost for the striping carried out by push trolley machine was due to the fact that it is used for most of the longer striping runs, e.g. Hume Highway and Calder Highway and because larger paint tanks are fitted resulting in less down time.

The total expenditure during the year for all pavement marking activities was $618,655. The total costs and the quantities of materials used in 1971/72 and 1972/73 are shown below:

	1971/72	1972/73
Total expenditure	$515,039	$618,655
Roadmarking paint used	80,921 gals.	71,000 gals.
Reflective glass beads used	245 tons	247 tons
Raised pavement markers used	7,430	3,589

ROADS TO SNOW RESORTS

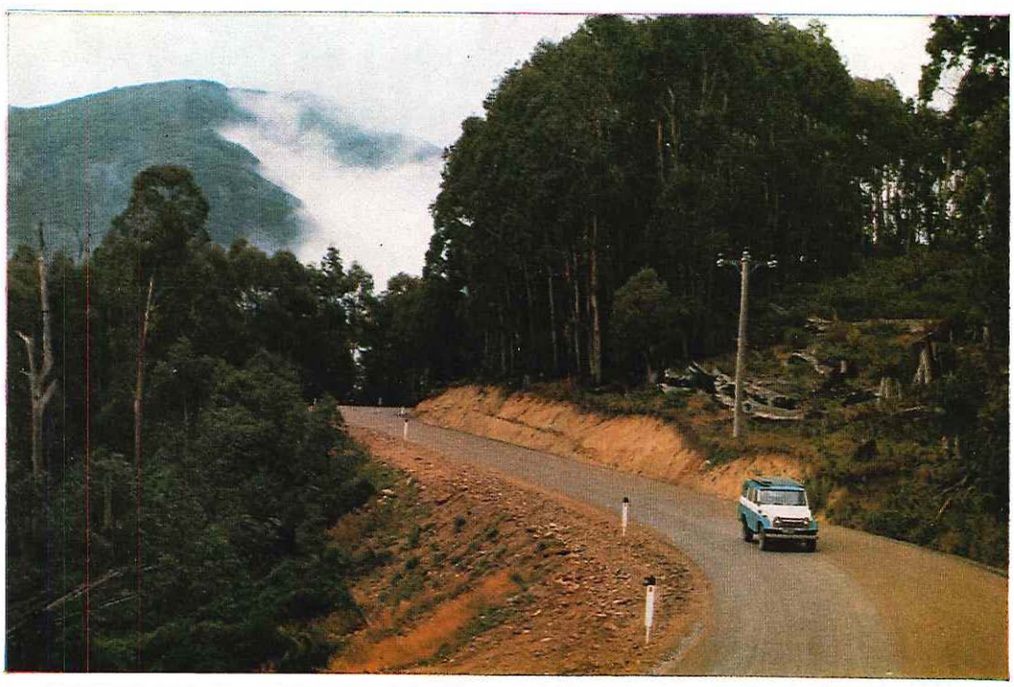
During the summer months the following improvements were carried out on tourists' roads which give access to winter snow fields:

Mount Buffalo Road

A further 0.5 mile of the road was sealed between the Cathedral and Cresta.

Bogong High Plains Road

Construction of two sections totalling 1.3 miles between Howmans Gap and Falls Creek to provide a sealed pavement 24 feet wide. This work completed the provision of a sealed road between Howmans Gap and the Falls Creek Alpine Village.



Reconstructed section of the Bogong High Plains Road between Howmans Gap and Falls Creek.

BRIDGES

CONSTRUCTION OF NEW BRIDGES

During the year the construction of 131 new bridges estimated to cost $11,350,000 commenced either under the direct supervision of the Board, or under municipal supervision with financial contribution from the Board. The table below gives a comparison between the number and estimated cost of bridge projects commenced in 1972/73 and those for the preceding financial year.

Description	1971/72		1972/73	
	No.	Estimated Cost	No.	Estimated Cost
Bridges commenced under the Board's supervision	69	$7,150,000	58	$10,100,000
Bridges commenced under municipal supervision with financial assistance from the Board	84	$1,440,000	73	$1,250,000
Total Bridges Commenced	153	$8,590,000	131	$11,350,000

The figures for bridges constructed directly by the Board, with an increase in average cost from $100,000 to $175,000 per structure, reflects the increase in their size and complexity, with an increasing proportion now being associated with urban or rural freeway projects.

LARGE BRIDGES COMPLETED IN RURAL AREAS

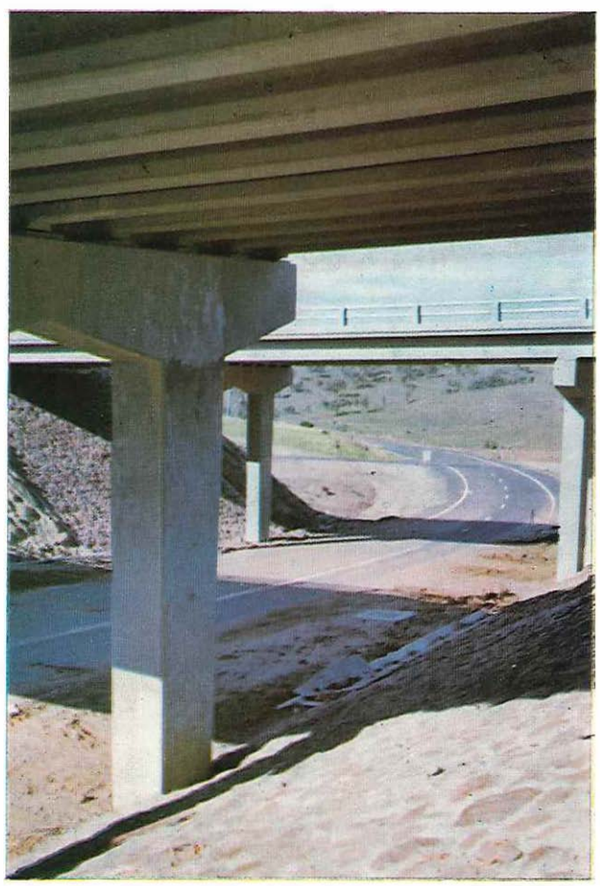
Some of the larger bridges completed in rural areas of Victoria under the supervision of the Board's staff during the financial year included:

(a) **Cann Valley Highway — Buldah River Bridge, Shire of Orbost:** A four-span prestressed concrete beam and reinforced concrete bridge, 200 feet in length by 28 feet between kerbs over the Buldah River (Cann River — West Branch) at Weeragua.

(b) **Gouiburn Valley Highway — Home Creek, Shire of Alexandra:** A five-span precast high strength U-slab and reinforced concrete bridge, 160 feet long and 28 feet between kerbs.

(c) **Great Ocean Road — Painkalac Creek, Shire of Barrabool:** A three-span prestressed concrete beam and reinforced concrete bridge, 122 feet long and 28 feet between kerbs plus a footway 5 feet wide, over the Painkalac Creek at Airey's Inlet.

(d) **Warburton Highway—Woori Yallock Creek, Shire of Lillydale:** A five-span bridge and a seven span bridge, respectively 175 feet long and 245 feet long by 28 feet between kerbs, over the Woori Yallock Creek on a major realignment of the Warburton Highway at Killara Hill.



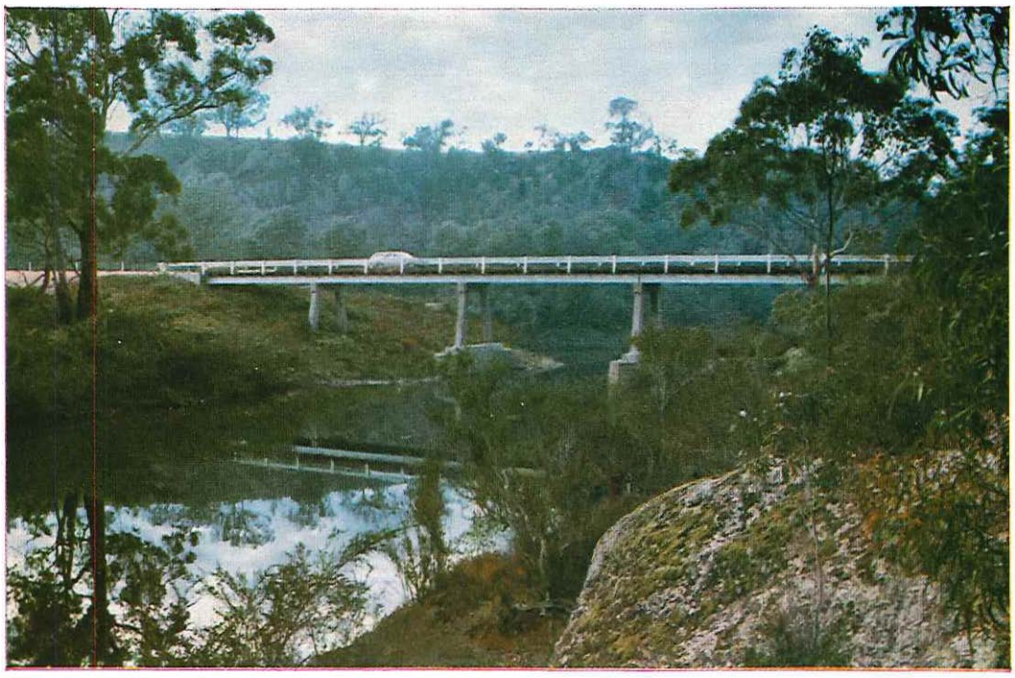
Twin bridges under construction on the Western Freeway (Pentland Hills Section) at the Lion Park interchange.

(e) **Western Freeway — Lion Park Interchange, Shire of Bacchus Marsh:** Two overpass structures, each of three spans and 144 feet long by 36 feet between kerbs of prestressed concrete beam and reinforced concrete construction.

(f) **Ocean Road — Campbell's Creek, Shire of Heytesbury:** A four-span precast high strength U-slab and reinforced concrete bridge, 142 feet long by 28 feet between kerbs over Campbell's Creek at Port Campbell.

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

(a) **Macalister River — Weir Road, Shire of Maffra:** A five-span steel beam, steel trough decking and reinforced concrete bridge, 220 feet long by 16 feet between kerbs replacing the old Lanigan's Bridge damaged by floods.

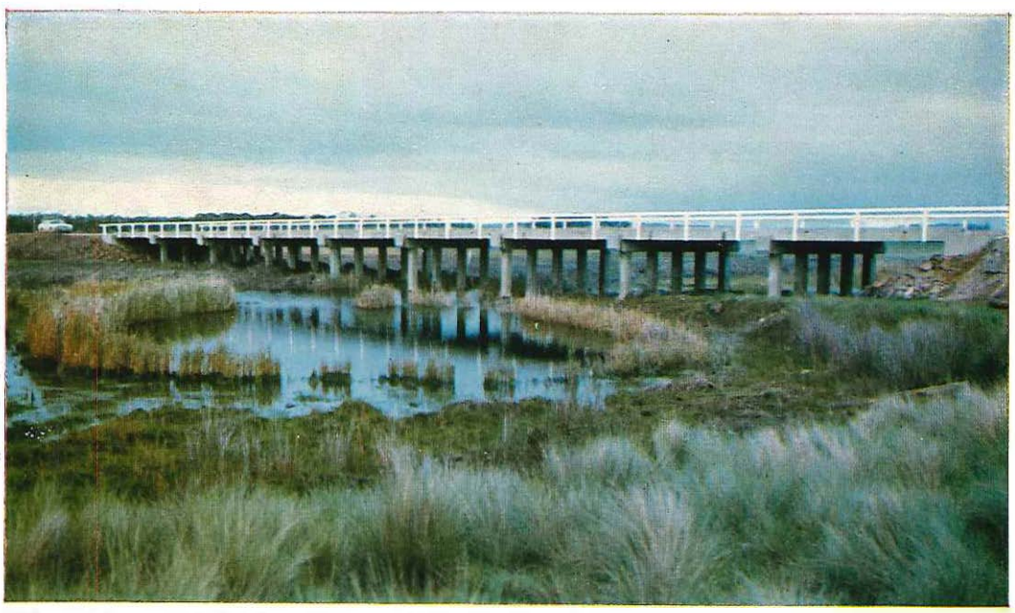


Weir Road, Shire of Maffra — new bridge over Macalister River.

(b) **Bream Creek — Torquay-Barwon Heads Road, Shire of South Barwon:** A six-span precast high strength U-slab and reinforced concrete bridge, 180 feet long by 28 feet between kerbs.

(c) **Moyne River — Toolong North Road, Shire of Belfast:** A three-span precast high strength concrete beam and reinforced concrete bridge 120 feet long and 24 feet between kerbs.

(d) **Hopkins River — Delacombe Way, Shire of Ararat:** A nine-span rail-in-slab and reinforced concrete bridge 210 feet long and 24 feet between kerbs.



Delacombe Way, Shire of Ararat — new bridge over Hopkins River.

c

(e) **Bass River — Dalyston-Glen Forbes Road, Shire of Bass:** A three-span prestressed concrete beam and reinforced concrete bridge 150 feet long and 24 feet between kerbs.

METROPOLITAN BRIDGES AND OVERPASSES

Some of the larger bridges in the metropolitan area on which construction proceeded or was completed under the direct supervision of the Board's staff included:

(a) **Mulgrave Freeway (Stud Road to Springvale Road):** Work proceeded almost to completion on seven major bridge crossings and three service tunnels associated with this section of the freeway, at a total cost of $2,500,000. Major bridges included the dual four-span overpass structures 485 feet long by 28 feet wide plus 7 feet wide footways to carry Wellington Road over the freeway, and the three-span prestressed concrete box girder overpass structure 311 feet long by 86 feet wide plus two footways each 7 feet wide to carry Springvale Road over the freeway.

(b) **Princes Highway West, Rail Overpass at West Footscray:** Construction proceeded on bridges over the railway, Cross Street and Gordon Street, a ramp structure providing a connection to Gordon Street, and a pedestrian overpass from Buckley Street to Errol Street over the railway, together with associated roadworks and service alterations.

The whole project will cost approximately $3,800,000 and when completed in 1973/74 will provide six lanes for highway traffic.

GRADE-SEPARATED PEDESTRIAN CROSSINGS

Grade-separated pedestrian crossings eliminate the risk of conflict between motor vehicles and pedestrians as well as improving the safety of the road facility by allowing a smoother flow of traffic.

The Board participates in the provision of grade-separated pedestrian crossings in three ways, namely:

(1) construction of pedestrian overpasses across newly constructed freeways to restore pedestrian access to areas either side of the freeway;

(2) the replacement of at-grade school crossings on busy roads with pedestrian overpasses or underpasses under a scheme introduced by the State Government in 1965. Under this scheme, applications for subsidies are received by the Board from municipal councils and priorities are allotted by the Road Safety and Traffic Authority in conjunction with the Board. The priorities are assessed on a formula which takes into account traffic volume, average speed of traffic, the number and age range of children crossing the road and the type of road to be crossed. Costs of these crossings are shared equally between the Government, the Board and the municipal council concerned;

(3) where a municipal council decides to provide a pedestrian overpass or underpass at its own expense, the Board is prepared to assist the council in the preparation of plans and specifications.

During 1972/73 the following grade-separated pedestrian crossings were constructed by the Board:

(a) **Restoration of Pedestrian Access across Freeways:**

(i) Mornington Peninsula Freeway, Dromana — a prestressed and reinforced concrete pedestrian overpass 570 feet long and 6 feet wide at Pier Street,

Mornington Peninsula Freeway — pedestrian overpass constructed at Pier Street, Dromana.

Dromana. A feature of this structure is the unusually long centre span of 145 feet.

(ii) Frankston Freeway, Frankston North — a prestressed and reinforced concrete pedestrian overpass 261 feet long by 6 feet wide at Austin Road in the vicinity of the Seaford Primary School.

(b) **State Government's Scheme for Grade-separated Crossings to serve Schools:**

No further grade-separated crossings to replace at-grade school crossings were added to the list of approved projects in 1972/73, due to limitation of funds.

One pedestrian overpass in this category was completed during the year:

Melbourne City — Boundary Road at Mark Street:

A prestressed and reinforced concrete overpass 350 feet long providing access over Boundary Road to the North Melbourne Primary School was completed in June, 1973.

In addition to the twelve grade-separated crossings already completed, thirteen other crossings to serve schools have already been approved by the Government.

BRIDGE AND CULVERT MATERIALS

The following bridge and culvert materials were either purchased directly by the Board or by municipal councils for use during the year on works financed wholly or partly by the Board:

ITEM	AMOUNT
Reinforced concrete pipes	$587,000
Reinforced concrete box culverts	$242,000
Corrugated steel pipes and culverts	$289,000
Corrugated steel guardrail (93,000')	$114,000
Precast concrete bridge units	$524,000
Fabricated reinforcing steel	3,070 tons
Welded steel girders, etc.	780 tons

ELIMINATION OF RAILWAY LEVEL CROSSINGS

Since the inception of the State Government Scheme in 1954, the Board and the Victorian Railways have replaced 59 level crossings with overpasses or underpasses as a means of reducing accidents and traffic delays. This work represents a total expenditure of approximately $29.5 million.

Since 1970/71 expenditure on such projects has been shared on the basis of Country Roads Board 50%, Victorian Railways 5%, and the Level Crossings Fund 45%.

The purposes for which the Level Crossings Fund may be used are:

(a) the elimination of level crossings or the provision of alternative routes to enable road traffic to avoid level crossings;

(b) the provision of lights, signs and lighting at level crossings, and improved approaches to level crossings;

(c) any other works calculated to improve the flow of traffic across, or to reduce the danger at, level crossings.

The following grade-separated overpasses were completed during the year:

Princes Highway West — Allansford

A road-over-rail overpass of the Melbourne-Warrnambool railway on a new alignment of the Princes Highway West at Allansford. Approximately 1,350 vehicles used the level crossing daily between 7.00 a.m. and 7.00 p.m. The Board was the constructing authority.

The portion of the total cost of $451,000 which was regarded as relevant to the replacement of the level crossing was $236,000.

Victoria Street (Margaret Street) — Geelong

A road overpass of both the Melbourne-Geelong railway and the Princes Highway West at Margaret Street, Geelong. The Board was the constructing authority.

The total cost of the project was $576,000, of which $192,000 was regarded as attributable to the elimination of the level crossing in Victoria Street.

New Margaret Street overpass replacing the level crossing at Victoria Street, Geelong.

Work continued on the construction of a road-over-rail overpass of the Melbourne-Warrnambool railway at Paisley to replace the existing level crossing in Millers Road. Approximately 11,000 vehicles use this section of Millers Road between 7.00 a.m. and 7.00 p.m. daily, and approximately 56 trains use the railway in a whole day. The total estimated cost of the project is $1,050,000.

NATIONAL PARKS SERVICE

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

Allocations were made by the Board after consultation with the National Parks Service for works in or near—

Bulga National Park in Alberton Shire.

Ferntree Gully National Park in Sherbrooke Shire.

Fraser National Park in Alexandra Shire.

Glenaladale National Park in Bairnsdale Shire.

Hattah Lakes National Park in Mildura Shire.

Kinglake National Park in Eltham and Whittlesea Shires.

Lind National Park in Orbost Shire.

Mount Buffalo National Park in Bright Shire.

Mount Eccles National Park in Minhamite Shire.

Mount Richmond National Park in Portland Shire.

Organ Pipes National Park in Keilor and Bulla Shires.

Port Campbell National Park in Heytesbury Shire.

Tarra Valley National Park in Alberton Shire.

Wilson's Promontary National Park in South Gippsland Shire.

Wyperfeld National Park in Karkarooc Shire.

The work consisted of construction and sealing of access roads and roads within National Parks, parking areas and maintenance of roads and parking areas already constructed. The works were carried out either by the Board or the municipal council concerned.

The Government has made loan funds totalling $997,000 available for these purposes since 1st July 1963.

MINISTRY OF TOURISM

An amount of $200,000 was again made available in financial year 1972/73 by the State Government from loan funds for expenditure on roads of a tourist nature other than roads proclaimed as tourists' roads under the provisions of the Country Roads Act. Allocations for particular projects are made by the Board after consultation with the Ministry of Tourism.

The total amount made available since 1960 is $2,594,000. The loan funds made available are repayable by the Board.

The allocations made in financial year 1972/73 included amounts for work to be carried out on the western access road to Mt Baw Baw in Narracan Shire, the Dargo High Plains Road in Avon Shire, the Wonderland Road in Stawell Shire and Cobbledicks Ford Road in Werribee Shire.

The applications for funds for works on roads of a tourist nature far exceed the amount of funds available but the allocations made since 1960 have made significant progress in the provision of adequate access to many tourist attractions in Victoria.

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 $685,912 was paid during the year. The Tourist Fund is administered by the Ministry of Tourism.

MUNICIPALITIES FOREST ROADS IMPROVEMENT FUND

In 1955 the State Treasury established the Municipalities Forest Roads Improvement Fund 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.

Priorities for eligible works are established on a State-wide basis, following investigation by the Board's Divisional Engineers and the appropriate Forests Commission officers. Allocations for particular works are made by the Board with the agreement of the Forests Commission.

An amount of $50,000 was contributed to the Fund by the Government during the year. The authorized contributions to the Fund by the Government to 30th June 1973, total $540,000.

Outstanding applications for assistance from the Fund at present total $292,500. The limited funds have enabled grants to be made for only the most urgent works and the large number of applications on hand is becoming of increasing concern to municipal councils and the Board.

CONTROL OF HEAVY TRAFFIC

In the interests of the safety of road users and to protect the road itself, it is necessary for the Government to impose statutory limits on the weight, width, height, and length of vehicles and their loads.

These limits are imposed under the provisions of the Motor Car Act, which also provides that the Board is the authority responsible for issuing permits for the movement of vehicles and loads exceeding the legal weight, height, length, and width on:

(a) roads declared or proclaimed under the provisions of the Country Roads Act; and
(b) a journey which includes unclassified roads in two or more greater metropolitan municipalities as defined under the Motor Car Act.

The following table sets out the number and types of permits issued during the year compared with those issued during financial year 1971/72:

	1971/72	1972/73
Single trip permits issued	28,821	24,128
Annual permits issued	3,433	3,935
90-day permits issued	538	—
Total number of permits issued	32,792	28,063

The heaviest loads for which permits were issued during the year were a steel vessel weighing 197 tons and a machine of 180 tons, both of which were moved in the metropolitan area. Permits issued for loads of 70 tons or more numbered 361 and these included 11 permits for loads of 100 tons or more.

The decrease in the total number of permits issued during 1972/73 when compared with the previous year was due to a substantial reduction in the demand for permits from the transport industry. There was a noticeable decline in applications for permits for the carriage of structural steel and large items associated with development projects. Permits issued for loads of 70 tons or more were less than half the number issued in the previous year.

The number of offences reported by the Board's 19 Traffic Officers and four Police Officers on attachment from the Victoria Police was 8,384. These offences, which resulted in $425,644 in fines and costs payable to Consolidated Revenue, related to such acts as overloading of axles and axle groups, exceeding length, height, and width limits, failure to comply with permit conditions, refusing to allow vehicles to be weighed, and speeding.

The Board's Inspecting Traffic Officer and two Load Inspectors, who ensure that vehicles and loads comply with permit descriptions prior to journeys commencing, inspected 1,291 over-dimensional loads. As a result 87 permits had to be amended because of inaccuracies, 10 loads had to be repositioned, and 28 permits were cancelled because the vehicles and loads were unable to comply with permit requirements. These inspections have had a marked effect on the care taken by operators applying for permits.

LEGISLATION AFFECTING THE BOARD

Legislation enacted during the year which affected the Board included the following:

Country Roads (Amendment) Act 1972, No. 8375

This Act made provision for:

(a) the protection of the rights of public statutory authorities to use areas of discontinued roads sold by the Country Roads Board;

(b) the repeal of Section 61 of the Country Roads Act which required that actions against the Board be brought in the County Court unless otherwise ordered;

(c) the period that shall expire before abandoned vehicles may be removed from the road reserves of freeways being reduced from 14 days to 7 days;

(d) the repeal of the words "on country roads" and "of country roads" in the headings of Divisions 2 and 3 respectively of Part VIII of the Country Roads Act;

(e) the Board to fix the maximum speed at which vehicles may be driven over roads being constructed or repaired under the direct supervision of the Board's staff;

(f) the Minister's consent to be obtained before the Board enters into a contract in excess of $100,000 (previously in excess of $20,000);

(g) the Board's powers to remove abandoned vehicles and dead animals from the road reserves of freeways to apply also to State highways, tourists' roads, forest roads and those main and unclassified roads the maintenance of which is carried out under the direct supervision of the Board's staff.

Lands Compensation Act 1973, No. 8432

This Act, which came into force on 1st June, 1973, included new provisions for the assessment of compensation where property is compulsorily acquired by Government organiations. Amongst other things the Act provided that the Lands Compensation Act 1958 and Part III of the Valuation of Land Act 1960 shall be incorporated with the Country Roads Act and shall be construed together therewith as one Act which will take effect with regard to all works and undertakings for the purposes for which the Country Roads Board is authorised to take and use lands and not otherwise.

The Lands Compensation Act 1973 also:

(a) outlined the principles to be used in determining the amount of compensation. In summary these new principles are:

  (i) compensation shall be based upon the market value of lands at the time that the notice to treat was given together with an additional amount not exceeding 10% of the market value of the lands required, by way of solatium, because of the compulsory nature of the acquisition of the lands;

  (ii) in the case of land used for residential purposes the compensation shall include an amount in respect of improvements or facilities of a special nature not reflected in the market value of the land;

  (iii) the compensation in addition shall include an amount equal to the legal and other costs that will necessarily be incurred by the owner of the land by reason

of the acquisition and an amount equal to any direct pecuniary losses caused by the acquisition of the land;

(iv) the amount of compensation shall be reduced by an amount equal to the enhancement in value of adjoining land belonging to the owner or any other benefit or advantage which the owner may or will obtain by reason of the execution of the works for which the land is being acquired;

(v) any remote, indirect or speculative damage that may be suffered by the owner by reason of the land being acquired shall be disregarded;

(vi) any change in the value of the property caused by the publication by or on behalf of the Board of any notice or statement relating to the proposal to investigate or to carry out the works or undertakings prior to the service of the notice to treat shall be disregarded;

(b) provided that where it appears that lands in respect to which notice to treat has been served are used solely for residential purposes, or where it appears that the market value of the land would be not more than $35,000, the acquiring authority shall:

(i) within 6 months after the service of the notice give an estimate in writing of the amount that would be payable to the owner of the land;

(ii) within 2 months after the receipt of the claim for compensation from the owner of the land make an offer of compensation based on the interest of the owner in the land.

If the authority fails to comply with the above provisions the owner shall be entitled in addition to any other compensation payable, to interest on the amount ultimately paid at the rate of 5% from the day on which there was a failure to comply with these provisions until the estimate was given or the offer was made;

(c) provided that the acquiring authority may grant an interest free loan to an owner where the following conditions all apply:

(i) the whole or part of the land required has been occupied as a residence by an owner or by his spouse for at least 2 years before a notice to treat is served;

(ii) the market value of the land does not exceed $35,000;

(iii) the compensation payable is insufficient to enable the owner to purchase comparable accommodation.

The interest free loan must be secured by a mortgage over the replacement property and becomes repayable;

(a) after the replacement property is sold, or

(b) the owner or his spouse cease to use the land as a permanent residence, or

(c) the owner and his spouse have both died;

(d) provided that where physical possession of the acquired land has been taken and the owner requests in writing that the acquiring authority advance an amount equal to 90% of the authority's estimate of compensation, the authority must advance this sum less the cost of securing the release of the interest of any mortgagee in the land. The money shall be advanced within one month of receipt of the owner's letter or within one month of the authority being satisfied as to the owner's entitlement to compensation, whichever last occurs;

(e) amended Section 20 of the Valuation of Land Act concerning the assessment of costs in the case of an appeal to a Board of Review or a Court.

Motor Car (Miscellaneous Provisions) Act, 1972, No. 8349

This Act, amongst other things, provided for:

(a) the maximum length of a rigid motor car other than an articulated motor car being increased from 31 feet to 36 feet provided that where the length of such motor car is greater than 33 feet the distance between the front of the motor car and the centre line of the rear axle or, where there is more than one rear axle, the distance between the front of the motor car and the line that is equidistant between the two rear-most axles, shall not exceed 27 feet and where the length of such motor car is greater than 31 feet the distance between the centre line of the rear axle, or where there is more than one rear axle, the line that is equidistant between the two rear-most axles and the back of the motor car or the load thereon (whichever is the greater) shall not exceed 12 feet;

(b) (i) the maximum length of a motor car, other than an articulated motor car, and having a trailer attached thereto being increased from 50 feet to 55 feet;

(ii) where the overall length exceeds 55 feet, the distance from the pintle of the motor car to the front axle of the trailer shall not exceed 16 feet.

Motor Car (Learner Drivers' Permits) Act 1972, No. 8345

Amongst other things, this Act provided for:

(a) the issue of a learner driver's permit to a person, not the holder of a licence to drive a motor car or motor cycle before he drives a motor car or motor cycle upon a highway;

(b) testing the proficiency of an applicant for a learner driver's permit;

(c) the payment of fees by applicants for learner drivers' permits which shall not exceed:

(i) for making an appointment or appointments for tests . . $2

(ii) for carrying out the tests $4

Seven-eighths of the revenue from these fees will be paid into the Country Roads Board Fund (see Motor Car (Amendment) Act 1973, No. 8430 hereunder).

Motor Car (Amendment) Act 1973, No. 8430

This Act amongst other things provided that all revenue from the fees of $2 paid for making appointments for proficiency tests for learner drivers' permits shall be paid into the Consolidated Fund.

TWENTY-NINTH CONFERENCE OF MUNICIPAL ENGINEERS

The Twenty-ninth Annual Conference of Municipal Engineers, convened by the Country Roads Board in conjunction with the Local Government Engineers' Association was held from 27th to 29th March, 1973, at the Board's Head Office.

The Conference was officially opened by the Hon. A. J. Hunt, MLC, Minister for Local Government, who, in welcoming the large gathering of some 250 engineers, paid tribute to the work carried out by the profession, and said that such conferences brought new approaches and a better understanding of the problems involved.

Special guests at the twenty-ninth Conference were seventeen senior engineers from twelve Asian and African countries, who were in Melbourne attending an International Seminar in Road and Bridge Engineering, conducted by the Board on behalf of the Commonwealth Government.

In addition to engineers from municipalities throughout Victoria, and visiting engineers from Tasmania and Western Australia, senior C.R.B. engineers including the Divisional Engineers from the Board's ten divisions and engineers representing other Government Departments and Instrumentalities also attended.

Under the chairmanship of Mr. R. E. V. Donaldson, the Conference was held in two sessions on 27th March and 29th March. Papers presented and topics discussed covered a wide range with the general theme of municipal engineering and the environment.

On 28th March technical tours of major engineering works were arranged for delegates to the Conference. In the morning the Lower Yarra Freeway and works on West Gate Bridge were visited, and in the afternoon works on the Hume Freeway (Wallan to Broadford Section) were inspected.

The Board records its thanks and appreciation to all engineers who contributed to the success of the Conference, particularly those who presented papers or addresses, and to the Lower Yarra Crossing Authority for assistance with the inspection of the West Gate Bridge project.

CONFERENCE OF MINISTERS CONCERNED WITH THE CONSTRUCTION OF HIGHWAYS

The fourth meeting of Ministers Concerned with the Construction of Highways was held in Darwin on 28th October 1972, at the offices of the Commonwealth Department of Works. These meetings serve as a platform for the exchange of information and the discussion of road management problems common to all States.

Victoria was represented at this conference by the Minister for Local Government, the Hon. A. J. Hunt, MLC, who was accompanied by the Board's Chairman, Mr R. E. V. Donaldson.

The agenda covered a wide range of subjects, including Commonwealth Aid Roads funds, road safety, the NAASRA road load economics project, Australian Post Office

services on roads, advertising signs on or in the vicinity of highways, the road implications of the Bland Report, public acceptance of freeways and uniform axle load and vehicle dimension legislation.

AUSTRALIAN ROAD RESEARCH BOARD

The Australian Road Research Board was established by NAASRA in 1960 as the centre for scientific research into roads and road traffic.

It was considered that such a body was needed so that all the information necessary for improvements in road engineering could be assembled or researched more efficiently than through the separate efforts of individual road authorities. From this primary need has grown the two main functions of the ARRB — research, and the dissemination of information.

For the first twelve years ARRB developed its organisation and services from headquarters in the head office buildings of the Country Road Board at Kew.

However, with increasing demands for research and the need to develop additional facilities, ARRB set up its own headquarters and laboratory — the Australian Road Research Centre.

The new centre built on a 17 acre site on Burwood Highway, Vermont, Victoria, was officially opened on 27th November 1972, by His Excellency, the Governor of Victoria, Major-General Sir Rohan Delacombe, KCMG, KCVO, KBE, CB, DSO, K.St.J.

The Board of Directors, consisting of the Heads of the State Road Authorities and the Commonwealth Director-General of Works meets at six-monthly intervals to formulate policy, review the progress of research projects currently being undertaken, consider new research proposals and exercise general control over the Centre's activities through the Director, Mr D. F. Glynn.

The Board is assisted in its primary field, the organising of research projects, by an Advisory Council representative of the fields of road design and engineering, science, medicine, transport planning and the extractive industry. In addition there are specialist committees and panels on which engineers of the State Road Authorities are represented, to direct and control research in specific areas.

The Board holds a major conference every two years, for the presentation and discussion of papers on road research. The Sixth Biennial Conference was held at the Australian National University, Canberra, from 14th to 18th August 1972.

This conference was opened by the then Federal Minister for Shipping and Transport, the Hon. P. J. Nixon, MP, who emphasized the increasing need for road planning in Australia to be carried out on a truly national basis.

The principal speaker at the opening ceremony was Mr E. H. Holmes, former Director of Policy Planning of the United States Federal Highway Administration, whose subject was "Balanced Transportation".

There were 36 technical sessions during the conference at which were presented about 100 papers covering many aspects of road research including bituminous surfacing, skidding and road drainage, properties of materials, traffic engineering, transport planning and road structures.

The Country Roads Board was represented at the Conference by the Chairman, Mr R. E. V. Donaldson. Papers were presented by nine C.R.B. officers, Mr D. P. Bowyer, Mr N. R. Butler, Mr S. C. B. Eriksson, Mr K. D. Freeman, Mr A. T. Fry, Mr R. C. Meggs, Mr M. A. P. Taylor, Mr H. D. Taskis, and Mr R. T. Underwood.

During the year three meetings of ARRB were held at the new Australian Road Research Centre at Vermont. Mr Donaldson attended the 22nd meeting of ARRB on 28th November 1972, and the 23rd meeting on 15th and 16th May 1973 when the Eighth Annual General Meeting of the Board was also held.

MUNICIPAL INSPECTIONS

Since the inception of the Country Roads Board 60 years ago, it has been the practice of the Members of the Board to visit municipalities to inspect roads and bridges throughout the State at regular intervals.

By this means the Members of the Board maintain up-to-date knowledge of road conditions and developments in all parts of the State and continue a personal relationship with municipal councillors and officers which has existed since the Board's formation. Discussions with municipal councillors during these official visits provide a valuable source of information on local problems and requirements.

During the year Members of the Board visited thirty-one municipalities in various parts of the State: the Cities of Ballarat, Coburg, Frankston, Heidelberg, Melbourne, Northcote, Preston and Port Melbourne; the Town of St Arnaud; the Boroughs of Kerang and Sebastopol; and the Shires of Avon, Bairnsdale, Ballarat, Bright, Bungaree, Cranbourne, Creswick, Diamond Valley, Dimboola, Dunmunkle, Hastings, Kara Kara, Kerang, Korong, Myrtleford, Otway, Ripon, South Gippsland, Talbot and Clunes, and Yea.

The many municipal Councillors and Council officers concerned readily extended their co-operation and hospitality. The Board is again pleased to place on record its appreciation for the assistance given in this important part of the Board's work.

DEPUTATIONS

During the year the Board received thirty-two deputations, twenty-three from municipal councils, and nine representing associations or local organizations. The submissions ranged from the provision of additional roads in the Big Desert to increasing the present programme of snow clearing in the alpine areas. Varying local problems were raised, nearly all with a common theme — the allocation of additional funds. It has been stated elsewhere that increases in the Board's revenue have not kept pace with rising costs and the Board regrets that it was unable to provide financial assistance during the year on the scale requested. However, the discussions and the submissions presented are a valuable source of information for future planning.

NATIONAL ASSOCIATION OF AUSTRALIAN STATE ROAD AUTHORITIES

The National Association of Australian State Road Authorities originated from the Conference of State Transport Ministers held in 1933, when it was decided that the road authorities from all States should meet at regular intervals.

NAASRA meetings held at six-monthly intervals in each State capital in turn, are generally attended by the heads of the State Road Authorities and the Director-General of the Commonwealth Department of Works.

Representatives of the Commonwealth Department of Transport are invited to attend for discussions on certain items.

The objects of the Association are to promote uniformity of policy and practice between the member organisations, to exchange information on all aspects of road and bridge construction and usage, and on planning and administration.

The detailed technical work of the Association is carried out by a series of specialist committees, who report to the Principal Technical Committee, comprising the Chief Engineers of the member organisations. Recommendations from the PTC are then considered by NAASRA at its regular bi-annual meetings.

The Annual Meeting (48th Meeting of NAASRA) was held at the offices of the Commonwealth Department of Works in Darwin, from 25th to 27th October, 1972.

The Board was represented by Mr R. E. V. Donaldson, Chairman. The other members attending were the Association's Chairman, Mr A. S. Reiher, Director-General, Commonwealth Department of Works; Mr R. J. S. Thomas, Commissioner for Main Roads, New South Wales; Mr A. K. Johinke, Commissioner of Highways, South Australia; Mr D. H. Aitken, Commissioner of Main Roads, Western Australia; Mr H. A. Lowe, Commissioner of Main Roads, Queensland; and Mr B. J. Donnelly, Director of Public Works, Tasmania.

Among the items considered were the planning, design and construction of urban freeways, freeway lighting, vehicle dimensions, road load economics, metric conversion, national review of the road accident situation, NAASRA and ARRB research projects, the Australian Roads Survey and revision of the Manual of Uniform Traffic Control Devices. The 49th (Intermediate) Meeting of the Association was held at the Australian Road Research Centre, Vermont, Victoria, on 17th May, 1973. Both the Chairman, Mr R. E. V. Donaldson, and the Deputy Chairman, Mr J. D. Thorpe, attended this meeting.

Many of the items on the agenda for this meeting were in continuation of subjects discussed or projects put in hand at the Annual Meeting. Additional items included representation at the 7th IRF World Meeting, Munich, training of African and Asian Engineers, engagement of consultants for road design, inter-regional group of National routes, and community and environmental problems associated with urban highway proposals.

During the year preparations were in progress for NAASRA to undertake an extensive national investigation into the economics of road vehicle limits. A Steering Committee was appointed to guide the study, the Convenor of the Steering Committee being Mr T. H. Russell, Member, Country Roads Board, Victoria. The formation of a study team to carry out the study is in hand, Mr A. T. Fry of the Board's staff having been appointed Study Team Leader.

CO-OPERATION WITH CITIZEN MILITARY FORCES

The Board continued its sponsorship of units of 22 Construction Regiment Royal Australian Engineers. These units are the Regimental Headquarters, 104 Construction Squadron, and 107 Plant Squadron. The Commanding Officer of the Regiment is Lt Col G. W. Marshallsea, ED, the Board's Divisional Engineer, Geelong.

The 1972 camp was held at Puckapunyal, where training was given in weapons, battlecraft, range shooting, water supply, and demolition. There are approximately 230 members of the Board's staff and employees in 22 Construction Regiment, of which 160 attended the camp.

PERSONNEL

The Board's employment strength as at 30th June, 1973, was as follows:

Salaried Staff

Professional Engineers	452
Professional Scientists	30
Professional Surveyors	24
Technical Staff (Male)	459
Technical Staff (Female)	17
Administrative Staff (Male — qualified)	64
Administrative Staff (Male — non-qualified)	328
Administrative Staff (Female)	229
Cadets	38
National Service Trainees	2
Technical Teacher Trainee	1
TOTAL	1,644

Supervisory Personnel and Employees

	*Field	Depot
Supervisory	297	61
Road Construction and Maintenance	1,643	—
Bridge Construction and Maintenance	174	99
Depot and Workshop	—	410
Transport	226	31
Personnel of miscellaneous classifications	—	159
TOTALS	2,340	760

*These figures do not include employees of contractors or municipal councils engaged on work financed by the Board.

As at 30th June, 1973, the Board was employing 81 personnel under the Government's scheme for providing rural unemployment relief work.

Recruitment

During the year, 160 new officers were recruited to the Board's salaried staff and 148 officers left the Board due to retirement or resignation.

The general economic situation during the year resulted in many applications being received in response to the Board's advertisements for staff. The recruitment of licensed surveyors and experienced draftsmen continued to be difficult.

High schools, technical schools, universities and colleges of advanced education were again visited by officers of the Personnel Section as part of the Board's recruiting activities. The practice of attending careers nights throughout the State was also continued.

Cadetships

The Board's cadetship scheme provides for the payment of all fees, a book allowance and a living allowance.

Nine Civil Engineering cadetships to commence in the 1973 academic year were awarded by the Board for study at either the University of Melbourne or Monash University.

The following table shows the total number of cadets in training for the various courses during the 1973 academic year:

Course	Year of Training 1st	2nd	3rd	4th	Total
Civil Engineering	4	9	11	7	31
Mechanical Engineering	—	1	—	1	2
Surveying	—	1	—	1	2
Science	—	1	—	2	3
	4	12	11	11	38

Apprentices

The Board indentured 9 apprentices in 1973 for training in the trades of Motor Mechanics, Carpentry and Joinery and Structural Steel (Fabrication).

As at 30th June 1973 the numbers of apprentices in training were —

Trade	Apprentices
Carpentry and Joinery	5
Electrical Mechanics	1
Fitting and Turning	1
Lithographic Printing	1
Motor Mechanics	49
Painting and Decorating	2
Plumbing and Gas Fitting	1
Structural Steel (Fabrication)	4
	64

Retirements

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

	Classification on Retirement	Years of Service
Salaried Staff		
Ashcroft, T.	Assistant Mechanical Engineer	20
Deany, S. B.	Asphalt Engineer	48
Fox, F. J.	Divisional Engineer's Clerk	38
Ryan, T. J.	Administrative Officer	22
Strover (Miss) N. C. I.	Secretarial Assistant (Archives)	43
White, R. A.	Senior Draftsman	23
Whitehead, R. V.	Administrative Officer	35
Supervisory Personnel and Employees		
Bourke, B. E.	Truck Driver	20
Cairns, G. S.	Foreman	27
Chiller, J. A. J.	Patrolman	37
Clarke, J. M.	Fitter	35
Cutting, F. E.	Overseer	21
Felmingham, V. R. S.	Patrolman	25
Hanley, M. J.	Overseer	22
Jackman, G. R.	Patrolman	20
James, E.	Clerk of Works	27
Jorgensen, E.	Truck Driver	37
McEvoy, M. J.	Patrol Assistant	32
McInnes, J. A.	Clerk of Works	37
McLaren, T. I.	Truck Driver	37
Marshall, G. E.	Truck Driver	26
Milanovic, M.	Patrol Assistant	22
Richardson, S.	Senior Storeman	30
Roussac, E. V.	Truck Driver	20
Turner, R. I.	Builders' Labourer	25
Wall, W. J.	Skilled Builders' Labourer	22

Industrial Relations

The Board was confronted during the year with many claims from various unions and staff associations for wage and salary increases and conditions improvements. The fact

that wages and salaries continue to increase so substantially and at such frequent intervals is a matter of great concern to the Board as it is for any large employer.

During the year three separate wage increases were granted to employees engaged on road and bridge construction and maintenance and in workshops and depots. The first increase occurred as the result of improvements in the State Incremental Payments Scheme, the second through variations in most awards following agreements reached in the metal trades area and the third arose from the National Wage Case 1973.

Staff covered by the Municipal Officers' Association of Australia (Country Roads Board, Victoria) Agreement, 1968 received salary increases of $6 per week as from 7th January 1973 and $3 per week as from 1st April 1973. Professional engineers received a salary increase of 8% following a similar increase given to professional engineers in the service of the Commonwealth Government.

As the financial year drew to a close four weeks' annual leave was being negotiated into regulations and awards concerning all Board's staff and employees. This arose out of the introduction of four weeks' annual leave into the Australian and Victorian Public Service areas of employment.

Negotiations were concluded in June 1973 for substantial increases in transport workers' rates of pay and discussions were taking place regarding increases for plant operators.

As the result of all the above matters the Board's wages and salaries costs have been increased by approximately $4,000,000 per annum.

Training

Modern management is vitally interested in developing the skills of its people. The need for increased productivity has been stressed by many Australian leaders and the training of the work force is essential in achieving this.

The Board's training programme included courses conducted for engineers, draftsmen and scientists to provide up-to-date information on bituminous surfacing of roads, traffic engineering matters, materials testing and road design.

Administrative staff attended general courses regarding the work and organization of the Board and communication skills.

Some of the more important external courses attended by officers of the Board were:

The Australian Administrative Staff College:

Advanced Course — Mr K. N. Opie (Chief Bridge Engineer), Mr. R. T. Underwood (Assistant Chief Road Design Engineer).

Intermediate Course — Mr D. S. Utting (Assistant Industrial Officer).

University of New South Wales:

The Government Administrative Staff Course—Mr D. G. Proudfoot (Assistant Accountant).

Traffic Planning and Control Course — Mr R. C. Stuart (Engineer), Mr R. F. Gooch (Assistant Divisional Engineer, Warrnambool).

Construction Management Course—Mr J. R. Robinson (Assistant Divisional Engineer, Dandenong).

University of Melbourne:

Summer School of Business Administration — Mr. P. W. Lowe (Assistant Divisional Engineer, Bendigo).

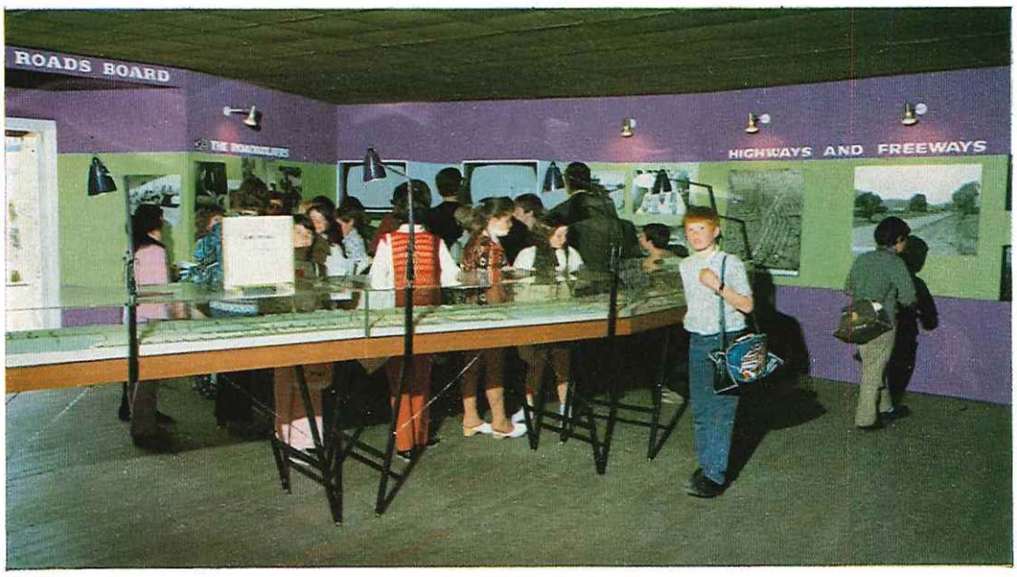
More than 150 officers were granted paid study leave to undertake courses of study at the Universities and Institutes of Technology.

To enable senior officers to discuss some of the future challenges facing the Board, a Senior Management Conference was held at the Australian Administrative Staff College on Thursday evening (24th May), Friday (25th May) and Saturday (26th May) 1973.

FILMS, PHOTOGRAPHY, AND DISPLAYS

Approximately 34,000 photographic prints in black and white or in colour were produced as permanent records of road and bridge works, in the preparation of technical and general interest publications, and for display to the public. Over 11,000 new photographic negatives were developed and added to the Board's negative files. For technical conferences, training courses, and seminars, there were 45 screenings using cine films, slides, overhead projectors or other visual aids.

A fifteen-minute cine film was produced for screening at the Board's 1972 Royal Agricultural Show display. Titled "Into the Seventies", the film described many of the major road and bridge projects undertaken by the Board in recent years. The display was based on the theme that roads are provided by one section of the community, for the benefit and enjoyment of all sections of the community. A popular feature with visitors to the display was a section showing samples of seedling trees and shrubs commonly used by the Board for planting on road reserves.



Part of the CRB stand at the 1972 Royal Agricultural Show.

"Sixty Years of Service" was the title of the Board's stand at the 1973 International Motor Show. Photographs of road construction activities since 1913 were featured in self-illuminated hexagons, and a series of slide projections operated by press button illustrated the contrasts between early and present-day roads. For the second year in succession the Board's stand was awarded first prize in the Special Exhibits section of the stand design competition.

APPENDIX 1

MILEAGES OF STATE HIGHWAYS, FREEWAYS, FOREST ROADS, AND TOURISTS' ROADS

As at 30th June, 1973

STATE HIGHWAYS

NAME	ROUTE	LENGTH (MILES)
BASS	Lang Lang-Inverloch	38.0
BELLARINE	Geelong-Queenscliffe	19.8
BONANG	Orbost-N.S.W. border near Delegate	72.0
BORUNG	Dimboola-Charlton	76.7
BURWOOD	Burwood-Ferntree Gully	12.8
CALDER	Melbourne-Mildura	347.6
CANN VALLEY	Cann River-N.S.W. border	28.9
GLENELG	Ballarat-S.A. border near Mt. Gambier	175.9
GOULBURN VALLEY	Eildon-Strathmerton	139.4
HAMILTON	Geelong-Hamilton	144.3
HENTY	Portland-Lascelles	209.6
HUME	Melbourne-N.S.W. border near Albury	153.2
KIEWA VALLEY	Bandiana-Mt. Beauty	48.9
LODDON VALLEY	Bendigo-Kerang	76.8
MAROONDAH	Melbourne-Mansfield	115.5
McIVOR	Heathcote-Bendigo	27.5
MIDLAND	Geelong-Ballarat-Bendigo-Shepparton-Benalla-Mansfield	259.6
	Morwell-Port Welshpool	51.4
MURRAY VALLEY	Corryong-Hattah	462.5
NEPEAN	Melbourne-Portsea	55.4
NORTHERN	Kilmore-Echuca	88.5
OMEO	Bairnsdale-Tallangatta	177.8
OUYEN	Ouyen-S.A. border near Pinnaroo	80.9
OVENS	Wangaratta-Bright	47.4
PRINCES (EAST)	Melbourne-N.S.W. border near Genoa	306.5
PRINCES (WEST)	Melbourne-S.A. border near Mt. Gambier	262.4
PYRENEES	Elphinstone-Ararat	91.9
SOUTH GIPPSLAND	Dandenong-Yarram-Sale	157.9
STURT	Mildura-S.A. border near Renmark	71.1
SUNRAYSIA	Ballarat-Calder Highway	212.0
WARBURTON	Lilydale-Warburton	22.9
WESTERN	Melbourne-Serviceton	242.1
WIMMERA	Apsley-St. Arnaud	136.8

FREEWAYS

NAME	SECTION	LENGTH (MILES)
CALDER	Keilor	1.0
	Elphinstone	1.7
EUMEMMERRING	Princes Highway to Mulgrave Freeway	0.7
FRANKSTON	Frankston-Cranbourne Road to Klauer Street	2.1
HUME	Craigieburn to Kalkallo	5.2
	Beveridge	2.0
	Broadford to Tallarook	9.4
	Chiltern	13.2
LOWER YARRA	Princes Freeway to west of Williamstown Road	3.4
MULGRAVE	Eumemmerring Freeway to Stud Road	3.0
PRINCES	Moe to Morwell	10.1
	Laverton	8.1
	Maltby (Werribee)	6.3
	Dartmoor	1.9
SOUTH GIPPSLAND	Whitelaw	2.4
TULLAMARINE	Bell Street to Melbourne Airport	7.0
WESTERN	Rockbank	8.7
	Bacchus Marsh	5.2
	Pykes Creek	3.6
	Gordon	5.4

TOURISTS' ROADS

NAME	MUNICIPALITIES	LENGTH (MILES)
ACHERON WAY	Healesville and Upper Yarra Shires	22.5
ALPINE	Bright and Omeo Shires	52.0
ARTHUR'S SEAT	Flinders Shire	5.4
BOGONG HIGH PLAINS	Bright and Omeo Shires	41.7
CAMERON DRIVE	Gisborne and Newham and Woodend Shires	2.7
DONNA BUANG	Healesville and Upper Yarra Shires	21.8
GIPSY POINT	Orbost Shire	1.5
GRAMPIANS	Ararat, Dundas, and Stawell Shires and Stawell Town	43.2
GREAT OCEAN ROAD	Barrabool, Winchelsea, Otway, Heytesbury and Warrnambool Shires	132.2
MALLACOOTA	Orbost Shire	15.0
MOUNT ABRUPT	Ararat and Mount Rouse Shires	15.4
MOUNT BUFFALO	Bright Shire	25.0
MOUNT BULLER	Mansfield Shire	15.7
MOUNT DANDENONG	Sherbrook and Lillydale Shires	13.7
MOUNT VICTORY	Arapiles, Stawell and Wimmera Shires	19.1
MARYSVILLE-WOODS POINT	Healesville Shire	9.2
OTWAY LIGHTHOUSE	Otway Shire	8.0
PHILLIP ISLAND	Bass and Phillip Island Shires	15.1
SILVERBAND	Stawell Shire	5.7
SYDENHAM INLET	Orbost Shire	14.0
WARTOOK	Wimmera Shire	2.2
WILSON'S PROMONTORY	South Gippsland Shire	19.3

FOREST ROADS

NAME	MUNICIPALITIES	LENGTH (MILES)
BAIRNSDALE-DARGO	Avon and Bairnsdale Shires	12.9
BEALIBA-MOLIAGUL	Bet Bet Shire	5.6
BEECH FOREST-MT. SABINE	Otway Shire	7.8
BENAMBRA-CORRYONG	Omeo, Towong, and Upper Murray Shires	47.7
BENAMBRA-LIMESTONE	Omeo Shire	8.9
BENDOC-ORBOST	Orbost Shire	13.0
BROOKVILLE	Omeo Shire	9.9
BRUTHEN-BUCHAN	Tambo Shire	22.7
BUCHAN-ENSAY	Tambo Shire	12.3
BULLUMWAAL-TABBERABBERA	Bairnsdale Shire	18.8
CARRAJUNG-WOODSIDE	Alberton Shire	11.0
DARGO	Avon Shire	46.5
DEAN MARSH-LORNE	Winchelsea Shire	14.9
DRUMMOND-VAUGHAN	Daylesford and Glenlyon and Newstead Shires	13.0
EPSOM-FOSTERVILLE	Huntly Shire	13.2
FORREST-APOLLO BAY	Otway Shire	13.9
GREENDALE-TRENTHAM	Ballan and Kyneton Shires	14.8
HEYFIELD-JAMIESON	Mansfield and Maffra Shires	90.6
INGLEWOOD-RHEOLA	Korong Shire	10.8
KIMBOLTON	Strathfieldsaye Shire	8.4
LAVERS HILL-COBDEN	Heytesbury and Otway Shires	29.2
MEREDITH-STEIGLITZ-MAUDE	Bannockburn Shire	12.9
MURRUNGOWER	Orbost Shire	13.2
PORTLAND-NELSON	Portland Shire	24.0
RED KNOB	Tambo Shire	4.2
TATONG-TOLMIE	Benalla Shire	22.7
WALHALLA	Narracan, Mansfield and Upper Yarra Shires	68.8
WARBURTON-WOODS POINT	Healesville, Upper Yarra and Mansfield Shires	64.7
WARROWITUE	McIvor Shire	10.2

APPENDIX 2

STATE HIGHWAYS AND FREEWAYS

Significant Works Completed During Financial Year 1972/73

BELLARINE HIGHWAY

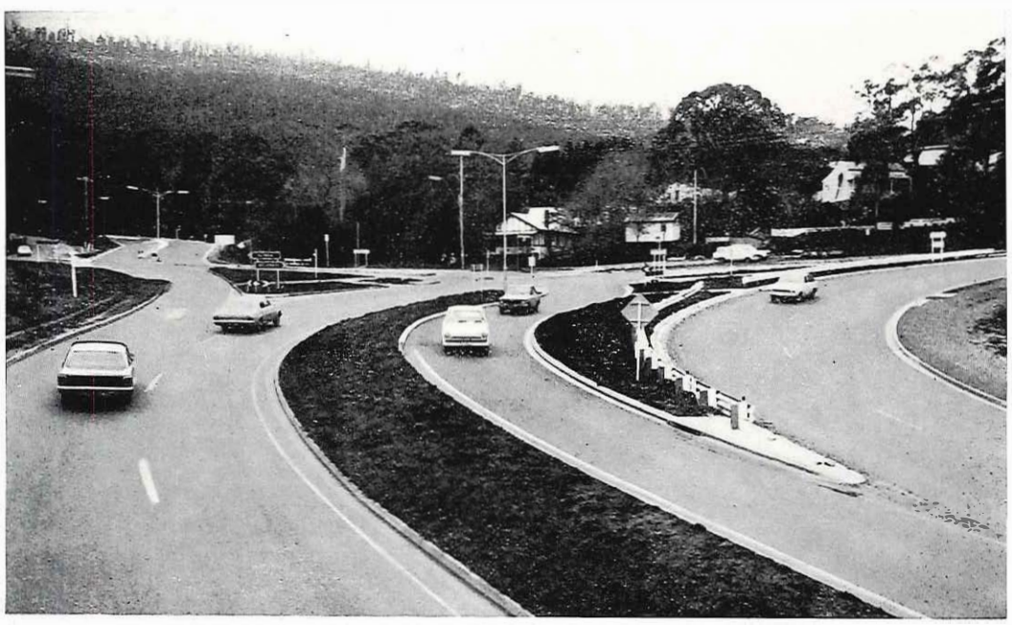
BELLARINE SHIRE	Construction of 1.0 mile from Twitt's Road to west of Whitehorse Road, to provide dual carriageways, 24 feet wide.

BONANG HIGHWAY

ORBOST SHIRE	Reconstruction and sealing of 1.0 mile, north of Orbost between Wild Cow Creek and Wallaby Creek to provide a pavement 24 feet wide.

BURWOOD HIGHWAY

KNOX CITY	Construction of 1.0 mile between Austin Street and Acacia Road, to provide dual carriageways each 36 feet wide.
SHERBROOKE SHIRE	Intersection treatment at the Burwood Highway/Mount Dandenong Tourists' Road/Monbulk Road intersection.



Intersection of the Burwood Highway, the Mount Dandenong Tourists' Road, and Monbulk Road.

FRANKSTON FREEWAY

FRANKSTON CITY	Construction of 1.4 miles between Armstrongs Road and Klauer Street to provide dual carriageways each 24 feet wide.

GLENELG HIGHWAY

ARARAT AND RIPON SHIRES	Construction of a reinforced concrete bridge 142 feet long 28 feet between kerbs over the Fiery Creek at Streatham, and construction of 0.7 mile of approaches to provide a sealed pavement 24 feet wide.

Glenelg Highway — new bridge over Fiery Creek at Streatham.

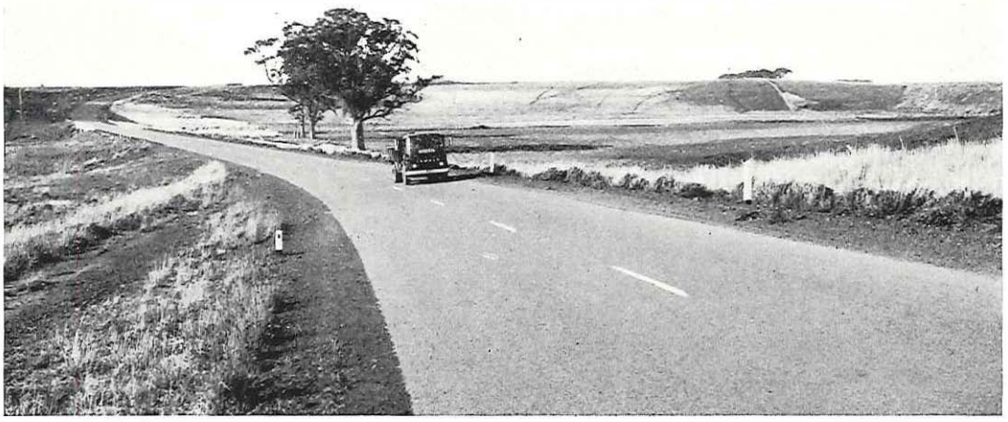
GOULBURN VALLEY HIGHWAY

YEA SHIRE	Reconstruction on a new alignment of 1.1 miles from the Goulburn River to Home Creek, and construction of 0.5 mile of pavement on the existing formation, west of Molesworth, to provide a sealed pavement 24 feet wide.

Reconstruction of the Goulburn Valley Highway on a new alignment near Molesworth.

HAMILTON HIGHWAY

HAMPDEN SHIRE	Reconstruction of 3.4 miles east of Duverney to provide a sealed pavement 24 feet wide.
LEIGH SHIRE	Construction of 3.5 miles to provide a sealed pavement 24 feet wide.



Hamilton Highway — reconstructed section east of Duverney.

HENTY HIGHWAY

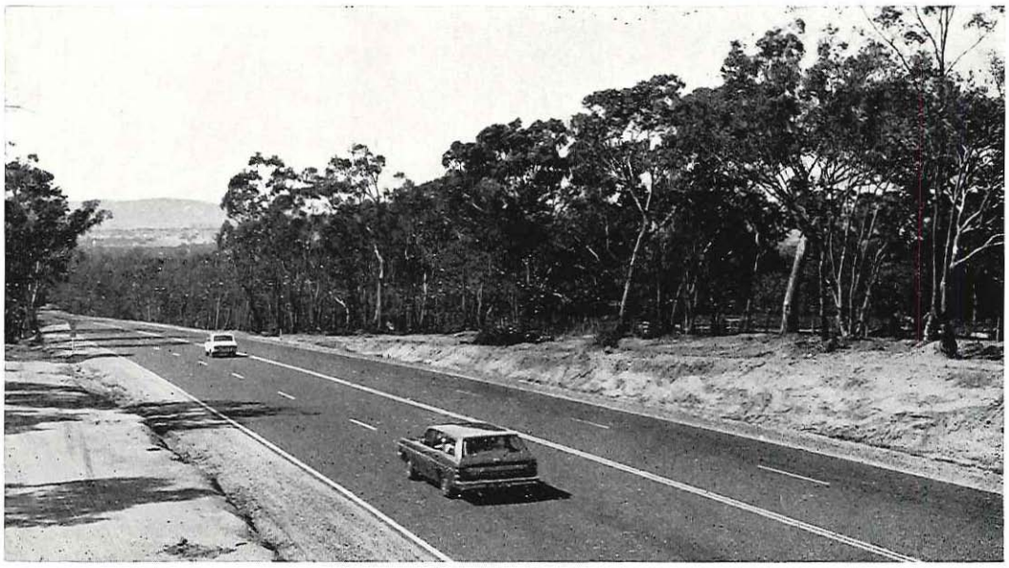
KARKAROOC AND WARRACKNABEAL SHIRES	Reconstruction of 1.9 miles south of Beulah, to provide a sealed pavement 24 feet wide.

HUME HIGHWAY

GOULBURN SHIRE	Construction of 1.5 miles at Teneriffe Hill, to provide a 12 feet wide climbing lane for use by slow moving vehicles.

Climbing lane constructed on the Hume Highway at Teneriffe Hill.

GOULBURN AND EUROA SHIRES	Construction of 0.4 mile to provide a 12 feet wide climbing lane for use by slow traffic moving north at Tubbs Hill, and construction of 0.7 miles of climbing lane south at Tubbs Hill.

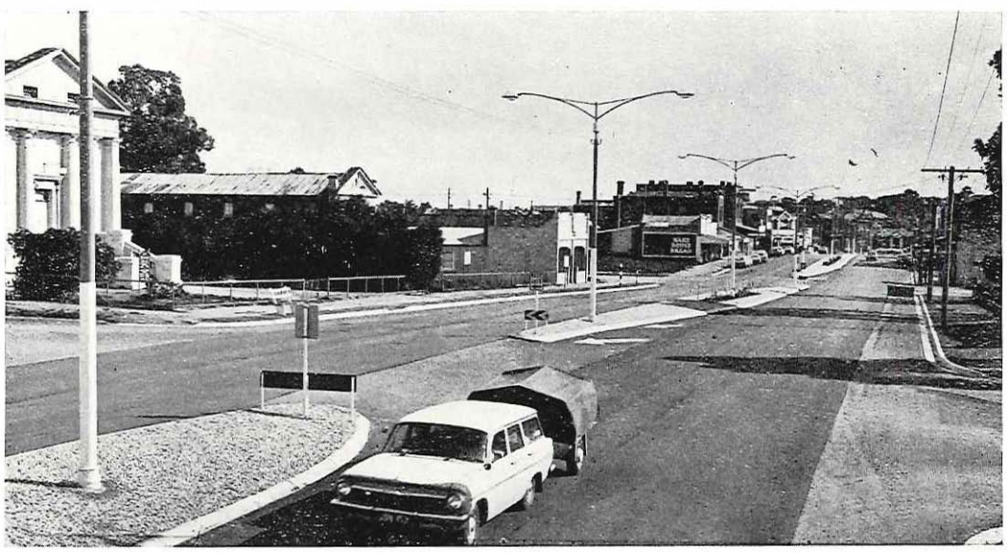


Additional lanes constructed on the Hume Highway at Tubbs Hill.

WODONGA CITY	Construction of 0.2 mile of central median in High Street, between Elgin Street and South Street, with installation of traffic lights at Elgin/High Street intersection, and widening of High Street to provide turning lanes at street intersections.

LODDON VALLEY HIGHWAY

BENDIGO SHIRE AND EAGLEHAWK BOROUGH	Removal of sections of tram-tracks totalling 1.8 miles at Bendigo City and restoration of the pavement to provide a sealed carriageway 48 feet wide.
EAGLEHAWK BOROUGH	Removal of tram-tracks over 0.4 mile at Eaglehawk and construction of dual carriageways, each 30 feet wide.



Dual carriageways constructed on the Loddon Valley Highway, Eaglehawk.

GORDON SHIRE — Reconstruction and widening of 3.6 miles at Durham Ox, to provide a sealed pavement 24 feet wide.

Reconstructed section of the Loddon Valley Highway at Durham Ox.

MAROONDAH HIGHWAY

MANSFIELD SHIRE — Reconstruction and realignment of 1.5 miles of approaches to the railway level crossing at Brankeet to provide a sealed pavement 24 feet wide.

MIDLAND HIGHWAY

CRESWICK SHIRE — Construction of a reinforced box culvert over the Creswick Creek at Creswick, with construction of 0.2 mile of approaches, to provide a sealed pavement 24 feet wide.

SHEPPARTON CITY — Construction of 0.4 mile to provide dual carriageways each 30 feet wide on the approaches to the railway level crossing in High Street, Shepparton.

MURRAY VALLEY HIGHWAY

COHUNA AND KERANG SHIRES — Reconstruction of 4.2 miles west of Cohuna to provide a sealed pavement 24 feet wide.

NUMURKAH SHIRE — Reconstruction of 2.6 miles east of Strathmerton to provide a sealed pavement 24 feet wide.

WODONGA SHIRE — Construction of 0.6 mile at Bandiana, to provide dual carriageways each 24 feet wide linking with the Kiewa Valley Highway. The work included widening the railway level crossing.

NEPEAN HIGHWAY

FRANKSTON CITY — Reconstruction of 2.9 miles to provide four through lanes and a parking lane on the western side from Keast Park to Mile Bridge, Frankston.

The Nepean Highway north of Mile Bridge, Frankston.

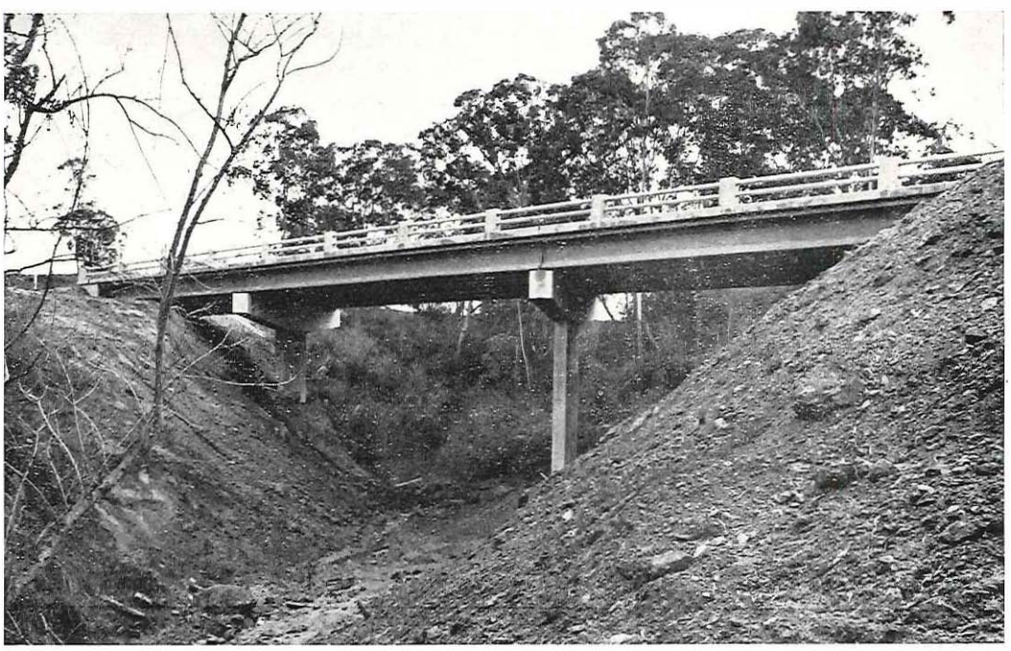
NORTHERN HIGHWAY

ROCHESTER SHIRE — Reconstruction of 4.0 miles south of the Township of Rochester to provide a sealed pavement 24 feet wide.

OMEO HIGHWAY

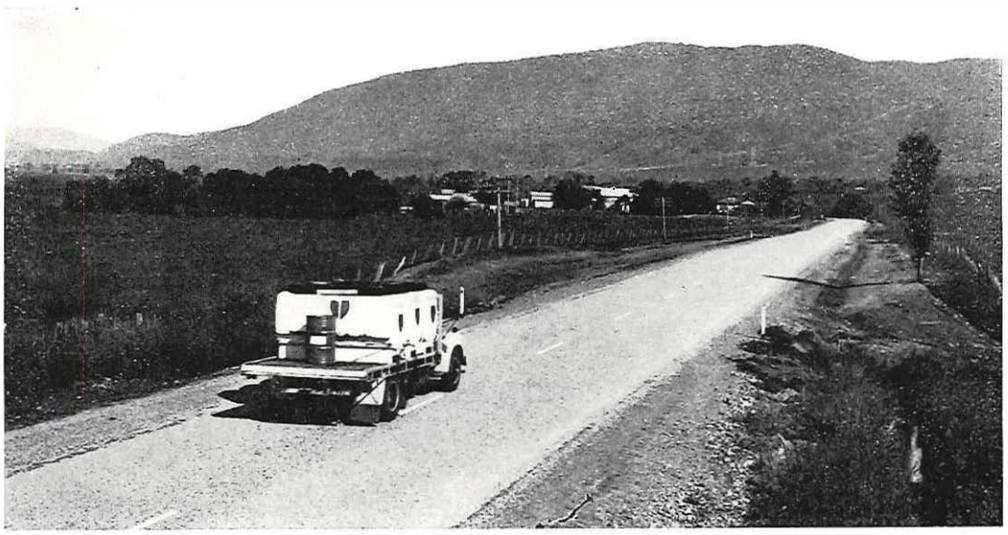
OMEO SHIRE — Construction of a box culvert at Cemetery Creek, and construction of 0.7 mile of approaches.

TAMBO SHIRE — Construction of a reinforced concrete bridge 98 feet long, 20 feet between kerbs over Ramrod Creek, with construction of 0.9 mile of approaches.



Ramrod Creek bridge on the Omeo Highway.

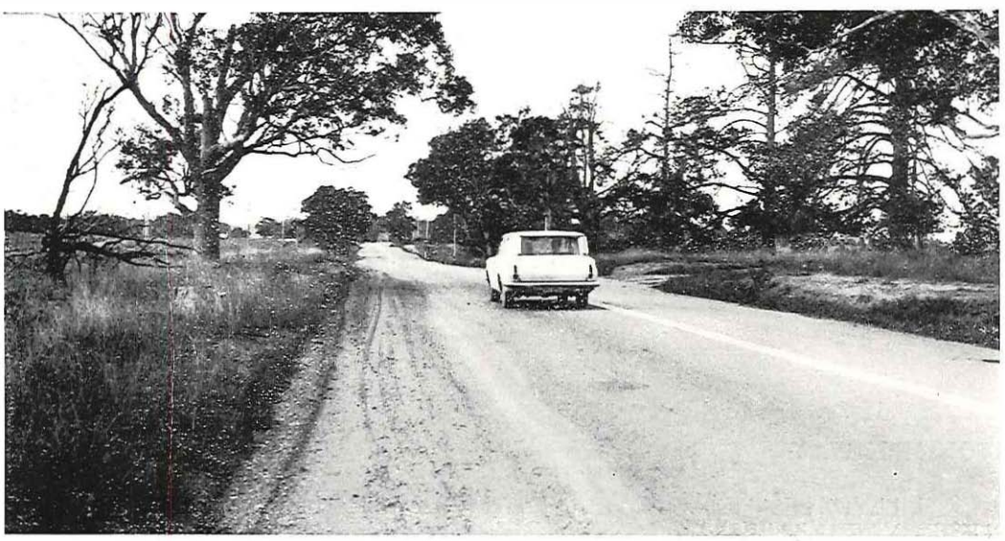
TOWONG SHIRE	Construction and resheeting of 2.4 miles to widen the seal from 12 feet to 24 feet. A precast reinforced concrete culvert 34 feet between kerbs was constructed, replacing a wooden bridge over Fernvale Creek.



Reconstructed section of the Omeo Highway at Noorongong.

PRINCES HIGHWAY EAST

ORBOST SHIRE	Reconstruction of 1.7 miles, east of Wingan Creek, to provide a sealed pavement 24 feet wide.
ROSEDALE SHIRE	Reconstruction and widening of 0.8 mile near Flynn, to provide a sealed pavement 24 feet wide.
SPRINGVALE CITY	Construction of kerbs and channels between Police Road and the Sandown overpass.
TAMBO SHIRE	Reconstruction of 1.0 mile east of Nicholson River, to provide a sealed pavement 24 feet wide.



Reconstructed section of the Princes Highway east of Nicholson River.

TRARALGON CITY	Construction of 0.8 mile to provide dual carriageways each 32 feet wide on the western approach to Traralgon City.
TRARALGON SHIRE	Reconstruction of 1.6 miles to provide a sealed pavement 24 feet wide.

PRINCES HIGHWAY WEST

BARRABOOL SHIRE	Completion of intersection treatment with Anglesea Road, including realignment, channelization and the provision of dual carriageways each 32 feet wide.
BELFAST SHIRE	Construction of a reinforced concrete bridge over the Eumeralla River, 4 miles west of Codrington, and 0.5 mile of approaches.
COLAC SHIRE	Resheeting, with associated crest visibility improvement, of 1.7 miles east of Warncoort to provide a sealed pavement 24 feet wide.
CORIO SHIRE AND GEELONG CITY	Construction of 0.8 mile to provide dual carriageways each 44 feet wide between MacKay Street and Bell Parade, Geelong.
HAMPDEN SHIRE	Reconstruction of 0.4 mile of the northern carriageway through Terang between Escort Street and Lyon Street.
WARRNAMBOOL SHIRE	Construction of 4.0 miles to provide dual carriageways each 24 feet wide between Allansford and East Warrnambool.

PYRENEES HIGHWAY

TULLAROOP SHIRE	Reconstruction of 2.1 miles between Carisbrook and Maryborough to provide a sealed pavement 24 feet wide.

SOUTH GIPPSLAND HIGHWAY

ALBERTON SHIRE	Reconstruction and raising of 0.7 mile subject to flooding at Gelliondale, providing a sealed pavement 24 feet wide.

SUNRAYSIA HIGHWAY

BIRCHIP SHIRE	Resheeting and widening 2.4 miles west of Birchip to provide a sealed pavement 24 feet wide.

WARBURTON HIGHWAY

LILLYDALE AND UPPER YARRA SHIRES	Construction of 3.2 miles between Seville East and Woori Yallock to provide a sealed pavement 24 feet wide.

WESTERN HIGHWAY

DIMBOOLA SHIRE	Reconstruction of a total length of 6.1 miles adjacent to the Wimmera River at Lochiel bridge to provide a sealed pavement 24 feet wide.
SUNSHINE CITY	Resheeting and widening 0.4 mile, and the reconstruction of the Churchill Avenue intersection.

WIMMERA HIGHWAY

KARA KARA SHIRE	Construction of a reinforced concrete bridge (Boyles Bridge) 90 feet long, 28 feet between kerbs, over the Avon River east of Marnoo. Construction of approaches to lift the road above flood level, and resheeting and widening 6.1 miles of adjacent sections to provide a sealed pavement 24 feet wide.

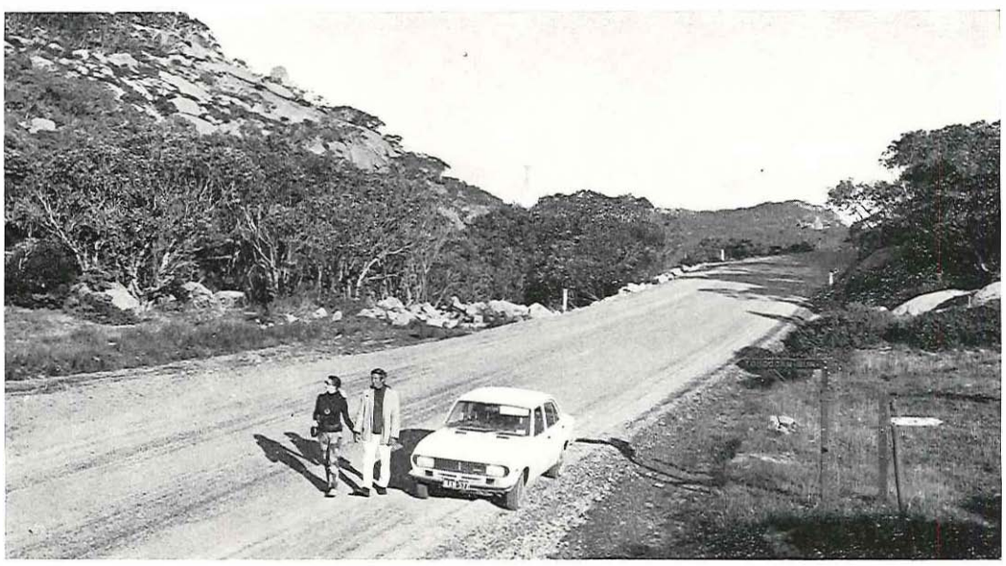
APPENDIX 3

TOURISTS' ROADS AND FOREST ROADS

Significant Works Completed During Financial Year 1972/1973

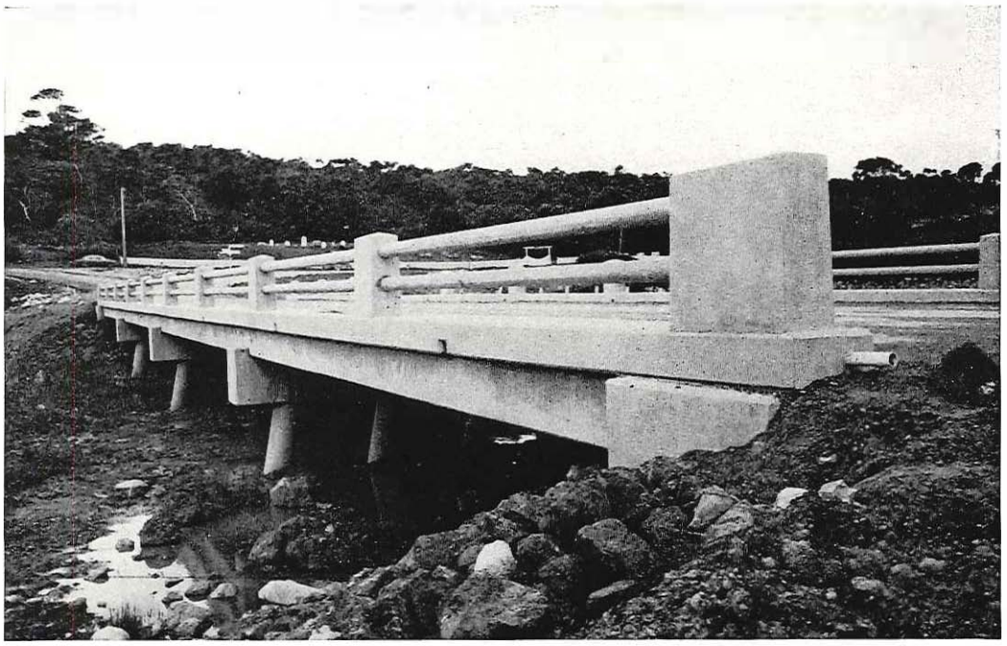
TOURISTS' ROADS

BOGONG HIGH PLAINS ROAD	Reconstruction of 1.1 miles to provide a sealed pavement 24 feet wide. This work completes the sealing between Howmans Gap and the Falls Creek Alpine Village.
MOUNT BUFFALO ROAD	Widening and reconstruction of 0.5 mile from the Cathedral to provide a sealed pavement 24 feet wide.



Reconstructed section of Mount Buffalo Road.

MOUNT VICTORY ROAD	Reconstruction and realignment of 1.5 miles to provide a sealed pavement 22 feet wide, completing the sealing between Halls Gap and the Wonderland turn-off.
GREAT OCEAN ROAD	Construction of a reinforced concrete bridge 40 feet long, 24 feet between kerbs over Port Campbell Creek. Reconstruction and realignment of 1.1 miles north and 1.0 mile south of Lavers Hill to provide a sealed pavement 24 feet wide. Reconstruction of 0.8 mile at Airey's Inlet to provide a sealed pavement 24 feet wide. Widening of Spring Creek Bridge and reconstruction of 1.1 miles of approaches at Torquay.



New bridge over Port Campbell Creek on the Great Ocean Road.

WONDERLAND ROAD	Reconstruction and sealing of 0.8 mile from the Mount Victory Tourists' Road to the turntable to provide a sealed pavement 18 feet wide.

FOREST ROADS

WALHALLA FOREST ROAD	Reconstruction of 1.0 mile north of Erica to provide a sealed pavement 20 feet wide.
WARBURTON-WOODS POINT ROAD	Reconstruction and realignment of 0.5 mile in the vicinity of Fehrings Clearing Camp to provide a pavement 21 feet wide.

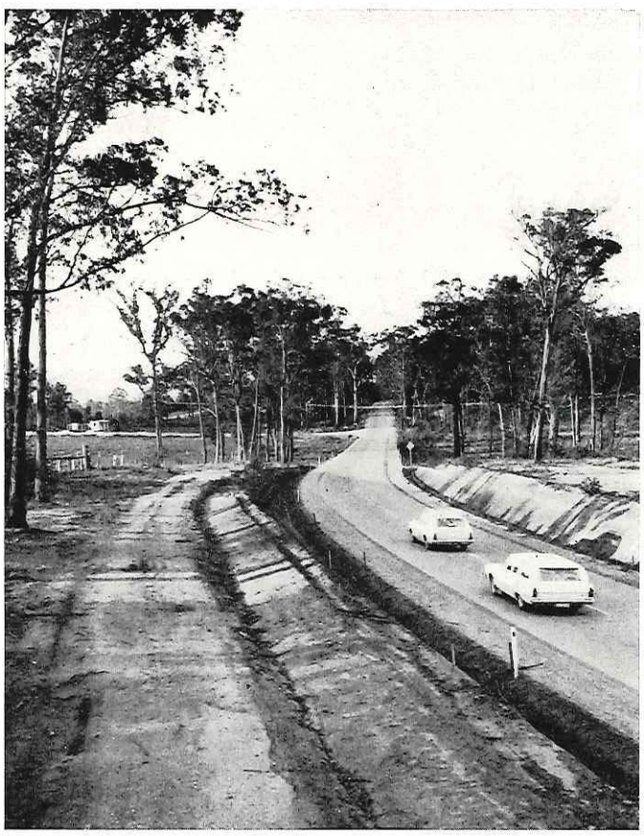
APPENDIX 4

MAIN ROADS

Significant Works Completed During Financial Year 1972/73

BAIRNSDALE DIVISION

TAMBO SHIRE	Bruthen-Buchan Road — Reconstruction and realignment of 1.0 mile with associated improvement of Buchan South Road intersection; and construction of 0.8 mile between Canni Creek and Ti Tree Creek, to improve vertical and horizontal alignment.



Reconstructed section of the Bruthen-Buchan Road, Tambo Shire.

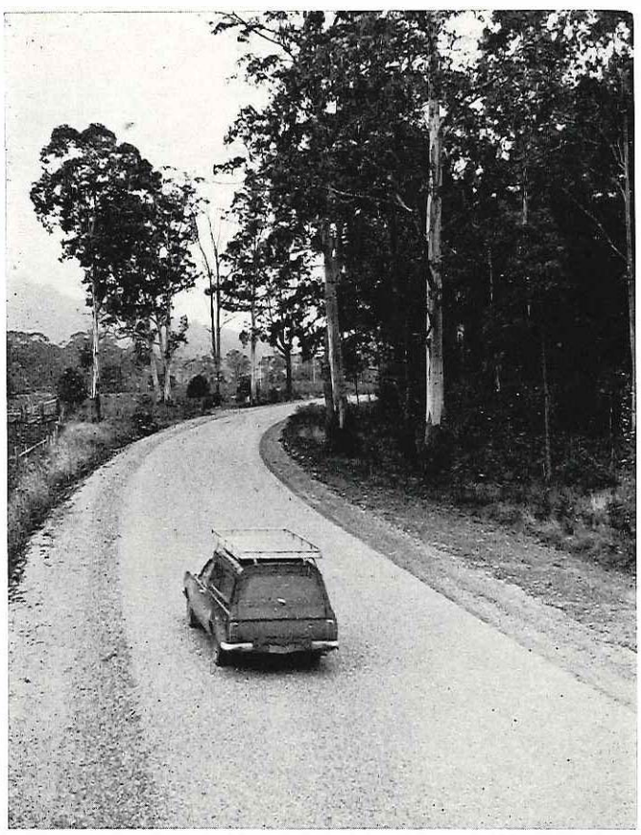
BALLARAT DIVISION

ARARAT SHIRE	Ararat-Warrnambool Road — Reconstruction of 1.3 miles south of Ararat to provide a climbing lane and a sealed pavement 24 feet wide.

CRESWICK SHIRE	Castlemaine-Ballarat Road—Reconstruction of 1.0 mile north of Smeaton to provide a sealed pavement 22 feet wide.
DAYLESFORD AND GLENLYON SHIRE	Malmsbury-Daylesford Road — Widening and regrading of 1.4 miles between Denver and Drummond to provide a sealed pavement 20 feet wide.
GRENVILLE SHIRE	Lismore-Pittong Road — Reconstruction of 1.4 miles in the township of Pittong to provide a sealed pavement 22 feet wide.
ROMSEY SHIRE	Lancefield-Tooborac Road — Construction of a reinforced concrete bridge, 140 feet long, 28 feet between kerbs over Deep Creek north of Lancefield and construction of 0.3 mile of approaches.

BENALLA DIVISION

ALEXANDRA SHIRE	Buxton-Marysville Road — Reconstruction and sealing of 0.8 mile to provide a sealed pavement 22 feet wide.



Reconstructed section of the Buxton-Marysville Road, Alexandra Shire.

BEECHWORTH SHIRE	Beechworth Road — Reconstruction and sealing of sections totalling 1.5 miles to provide a sealed pavement 18 feet wide.
BENALLA SHIRE	Benalla-Tatong Road — Redecking of timber bridge over Hollands Creek at Benalla with a 160 feet long reinforced concrete deck. Benalla-Tocumwal Road — Reconstruction and sealing of 2.2 miles north from the Goorambat turn-off to provide a sealed pavement 22 feet wide.
COBRAM SHIRE	Benalla-Tocumwal Road—Construction and resheeting of 0.8 mile north of the Murray Valley Highway to provide a sealed pavement 24 feet wide.

MANSFIELD SHIRE	Mansfield Road — Reconstruction and realignment of 0.8 mile east of Mansfield, to provide a sealed pavement 24 feet wide. Mansfield-Woods Point Road — Widening of parts of a 3.8 mile section between Kevington and Woods Point, increasing the width of the road formation from 12 feet to 24 feet.
TOWONG SHIRE	Tallangatta Creek Road — Reconstruction and sealing of 2.8 miles near Cravensville to provide a sealed pavement 22 feet wide. Yabba Road — Reconstruction and realignment of 1.1 miles near Tallandoon North to provide a sealed pavement 18 feet wide, and widening a 14 feet reinforced concrete box culvert to 18 feet.
UPPER MURRAY SHIRE	Cudgewa-Tintaldra Road—Reconstruction and realignment of 1.1 miles west of Cudgewa to provide a sealed pavement 20 feet wide, and installation of flashing lights at the railway crossing.
WANGARATTA SHIRE	Rutherglen Road—Construction of 0.8 mile at Rutherglen to provide a sealed pavement 22 feet wide, and construction of a twin reinforced concrete box culvert.
YACKANDANDAH SHIRE	Gundowring Road — Reconstruction of 0.7 mile to provide intersection treatment with Sandy Creek Road and the Kiewa East Road. Reconstruction and realignment of sections totalling 2.9 miles to provide a sealed pavement 20 feet wide.
YEA SHIRE	Whittlesea-Yea Road — Reconstruction and realignment of 1.7 miles south of Flowerdale to provide a sealed pavement 18 feet wide.

BENDIGO DIVISION

CHARLTON SHIRE	St. Arnaud-Wycheproof Road — Reconstruction of 2.0 miles north of St. Arnaud, to provide a sealed pavement 20 feet wide.
DEAKIN SHIRE	Rushworth-Girgarre Road—Reconstruction of 2.5 miles south of Girgarre, to provide a sealed pavement 24 feet wide.
GORDON SHIRE	Boort-Kerang Road — Reconstruction of 2.4 miles at Leaghur to provide a sealed pavement 22 feet wide.
KORONG SHIRE	Wedderburn-Boort Road—Reconstruction of 2.2 miles south of Borung to provide a sealed pavement 22 feet wide.
METCALFE SHIRE	Bendigo-Sutton Grange Road — Reconstruction of 2.1 miles at Elphinstone to provide a 22 feet wide sealed pavement.
ROCHESTER SHIRE	Echuca-Mitiamo Road — Reconstruction of 1.3 miles at Bamawm North to provide a sealed pavement 22 feet wide. Echuca-Serpentine Road — Reconstruction of 2.5 miles at Roslynmead to provide a 20 feet wide sealed pavement.

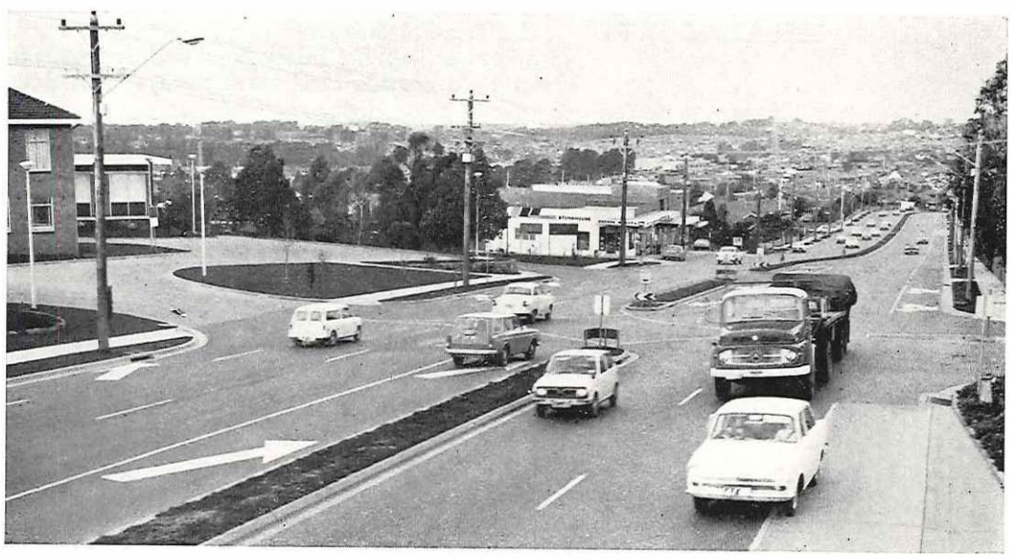
RODNEY SHIRE	Lancaster-Mooroopna Road — Reconstruction of 1.2 miles east of Lancaster to provide a sealed pavement 24 feet wide.
SWAN HILL SHIRE	Ouyen-Piangil Road — Reconstruction of 3.3 miles at Piangil to provide a sealed pavement 20 feet wide.

DANDENONG DIVISION

BASS SHIRE	Dalyston-Glen Forbes Road — Construction of a pre-stressed concrete bridge 50 feet long, over the Bass River.
BERWICK SHIRE	Beaconsfield-Emerald Road — Reconstruction of sections totalling 5.8 miles to provide a sealed pavement 22 feet wide.

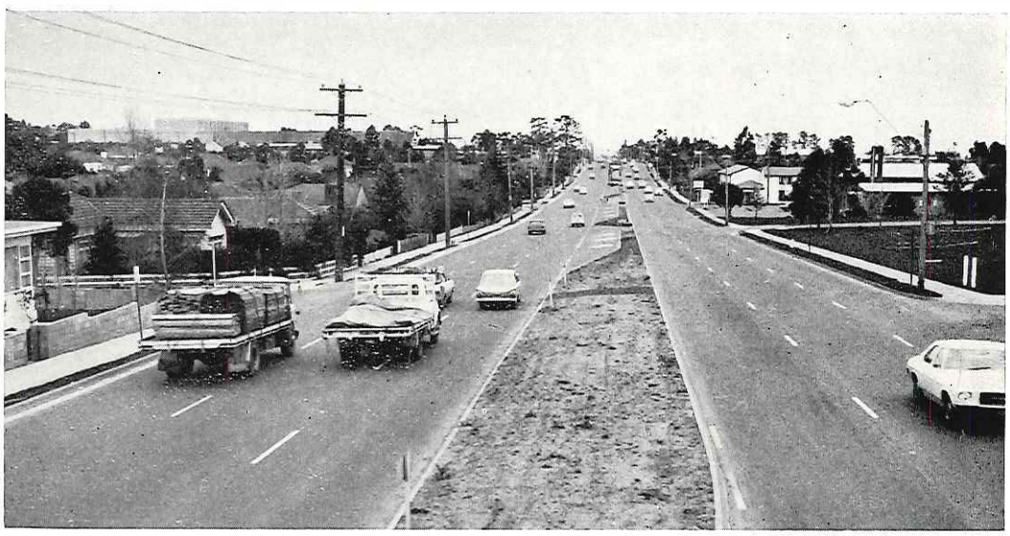
Beaconsfield-Emerald Road reconstructed north of Upper Beaconsfield, Berwick Shire.

CRANBOURNE SHIRE	Dandenong-Hastings Road — Reconstruction of 2.2 miles at Hampton Park to provide a sealed pavement 24 feet wide.
CROYDON CITY	Canterbury Road — Reconstruction of 0.8 mile to provide a 60 feet wide sealed pavement, and associated intersection reconstruction at Bayswater Road.
DANDENONG CITY	Cheltenham Road — Construction of 0.4 mile of approaches to the Mile Creek bridge, to provide dual carriageways each 33 feet wide.
DONCASTER AND TEMPLESTOWE CITY	Doncaster Road — Construction of 1.0 mile of dual carriageways each 33 feet wide, between Short Street and Dehnert Street.



Dual carriageways constructed on Doncaster Road, City of Doncaster and Templestowe City.

ELTHAM SHIRE	Eltham-Yarra Glen Road — Construction of 0.4 mile of eastern carriageway between Eltham and Lower Plenty to provide dual carriageways each 30 feet wide. Whittlesea-Kinglake Road — Reconstruction of 0.8 mile between Ganglehoff Road and the Kinglake Township to provide a sealed pavement 20 feet wide.
HASTINGS SHIRE	Tyabb-Mornington Road — Reconstruction of 2.4 miles between Jones Road and Stumpy Gully Road to provide a sealed pavement 26 feet wide.
HEALESVILLE SHIRE	Eltham-Yarra Glen Road — Reconstruction of 1.3 miles in the vicinity of Christmas Hills to provide a sealed pavement 20 feet wide.
KNOX CITY	Stud Road — Construction of 1.1 miles of eastern carriageway between Boronia Road and Burwood Highway to provide dual carriageways each 33 feet wide.
SHERBROOKE SHIRE	Wellington Road — Construction of sections totalling 4.0 miles to provide a sealed pavement 24 feet wide.
SPRINGVALE CITY	Springvale Road — The channelization of Springvale Road, Wells Road and Edithvale Road intersection.
WAVERLEY CITY	Springvale Road — Construction of 1.0 mile of eastern carriageway between High Street Road and Waverley Road to provide dual carriageways each 33 feet wide.



Springvale Road, Waverley City — additional carriageway constructed between High Street Road and Waverley Road.

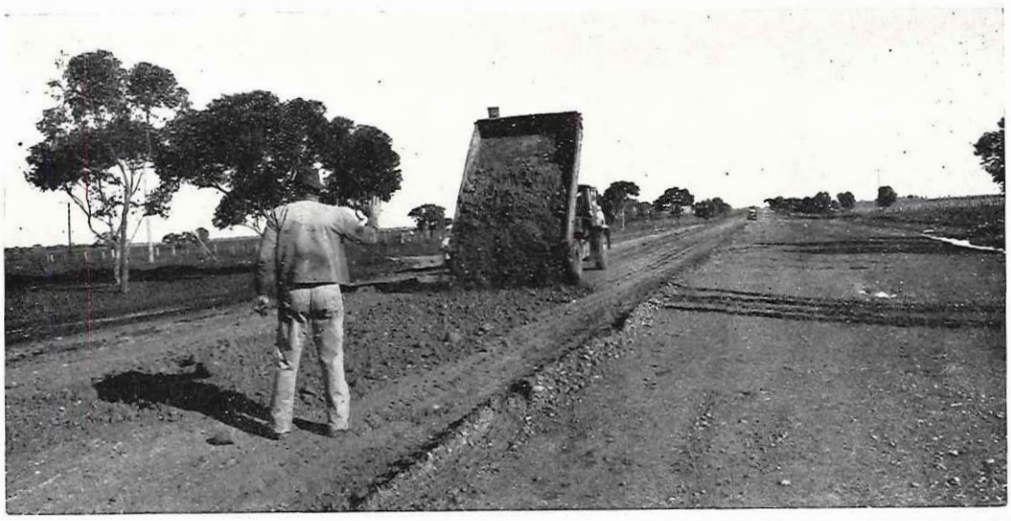
GEELONG DIVISION

BELLARINE SHIRE	Geelong-Portarlington Road — Reconstruction of 1.2 miles between Boundary Road and Coppards Road, Geelong, to provide dual carriageways each 24 feet wide.
OTWAY SHIRE	Beech Forest-Lavers Hill Road — Reconstruction of 0.4 mile to provide a sealed pavement 20 feet wide.

HORSHAM DIVISION

HORSHAM CITY	Kalkee Road—Construction of 0.2 mile between Henty Highway and the railway overpass to provide dual carriageways.
MILDURA SHIRE	Red Cliffs-Colignan Road — Widening and resealing 3.0 miles south of Red Cliffs to provide a sealed pavement 20 feet wide.
STAWELL SHIRE	Stawell-Warracknabeal Road — Reconstruction and realignment of 1.9 miles to eliminate the floodway at Glenorchy and to provide a sealed pavement 24 feet wide.

WYCHEPROOF SHIRE — Birchip-Wycheproof Road — Reconstruction of 3.5 miles west of Wycheproof to provide a sealed pavement 22 feet wide.



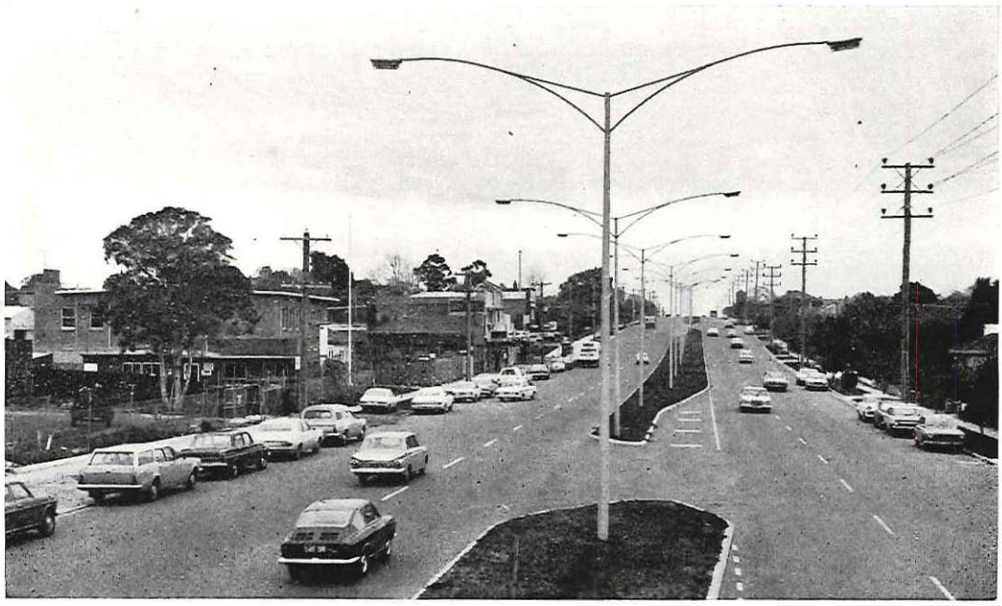
Birchip-Wycheproof Road, Wycheproof Shire — reconstruction in progress west of Wycheproof.

METROPOLITAN DIVISION

BOX HILL CITY — Canterbury Road — Reconstruction of 0.3 mile between Warrigal Road and Benwerrin Street to provide a sealed pavement 42 feet wide.

Reconstructed section of Canterbury Road east of Warrigal Road, Box Hill City.

CAULFIELD CITY — North Road — Reconstruction of 0.5 mile between Bambra Road and Booran Road to provide dual carriageways each 32 feet wide.



Dual carriageways on North Road between Bambra Road and Booran Road, Caulfield City.

HEIDELBERG CITY — Bell Street — Reconstruction of 0.6 mile between Waterdale Road and Upper Heidelberg Road to provide a sealed pavement 58 feet wide.

Reconstructed section of Bell Street between Waterdale Road and Upper Heidelberg Road, City of Heidelberg.

MOORABBIN CITY — Jasper Road — Reconstruction of 0.5 mile between McKinnon Road and North Road to provide a sealed pavement 36 feet wide.

PRESTON CITY — Whittlesea Road — Reconstruction of 0.6 mile between Tyler Street and Albert Street to provide a sealed pavement 44 feet wide.

Whittlesea Road reconstructed between Tyler Street and Albert Street, Preston City.

TRARALGON DIVISION

ALBERTON SHIRE	Yarram-Traralgon Road — Reconstruction of 0.8 mile north of the South Gippsland Highway to provide a sealed pavement 24 feet wide.

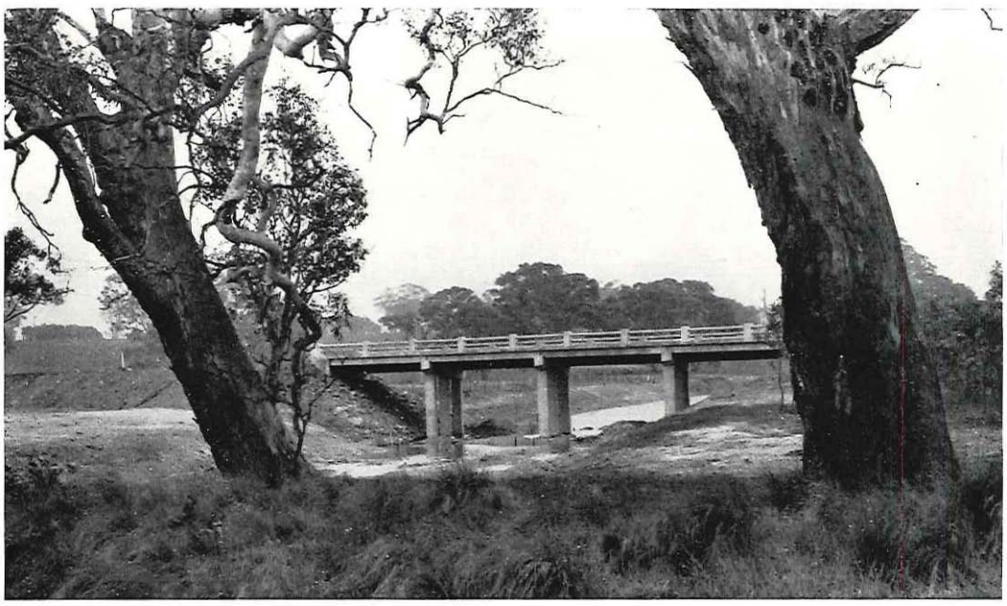
Reconstructed section of the Yarram-Traralgon Road, Alberton Shire.

KORUMBURRA SHIRE	Jeetho West Road—Reconstruction of 1.3 miles south-west of Bena to provide a sealed pavement 22 feet wide. Korumburra-Warragul Road — Reconstruction of 1.2 miles to provide a sealed pavement 20 feet wide.
MIRBOO SHIRE	Mirboo South Road — Reconstruction and realignment of 2.0 miles to provide a sealed pavement 22 feet wide.
NARRACAN SHIRE	Willowgrove Road — Reconstruction and realignment of 2.0 miles to provide a sealed pavement 22 feet wide.
SOUTH GIPPSLAND SHIRE	Hazel Park Road — Construction of a reinforced concrete bridge 90 feet long and 24 feet between kerbs over the Agnes River and construction of 1.6 miles of approaches to provide sealed pavement 20 feet wide.

WARRAGUL SHIRE	Bloomfield Road — Reconstruction of 0.9 mile to provide a sealed pavement 20 feet wide.
WOORAYL SHIRE	Farmers Road — Reconstruction of 0.7 mile to provide a sealed pavement 20 feet wide.

WARRNAMBOOL DIVISION

DUNDAS SHIRE	Cavendish-Coleraine Road — Construction of a reinforced concrete bridge 120 feet long, 24 feet between kerbs over the Dundas River. Dartmoor-Hamilton Road — Reconstruction and realignment of 2.5 miles to provide a sealed pavement 20 feet wide. Macarthur-Dunkeld Road — Reconstruction of 3.5 miles to provide a sealed pavement 20 feet wide.



New bridge over the Dundas River — Cavendish-Coleraine Road, Dundas Shire.

HEYTESBURY SHIRE	Cobden-Port Campbell Road — Reconstruction of 1.0 mile to provide a sealed pavement 20 feet wide. Cobden-Stoneyford Road — Reconstruction and realignment of 1.4 miles to provide a sealed pavement 22 feet wide. Cobden-Warrnambool Road — Reconstruction of 2.1 miles to provide a sealed pavement 20 feet wide.
MORTLAKE SHIRE	Mortlake-Ararat Road — Reconstruction of 3.8 miles to provide a sealed pavement 20 feet wide.
PORTLAND SHIRE	Portland-Nelson Road — Reconstruction of 7.5 miles to provide a sealed pavement 20 feet wide.

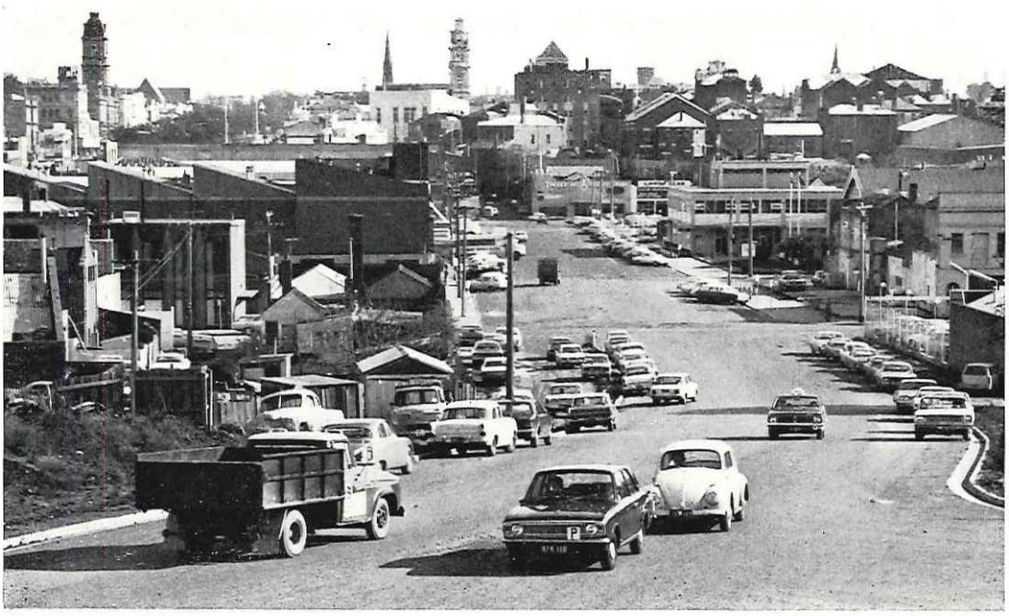
APPENDIX 5

UNCLASSIFIED ROADS

Significant Works Completed During Financial Year 1972/73

BALLARAT DIVISION

ARARAT SHIRE	Delacombe Way — Construction of a nine-span steel and concrete bridge 210 feet long, 24 feet between kerbs over the Hopkins River east of Willaura.
AVOCA SHIRE	Navarre-Wattle Creek Road — Construction of a three-span reinforced concrete bridge 80 feet long, 22 feet between kerbs over the Wattle Creek in Navarre township.
BALLAARAT CITY	Curtis Street — Construction of 0.3 mile between Humffray Street and Victoria Street to provide a sealed pavement 24 feet wide. Eureka Street — Construction of 0.5 mile between King Street and Stawell Street to provide a sealed pavement 37 feet wide.



Constructed section of Curtis Street, Ballaarat City.

BENALLA DIVISION

GOULBURN SHIRE	Kirwans Bridge-Longwood Road — Reconstruction and sealing of 1.0 mile to provide a sealed pavement 18 feet wide. Construction of a five-cell reinforced concrete culvert, and approaches north-west of Longwood.
MANSFIELD SHIRE	Piries-Goughs Road — Reconstruction and sealing of 2.0 miles to provide a sealed pavement 22 feet wide.

OXLEY SHIRE	Milawa-Glenrowan Road — Construction of a four-span reinforced concrete bridge 140 feet long, 28 feet between kerbs west of Milawa.
SHEPPARTON CITY	Central Avenue — Construction and sealing of 2.3 miles to provide a sealed pavement 22 feet wide.
TOWONG SHIRE	Tallangatta-Bethanga Road—Construction of 2.1 miles to provide a sealed pavement 18 feet wide.
WANGARATTA SHIRE	Three Chain Road — Reconstruction of 3.3 miles to provide a sealed pavement 18 feet wide.
YEA SHIRE	Breako'day Road — Reconstruction and realignment of 1.1 miles to provide a sealed pavement 18 feet wide.

BENDIGO DIVISION

BENDIGO CITY	Mitchell Street — Reconstruction and sealing of 0.5 mile to provide a sealed pavement 23 feet wide. Myrtle Street — Construction of a reinforced concrete bridge 188 feet long and 40 feet between kerbs; with construction of associated approaches.

Myrtle Street bridge over the railway, Bendigo City.

DEAKIN SHIRE	Finlay Road — Reconstruction of 1.5 miles to provide a sealed pavement 22 feet wide. Simmie Road — Reconstruction of 1.2 miles to provide a sealed pavement 12 feet wide. Wilson Road — Reconstruction of 1.3 miles to provide a sealed pavement 22 feet wide.
EAST LODDON SHIRE	Echuca-Serpentine Road — Reconstruction of 3.0 miles to provide a sealed pavement 12 feet wide.
KERANG SHIRE	Kerang-Koondrook Road — Reconstruction of 1.0 mile to provide a sealed pavement 24 feet wide. Murrabit West Road — Resheeting prior to sealing of 1.0 mile to provide a pavement 22 feet wide.

KORONG SHIRE	Gowar-Coonooer Road — Construction of reinforced concrete bridge, 121 feet long, 20 feet between kerbs, north-west of Gowar.
METCALFE SHIRE	Faraday-Sutton Grange Road — Construction of 1.5 miles to provide a pavement 22 feet wide.
	Metcalfe-Redesdale Road — Construction and sealing of 2.5 miles to provide a sealed pavement 18 feet wide.

DANDENONG DIVISION

BERWICK SHIRE	Bunyip-Modella Road — Reconstruction of 1.2 miles to provide a sealed pavement 22 feet wide.
CRANBOURNE SHIRE	Thompsons Road — Reconstruction of 0.9 mile to provide a sealed pavement 21 feet wide.
DANDENONG CITY	Heatherton Road — Reconstruction of 0.4 mile to provide a sealed pavement 36 feet wide, between Stud Road and Cleeland Street.
DONCASTER AND TEMPLESTOWE CITY	Reynolds Road — Reconstruction of 0.6 mile between Mullums Creek and Tindalls Road to provide a sealed pavement 26 feet wide.
FLINDERS SHIRE	Jetty Road — Reconstruction of 1.3 miles to provide a sealed pavement 26 feet wide.
LILLYDALE SHIRE	Hardy Street — Reconstruction of 0.5 mile to provide a sealed pavement 40 feet wide, between John Street and the Lillydale-Monbulk Road.
NUNAWADING CITY	Blackburn Road — Construction of 0.5 mile between Highbury Road and Burwood Highway to provide dual carriageways each 30 feet wide.
	Highbury Road — Reconstruction of 1.1 miles between Blackburn Road and Springvale Road to provide a sealed pavement 40 feet wide.

Dual carriageways constructed on Blackburn Road, Nunawading City.

SPRINGVALE CITY	Harold Road — Construction of 1.3 miles between Springvale Road and Corrigan Road to provide a sealed pavement 33 feet wide.
WAVERLEY CITY	Lum Road — Reconstruction of 0.5 mile to provide a sealed pavement 29 feet wide.

GEELONG DIVISION

GEELONG WEST CITY	Glenleith Avenue — Reconstruction of 0.3 mile between Princes Highway West and The Esplanade to provide a sealed pavement 22 feet wide.
SOUTH BARWON SHIRE	Barwon Heads-Torquay Road — Construction of a reinforced concrete and steel bridge 180 feet long and 28 feet between kerbs over the Bream Creek at Breamlea.

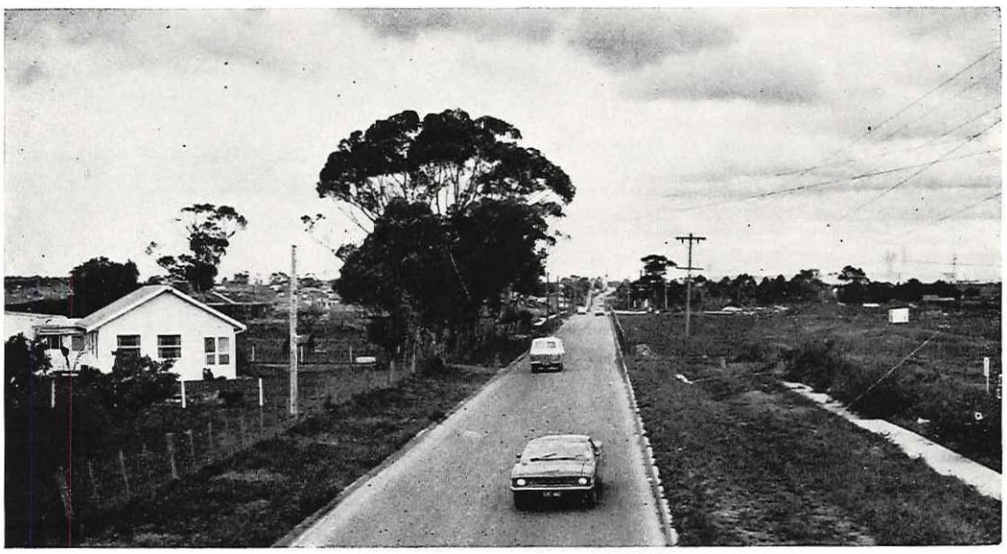
HORSHAM DIVISION

KOWREE SHIRE	Harrow-Goroke Road — Reconstruction of two sections between Harrow and the Wimmera Highway totalling 5.0 miles to provide a sealed pavement 12 feet wide.
LOWAN SHIRE	Yanac Road — Reconstruction and regrading of 2.9 miles between Nhill and the Big Desert area to provide a sealed pavement 12 feet wide.
MILDURA SHIRE	Red Cliffs-Colignan Road — Widening and resealing of 3.0 miles south of Red Cliffs to provide a sealed pavement 20 feet wide.
WALPEUP SHIRE	Walpeup-Patchewollock Road — Reconstruction of 5.0 miles between Walpeup and Patchewollock to provide a sealed pavement 12 feet wide.

METROPOLITAN DIVISION

BOX HILL CITY	Elgar Road — Reconstruction of Elgar Road in the vicinity of the Elgar Road grade-separation project. Station Street — Reconstruction of 0.6 mile between the railway and Canterbury Road to provide a sealed pavement 42 feet between kerbs.
BROADMEADOWS CITY	Barry Road — Reconstruction of 0.4 mile between the railway overpass and Hume Highway to provide a sealed pavement 44 feet wide.
BRUNSWICK CITY	Moreland Road — Reconstruction of 0.9 mile between Melville Road and Station Street, and 0.6 mile between Sydney Road and Holmes Street to provide a sealed pavement 46 feet wide.
DIAMOND VALLEY SHIRE	Grimshaw Street—Reconstruction of 0.4 mile between Main Street and Para Road to provide a sealed pavement 42 feet wide.
FOOTSCRAY CITY	Williamstown Road — Reconstruction of 0.2 mile between Anderson Road and Somerville Road to provide a sealed pavement 44 feet wide.
HEIDELBERG CITY	Upper Heidelberg Road — Reconstruction of 0.6 mile between the railway and Studley Road to provide a sealed pavement 42 feet wide. Southern Road — Reconstruction of 0.3 mile between Liberty Parade and Oriel Road to provide a sealed pavement 26 feet wide.

KEILOR CITY — Sharps Road — Reconstruction of 1.6 miles between the Tullamarine Airport and Lancefield Road to provide a sealed pavement 30 feet wide.



Reconstructed section of Sharps Road, Keilor City.

PRESTON CITY — Murray Road — Reconstruction of 0.3 mile between Gilbert Road and St. James Street to provide dual carriageways each 30 feet wide.

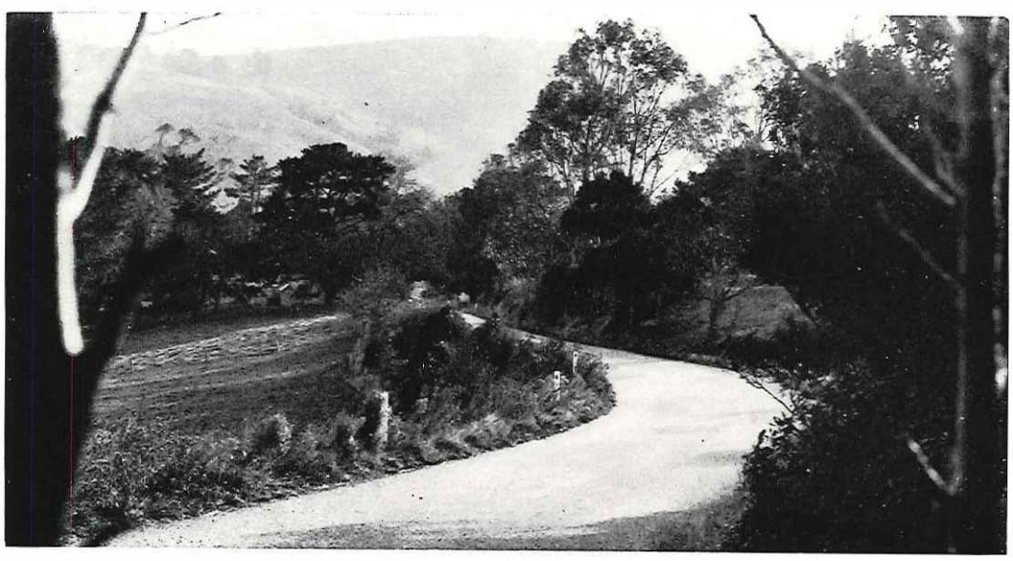
RICHMOND CITY — Elizabeth Street — Reconstruction of 0.5 mile between Hoddle Street and Church Street to provide a sealed pavement 46 feet wide.

SUNSHINE CITY — Anderson Road and Graham Street — Reconstruction of 0.7 mile between Forest Street and Wright Street to provide a sealed pavement 44 feet wide.

TRARALGON DIVISION

BULN BULN SHIRE — Jindivick Road — Reconstruction of 1.5 miles to provide a sealed pavement 18 feet wide.

KORUMBURRA SHIRE — Kardella Road — Reconstruction of 0.7 mile in the Township of Korumburra to provide a sealed pavement 20 feet wide.

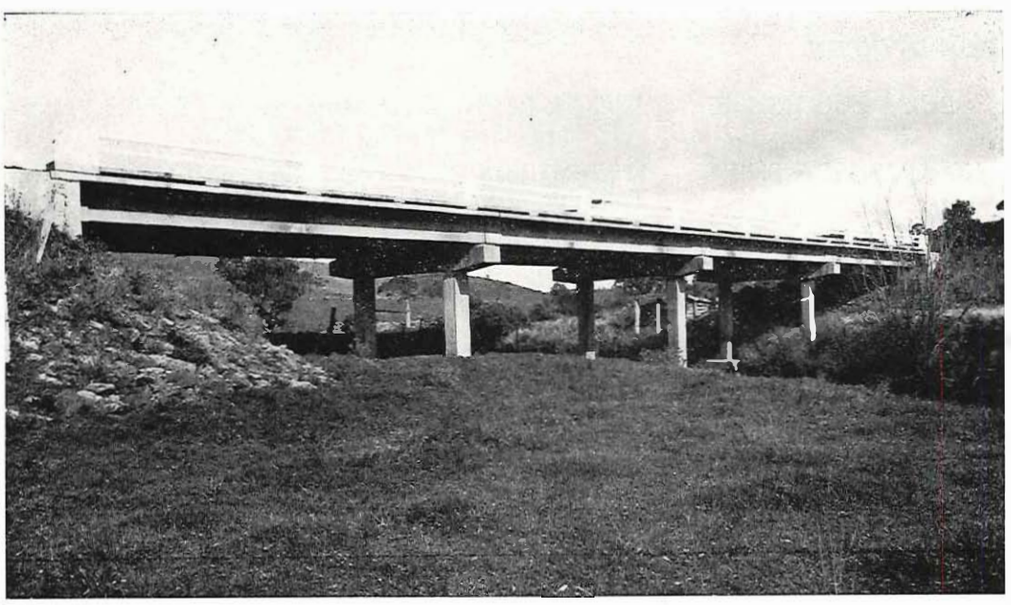


Reconstructed section of Kardella Road, Korumburra Shire.

ROSEDALE SHIRE	Rosedale-Longford Road—Reconstruction of 2.8 miles to provide a sealed pavement 20 feet wide.
SOUTH GIPPSLAND SHIRE	Foster-Promontory Road — Reconstruction of 1.0 mile south of Foster to provide a sealed pavement 24 feet wide.
TRARALGON SHIRE	Hazelwood Road — Reconstruction of 1.3 miles to provide a sealed pavement 20 feet wide.
WARRAGUL SHIRE	Nilma-Shady Creek Road—Reconstruction of 1.2 miles to provide a sealed pavement 18 feet wide.

WARRNAMBOOL DIVISION

BELFAST SHIRE	Toolong North Road — Construction of a reinforced concrete bridge 120 feet long and 24 feet between the kerbs over the Moyne River.
DUNDAS SHIRE	Luhrs Road — Reconstruction of 3.7 miles to provide a sealed pavement 12 feet wide.
HEYTESBURY SHIRE	Curdies-Brucknell Road — Construction of a reinforced concrete bridge 105 feet long, 20 feet between kerbs over the Curdies River. Irrewillipe Road — Construction and primer-sealing of 5.0 miles within the Rural Finance and Settlement Commission's Estate at Heytesbury.



New bridge over Curdies River on the Curdies-Brucknell Road, Heytesbury Shire.

PORTLAND TOWN	Construction of sections totalling 2.2 miles of the Portland Ring Road to provide a sealed pavement 24 feet wide.

PORTLAND SHIRE

Drik Drik-Nelson Road — Reconstruction and sealing of 6.0 miles to provide a sealed pavement 20 feet wide.

Nelson Beach Road — Reconstruction of 2.5 miles to provide a sealed pavement 22 feet wide.

Reconstructed section of the Drik Drik-Nelson Road, Portland Shire.

APPENDIX 6

SPECIAL PROJECTS FINANCED FROM THE ROADS (SPECIAL PROJECTS) FUND

Details of Special Projects on which Work was Carried Out During the Year

Project No.	Project	Length (Miles)	Progress of Work
17	**Hume Freeway** — Construction of a four-lane divided freeway from south of Wallan to north of Broadford.	21.3	Work continued on the southern section of 7.1 miles and work commenced on the centre section of 7.4 miles and the northern section of 6.8 miles.
27	**Mulgrave Freeway** — Construction of a four-lane freeway from west of Stud Road to and including the interchange with Eumemmerring Freeway.	2.7	The construction of 3.7 miles was completed during the year.
28	**Eumemmerring Freeway**—Construction of a four-lane freeway from the interchange with the Mulgrave Freeway south to the Princes Highway East.	1.0	
29	**Mornington Peninsula Freeway** — Construction of a four-lane freeway for a length of 5 miles from the Nepean Highway near Palmerston Avenue, Dromana, to Eastbourne Road.	5.0	$2\frac{1}{2}$ miles completed. Construction continued on the remaining length of $2\frac{1}{2}$ miles.
30	**Western Freeway** — Pentland Hills section, including a by-pass of Myrniong.	7.0	Work continued on the construction of 4 miles through the Pentland Hills.
31	**Calder Highway**—Realignment of the highway at Porcupine Hill.	1.3	Work was completed during the year.

APPENDIX 7

MOTOR VEHICLE REGISTRATIONS

Registrations under the Motor Car Act during the year 1972/73 totalled 1,781,540, an increase of 3.4% over the total for the previous year.

Vehicle	Financial Year 1971/72		Financial Year 1972/73		Decrease	Increase
Private						
New	110,211		113,031			
Secondhand:						
Re-registered	40,305		42,731			
Renewed	1,111,764		1,148,432			
		1,262,280		1,304,194	41,914	
Commercial and Hire						
New	14,855		17,040			
Secondhand:						
Re-registered	5,082		5,135			
Renewed	117,115		115,935			
		137,052		138,110	1,058	
Primary Producers' Trucks and Tractors						
New	3,265		4,074			
Secondhand:						
Re-registered	3,919		3,821			
Renewed	81,642		80,154			
		88,826*		88,049†		777
Licences under the Motor Omnibus Act		683		704	21	
Trailers		199,646		209,748	10,102	
Motor Cycles		35,221		40,735	5,514	
TOTAL		1,723,708		1,781,540	58,609	777

*Includes 45,979 no-fee tractors.
†Includes 45,785 no-fee tractors.

APPENDIX 8

COUNTRY ROADS BOARD

Statement of Receipts and Payments (to Nearest Dollar) for Year Ended 30th June, 1973

		Country Roads Board Fund		Loan Funds	Commonwealth Aid Roads Act 1969						Total
		Act 6229	Act 6222 Rd. Mtce. A/c		Sec. 4(1)	Sec. 4(2)	Sec. 4(3)	Sec. 4(4)			
RECEIPTS		$	$	$	$	$	$	$	$	$	$
Balance as at 1st July, 1972		132,127	..	..	..	..	..	..	..	..	132,127
Motor Car Act 1958 (No. 6325)											
Motor Car Registration Fees	35,289,796										
Additional Registration Fees	2,561,021										
Drivers' Licence Fees	871,862										
Drivers' Licence Testing Fees	516,566										
Trailer Registration Fees	856,012										
Examiners' Licence Fees	7,613										
Sale of Log Books	10,193										
Motor Driving Instructors' Licence—Appointment and Testing Fees	3,964										
Motor Driving Instructors' Licence Fees	3,971										
	40,120,998										
Less Cost of Collection	4,693,227	35,427,771	..	..	..	..	..	..	..	35,427,771	
Municipalities Contributions—											
Permanent Works — Main Roads	128,329										
Maintenance Works — Main Roads	2.053,961	2,182,290	..	..	..	..	..	..	..	2,182,290	
Commercial Goods Vehicles Act No. 6222		..	9,744,729	..	..	..	..	..	..	9,744,729	
Public Works and Services Act No. 8365		1,333,000	..	..	..	..	..	..	..	1,333,000	
Fines — *Country Roads Act* No. 6229		1,624	..	..	..	..	..	..	..	1,624	
General Receipts		701,373	..	..	..	..	..	..	..	701,373	
State Loan Funds Act No. 6229		..	..	400,000	..	..	..	..	..	400,000	
											49,790,787
Commonwealth Aid Roads Act 1969		..	..	..	28,715,000	4,110,000	16,100,000	860,000	..	..	49,785,000
		$39,778,185	$9,744,729	$400,000	$28,715,000	$4,110,000	$16,100,000	$860,000	..	..	$99,707,914
PAYMENTS											
Road Expenditure											
Main Roads—											
Construction and Reconstruction	8,993,221	..	..	..	3,320,978	30,646	2,117,275	..	14,468,466	..	
Maintenance	3,054,646	3,137,217	6,346	..	..	..	..	..	6,191,863	..	
										20,660,329	
State Highways—											
Construction and Reconstruction	2,826,000	..	393,654	4,023,306	3,368,188	..	..	10,611,148	..		
Maintenance	760,712	6,352,010	..	..	..	..	..	7,112,722	..		
										17,723,870	
Freeways—											
Construction and Reconstruction	3,577,416	..	..	14,410,678	..	..	..	17,988,094	..		
Maintenance	260,486	255,502	..	..	..	..	..	515,988	..		
										18,504,082	
Tourists' Roads—											
Construction and Reconstruction	1,019,384	..	..	34,132	..	..	..	1,053,516	..		
Maintenance	695,431	..	..	..	..	..	..	695,431	..		
										1,748,947	
Forest Roads—											
Construction and Reconstruction	..	..	..	..	..	349,419	..	349,419	..		
Maintenance	233,004	..	..	..	..	257,965	..	490,969	..		
										840,388	
Unclassified Roads—											
Construction and Reconstruction	2,137,036	..	..	2,979,950	16,574	8,985,388	..	14,118,948	..		
Maintenance	390,947	..	..	..	..	3,000,001	..	3,390,948	..		
Contribution to Melbourne and Metropolitan Tramways Board—											
Tram Tracks Reconstruction	200.000	..	..	..	..	..	..	200,000	..		
										17,709,896	
Murray River Bridges and Punts	129,766	..	..	..	..	..	..	..	129.766		
Traffic Line Marking	618,655	..	..	..	..	..	..	..	618,655		
											77,935,933
Statutory Payments											
Interest and Sinking Fund	2,611,805										
Traffic Authority Fund	342,956										
Tourist Fund	685,912										
Transport Regulation Fund	548,173										
		4,188,846	..	..	..	..	..	..	..	..	4,188.846
Planning and Research		297,324	..	..	..	..	..	860,000	..	..	1,157,324
Capital Expenditure											
Plant Replacement and Additions	1,765.088										
Buildings, Workshops, etc.	641.486										
		2,406.574	..	..	..	..	..	..	..	..	2,406,574
Management and Operating Expenditure		6,092,933	..	..	3,945,956	694,592	1,389,952	..	..	..	12,123,433
		$37,882,381	$9,744,729	$400,000	$28,715,000	$4,110,000	$16,100,000	$860,000	..	..	$97,812,110
Balance as at 30th June, 1973		$1,895,804									$1,895,804

R. G. COOPER,
Chief Accountant,
19th September, 1973.

AUDITOR-GENERAL'S CERTIFICATE

The accounts of the Country Roads Board for the year ended 30th June, 1973, have been audited. In my opinion the above Statement of Receipts and Payments fairly presents in summary form the transactions during the year.

B. HAMILTON,
Auditor-General,
25th September, 1973.

APPENDIX 9

COUNTRY ROADS BOARD

Loan Liability as at 30th June, 1973

	Main Roads, etc.	Developmental Roads	Total
	$		
Permanent Works			
Main Roads	16,730,322.16		16,730,322.16
State Highways	17,704,304.20		17,704,304.20
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	729,884.73	581,058.21	1,310,942.94
Total Amount Borrowed	$38,393,995.42	$13,432,573.30	$51,826,568.72
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	3,259,433.67		3,259,433.67
National Debt Sinking Fund	6,882,440.02	6,769,716.01	13,652,156.03
Consolidated Fund	7,089.65		7,089.65
	$10,890,778.21	$8,172,654.76	$19,063,432.97
Loan Liability at 30th June, 1973	$27,503,217.21	$5,259,918.54	$32,763,135.75

APPENDIX 10

Works Executed on Behalf of Commonwealth and State Government Authorities, etc., for the Year Ended 30th June, 1973

(Adjusted to Nearest Dollar)

Departments	Description of Works	Expenditure	
Commonwealth—			
Department of Works	Access roads to various Commonwealth establishments	2,193	2,193
Victoria—			
Lands and Survey Department	Roadworks in Glenelg and Kowree Shires	740	
Melbourne and Metropolitan Board of Works	Roadworks in Healesville Shire, Sherbrooke Shire and Berwick Shire	88,785	
Ministry of Tourism	Development of toilet facilities in Rest Areas on State Highways at selected locations throughout the State	1,822	
Public Works Department	Bituminous sealing at Dookie Agricultural College	254	
Rural Finance and Settlement Commission	Roads in Commission land settlement projects throughout the State	42,678	
State Rivers and Water Supply Commission	Road and bridge works in connection with Dartmouth Dam project	198,650	332,929
State Treasury	Kings Bridge — land compensation and other sundry expenditure less proceeds of rental of properties acquired in connection with the construction of Kings Bridge	8,397 Cr.	
" "	Grade-Separation Projects, etc., charged to Level Crossings Fund ($625,848) and Railways Department ($94,295 Cr.)	531,553	
" "	Pedestrian Overpasses and Underpasses charged to State Treasury ($62,988) and Municipalities ($62,988)	125,976	
" "	Improvements to various roads adjacent to State Forests to facilitate the extraction of timber and charged to the Municipalities Forest Roads Improvement Fund	9,277	
" "	Construction of roads and bridges charged to the Roads (Special Projects) Fund	5,675,491	
" "	Unemployment relief in rural areas — roadworks	737,885	7,071,785
			$7,406,907

APPENDIX 11

CHIEF ENGINEER'S REPORT

Country Roads Board
Melbourne

THE CHAIRMAN,

I have the honour to submit the Chief Engineer's Report for 1972/73. The report deals with those activities within the Chief Engineer's Branch which are considered to be of general and special technical interest.

W. S. BRAKE,
Chief Engineer

Research into Thermal Effects on Bridge Superstructures

A research project aimed at development of a design office analysis for the effect of cyclic thermal effects on continuous concrete bridges is being carried out at the University of Melbourne, under joint sponsorship by the Country Roads Board and the Australian Road Research Board. Funds are allocated under a Commonwealth Aid Roads Act 1969 Planning and Research grant.

Progress has been made in three main areas:

(i) measurement of temperature distribution in existing bridge superstructures,

(ii) laboratory measurement of stress distributions produced by known induced temperature distributions in a concrete model bridge element and

(iii) development of an analysis for three dimensional heat flow and corresponding stresses for a general bridge superstructure.

The field measurements programme initiated on the Bell Street bridge over Tullamarine Freeway has been extended by the instrumentation of the Springvale Road bridge over Mulgrave Freeway. Four hundred and sixty-four thermocouples were placed in the bridge superstructure during construction; and a system of horizontal and vertical displacement transducers has been designed for detection and automatic readout of superstructure displacements.

Temperature measurements have been made continuously since 19th January 1973 on one hundred thermocouples in the Springvale Road bridge. The maximum temperature differentials recorded within this period have been 15.1 °C across the 8 in. thick deck slab, 21.4°C over the full 4 ft 6 in. depth of box girder, and 27.1 °C in the depth of the solid pier diaphragm beams.

Figure 1 shows the temperature distribution in a typical internal web section for the critical temperature difference. Stresses resulting from these effects, represented as the sum of internal stresses required to maintain internal equilibrium, and continuity stresses from displacement compatibility requirements at piers, are given in Figure 2. Figure 3 compares thermal stresses with stresses from dead and live loads, for three points in the superstructure. In positive moment areas, thermal stresses are found to be of the same order as those resulting from design live loading. Web tensile stresses are additive to design diagonal shear tensions from other loads, and are found to be of the same order.

A theoretical analysis for thermal stresses and displacements resulting from non-uniform temperature distributions is under development. The analysis for heat flow and corresponding stresses is solved by using three-dimensional isoparametric finite elements with cubic relations describing temperature fields and element face strains. The increase in available parameters associated with these elements, compared with those for more simple forms, leads to improved accuracy of solution for a given number of parameters. It is thus possible to carry out an adequate analysis with considerably fewer elements, which leads to a more useful design office procedure by minimizing input data requirements.

The research programme is to be extended to include field measurements on different types of continuous bridge superstructures, and bridges under different climatic conditions. With the co-operation of the Department of Main Roads, N.S.W., a composite steel and concrete box girder bridge over the Hawkesbury River on the Sydney-Newcastle Expressway has been instrumented with one hundred thermocouples to measure temperature distributions in steel web and soffit plates, and concrete deck slabs. An inverted T-beam superstructure at Stephensons Road and a two-cell curved box girder at Ferntree Gully Road, both being bridges over Mulgrave Freeway, are to be instrumented for temperature distribution and displacement measurements.

The collection of data from these different superstructure types is expected to continue for at least three years to allow statistical evaluation of critical thermal effects, as well as to provide a range of temperature distribution and displacement measurements for correlation with results predicted by the analytical procedure.

Use of Bar Tendons for Post-Tensioning

A variation of normal post-tensioning technique was used, for the first time by the Board, in the manufacture of prestressed concrete beams for pedestrian bridges over Frankston Freeway in the vicinity of Austin Road and Seaford Road at Seaford.
Bar tendons of $1\frac{3}{8}$ in. diameter were located in the cavities inside the box-section beams, in lieu of tendons encased in ducts within the webs as had been the case in previous designs (Figure 4).

The tendons were stressed by means of a hydraulic jack, and were locked by positive nut anchorages, thus obviating the anchorage losses which occur in the use of wedging systems. Friction losses, measured at around 2%, were also significantly reduced.

This form of design offers the following advantages:

(i) the thickness of the webs and soffit of the concrete section can be reduced, resulting in reductions of about 20% in weight and 15% in total loading sustained by the beam, as compared with previous designs,

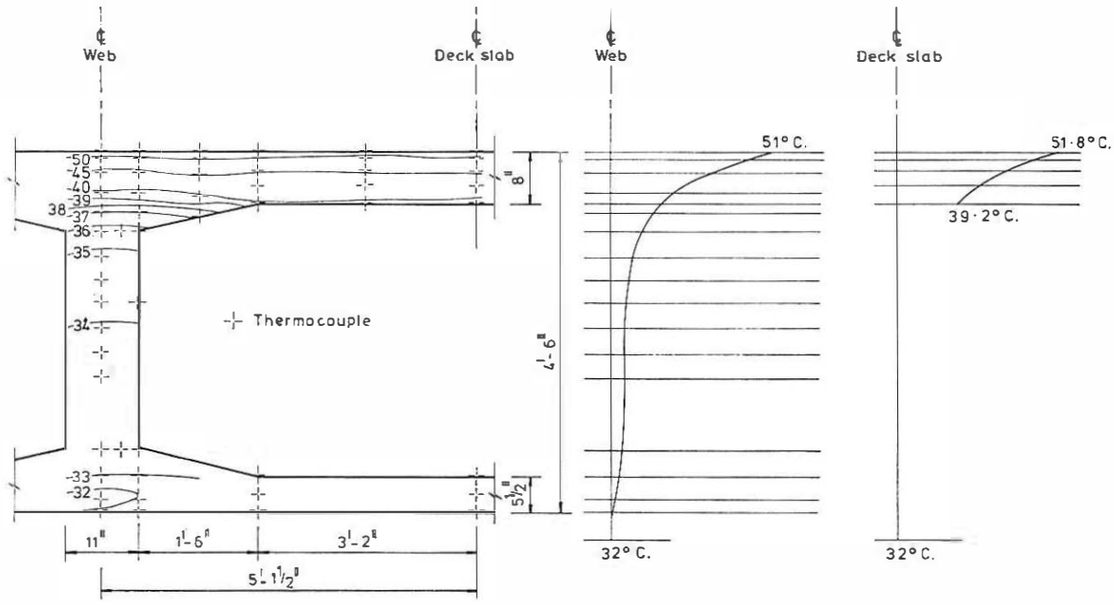


Figure 1—Internal web and deck temperature distribution, Springvale Road overpass, Mulgrave Freeway, 6 p.m., 20th January, 1973.

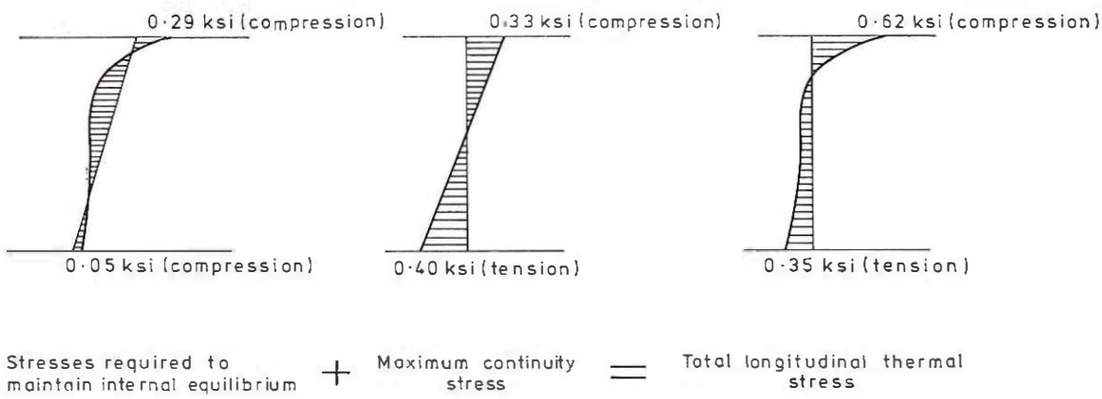


Figure 2—Springvale Road bridge. Typical internal web thermal stresses for the temperature distribution situation shown in Figure 1.

(ii) simplified reinforcement, comprising single layers of steel mesh in the webs and soffit, can be used and

(iii) placing and compaction of concrete is facilitated by the absence of ducts in the webs.

Protection against corrosion was provided by encasing each bar tendon in a 2 in. inside diameter polythene duct, which was pressure grouted after stressing had been completed.

It is expected that economies will result from the adoption of this technique for structures with spans ranging from 50 ft to 90 ft.

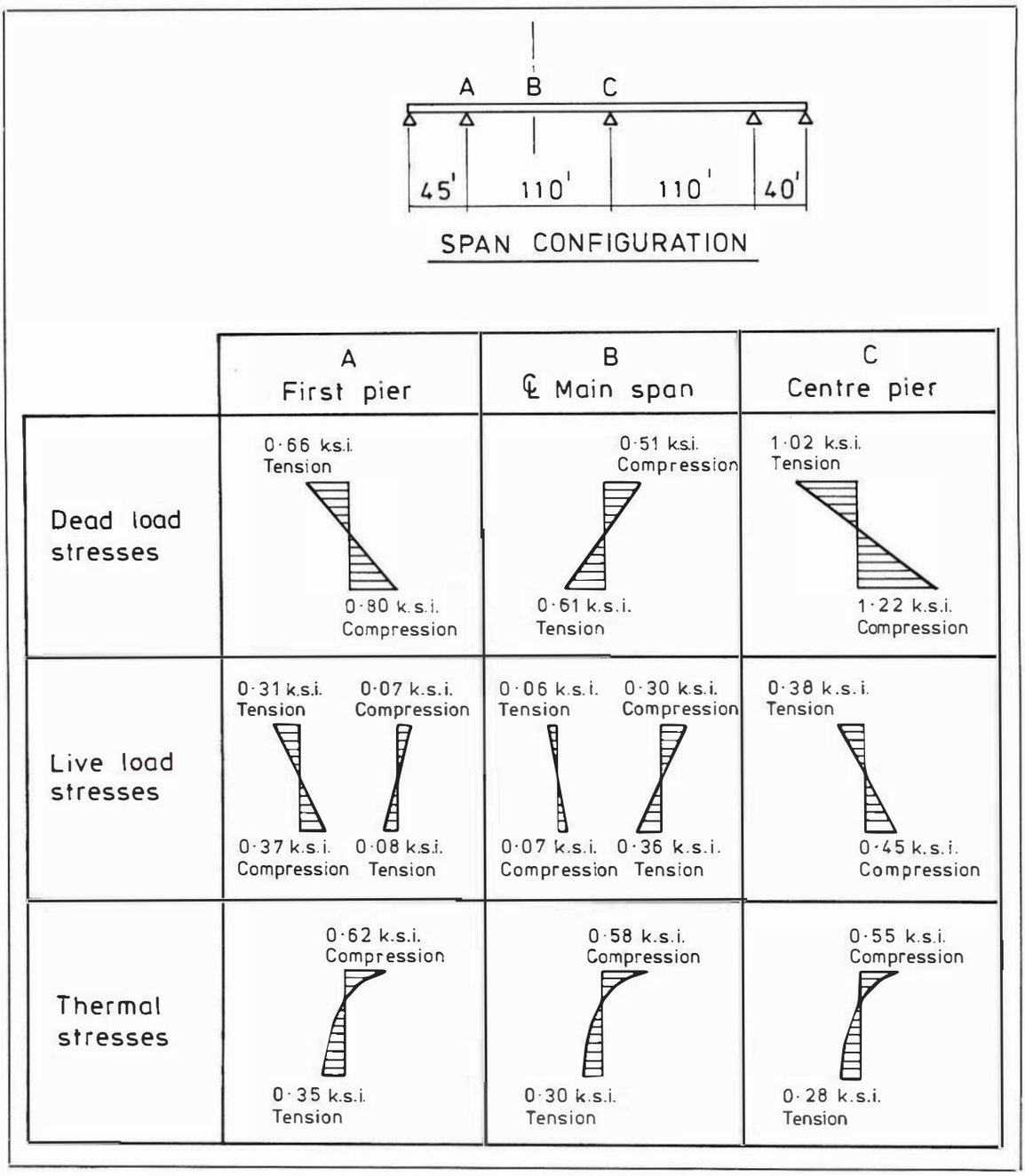


Figure 3—Springvale Road bridge. Comparison between thermal stresses corresponding to the temperature conditions shown in Figure 1, and design dead load and live load stresses.

Scheduling Design Resources

With the assistance of P.A. Management Consultants Pty. Ltd. a resource scheduling system has been introduced into the Design Section of the Bridge Sub-branch and has been operating, in conjunction with similar systems in the Plans and Surveys Division and the Materials Research Division, during the past year.

The objective of the system is to improve the productivity and job satisfaction of staff, by facilitating the allocation of design work by designers and draftsmen. Features of the system are that it is based on simple manual methods and that it was evolved in collaboration with, and is operated by, the staff of the Design Section. The system was implemented in the Bridge Design Section as set out below.

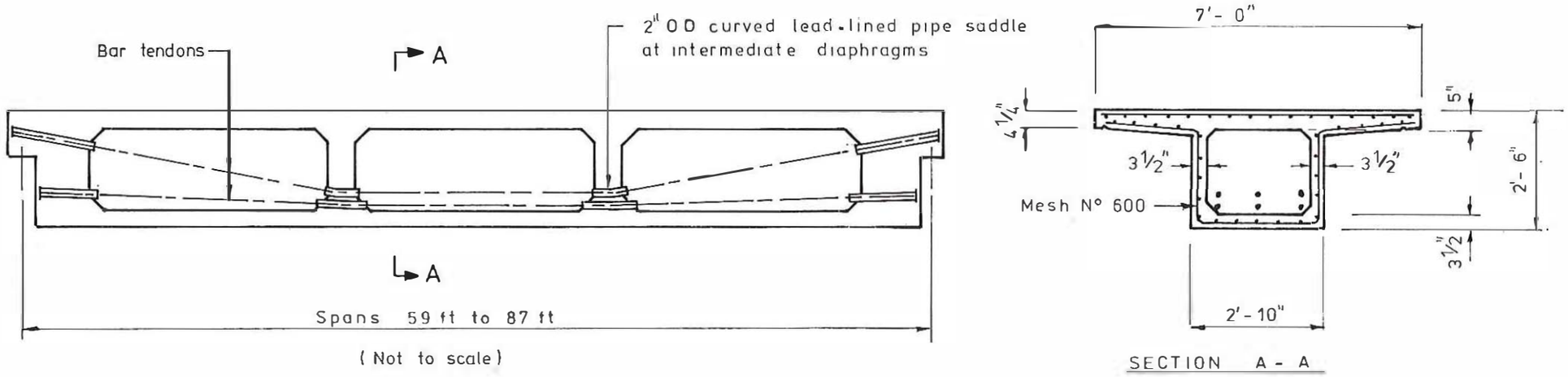


Figure 4—Pedestrian bridge over Frankston Freeway, Seaford. Cross section and longitudinal section of prestressed post-tensioned beam.

A design programme was established after—

(i) review of applications for funds for bridgeworks and review of the approved programmes for Special Projects, major works, rail level crossing grade separation projects and pedestrian bridges,

(ii) consultation with Divisional Engineers and Project Engineers concerning feasibility, phasing and state of preparation of the respective jobs,

(iii) consultation with the Chief Works Engineer and the Assistant Chief Works Engineer concerning priorities, phasing and funding of the jobs, and

(iv) consultation with Plans and Surveys Division regarding acquisition of the survey and road design data required to allow bridge design to proceed.

The programme which was established following this liaison was accepted as a firm statement of the requirements for structural designs.

Measures of performance of design staff were derived in the following way:

(i) preliminary estimates of the design effort required for various categories of jobs were made, by reference to records for individual jobs,

(ii) these estimates were reviewed by senior members of the staff and adjusted accordingly, and

(iii) the output of the design and drafting offices over a three-year period from June 1968 to June 1971 was used as a check against the adjusted estimates.

In using these estimates, judgement must still be applied to take account of a number of factors which can have a significant influence on the productivity of the design staff.

The design schedule was derived by use of a central scheduling board on which all engineers Classes 1-2 and all draftsmen Classes 1-3 were listed. The allocation of the time of these officers to various aspects of design work for each specific job was achieved by the use of colour-coded cards, cut to length according to a time scale and mounted in channels on the board, against the name of each officer. This arrangement facilitated the process of phasing and co-ordinating the application of resources to tasks. Subsidiary scheduling boards were later set up to cover the activities of each of the design groups, which are thus enabled to refine their own planning and to achieve greater flexibility.

Bar charts showing the commencement and estimated completion dates for relevant design tasks were prepared, and distributed to Divisional Engineers, Project Engineers and others involved in the execution or co-ordination of related activities.

The progress of jobs has been reviewed by senior staff at monthly meetings, at which—

(i) deviations from the schedule are identified,

(ii) corrective action is decided, and

(iii) allocation of staff and scheduling of new activities is considered.

Data is being acquired, through the submission by design and drafting staff of weekly returns which indicate the allocation of their time to the various jobs they perform, for checking the estimates of performance.

Two of the matters that have presented some difficulty deserve mention. One is that the present system of allocating funds for municipal works on an annual basis gives insufficient lead time to permit design work for municipal bridges to be scheduled in the normal way. The second is the very substantial, and rapidly increasing, investment of effort, usually at short notice, for the detailed investigation of structural aspects of future road proposals. These investigations form a significant part of the overall work load and must be scheduled accordingly.

Despite some difficulties such as those indicated above, the system has produced definite advantages. The increase in the value of bridge design work completed in each year, from $7.15 m in 1971/72 to $10.1 m in 1972/73, represents a substantial increase in productivity, even if allowance is made for some increase in staff and for the effects of inflation. Other intangible benefits include improved communication and understanding with other sections of the organisation, and facilitation of improved foresight regarding design problems which may arise.

Study of Deck Expansion Joints

Further to the information in the 1971/72 Report, it is now possible to report on the performance of two joint types which have movement capacities of 2 in. or more, viz, Transflex and P.S.C. Heavy Duty joint.

Transflex jointing (Figure 5) has been used extensively on structures on Mulgrave Freeway and is performing satisfactorily. Some problems have been experienced with the joint detail at the kerb, particularly on skew structures, and several joints are allowing small volumes of water to pass through. On the more recently completed structures, an improved riding quality has been achieved by placing the Transflex after placing the final layer of bituminous concrete wearing surface.

P.S.C. Heavy Duty joint (Figure 5) transfers relatively small longitudinal forces across the expansion joint and readily accommodates skew movements. The joint is not designed to be waterproof and a flexible waterstop is placed beneath the joint as a standard detail. The resin based non-skid surface of the joint shows signs of wear after two years' service.

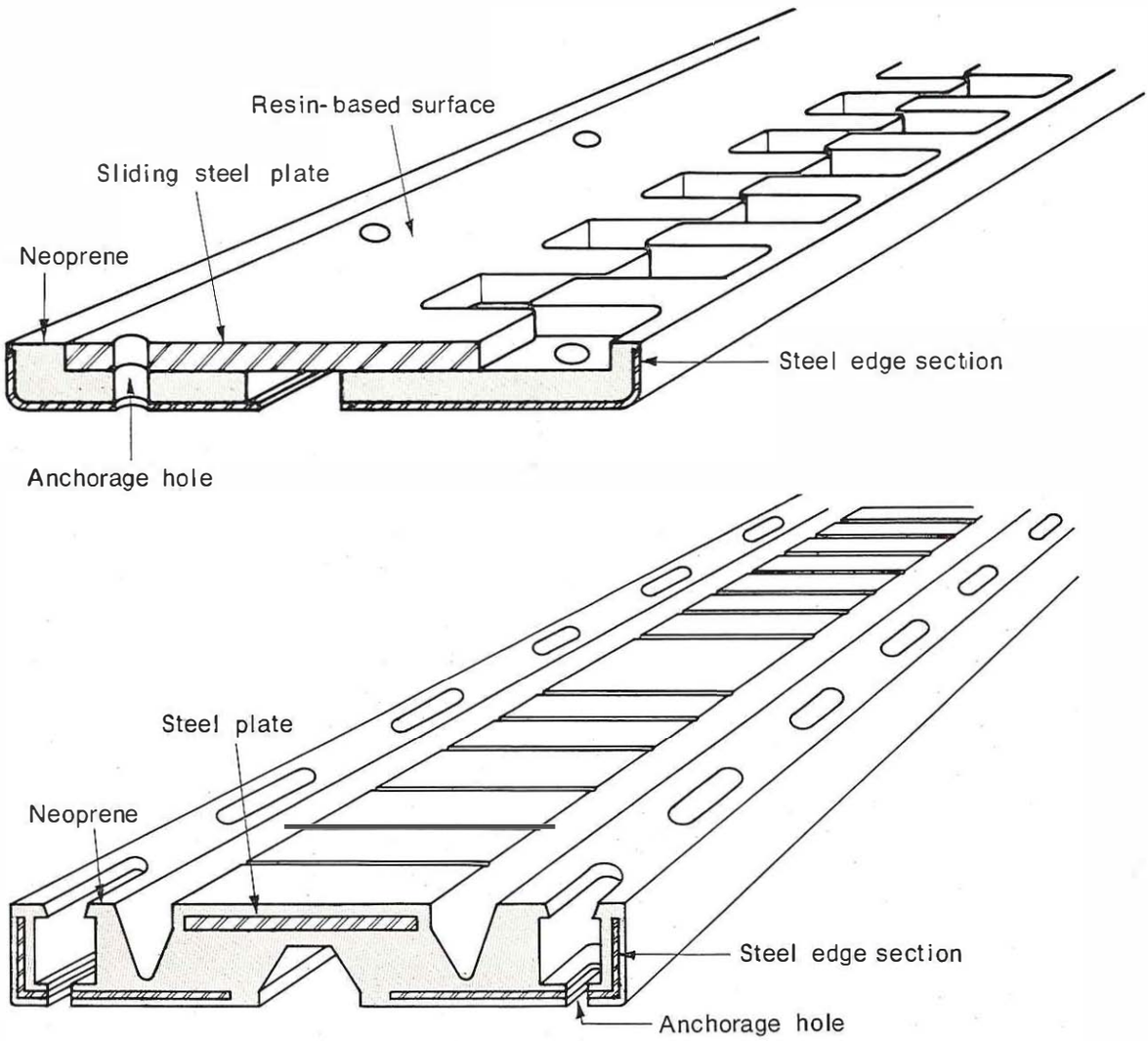


Figure 5—Top, P.S.C. Heavy Duty expansion joint.
Bottom, Transflex expansion joint.

Use of Expanded Polystyrene Foam Blocks for Internal Forming of Box Sections

Economies in time and cost have been achieved by the use of expanded polystyrene foam for the internal forming of box sections of curved end ramps and precast beams for pedestrian overpasses. The technique was first used by the Board for the structure over Calder Freeway at Niddrie and has since been used in the Pier Street structure at Dromana.

The construction of the circular ramps, in particular, presented difficulties in formwork fabrication due to their curvature and sloping sides, and the use of preformed polystyrene blocks saved considerable job time and avoided the need to employ skilled carpenters.

The polystyrene foam was delivered to the Niddrie site in 8 ft by 4 ft by 3 ft blocks which were then shaped by saw cutting or cutting with electrically heated wires. For the Dromana project the blocks were preformed at the factory, thus further speeding the manufacture of the beams and enabling the use of skilled tradesmen on other work.

The blocks were firmly clamped to the formwork to prevent them from floating and the concrete was cast around them. The foam was found to be entirely satisfactory for this purpose.

MECHANICAL SUB-BRANCH

Design and Development

The following design, development and construction work either has been completed or is in progress:

(i) Paynesville Ferry.

The power unit and the drive to the propulsion chain of the ferry have been redesigned and subsequently modified. This modification eliminates the possibility of oil from the hydrostatic drive reaching the water at the ferry crossing and so ensures that this form of water pollution is prevented.

(ii) Bitumen road tanker.

A new insulated road tanker with a total bitumen capacity of 3,700 gal. is being constructed by a private firm to specifications drawn up by the Board. The unit is a departure from the 2,000 gal. tankers previously used in the Board's fleet, and incorporates some novel design features. These are:

- hydrostatic drive to the bitumen pump, powered by a power take-off from the prime mover and
- an L P gas heating system which enables very high gas withdrawal and heating rates without freezing of the gas bottles.

These features save considerable weight and will simplify the operation of the tanker.

(iii) Oil filtering.

With the increased use of hydrostatic transmissions in Board designed plant, considerable attention has been paid to the reduction of wear of the components of the transmission systems. The wear is due to particles, one to five microns in size, which contaminate the oil. The elimination of these particles at the flow rates required by the transmissions is a complex problem. A valving arrangement is in an advanced stage of development and this will enable, through the use of a simple high performance filter, the cleaning of hydrostatic oil, irrespective of direction of flow. The latter feature is important, as all these transmission systems provide drives in both directions. The new arrangement will obviate the need to have two expensive filters fitted to each system.

(iv) Water sprayers.

Investigation and design is well advanced towards production of a water spraying system which not only will utilize the spoon shaped nozzles referred to in the 1971/72 Report, but will be capable of water output rates adjustable to a maximum of 1,000 gal. per minute. An experimental unit, with the new design features fitted to a skid mounted tanker, should be ready for test early in the 1973/74 year.

(v) Snow removal.

The overseas-made dry clutch which had given considerable trouble on one of the Board's snow ploughs was replaced by a fluid coupling drive to the snow cutting and blower unit. The drive has also been fitted with a brake to eliminate overrun of the blower. The new system performed very satisfactorily in the 1972 snow season.

Training

A hydraulics course for workshop personnel and a basic metric conversion course for workshop and stores personnel have been developed and found very successful. A more advanced course in metric conversion will later be presented to classes of selected workshop personnel.

Plant Maintenance

A shortage of highly skilled personnel is being experienced and the following action has been taken to offset the effects:

- the maintenance of bituminous surfacing equipment is now spread throughout the year, instead of being concentrated into the winter months,
- intensive training is being given to the less skilled tradesmen in their particular trades and, generally, to widen the skills of tradesmen in fields such as hydraulics, and
- greater attention has been paid to the planning of workshop operations in order to achieve improved efficiency.

As in previous years, there were very substantial increases in the cost of parts, materials and labour required for the operation of the maintenance organization during 1972/73.

PLANNING SUB-BRANCH

1. ADVANCE PLANNING DIVISION

Australian Roads Survey 1969/74

The Board's Annual Reports for 1970/71 and 1971/72 described the survey of roads being undertaken by the National Association of Australian State Road Authorities in conjunction with the Commonwealth Bureau of Roads, to provide information for consideration by the Commonwealth Government in preparing legislation to replace the present Commonwealth Aid Roads Act, which will expire on 30th June 1974.

The first three phases of the Australian Roads Survey (A.R.S.), namely—

(i) collection of inventory data on roads and bridges,

(ii) identification of deficiencies and

(iii) selection of and cost estimating for improvement projects, and the preparation of maintenance estimates,

have been completed for Victoria in accordance with the Survey specification, whilst the last two phases,

(iv) economic evaluation of improvement projects, and

(v) scheduling

are still proceeding.

Phase (i), Inventory

C.R.B. officers collected the inventory data on roads, and crossings of streams and railways, in these categories:

- in rural and outer urban areas, roads or crossings declared or proclaimed under the Country Roads Act,
- arterial and sub-arterial roads and all crossings, in the inner urban Melbourne area.

} Total mileage approximately 15,400 and total crossings, 4,100.

The Advance Planning Division inventory team, using the instrumented vehicle described in the 1970/71 Chief Engineer's Report, collected the data for 12,800 miles of roads.

Municipal officers provided inventory data for 63,000 miles of trafficked unclassified roads and 10,000 crossings in rural and outer urban areas, and also provided inventory data in summary form for 6,160 miles of roads other than arterials and sub-arterials in the inner urban areas of Melbourne, Ballarat, Bendigo and Geelong.

The consultants who had performed the Transportation Studies in the provincial cities of Ballarat, Bendigo and Geelong provided the inventories, and also the identification of deficiencies, and project selection, for arterial and sub-arterial roads in the inner urban areas of these cities.

A very extensive checking procedure was adopted for the editing of the collected data. Notwithstanding that the editing was done with the assistance of a computer, a significant amount of manual work was required for tracing, coding and correcting errors, which were unavoidable when such a large volume of manually collected data was involved. For the editing procedure, 25 computer programmes were developed and operated over a period of 15 months. There were over six million items of inventory data edited and then stored on magnetic tape.

Phases (ii, iii), Identification of Deficiencies and Selection of Projects

For rural and outer urban roads, deficiencies were identified by a computer programme which compared inventory data with standards for traffic volume, width, alignment, etc., as defined by the survey specification for the identification of deficiencies. Traffic volumes, for road sections and structures identified as being deficient, were projected to the design year. Projects were then selected and costs were calculated from a "cost matrix" based on locality, general terrain and functional class of the road. Computer programmes for the above purposes were provided by the Commonwealth Bureau of Roads and further developed by Country Roads Board officers.

For inner urban areas, the road inventory was compared with operational, structural and safety standards in order to identify deficiencies. Operational deficiencies between 1972 and 1979, expressed in terms of travel speed deficiencies, were identified by comparing overall travel speeds with speed standards. For identification of additional operational deficiencies, the 1979 projected traffic volumes, predicted by the use of traffic assignment procedures, were compared with the capacity of the existing unimproved 1972 road network in each area. Traffic assignments for the Melbourne 1972 network and an improved 1979 network were made available by the Metropolitan Transportation Committee (M.T.C.). For the identification of safety deficiencies, tolerable accident rates and street lighting standards were used.

Minor projects, i.e. with expected costs below $50,000, were selected on the basis of direct replacement of existing deficient road sections and intersections.

Major projects were selected on a corridor basis and were such as to close the gaps between the available capacity of the 1972 network after allowing for the additional capacity achieved through minor improvement projects, and the 1979 projected volumes.

The solution network for inner urban Melbourne was derived in accordance with the A.R.S. specification and, also, was based on the M.T.C. network, published in 1969, for design year 1985. However, in March 1973, the State Government indicated that the construction of certain freeways, some of the links forming part of the A.R.S. network, would not now proceed. On this account, the solution network must be reviewed. The review, which will occupy several months, will not be a simple matter of reducing the total cost of the network by the cost of the deleted links. Other measures must be introduced to alleviate the problems resulting from the deletions. These measures will almost certainly involve extensive widening of existing surface arterial roads.

Phases (iv), (v), Evaluation and Scheduling

The final phases of the Survey, i.e. the economic evaluation of the improvement projects, and scheduling (listing of projects allowing for restrictions on finance and other resources) are being carried out largely by the Commonwealth Bureau of Roads. Results will be available early in the 1973/74 financial year.

The preliminary results of the first three phases of the Survey, for rural, outer urban and inner urban areas in Victoria are set out in Tables 1 to 7. In the tables, reference to roads or structures "inventoried" should be understood to mean, "those roads or structures which were inventoried for the purpose of the survey according to the A.R.S. specifications". The date of the inventory is nominally 30th June 1972. "Deficiencies" should be understood to mean, "those sections of road or structures assessed, according to the A.R.S. rules, as becoming deficient by June 1979". "Costs" are the costs of remedying the deficiencies by standard projects at June 1972.

These figures are preliminary data and are subject to final checking.

TABLE 1

AUSTRALIAN ROADS SURVEY 1971/72
DEFINITIONS OF FUNCTIONAL CLASSIFICATION OF ROADS

Rural Areas

Class 1 Those roads which form the principal avenue for communication between major regions of the Commonwealth, including direct connections between capital cities.

Class 2 Those roads, not being Class 1, whose main function is to form the principal avenue of communications for movements:

(i) between a capital city and adjoining States and their capital cities,

(ii) between a capital city and key towns, or

(iii) between key towns.

Class 3 Those roads, not being Class 1 or Class 2, whose main function is to form an avenue of communication for movements:

(i) between important centres and the Class 1 and Class 2 roads and/or key towns,

(ii) between important centres; or

(iii) of an arterial nature within a town in a rural area.

Class 4 Those roads, not being Classes 1, 2 or 3, whose main function is to provide access to abutting property (including property within a town in a rural area).

Class 5 Those roads which provide almost exclusively for one activity or function and which cannot be assigned to Classes 1, 2, 3 or 4.

Urban Areas

Class 6 Those roads whose main function is to form the principal avenue of communication for massive traffic movements.

Class 7 Those roads, not being Class 6, whose main function is to supplement the Class 6 roads in providing for traffic movements or which distribute traffic to local street systems.

Class 8 Those roads, not being Classes 6 or 7, whose main function is to provide access to abutting property.

Class 9 Those roads which provide almost exclusively for one activity or function and which cannot be assigned to Classes 6, 7 or 8.

TABLE 2

AUSTRALIAN ROADS SURVEY 1971/72

RURAL AND OUTER URBAN AREAS OF VICTORIA

LENGTH OF ROADS INVENTORIED, LENGTH OF ROADS ASSESSED AS DEFICIENT BY JUNE 1979, AND COST OF WORKS, IN 1973 VALUES, TO ELIMINATE DEFICIENCIES, BY LEGAL CLASS AND FUNCTIONAL CLASS

Legal Class	Tabulated Item	Natural Surface and Formed				Gravel				Sealed				Total*			
		Rural	Outer Urban		Total*	Rural	Outer Urban		Total*	Rural	Outer Urban		Total*	Rural	Outer Urban		Total*
			Melbourne	Geelong			Melbourne	Geelong			Melbourne	Geelong			Melbourne	Geelong	
Freeways	Inventoried miles	—	—	—	—	—	—	—	—	36	23	—	59	36	23	—	59
	Deficient miles	—	—	—	—	—	—	—	—	31	23	—	53	31	23	—	53
	Cost $ million	—	—	—	—	—	—	—	—	10.4	15.9	—	26.4	10.4	15.9	—	26.4
State highways	Inventoried miles	—	—	—	—	157	—	—	157	3,983	118	20	4,121	4,139	118	20	4,277
	Deficient miles	—	—	—	—	150	—	—	150	2,029	118	14	2,162	2,179	118	14	2,312
	Cost $ million	—	—	—	—	8.9	—	—	8.9	274.6	60.8	2.0	337.5	283.5	60.8	2.0	346.4
Tourists' roads	Inventoried miles	—	—	—	—	147	—	—	147	313	22	—	334	460	22	—	481
	Deficient miles	—	—	—	—	146	—	—	146	138	20	—	158	284	20	—	304
	Cost $ million	—	—	—	—	10.4	—	—	10.4	9.6	12.2	—	21.9	20.0	12.2	—	32.2
Main roads	Inventoried miles	11	—	—	11	650	32	—	682	7,458	437	27	7,922	8,120	468	27	8,615
	Deficient miles	11	—	—	11	626	32	—	658	2,769	352	10	3,131	3,406	384	10	3,800
	Cost $ million	0.5	—	—	0.5	21.9	7.1	—	28.9	105.9	102.0	0.9	208.8	128.3	109.1	0.8	238.2
Forest roads	Inventoried miles	—	—	—	—	368	—	—	368	271	—	—	271	639	—	—	639
	Deficient miles	—	—	—	—	345	—	—	345	68	—	—	68	413	—	—	413
	Cost $ million	—	—	—	—	12.2	—	—	12.2	4.1	—	—	4.1	16.3	—	—	16.3
All declared and proclaimed roads*	Inventoried miles	11	—	—	11	1,322	32	—	1,354	12,061	600	46	12,707	13,394	631	46	14,072
	Deficient miles	11	—	—	11	1,268	32	—	1,299	5,033	514	25	5,572	6,312	545	25	6,882
	Cost $ million	0.5	—	—	0.5	53.3	7.1	—	60.4	404.7	191.0	2.9	598.6	458.5	198.1	2.9	659.5
Unclassified roads	Inventoried miles	22,933	873	44	23,850	24,563	1,169	83	25,815	12,408	982	83	13,473	59,904	3,024	210	63,138
	Deficient miles	14,666	694	24	15,384	22,964	1,144	80	24,189	5,064	553	45	5,662	42,695	2,391	149	45,236
	Cost $ million	222.8	67.2	1.1	291.1	441.0	104.1	3.8	548.8	147.2	71.8	2.7	221.7	811.0	243.1	7.5	1,061.5
All roads*	Inventoried miles	22,944	873	44	23,861	25,885	1,200	83	27,169	24,469	1,582	130	26,180	73,299	3,655	256	77,210
	Deficient miles	14,677	694	24	15,395	24,232	1,176	80	25,488	10,098	1,067	69	11,234	49,007	2,937	174	52,118
	Cost $ million	223.3	67.2	1.1	291.6	494.3	111.1	3.8	609.2	551.9	262.9	5.6	802.3	1,269.5	441.2	10.4	1,721.1

*NOTE: Distances have been rounded off to the nearest mile and costs of remedying deficiencies have been rounded off to nearest $100,000. Because of this, totals may not agree with sum of components.

TABLE 3

AUSTRALIAN ROADS SURVEY 1971/72

RURAL AND OUTER URBAN AREAS OF VICTORIA

LENGTH OF ROADS INVENTORIED, LENGTH OF ROADS ASSESSED AS DEFICIENT BY JUNE 1979, AND COST OF WORKS, IN 1973 VALUES, TO ELIMINATE DEFICIENCIES, BY LEGAL CLASS AND CROSSING TYPE

Legal Class	Tabulated Item	Rural						Outer Urban Melbourne				Outer Urban Geelong			
		Functional Class					Total*	Functional Class			Total*	Functional Class			Total*
		1	2	3	4	5		6	7	8		6	7	8	
Freeways	Inventoried miles	22	14	—	—	—	36	23	—	—	23	—	—	—	—
	Deficient miles	22	8	—	—	—	31	23	—	—	23	—	—	—	—
	Cost $ million	9.4	1.0	—	—	—	10.4	15.9	—	—	15.9	—	—	—	—
State highways	Inventoried miles	547	2,247	1,346	—	—	4,139	118	—	—	118	12	8	—	20
	Deficient miles	402	1,175	602	—	—	2,179	118	—	—	118	9	6	—	14
	Cost $ million	99.5	150.9	33.1	—	—	283.5	60.8	—	—	60.8	1.0	1.0	—	2.0
Tourists' roads	Inventoried miles	—	—	202	33	225	460	—	22	—	22	—	—	—	—
	Deficient miles	—	—	106	19	158	284	—	20	—	20	—	—	—	—
	Cost $ million	—	—	7.8	0.5	11.7	20.0	—	12.2	—	12.2	—	—	—	—
Main roads	Inventoried miles	9	175	4,859	3,007	70	8,120	61	407	—	468	—	27	—	27
	Deficient miles	6	48	1,783	1,540	29	3,406	53	331	—	384	—	10	—	10
	Cost $ million	0.2	1.9	81.5	42.9	1.7	128.3	17.1	92.1	—	109.1	—	0.8	—	0.8
Forest roads	Inventoried miles	—	—	110	414	115	639	—	—	—	—	—	—	—	—
	Deficient miles	—	—	52	278	83	413	—	—	—	—	—	—	—	—
	Cost $ million	—	—	3.0	8.5	4.7	16.3	—	—	—	—	—	—	—	—
All declared and proclaimed roads*	Inventoried miles	578	2,437	6,516	3,454	410	13,394	202	429	—	631	12	35	—	46
	Deficient miles	430	1,232	2,544	1,836	270	6,312	194	351	—	545	9	16	—	25
	Cost $ million	109.0	154.1	125.5	52.0	18.1	458.5	93.8	104.3	—	198.1	1.0	1.9	—	2.9
Unclassified roads	Inventoried miles	—	5	436	59,464	—	59,904	3	425	2,596	3,024	—	0	210	210
	Deficient miles	—	5	298	42,392	—	42,695	3	354	2,034	2,391	—	0	149	149
	Cost $ million	—	0.1	23.3	787.5	—	811.0	1.2	58.3	183.6	243.1	—	0.0	7.5	7.5
All roads*	Inventoried miles	578	2,442	6,951	62,918	410	73,299	205	853	2,596	3,655	12	35	210	256
	Deficient miles	430	1,237	2,842	44,228	270	49,007	197	705	2,034	2,937	9	16	149	174
	Cost $ million	109.0	154.2	148.8	839.4	18.1	1,269.5	95.0	162.6	183.6	441.2	1.0	1.9	7.5	10.4

*NOTE: Distances have been rounded off to the nearest mile and costs of remedying deficiencies have been rounded off to nearest $100,000. Because of this, totals may not agree with sum of components.

TABLE 4

AUSTRALIAN ROADS SURVEY 1971/72

NUMBER OF STRUCTURES INVENTORIED, NUMBER OF STRUCTURES ASSESSED AS DEFICIENT BY JUNE 1979 AND COST OF WORKS, IN 1973 VALUES, TO ELIMINATE DEFICIENCIES, BY LEGAL CLASS AND CROSSING TYPE

Tabulated Item	Legal Class	Ford, Floodway, Causeway				Major Culvert				Bridge				Railway Level Crossing				All Crossings
		Rural	Outer Urban		Total	Rural	Outer Urban		Total	Rural	Outer Urban		Total	Rural	Outer Urban		Total	
			Melbourne	Geelong			Melbourne	Geelong			Melbourne	Geelong			Melbourne	Geelong		
Freeways	Number inventoried	—	—	—	—	5	1	—	6	20	9	—	29	—	—	—	—	35
	Number deficient	—	—	—	—	4	—	—	4	9	8	—	17	—	—	—	—	21
	Cost $ million	—	—	—	—	0.1	—	—	0.1	0.6	2.1	—	2.7	—	—	—	—	2.8
State highways	Number inventoried	4	6	—	10	123	3	—	126	848	33	7	888	145	4	—	149	1,173
	Number deficient	—	1	—	1	33	2	—	35	286	32	5	323	19	4	—	23	382
	Cost $ million	—	0.0	—	0.0	0.5	0.1	—	0.5	32.5	5.3	1.8	39.6	1.2	0.3	—	1.5	41.7
Tourists' roads	Number inventoried	1	—	—	1	10	—	—	10	66	2	—	68	—	—	—	—	79
	Number deficient	—	—	—	—	1	—	—	1	21	1	—	22	—	—	—	—	23
	Cost $ million	—	—	—	—	0.0	—	—	0.0	1.2	0.0	—	1.2	—	—	—	—	1.3
Main roads	Number inventoried	68	13	—	81	146	2	—	148	1,260	81	2	1,343	245	16	—	261	1,833
	Number deficient	5	6	—	11	18	2	—	20	453	56	—	509	15	14	—	29	569
	Cost $ million	0.0	0.0	—	0.1	0.2	0.0	—	0.2	23.1	5.8	—	29.0	0.4	1.4	—	1.8	31.1
Forest roads	Number inventoried	2	—	—	2	23	—	—	23	72	—	—	72	2	—	—	2	99
	Number deficient	2	—	—	2	3	—	—	3	44	—	—	44	—	—	—	—	49
	Cost $ million	0.0	—	—	0.0	0.0	—	—	0.0	1.8	—	—	1.8	—	—	—	—	1.8
Total declared and proclaimed roads	Number inventoried	75	19	—	94	307	6	—	313	2,266	125	9	2,400	392	20	—	412	3,219
	Number deficient	7	7	—	14	59	4	—	63	813	97	5	915	34	18	—	52	1,044
	Cost $ million	0.0	0.0	—	0.1	0.8	0.1	—	0.9	59.3	13.3	1.8	74.4	1.6	1.7	—	3.3	78.6
Unclassified roads	Number inventoried	2,246	121	4	2,371	920	48	2	970	4,494	219	10	4,723	1,817	63	14	1,894	9,958
	Number deficient	1,185	90	1	1,276	323	29	1	353	2,507	147	6	2,660	107	25	2	134	4,423
	Cost $ million	9.9	0.8	0.0	10.7	3.3	0.4	0.0	3.7	70.6	4.9	0.3	75.8	1.1	1.1	0.1	2.2	92.5
All roads	Number inventoried	2,321	140	4	2,465	1,227	54	2	1,283	6,760	344	19	7,123	2,209	83	14	2,306	13,177
	Number deficient	1,192	97	1	1,290	382	33	1	416	3,320	244	11	3,575	141	43	2	186	5,467
	Cost $ million	9.9	0.8	0.0	10.8	4.1	0.6	0.0	4.6	129.8	18.2	2.2	150.2	2.7	2.8	0.1	5.6	171.1

NOTE: Structures on duplicated roads have been counted as one structure.

TABLE 5

AUSTRALIAN ROADS SURVEY 1971/72

INNER URBAN AREAS OF VICTORIA

INVENTORY OF ROADS, INTERSECTIONS AND CROSSINGS

	Tabulated Item	Inner Urban				Total Urban
		Melbourne	Geelong	Ballarat	Bendigo	
Functional Classification						
Class 6	Miles	417	41	26	29	513
Class 7	Miles	794	70	41	47	952
Class 8	Miles	5,457	328	230	182	6,197
Total	Miles	6,668	439	297	258	7,662
Legal Classification (Functional Classes 6 and 7 only)						
C.R.B. declared freeways	Miles	11	—	—	—	11
Undeclared freeways (includes M.M.B.W freeways)	Miles	14	—	—	—	14
Ramps	Carriageway Miles	12	3	—	—	15
State highways—divided	Miles	70	11	5	1	87
State highways—undivided	Miles	28	10	11	17	66
Main roads—divided	Miles	68	3	—	—	71
Main roads—undivided	Miles	249	6	9	7	271
Unclassified roads—divided	Miles	40	2	1	—	43
Unclassified roads—undivided	Miles	719	76	41	51	887
Total	Miles	1,211	111	67	76	1,465
Surface Type (Functional Classes 6 and 7 only)						
Bituminous concrete	Miles	518	50	5	17	590
Bituminous seal	Miles	654	58	62	58	832
Concrete	Miles	17	1	—	—	18
Gravel	Miles	22	2	—	1	25
Total	Miles	1,211	111	67	76	1,465
Traffic Control at Intersections (of Functional Classes 6 and 7 roads)						
Signals with channelization	Number	56	11	2	—	68
Signals—no channelization	Number	325	3	—	1	329
Flashing lights	Number	30	2	—	—	32
Channelization	Number	134	54	8	12	208
Signs	Number	49	40	4	—	93
No controls	Number	515	70	62	89	736
Total	Number	1,109	180	76	102	1,467
Crossings						
Road over waterway	Number	397	14	34	48	493
Road over rail	Number	119	7	3	8	137
Road under rail	Number	143	7	2	4	156
Inventoried road over road	Number	77	1	2	—	80
Inventoried road under road	Number	108	3	1	—	112
Pedestrian underpass	Number	4	—	—	—	4
Rail level crossing	Number	243	35	17	19	314
Total	Number	1,119	68	59	79	1,325

TABLE 6

AUSTRALIAN ROADS SURVEY 1971/72

INNER URBAN AREAS OF VICTORIA

LENGTH OF ROADS ASSESSED AS DEFICIENT (BY JUNE 1979) AND COST OF WORKS TO ELIMINATE DEFICIENCIES

MELBOURNE	Miles				$million
(a) Functional Classes 6 and 7 roads					
(i) Deficiencies					
Deficient due to insufficient capacity only	328				
Deficient due to excessive travel time only	75				
Due to structural condition only	41				
Deficient due to both capacity and travel time only	291				
Deficient due to both capacity and structural condition only	59				
Deficient due to both travel time and structural condition only	16				
Deficient due to all three causes	189				
	999				
(ii) Solutions	Miles				
Solutions for arterial roads					
Construct new freeways	139				1,530.6
Widen existing freeways	4				8.0
Construct new arterial roads	19				17.0
Widen existing arterial roads	67				24.2
Duplication of existing arterial roads	54				49.6
Reconstruct existing arterial roads	240				60.6
Apply parking bans	60				0.1
Improve street lighting	703				11.1
					1,701.2
Solutions for intersections of arterial roads	Number				
Major intersection improvements	26				14.0
Flare and channelize	37				0.9
Improve existing channelization	19				0.3
Install traffic signals	253				5.1
Improve existing signals	292				2.9
Other minor improvements	19				0.1
	646				23.3
(b) Functional Class 8 roads	Miles				
(i) Deficiencies					
(a) Structural, surface type, and width deficiencies (for which the road reserve is adequate to permit widening when required)	1,324				
(b) Environmental (i.e. excessive traffic volume)	381				
(ii) Solutions					
(a) Construction and reconstruction	1,324				211.5
(b) Divert excess traffic to arterial roads (costs included in arterial road projects)					
(c) Crossings on roads of all functional classes					
Costs of remedying deficiencies—costs which are not included in road projects					14.7
Total cost for Melbourne inner urban area					1,950.7
BALLARAT, BENDIGO, GEELONG		Ballarat $million	Bendigo $million	Geelong $million	
Estimated cost of remedying deficiencies					
Functional classes 6 and 7 roads		5.8	6.4	10.2	
Functional class 8 roads		2.6	2.0	10.9	
Intersections of functional classes 6 and 7 roads		1.0	0.6	2.7	
Crossing costs not included in road projects		4.3	1.7	6.1	
Total cost for Ballarat, Bendigo and Geelong inner urban areas		13.7	10.7	29.9	54.3
Total cost for inner urban areas					2,005.0

TABLE 7

AUSTRALIAN ROADS SURVEY 1971/72

TRAFFIC ACCIDENTS RECORDED ON ARTERIAL ROADS (FUNCTIONAL CLASSES 6 AND 7) IN THE MELBOURNE INNER URBAN AREA

Road Type	Number of Accidents 1968-70 (3 years' total)						Vehicle-miles of Travel x 10^6 1969*	Accident Rate per Annum per 10^7 Vehicle-miles	
	Fatal Accidents			Injury Accidents					
	Day	Night	Total	Day	Night	Total		Fatal	Injury
Undivided roads (Excluding intersections with arterial roads)	235	424	659	6,988	5,389	12,377	3,760	0.6	11.0
Divided roads (Excluding intersections with arterial roads)	72	104	176	1,722	1,444	3,166	1,410	0.4	7.5
Freeways (Excluding intersections with arterial roads)	1	3	4	35	28	63	126**	0.1	1.7
Sub-total	308	531	839	8,745	6,861	15,606	5,296	Av. 0.5	9.8
Intersections of arterial roads	67	98	165	3,549	2,935	6,484	***	***	***
Total	375	629	1,004	12,294	9,796	22,090	5,296	Av. 0.6	13.8

* The vehicle-miles of travel for 1972 were factored back to 1969.
** The vehicle-miles for freeways have been adjusted to exclude sections not open during 1968-70. A proportional allowance has been made for sections of freeway opened during 1968-70.
*** No vehicle-miles are allocated to intersections.

Note: Arterial roads are functional class 6 and 7 roads.

2. FREEWAY PLANNING DIVISION

Provincial Urban Transportation Studies

The 1969/70, 1970/71 and 1971/72 Reports outlined progress on transportation studies for the provincial cities of Ballarat, Bendigo and Geelong. The 1971/72 Report indicated that the Ballarat Study was complete and that the Bendigo Study was nearly complete. The situation with the Bendigo and Geelong Studies as at 30th June 1973 is set out below.

(i) The Bendigo Study was completed during 1972/73. The total fee paid to the consultant, Rankine and Hill, was $118,040. Of this sum, $14,755 was met by the municipalities concerned which, with the Board, were co-sponsors of the Study.

Following the release of the consultant's Report No. 4, "The Recommended Road Plan, June 1972", a meeting between the Study Committee, the consultant and city and shire officials was held in July 1972 to discuss the recommended road plan. At the meeting it was decided to form a Standing Committee, consisting of representatives of the municipalities, to co-operate with the Board in co-ordinating local activities for the adoption and implementation of the plan. All the councils involved in the Study have advised the Board of their acceptance in principle of the road plan.

(ii) Three summary reports regarding the Geelong Study were presented to the Geelong Regional Planning Authority by the consultants on behalf of the Transportation Study Committee:

- "The Need for Road Planning in Geelong" (September 1972),
- "Development of a Transportation Plan for Geelong" (October 1972),
- "The Recommended Transportation Plan for Geelong" (March 1973).

The first and third reports were released to the public. The third report has not yet been approved by either the Geelong Regional Planning Authority or the Board.

A meeting was held in April 1973 to inform the public of the general transportation plan for Geelong.

The fee paid to the consultant, Wilbur Smith and Associates, to 30th June 1973 was $204,284, of which $25,376 had been met by the Geelong Regional Planning Authority which, with the Board, is the co-sponsor of the Study.

Freeway Route Planning

The following developments took place during 1972/73:

(i) Freeway F6: South Road, Moorabbin to Edithvale Road, Edithvale Section

The Country Roads Board and the Melbourne and Metropolitan Board of Works jointly engaged a firm of consulting engineers, Loder and Bayly, to conduct a community attitude survey in connection with investigations for the route of the above section of Freeway F6. Municipal councils, and the community at group and individual levels, have been interviewed.

(ii) Eastern Freeway

Following the receipt of Ministerial approval, route feasibility investigations were conducted, generally along the alignment of the Metropolitan Planning Scheme Route 19 from Mitcham Road, Donvale, to Mt. Dandenong Road, Ringwood, as shown in Figure 6.

(iii) Calder Freeway: Kyneton Section

In 1969 the Board approved in principle the location of this section. The Shire of Kyneton was subsequently notified and the scheme was put on public display. After discussion between the Kyneton Shire Council and C.R.B. officers, and a public meeting, the scheme was reviewed in 1972. The Board adopted layouts for the route during the latter part of the 1972/73 financial year.

The adopted route will connect to the existing Calder Highway near the 50-mile post south-east of Kyneton. and re-connect to the highway at mileage 55.5, north-west of Kyneton. North of Kyneton, the route will pass close to the town, and will allow direct access from the freeway to the expanding sale-yards/abattoirs complex and the nearby light industrial area. Interchanges will be provided at Bourke Street (allowing direct access from Melbourne to the town). Abattoirs Road and the north-west terminal. The

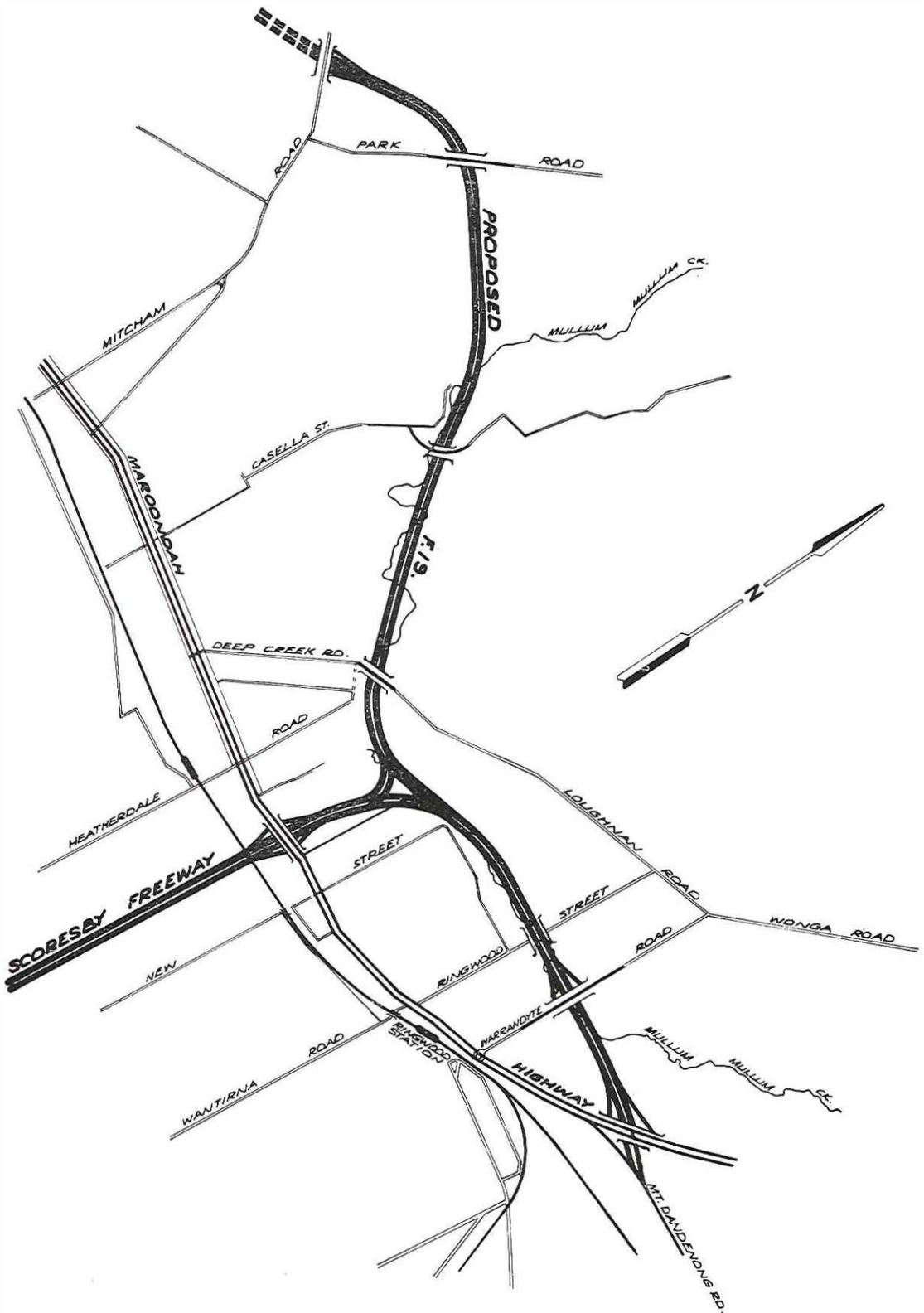


Figure 6—Route feasibility investigation for Eastern Freeway, Donvale to Ringwood.

freeway will also overpass an extension of Mollison Street, so that direct access between the town and the sale-yards may be maintained.

After construction of the freeway including the interchange at Abattoirs Road, and construction of a deviation of the Kyneton-Redesdale Main Road, the principal connection to Redesdale will be via Abattoirs Road. Use of this route will enable traffic through Kyneton en route from Melbourne to Lake Eppalock to by-pass the commercial centre of Kyneton.

(iv) Mornington Peninsula Freeway: Mount Martha-Dromana

The Board has approved preliminary layout plans for an extension of Mornington Peninsula Freeway from its present stage terminal at the Nepean Highway, Dromana, northerly to Mount Martha. The extension will connect with the Nepean Highway at the foot of Mount Martha hill. When constructed it will provide a second route to the Nepean Highway between Moorooduc Road and Dromana.

At the southern end of this section the freeway will overpass the Nepean Highway at Dromana. An overpass will be provided at Pickings Road, an existing direct connection between the Nepean Highway and Safety Beach.

(v) Mornington Peninsula Freeway: Chelsea-Seaford

During 1972/73 the Board approved preliminary layouts for the section of Mornington Peninsula Freeway from Eighth Avenue, Chelsea Heights to Armstrongs Road, Seaford, a distance of 4.4 miles. The route is located along the eastern boundary of Wells Road. Fully directional interchanges at Chelsea Road and Thompsons Road are proposed. The construction of this section, together with Frankston Freeway, will provide a continuous eight mile length of freeway from Chelsea Heights to the Frankston-Cranbourne Road as shown in Figure 7.

(vi) Hume Highway: Development to Freeway Standards

The planning of improvements to the Hume Highway has proceeded as resources and priorities have permitted, in order to achieve, ultimately, continuous freeway standards on this nationally important route.

Completion of current construction will provide two, two-lane carriageways, median divided and mostly to freeway standards, from Fawkner, approximately seven miles north of Melbourne, to the 58-mile post, south of Seymour.

Investigations of improvements to other sections of the Hume Highway have commenced. These include—

- a 14-mile freeway by-pass of Seymour and Avenel.
- freeway by-passes of the urban development areas of Benalla and Wangaratta, and upgrading of the route between these cities, and
- conversion to freeway standards of the existing highway between mileages 176, near Chiltern and 185, south-east of Wodonga.

Arterial Roads

Following a Government directive, investigations are proceeding into the feasibility of improving arterial roads in the inner suburbs to the east of Melbourne, mainly in the Richmond area. An extensive travel speed study has indicated that many of these roads operate with travel speeds of less than 10 km/hr. during peak periods. One possibility being investigated to alleviate the situation is an additional bridge over the Yarra River to connect Burnley Street with Williams Road.

Attitude Survey

Calder Freeway: Post-construction Attitude Survey.

Calder Freeway (Niddrie Section) by-passes the Keilor Road shopping centre. In the latter part of the 1972/73 financial year, after this section of the freeway had been in operation for some twelve months, a survey was conducted to obtain opinions regarding the freeway. Some 550 shoppers and businessmen in the shopping centre were interviewed. The survey was initiated and conducted by the Sociologist, Economist, Town Planner and engineers of the Freeway Planning Division.

One of the principal objectives of the survey was to obtain information that would assist the C.R.B. in the location and design of future projects. Investigations will be made on the comments received, which included the following—

- difficulties of entering and leaving the freeway,
- signing of the freeway exits,
- the pedestrian overpass near Niddrie High and State Schools arouses nervousness in some pedestrians when they walk on it during high winds,
- the need for improvement of landscaping and tree planting on areas adjacent to the freeway.

The majority of people who were interviewed considered that the freeway was a major benefit to the Niddrie area, in that travelling to the city and other suburbs had been made safer; through traffic on the local street system had been reduced, resulting in reduced noise and greater safety for pedestrians; and the shopping centre was now more attractive on account of reduced through traffic on Keilor Road.

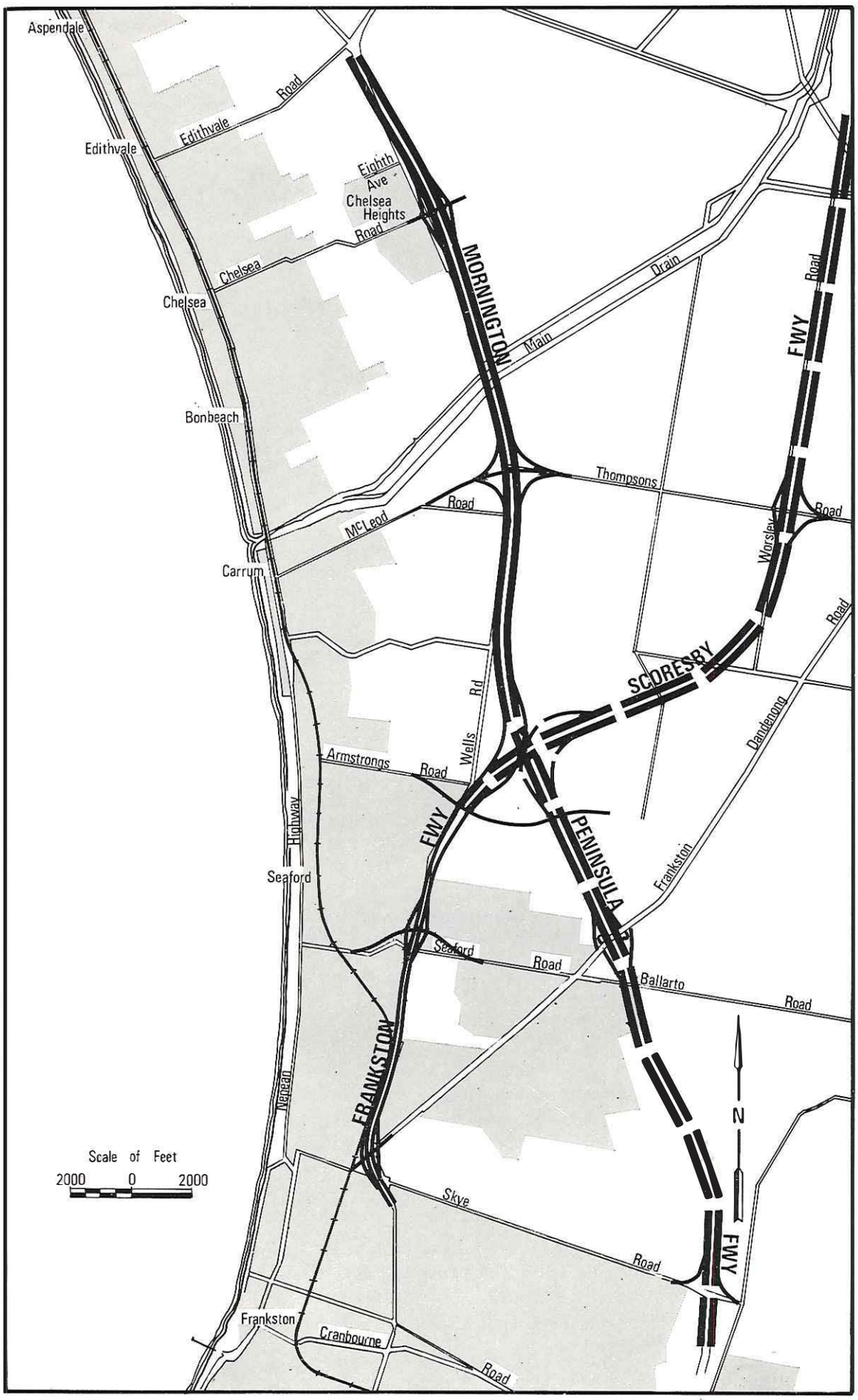


Figure 7—Mornington Peninsula Freeway and Frankston Freeway between Chelsea Heights and Frankston.

1. PLANS AND SURVEYS DIVISION

The Changing Design Task

The 1967/68 Report referred to trends in the nature of the Plans and Surveys Division's design task. These trends, from the design of undivided rural roads towards the design of divided arterial roads and freeways, have strengthened since 1967/68. Today, the majority of the resources of the Division are employed in connection with major projects, i.e. on surveys, photogrammetry, detailed location studies, boundary definitions and the preparation of detailed designs and specifications. The nature of the changes is discussed below.

Programming and Scheduling

The shift in emphasis requires more sophisticated programming and scheduling methods than were required a decade ago. In 1962/63 the majority of works required a period of twelve to eighteen months from the commencement of survey to the completion of specifications. However, because of the complexity of present day urban and rural road projects, more liaison with municipalities, planning authorities and service instrumentalities is now required and much longer investigation, planning and design periods are necessary. The work now carried out in the Division may require developmental periods of two to four years for rural projects and six to eight years for urban projects.

A resources scheduling system has been developed by P.A. Management Consultants Pty. Ltd. for use in the Chief Engineer's Branch of the Board (some details regarding the system are set out in the Bridge Sub-branch Section of this Report). Its use in the Plans and Surveys Division, in conjunction with similar scheduling systems in the Bridge Sub-branch and the Materials Research Division, is proving invaluable in the scheduling of the design operations included in major works. The system has been supplemented with a computer based system for the recording and retrieval of design performance. Under this system, individual designers record at the end of each week on a standard form, the type of work on which they have been engaged. The resultant data is recorded on punched cards and can be extracted in a variety of forms in order to ascertain the design effort employed on all facets of major projects. The data bank is expected to provide an improved basis for ascertaining the design resources that will be required for future projects.

Analysis and Design

The shift in emphasis to freeways and major arterial road projects has also necessitated the development of new techniques for analysis and design, as a result of the increasing demand for construction drawings. Within each design team, a particular designer now tends to concentrate on a certain aspect of a project. This specialization, together with advances in computer technology, has accelerated the development of more rigorous methods of analysis.

These new technologies are disseminated to the Divisional design offices through formal training courses and regular visits by senior members of this Division's staff, and are reflected in improved design practices and methods on all projects.

Computer-based design systems

The Division's computer programming and data processing section has continued to develop sophisticated programming techniques which are being integrated into a computer-based design system. The major advantage of this system is that it enables a far greater number of alternative designs to be studied, at a much lower cost than would be possible with manual techniques.

The following are the main tasks carried out by the section over the past year:

(i) Digital Terrain Model design system

Further work continued on integration of various existing programmes, under a Commonwealth Aid Roads Planning and Research grant. The following three phases of the system are now operational:

- Terrain collection phase

  This provides for the various methods of collection, such as stadia, digitizing or stereoplotter, to produce base terrain data, including cross sections and longitudinal plottings, for design.

- Horizontal geometry and offsets

  This phase provides the geometric computation to produce the co-ordinated design lines, offsets, offset co-ordinates and setting out tables, etc.

- Earthworks

  This phase computes the design levels of earthwork quantities and final listings and plots of cross sections.

The system is being developed on the CDC 3600 computer located at Canberra in the C.S.I.R.O. network, and further work is proceeding to integrate the above phases into the design system, using a data base concept.

(ii) Metric conversion

Metric versions of all road design programmes have been produced over the past year.

(iii) Perspective drawings

A programme was made available by the M.M.B.W. and, after amendment to C.R.B. requirements, is now available for use on an external IBM 360 50K computer and a Calcomp plotter.

(iv) Computer type-setting and photo composition

This system, which was extended during 1972/73, stores the base text on magnetic type. The text is thus more readily available for revision, alteration or amendment than is the case with conventional type-setting methods.

The output is in the form of bromide prints of high quality definition, in the size and style required, and needing only minor artwork prior to printing. The cost is competitive with traditional printing methods.

The system was used during 1972/73 to produce the C.R.B. General Conditions of Contract for Road and Bridge Works 1973 and a revision of the Road Design Manual (imperial edition). The revision and metric conversion of other C.R.B. manuals are also making extensive use of the system.

Photogrammetry

Photogrammetry programmes have been expanded rapidly to keep pace with the increased requirements of base mapping for freeway design. The Board's two Wild A8 stereoplotters at the Department of Crown Lands and Survey were continuously engaged on compilation of small scale photogrammetry for route locations and large scale photogrammetry for detail design. The following projects were mapped:

- Calder Freeway, Keilor to Bendigo (for route location),
- Latrobe Valley Freeway, Drouin to Warragul (for detailed design),
- Mornington Peninsula Freeway, Tuerong Road to Nepean Highway (for detailed design).

In addition, several mapping consultants were engaged to prepare large scale photogrammetric mapping. To facilitate this work, preliminary planning for all the projects was undertaken by two of the consultants. All project control surveys and photocontrol surveys for mapping purposes were done by the Board's surveyors.

A total of 29 mapping projects were initiated during the year and 19 were completed. Large and small scale photomosaics of each project are prepared for survey control establishment, for liaison with consultant mappers and for the supporting documents in the illustration of reports.

The total expenditure on photogrammetry, including planning, photography, control surveys, mapping and drafting requirements, was $242,000.

Further experimental and investigational work in photogrammetry was initiated. One experiment is the use of the Department of Crown Lands and Survey orthoprojector for the presentation of base mapping orthophotography (i.e. true to scale photography) over project routes in the Geelong area. This system is combined with existing topographic plans for use in preliminary location work. The end result is a contoured, true to scale photograph which is cheaper to produce than the conventional photogrammetric map.

2. TRAFFIC ENGINEERING DIVISION

Traffic Data Collection

For the first time, the results of the State highway coverage counting programme, for calendar years 1971 and 1972, were published in book form, for use within the Board. The same volume also contained the results of all intersection turning movement studies carried out by the Traffic Engineering Division during calendar years 1971 and 1972.

Turning movement study results are now processed with the use of the Board's computer. The programme calculates morning and evening peak hour volumes, and twelve-hour volumes, for each leg, and total traffic volumes using the intersection. The output, after superposition of a transparent overlay prior to production, is in the form shown in Figure 8.

Approximately 180 manual traffic surveys were carried out in 1972/73. These included intersection turning movement counts, pedestrian movement counts, speed studies, advisory speed determinations, railway level crossing delay studies and intersection delay studies. A major numberplate type origin and destination survey was made at Kilmore and a 24-hour combined numberplate and interview type origin and destination survey was made in the Benalla-Wangaratta area.

The annual traffic census was held on 21st March 1973. Twelve-hour (7 a.m.-7 p.m.) classification counts were taken manually at 2004 stations, 579 more stations than for 1972 due to augmented counting in Bendigo and Horsham Divisions. The following tabulation sets out the

increase in the Rural Highway Traffic Index (100 average for the base years 1957 and 1958) for the five years 1969 to 1973:

1969	1970	1971	1972	1973
193	201	218	240	250

In the 1973 census, an improved method of counting was used at three metropolitan intersections. Previously, at a high-volume, four leg intersection, eight persons were employed, recording one-way volumes on each of the legs. Turning movement volumes could not be obtained from the results. In the revised method, through and turning movements were recorded from each leg, requiring a total of four persons. To enable this, a simplified vehicle classification, as either cars or commercial vehicles, was used. Vans and utilities were classed as cars, and buses were classed as commercial vehicles. The estimated savings for the three intersections was approximately $400, and the use of the method is proposed to be extended in future.

The conversion from the system of portable counters using rubber tube detectors, to Sangamo counters using inductive loop detectors, continued during 1972/73, when seven rural counting stations were converted.

Linemarking

Three large and five medium machines and one small machine were available for linemarking operations in 1972/73. With the increase in fleet size, it is now possible to provide a more prompt service in the restriping of resurfaced lengths of road than was formerly the case, and in many instances restriping can currently be done within twenty-four hours of resurfacing. The average cost of linemarking per mile of equivalent standard stripe has increased as follows over the last five financial years:

1968/69	1969/70	1970/71	1971/72	1972/73
$12.91	—	$12.87	$13.69	$14.31
		100	106	111

Lighting on State Highways

An amendment to the Country Roads Act in 1971 provided for the Board, the electricity supply authority and the municipal council concerned to share the costs of street lighting on State highways, in cases where the lighting is not of a standard lower than the minimum standard determined by the Street Lighting Committee. This statutory committee set up under the Country Roads Act consists of one representative from the State Electricity Commission of Victoria, the Municipal Association and the Country Roads Board.

During the financial year 1972/73, 37 existing lighting installations involving approximately 31 miles of State highway lighting were approved by the Board and the Street Lighting Committee for cost sharing purposes. The annual tariff for these installations is approximately $90,400.

Three new installations involving approximately 1.3 miles of State highway were also approved. The estimated capital costs of these installations is $9,800 and the annual tariff is some $5,400. On completion of these installations capital costs and tariffs will be apportioned equally between the Board, the electricity authority and the council involved.

CRB

TRAFFIC ENGINEERING DIVISION

SUMMARY OF TURNING MOVEMENT STUDY

JOB NO.= 70

Intersection of PRINCES HWY EAST with WARRIGAL RD

Municipality OAKLEIGH Map Reference 69 F 6

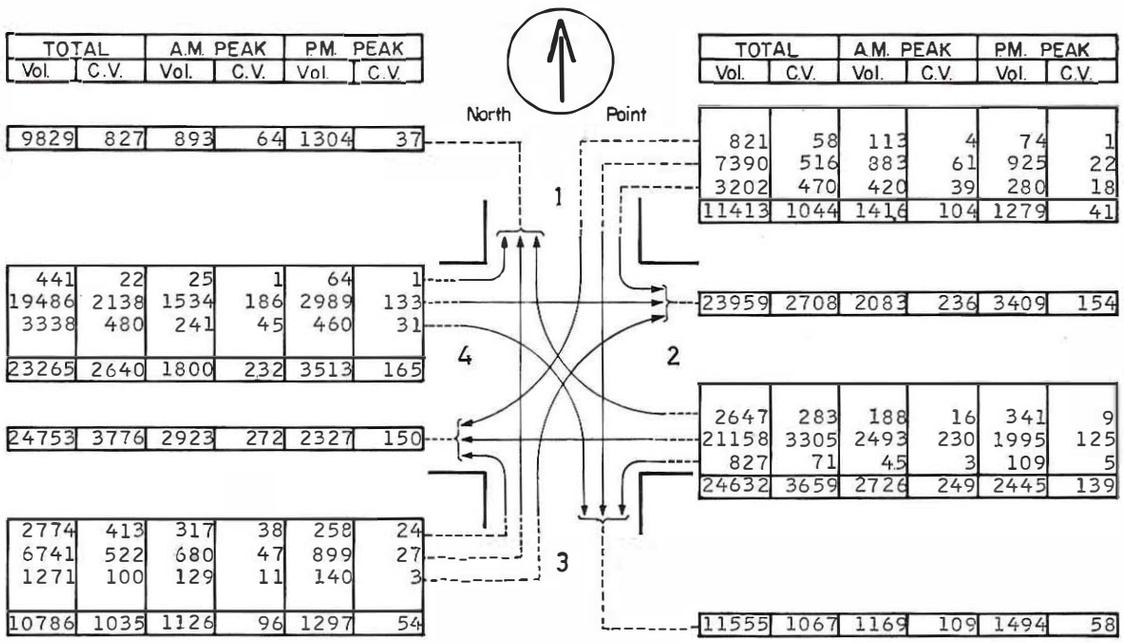
Day THURSDAY Date 30 AUG 73 Job Reference No. 73-070

Leg No.	Leg name	Bearing
1	WARRIGAL RD	NORTH
2	PRINCES HWY EAST	EAST
3	WARRIGAL RD	SOUTH
4	PRINCES HWY EAST	WEST

Duration of Count 7AM TO 7PM

A.M. Peak Hour 7.45- 8.45AM

P.M. Peak Hour 4.30- 5.30PM



	TOTAL		A.M. PEAK		P.M. PEAK	
	Vol.	C.V.	Vol.	C.V.	Vol.	C.V.
1	9829	827	893	64	1304	37
2	23959	2708	2083	236	3409	154
3	11555	1067	1169	109	1494	58
4	24753	3776	2923	272	2327	150
	70096	8378	7068	681	8534	399

	TOTAL		A.M. PEAK		P.M. PEAK	
	Vol.	C.V.	Vol.	C.V.	Vol.	C.V.
821	58	113	4	74	1	
7390	516	883	61	925	22	
3202	470	420	39	280	18	
11413	1044	1416	104	1279	41	
441	22	25	1	64	1	
19486	2138	1534	186	2989	133	
3338	480	241	45	460	31	
23265	2640	1800	232	3513	165	
2647	283	188	16	341	9	
21158	3305	2493	230	1995	125	
827	71	45	3	109	5	
24632	3659	2726	249	2445	139	
2774	413	317	38	258	24	
6741	522	680	47	899	27	
1271	100	129	11	140	3	
10786	1035	1126	96	1297	54	

Total vehicles using intersection

Vol. = TOTAL VOLUMES OF CARS AND COMMERCIAL VEHICLES

C.V. = VOLUMES OF COMMERCIAL VEHICLES

REMARKS:

Figure 8—Typical turning movement study results produced by computer processing.

1. ROAD CONSTRUCTION AND MAINTENANCE

Direct Labour Road Construction Costs

Tables 8 to 11 set out analyses of the costs of 84 construction and reconstruction jobs completed by direct labour by the Board during 1972/73 at a total cost of $6·3 m. Because of annual variations in regional and job mix factors and the number of cost statements submitted for analysis, the unit costs indicate only the general level of unit costs of carrying out particular stages of construction work.

TABLE 8—DISTRIBUTION OF EXPENDITURE

	1972/73	Five-year Average 1968/69 to 1972/73
	%	%
Plant	28.0	32.7
Labour	33.9	33.4
Materials	27.5	24.1
Stores	10.6	9.8
	100.0	100.0

TABLE 9—WORKS OVERHEAD EXPENDITURE

(Percentage of productive costs)

	1972/73	Five-year Average 1968/69 to 1972/73
	%	%
Construction overhead expenses	15.6	14.1
Camp expenses	8.3	10.1
	23.9	24.2

TABLE 10—FORMATION COSTS

(Including distributed overhead expenditure)

	ROCK		EARTH UNCLASSIFIED		TOTAL	
	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost
	cu. yd.	$	cu. yd.	$	cu. yd.	$
1972/73	84,037	2.11	1,390,696	1.19	1,474,733	1.24
Five-year average 1968/69 to 1972/73	123,517	1.72	1.526,021	1.18	1,624,835	1.23

TABLE 11—PAVEMENT COSTS

(Consolidated in place, including distributed overheads)

	FINE CRUSHED ROCK		COARSE CRUSHED ROCK		GRAVEL, ETC.		TOTAL	
	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost
	cu. yd. loose	$	cu. yd. loose	$	cu. yd. loose	$	cu. yd. loose	$
1972/73	140,375	6.78	77,803	5.92	675,935	2.43	894,113	3.42
Five-year average 1968/69 to 1972/73	121,588	5.50	67,622	5.03	934,862	2.37	1,224,073	2.87

2. MATERIALS RESEARCH DIVISION

Testing of Load Capacity and Settlement of Piles in Clay

The 1970/71 Report referred to pile loading tests carried out on prebored piles cast into clayey sands at the intersection of Gladstone Road with the Mulgrave Freeway. In 1972/73, six piles, in two separate rows of three, were driven in uniform medium clay at a site near the Stud Road Interchange on the Mulgrave Freeway, for purposes of research into the load capacity and settlement of piles in clay.

The piles are 14 in. x 14 in. reinforced concrete driven to a depth of 27 ft. Steel cables are grouted into bedrock at a depth of 110 ft to provide a reaction for loading the piles. The test arrangement is shown in Plate 1.

During pile driving, the relative performances of a steam hammer and a drop hammer were assessed and pile driving formulae were applied to the driving results to estimate pile loading capacities. Subsequent tests showed that the estimates of pile capacity correlated closely with the measured values.

A system of dial gauges mounted on datum beams was installed to measure the settlement of piles relative to the ground surface and relative to adjacent piles. An accurate optical level with a micrometer attachment was mounted on a pile remote from the test group to measure the absolute settlement of the group. Readings were taken to 0.001 in. and the accuracy was of the order of 0.002 in. for short term readings. This high degree of accuracy was necessary because of the very small settlements measured under working loads.

A typical loaded pile settled 0.030 in. under a load of 25 tons. An adjacent unloaded pile settled 0.006 in. due to the effect of interaction from the loaded pile.

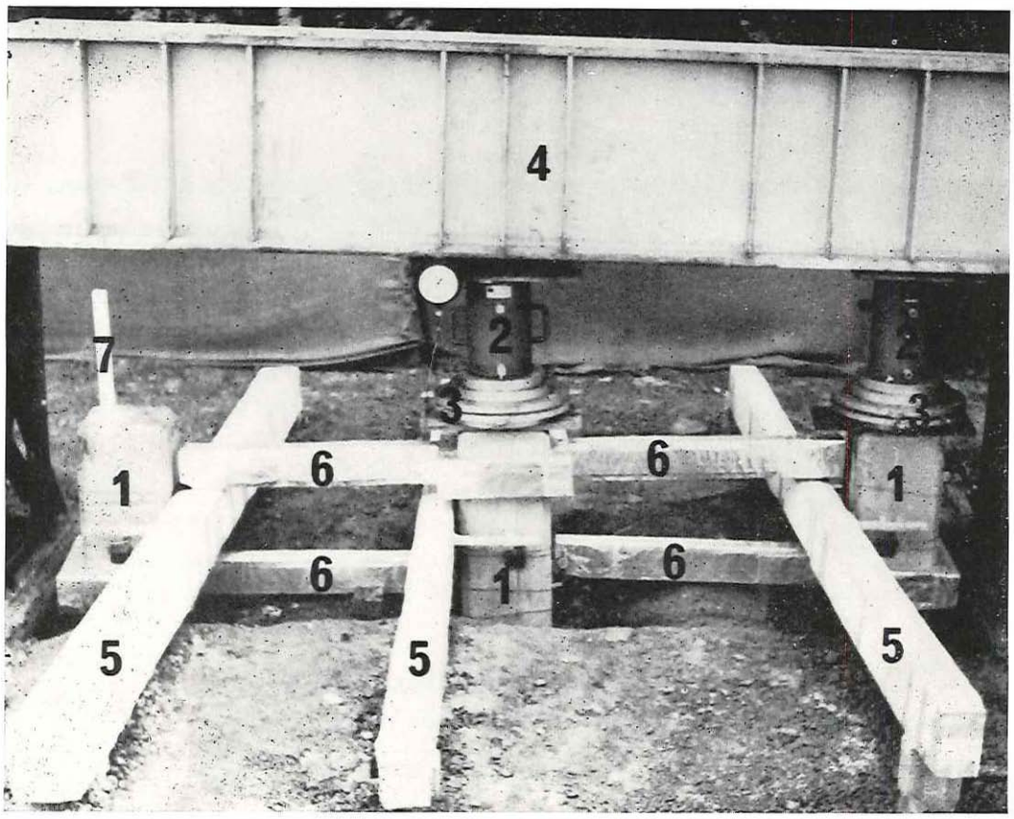


Plate 1—Pile testing at Stud Road.

1. *One row of test piles—14 in. square R.C. piles, toe depth 27 ft.*
2. *Hydraulic jacks, 200 ton capacity.*
3. *Load cells between load distribution plates.*
4. *Reaction beam, resting on supports. Anchor cables provide reaction.*
5. *Datum beams to measure pile movement relative to ground.*
6. *Beams to measure relative movement between piles.*
7. *Graduated scale, sight for optical level.*

Stress Corrosion Testing of Prestressing Tendons

In prestressed concrete bridge construction, the integrity of the structure depends on the steel prestressing tendons maintaining their applied tendon force. This represents a stress in each tendon of approximately 170,000 psi. Occasionally, failures of prestressing tendons have occurred in bridges, although most recorded failures have been found in prestressed concrete tanks and pipes. One failure mode involved in these circumstances is called stress corrosion cracking, which is a form of cracking produced by the combined effect of stress and a corrosive environment. Although the prestressed tendons in a bridge structure are surrounded by a nominally protective grout environment, entry of corrodants could be possible in a poorly grouted duct or corrosion could be induced by the grout components themselves. For this reason, since there is this possibility of a stress corrosion cracking failure of prestressing tendons in bridge structures, a research project has been undertaken in the Materials Research Division.

The susceptibility to stress corrosion cracking of various makes of 0.276 in. diameter steel tendon, and the relative effects of various environments, have been examined using a technique derived from fracture mechanics considerations. This approach requires a pre-existing crack in the tendon at the beginning of the test, as this obviates the period necessary for crack initiation, and allows crack growth to begin immediately the test commences.

Several brands of prestressing tendon have been tested in various environments, including water saturated with hydrogen sulphide, 3½% sodium chloride solution, distilled water, methocel and saturated calcium hydroxide solution. The first two of these environments are severe and would not be expected to occur in a tendon duct. The latter three are more typical of the environments which occur in a duct.

A testing technique has been developed using short lengths of tendon, each of which contains a circumferential fatigue crack which has a diameter approximately half that of the tendon. The notched tendon is loaded in tension in a special test frame which allows the load to be monitored by means of a loadcell. The corrosive environment is contained in a tube around the notch, with provision made for aeration of the solution if necessary. Plate 2 illustrates the test arrangement showing the loading frame, tendon and environment tube.

The load and the fatigue crack diameter are expressed as a single variable, the apparent stress intensity factor (K_Q), which is given by

$$K_Q = \frac{P}{D^{3/2}}\left[1{\cdot}72\ \frac{D}{d} - 1.27\right]$$

where P = load
D = tendon diameter
d = diameter of fatigue crack.

During a test the pre-existing fatigue crack will grow until the tendon fails due to overload after a period of time. This allows a plot of K_Q versus time to failure to be made, and the susceptibility of a tendon to fail by stress corrosion cracking in a given environment determines the shape of this curve.

Occasionally a tendon will not fail after several months of continual testing and on sectioning the tendon little or no stress corrosion cracking is found. This suggests that there may be a threshold stress intensity below which stress corrosion cracking is not initiated and consequently does not occur. This minimum value of stress intensity required to initiate stress corrosion is known as K_{Qscc}. As K_{Qscc} becomes larger, the defect necessary to initiate stress corrosion cracking increases in size, i.e. the tendon will tolerate larger defects without failure. A typical tendon when tested in 3½% sodium chloride solution has a value of K_{Qscc} of 38,000 lb/in.$^{3/2}$. For a realistic defect such as a thumbnail defect, the defect depth necessary to cause failure by stress corrosion cracking is given by

$$a = \frac{K^2_{Qscc}\left[1.46 - 0.212\left(\frac{\sigma}{\sigma_\gamma}\right)^2\right]}{1.2\,\pi\,\sigma^2}$$

where a = defect depth
σ = design stress, say, 0.7 UTS
σ_γ = yield stress, say, 0.85 UTS
UTS = 240,000 lb/in.^{2}

Then the maximum depth of tolerable defect will be 0.018 in.

K_{Qscc} for water saturated with hydrogen sulphide is approximately 15,000 lb/in.$^{3/2}$ and this corresponds to a maximum tolerable thumbnail defect depth of about 0.003 in. No test failures have occurred with the other environments used and so no estimate of tolerable defect sizes can be given, but these sizes of defect would not be less than that for 3½% sodium chloride solution. This grading in tolerable defect size enables the classification of various tendon/environment combinations into an order of relative susceptibility to stress corrosion cracking. Only small variations in susceptibility have occurred between different brands of tendons tested in a particular environment, and the important variable in the tests has been found to be the corrodant.

The severe conditions under which failures have occurred are not typical of conditions in a bridge duct. The two severe environments, sodium chloride and hydrogen sulphide, are not normally encountered in a duct and the pre-existing crack is a more severe defect than

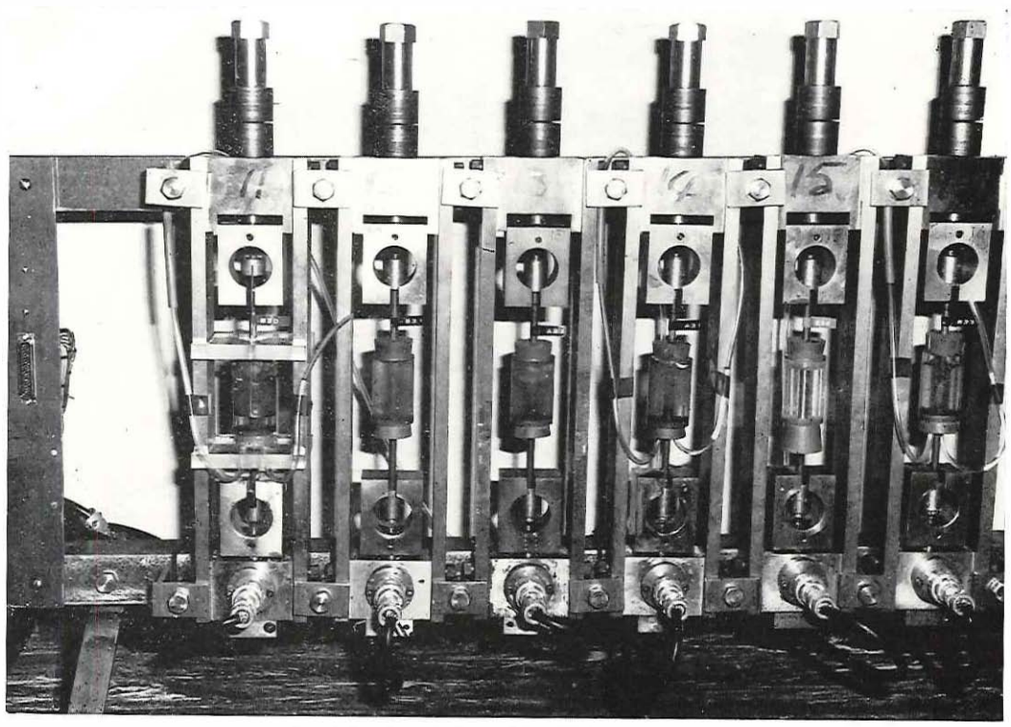


Plate 2—Array of stress corrosion tensioning frames.

the very small pit which would at worst occur in a tendon. However, there may also be an additional effect involved with the stray and leakage potentials which often exist in a bridge due to the location of electricity cables on or near the bridge. It is known that the presence of an external potential, such as those occurring in a bridge, can alter the corrosion behaviour of a given system, so much so that a normally passive system can be made highly corrosive. With regard to the influence of these potentials, the investigation is still proceeding.

Data Acquisition System

In research projects it is quite common for large volumes of data to be recorded in the course of experiments. The point is quickly reached where manual recording of the data becomes uneconomical and impracticable. An example is the loading programme necessary to develop full tendon load and simulated dead load on a scale model, which has recently been built, of the Gordon Street Overpass of the Princes Highway West. Calculations indicated that, for this preliminary part of the project, a total of about 30,000 readings would have to be made on the various strain gauges and load cells on the model. Manual recording of this data would take two men a minimum of 30 seconds per reading, requiring a total time of 500 man-hours of continuous data recording.

A data acquisition system, which can automatically read and record at high speed the data from the model, was recently installed (Plate 3). The system consists of a digital voltmeter which records voltage to 0.0001 millivolts, a 130 channel automatic scanner and a punched tape output. Using this system, a reading can be made and recorded in less than half a second, so that 30,000 readings can now be recorded in about 4 man-hours. The system can be expanded to 1,000 channels if required.

Plate 3—Data acquisition system recording data from the 1/10th scale model of Gordon Street Overpass.

Signing and Delineation Materials

(a) Corner-cube Guide-post Delineators

A corner-cube delineator is a compound prismatic lens system moulded from acrylic plastic and possessing the ability to accept light from a vehicle headlamp and to reflect it back to the vehicle in a limited cone, the axis of which is a line between the headlamp and the delineator. A corner-cube delineator provides efficient reflection back to the driver at angles up to 30° incident to the face of the delineator.

The assessment of high intensity corner-cube delineators on guide-posts has been in progress on the Calder Highway (Gisborne-Woodend section) for almost a year. This project is evaluating the relative performances of 2 in. and 3 in. diameter corner-cube button delineators and the current standard reflective sheeting strip delineators, shown in Plate 4. Initially, the corner-cube delineator exhibits a reflectance per unit area some 20 times greater than the strip delineator and, further, the life of an undamaged corner-cube has been recorded overseas to exceed 30 years, compared with a life expectancy of three to five years for reflective sheeting strip delineators.

The night view (Plate 5) indicates the greater efficiency of the corner-cube delineators compared with the standard strips.

During periods of wet weather, the performance of any delineators mounted close to the travelled way is drastically reduced due to a film of mud splashed on them by passing vehicles. Corner-cube delineators continue to provide more acceptable delineation under these conditions than do the strip delineators, which soon become ineffective. Frequent washing of the strip delineators is required to maintain an acceptable level of reflective efficiency, and this is a costly maintenance operation.

Preliminary subjective reports on the Calder Highway test section indicate that:

(i) the reflective performance of the corner-cube delineators has continuously exceeded that of the strip delineators, although the corner-cube delineators have only been washed once in the test period and

(ii) the efficiency of the corner-cube delineation is particularly apparent when driving along the section during heavy rain, when on-coming cars create windscreen glare. Under these conditions the strip delineators are all but invisible.

The only problem with the corner-cube delineators observed to date is the high rate of vandalism which occurred during the first four months after installation, when 36% of the delineators were removed or damaged. It has been encouraging to note that during the second four-month period, after replacing all damaged or missing buttons, only 10% were damaged by vandals. During the third four-month period, very few damaged or missing buttons were noted.

(b) Road Luminance and Illumination Measurements

Road luminance measurements assess the brightness of pavements illuminated by overhead lanterns. Periodic measurements of road surface luminance provide data that will aid engineers in making objective assessments of changes in surface texture that affect night time visibility.

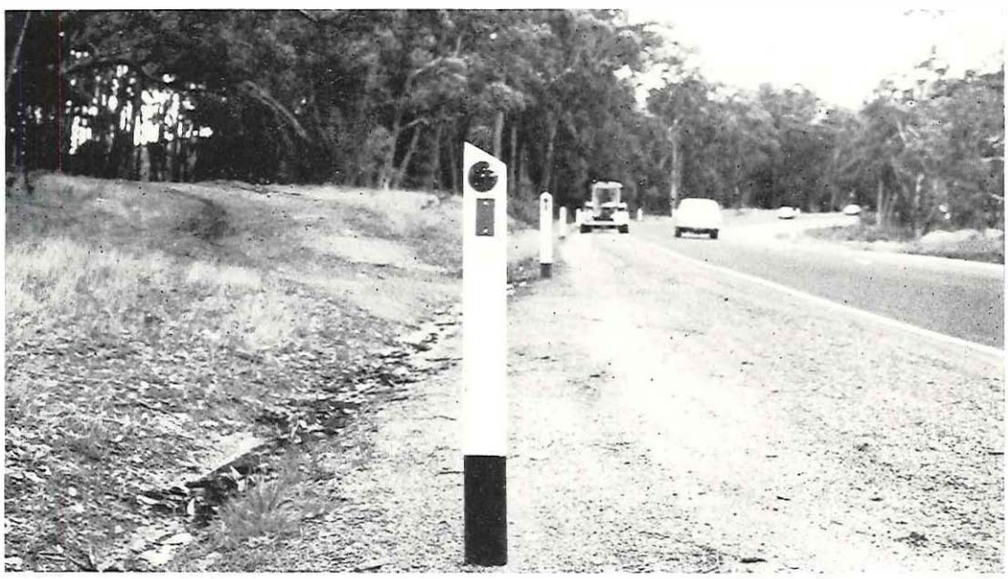


Plate 4—Red corner-cube delineator and red reflective sheeting strip delineator.

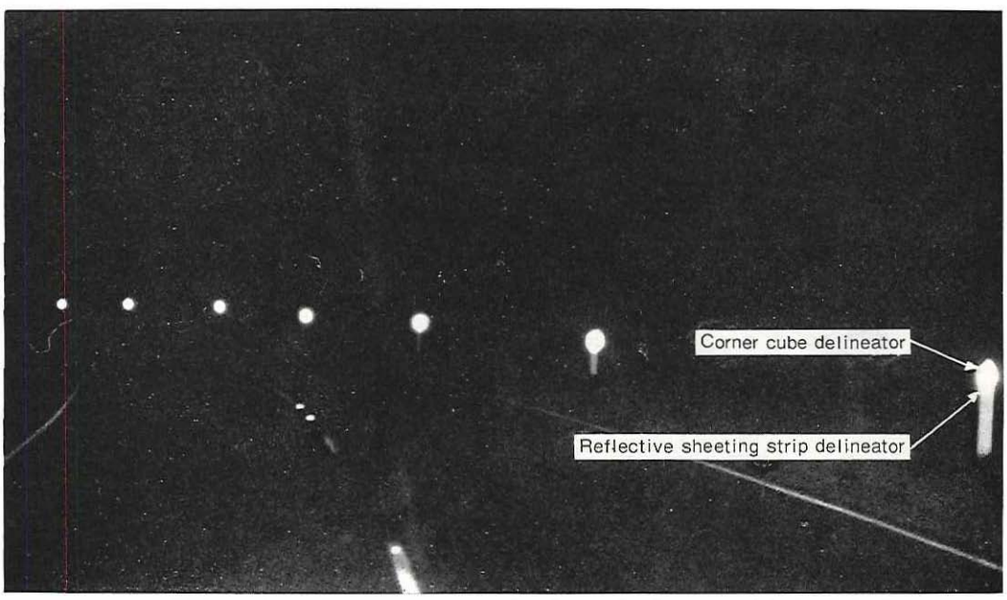


Plate 5—Night view of guide-posts, showing the relative performances of corner-cube delineators and reflective sheeting strip delineators. It will be noted that the former appear far larger and brighter than the latter.

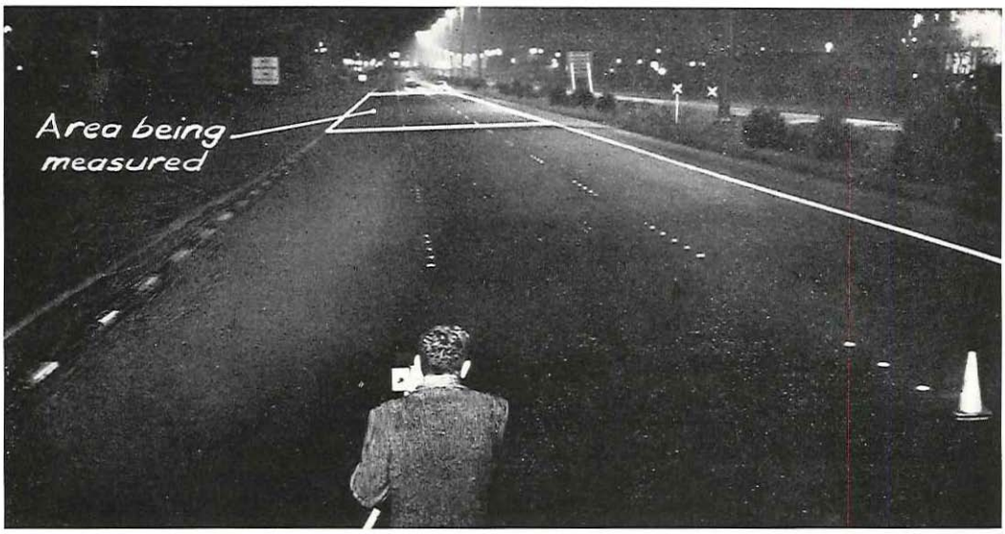


Plate 6—Rosenhagen road luminance meter in use to determine the average luminance of the area shown. The 1° observation angle between the instrument and the road at the centre of the observed area is approximately equal to the angle between a car driver's line of vision and the road.

Plate 6 shows the Rosenhagen road luminance meter set up to measure the average luminance of a section of roadway. Provision is made for either measuring the average luminance of various pavement areas or taking spot readings by inserting any of 20 masking slides into the optical system of the meter.

Illumination measurements indicate the amount of light received from the overhead lanterns by the road surface. The measurements provide data to determine the efficiency and maintenance factor of the various lanterns.

For making illumination measurements, a United Detector photometer is used. A grid pattern is laid out on the roadway (including the shoulders) between two adjacent lighting poles. Spot measurements are taken at each point in the grid by placing the photoreceptor unit face up on the pavement.

Road luminance and illumination measurements have been taken on the Lower Yarra Freeway. The results of the measurements are shown in Figure 9.

(c) Weathering Rack for Signing Materials

A weathering rack for signing materials has been installed on the roof of the Materials Research Laboratory, Kew, to complete the scheduled four environmental stations. The other stations are at Warrnambool, Warracknabeal and Mt. St. Bernard. These environmental weathering stations are to provide data on the performance of various reflective materials, fluorescent sign face materials and paint systems being used or proposed for use in the Board's road signing. All installations are similar and the Warrnambool station exposes the materials to a coastal environment, the Warracknabeal station (Plate 7) to warm, dry, inland conditions and the Mt. St. Bernard station to cold, mountain con-

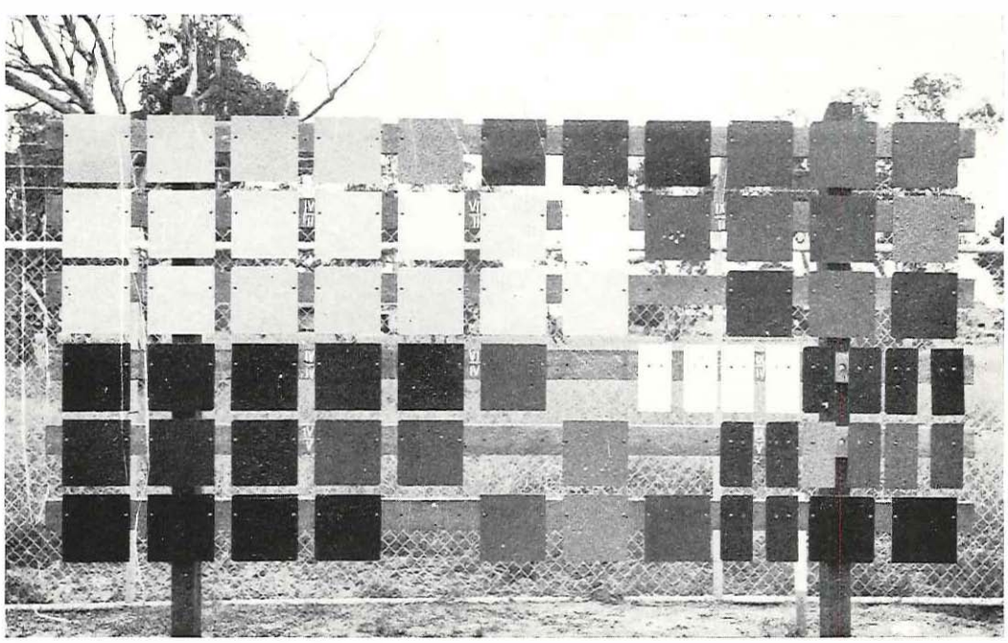
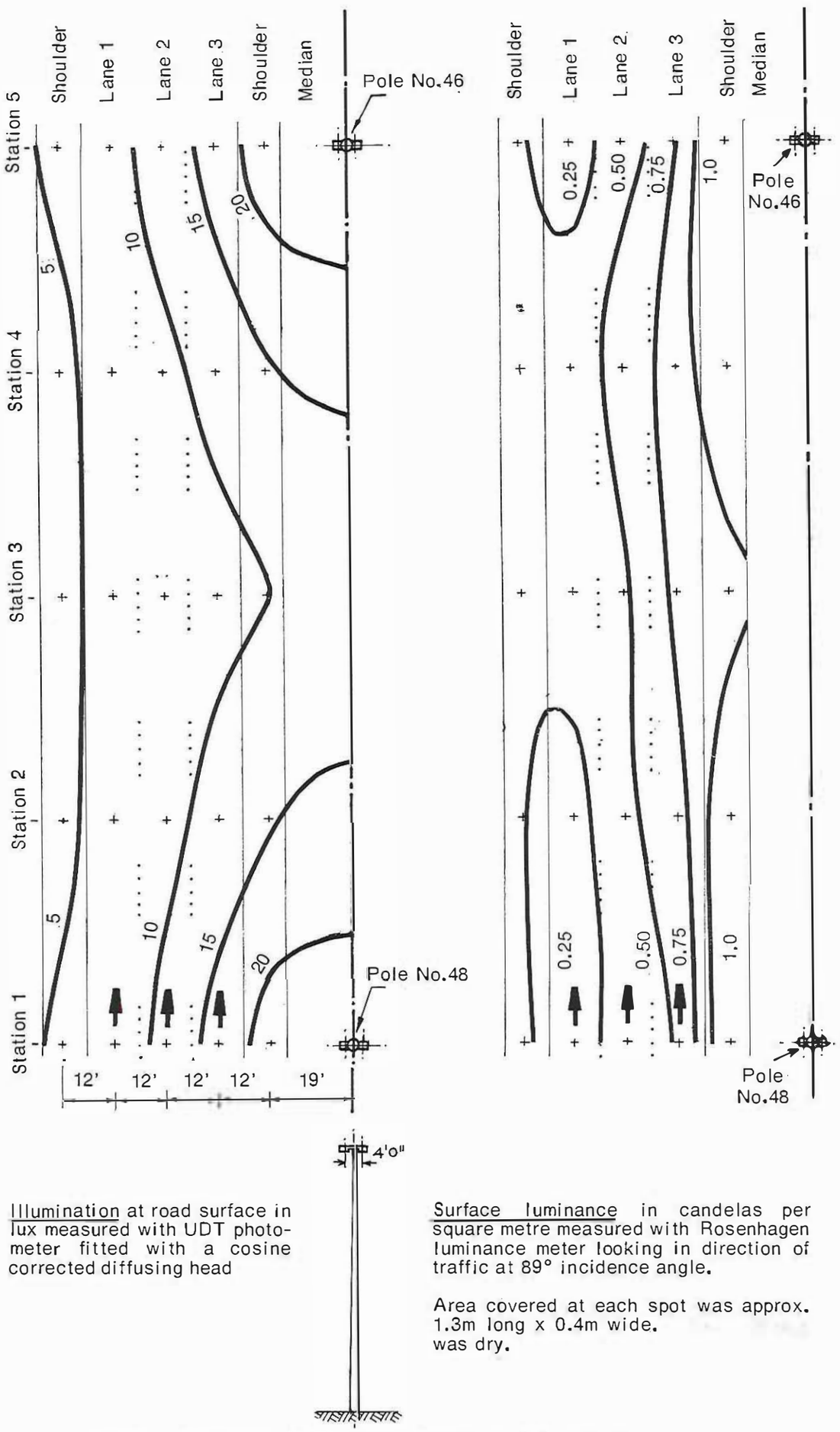


Plate 7—Weathering rack at Warracknabeal.



Illumination at road surface in lux measured with UDT photometer fitted with a cosine corrected diffusing head

Surface luminance in candelas per square metre measured with Rosenhagen luminance meter looking in direction of traffic at 89° incidence angle.

Area covered at each spot was approx. 1.3m long x 0.4m wide.
was dry.

Lanterns 60 ft high on poles at 208 ft centres. Philips 1 x SON-7, 400 W, 2 lanterns per pole.

Figure 9—Road illumination and luminance measurements taken on the Lower Yarra Freeway east of Millers Road at 7.00 p.m. on 8th June 1973.

ditions. As these three racks are inspected only once a year, the rack on the laboratory roof was installed primarily to facilitate frequent observations of the performance of the various signing materials.

(d) Evaluation of Safety Jackets

The "target value", wearability and fade resistance of available textiles and plastics suitable for making into red safety jackets for patrolmen and traffic controlmen have been assessed. It is important that these men be supplied with safety jackets which will be clearly visible, so reducing the hazards associated with road construction and maintenance work. Of primary importance is that the shade and intensity of colour provide the highest possible contrast with all roadside backgrounds that may be encountered, such as yellow trucks, construction equipment, green foliage, clear sky and various soils. Studies in the United States, Canada and Europe proved that the most "eye-catching" colour under all terrain conditions is fluorescent red-orange. Subsequently the textile industry developed a fabric-backed plastic that met the colour requirements. Unfortunately, the plastic jackets had a low "wearability" characteristic because plastic does not "breathe" and, although the material produced was excellent for warning flags and signs, patrolmen and traffic controlmen were understandably reluctant to wear a jacket of this material on a hot day.

Recent concentrated efforts on the part of the dye and textile industry have produced a mixture of relatively stable fluorescent red-yellow dyes in combination with an acrylic fibre which can be woven into a suitable fabric. Economy dictates that after safety and wearability, resistance to fade is the controlling factor influencing the adoption of a particular material, as any fluorescent material necessarily deteriorates rapidly under ultraviolet radiation from the sun. To evaluate this factor, the Board has constructed a fade tester (Plate 8), similar to a design developed by the Defence Standards Laboratories and the textile industry in the United Kingdom. The tester is inexpensive ($50) and simple in design, and results correlate reasonably closely to those obtained from the industry's standard Fade-O-Meter (cost approximately $2,000). The light source is a 500 watt mercury-tungsten fluorescent lamp with a life of about 2000 hours.

The fade tester has been operated more than 6000 hours, evaluating some ten different types of fluorescent materials and fabrics (Plate 9) as well as reflective sheeting and coloured plastic safety devices.

The final selection of the red-orange acrylic fabric for the patrolmen's safety jacket has been based primarily on the superior performance exhibited in the fade tester. Prototype jackets have been made of the selected material and samples have been field tested for evaluation of wearability and washability.

Effect of Wet Road Conditions on Drivers' Visual Perception

An audio-visual presentation has been prepared and shown to the Board's road construction and traffic engineers to draw attention to the serious optical deficiency of smooth roads under wet conditions at night, and the advantages in these conditions of sprayed seals with deep surface texture.

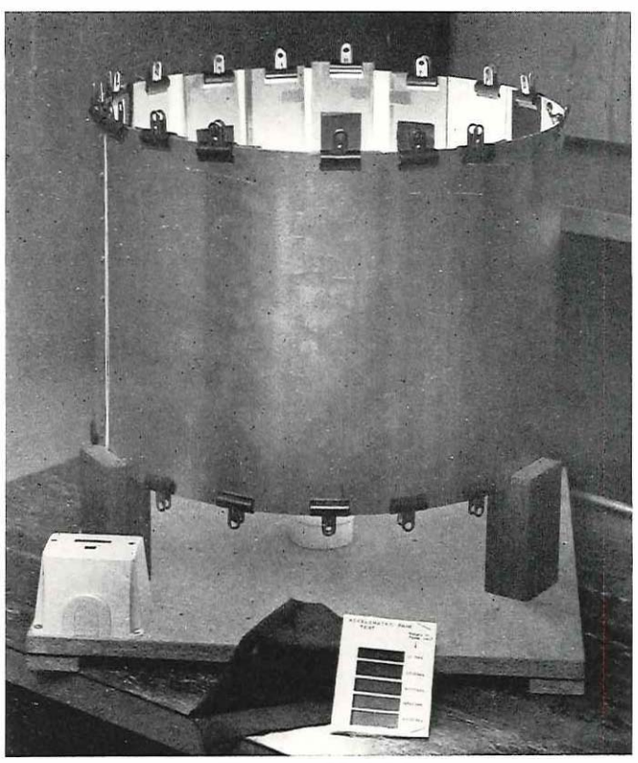


Plate 8—Fade tester.

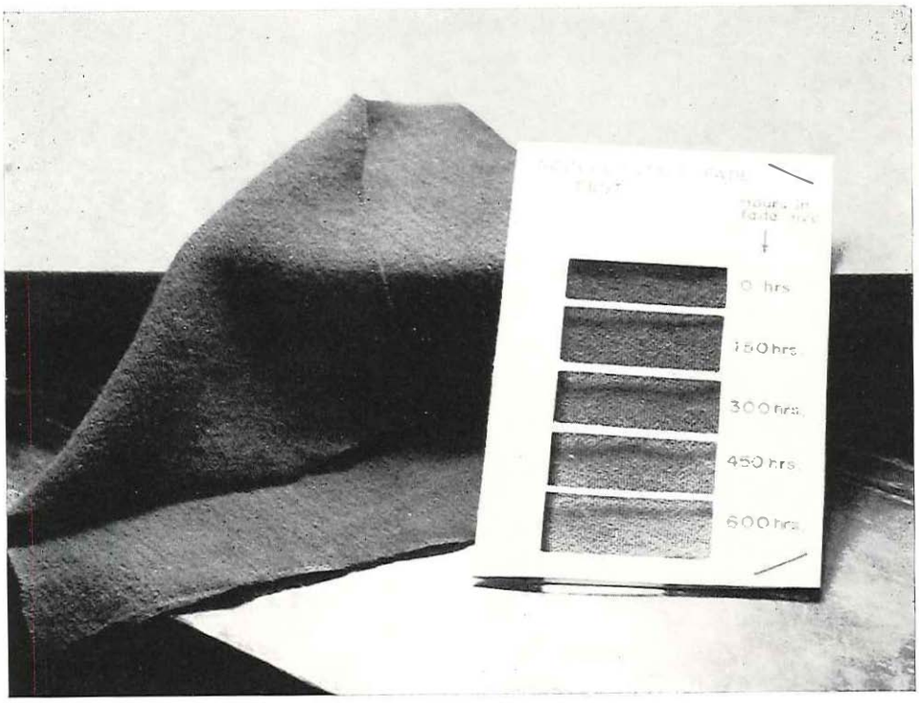


Plate 9—Fabric after fade testing.

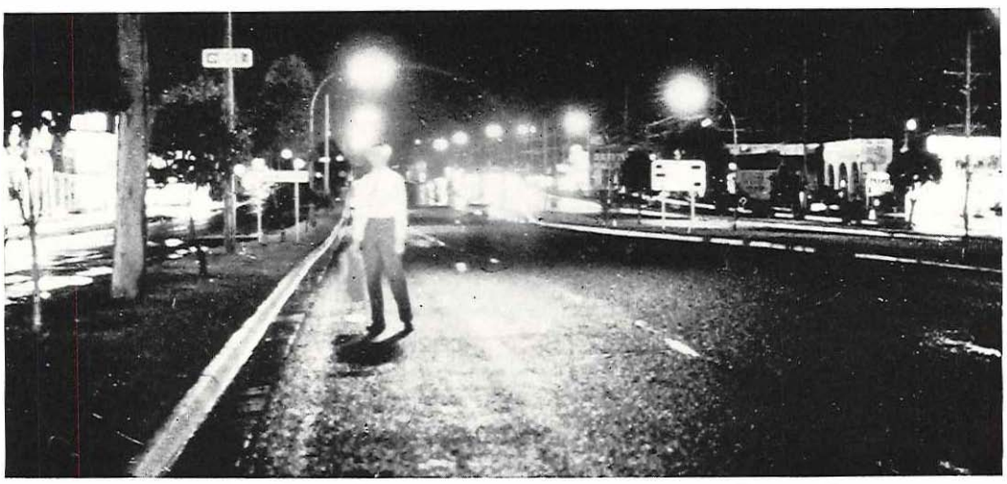


Plate 10—Pedestrian clearly visible while standing on a sprayed seal on the Maroondah Highway at night under wet conditions.

When a road with a smooth surface is wet, water can bridge the gaps in the surface and form a continuous sheet, so that the roadway becomes an imperfect mirror, which reflects lights as streaks. When there are many light sources, which may be of all colours and intensities, fixed or attached to moving vehicles, and flashing or constant, the driver is aware of a multitude of streaks, all in motion relative to him. It will be evident that in these conditions, objects which are otherwise obvious may not be perceptible to the driver.

However, if the surface is rough, as in the case of a sprayed seal, water can no longer bridge the gaps between asperities and mirror reflection does not take place. As a result, the reflection of light sources is greatly reduced.

The contrast between a smooth asphalt and a rough sprayed seal at a junction of the two types of surface on Maroondah Highway is illustrated in Plates 10 and 11. The relative perceptibility of a pedestrian in the two environments is obvious from the photographs.

Retroreflectors with exposed beads, eg. the Board's centreline markings, become difficult to see in wet conditions, mainly because the beads are small and the gaps between them are easily bridged by water on the road surface. Also, they cannot function satisfactorily without a spherical glass-to-air interface, which is removed by the presence of water. Corner-cube pavement markers continue to be useful and they even improve in performance, in wet conditions.

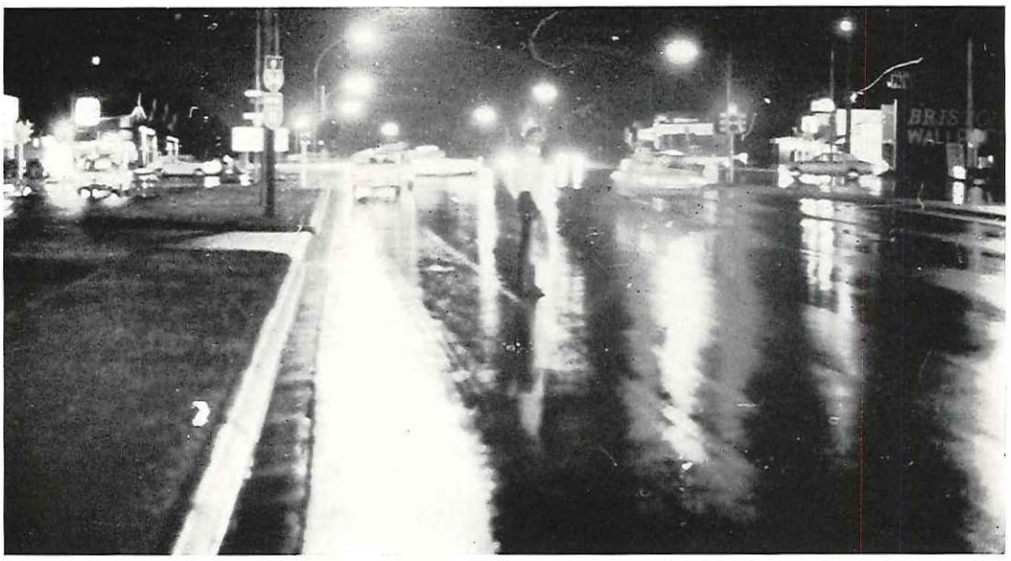


Plate 11—Pedestrian scarcely visible, due to light reflections, when standing on a smooth asphalt pavement on the Maroondah Highway. This pavement is adjacent to that shown in Plate 10 and the conditions of weather and lighting were the same in each case.

New C.R.B. Electrical Friction Cone Penetrometer

The Materials Research Division has developed a new model electrical friction cone penetrometer, shown in Figure 10. The design is based on a design used by Fugro Ltd., Holland, but has a simplified assembly.

The new model is much smaller than the original C.R.B. electrical friction cone penetrometer, as indicated by the following data:

	New	Original
Projected area of cone (sq.cm.)	10	20 approx.
Friction sleeve area (sq.cm.)	150	465

The major reasons for adopting the new penetrometer are:

(i) halving the cone area greatly increases (up to twice) the penetrating capability for a given reaction from the penetrometer test vehicle,

(ii) the smaller cone can be better calibrated in the laboratory under controlled stress and soil conditions and

(iii) the new size conforms with the standard European size, thus enabling direct comparison of test results.

The penetrometer is at present undergoing field trials in preparation for use in routine foundation investigations when a new penetrometer test vehicle is available late in 1973.

Full Depth and Deep Strength Asphalt Pavements

The Board and municipalities are making increasing use of both full depth and deep strength asphalt pavements in the Melbourne urban area. Recently this type of construction has been used at Kew Junction in the City of Kew (9 in. of asphalt on 6 in. of granular material on a sub-grade of design C.B.R. of 6, with design traffic of 1,500-4,500 commercial vehicles per day), and Springvale Road (Plate 12) in the City of Waverley (11 in. of asphalt on 6 in. of lime stabilized clay subgrade of design C.B.R. of 4, with design traffic of 1,500-4,500 commercial vehicles per day).

The major advantages of these two types of pavement when compared with a conventional flexible granular pavement are that the depth is about halved: less materials are used: cost is usually no greater; and perhaps the most important factor is that construction time can be reduced, provided that adequate job control is exercised.

Pavement design and cost considerations led to the adoption of a deep strength asphalt pavement, consisting of 13 in. of asphalt on 5 in. of granular subbase placed on the prepared subgrade, for a proposed north-south freeway in the Melbourne metropolitan area. Where satisfactory subgrades exist on the route, consideration will be given to adopting a 14 in. full depth asphalt pavement placed directly on the prepared subgrade. A conventional flexible granular pavement would require an 18 in. total pavement depth made up of 4 in. asphalt surfacing and a balance of granular materials.

To obtain first-hand knowledge of the use of this type of pavement, a senior Board engineer travelled overseas in 1972 to study the design and construction of full depth and deep strength asphalt pavements in Canada, the United States of America, the United Kingdom, the Netherlands and West Germany. The engineer also attended the Third International Conference on the Structural Design of Asphalt Pavements in London. The report of this study tour, which is listed in the Publications section of this Chief Engineer's Report, comments favourably on these types of pavement.

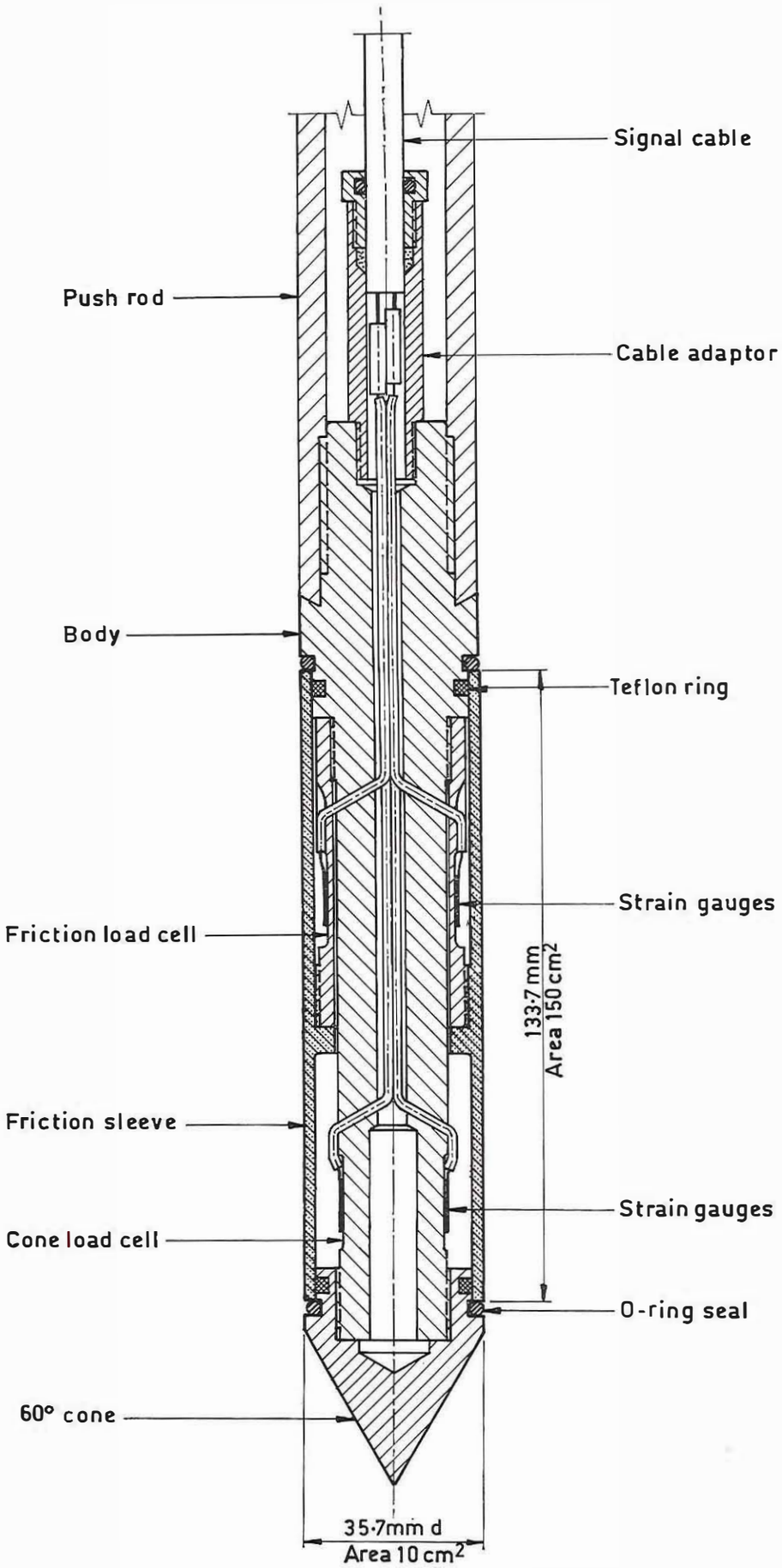


Figure 10—New model C.R.B. electrical friction cone penetrometer.

Plate 12—Springvale Road in Waverley City under construction with a deep strength asphalt pavement. The first 4 in. layer of asphalt is being placed on a 6 in. lime stabilized clay subgrade.

Research, and test roads under various environmental conditions overseas, have shown the full depth asphalt pavement to be superior in strength and performance to both the deep-strength asphalt and conventional granular pavements, mainly because, in these latter two types, the granular layers collect and hold water on the top of the subgrade, thus leading to weakening of the subgrade.

There are several methods of design of full depth and deep strength asphalt pavements, such as the Shell Method, the Asphalt Institute Method, and the Equivalencies Method (based on the AASHO road test and other experimental road sections). The "equivalencies" are usually of the order of:

1 in. of asphalt = 1 in. of asphalt surfacing = 2 in. of crushed stone or granular base = 2.7 in. of gravel or granular subbase.

Skid Resistance Measurements with SCRIM

In March 1971, experimental sections of sprayed seal were placed on the Maroondah Highway at Blackburn. Three different aggregates were used, representing a range of polished stone values (polished stone value is a measure of how a stone will polish under a standardized amount of laboratory polishing. It is indicated on a scale of 0 to 100: the higher the polished stone value of a stone, the more resistant it is to polishing). The intention was to assess the performance of various aggregates under heavy traffic to provide a guide in the selection of sealing aggregates for areas where skidding may be a problem.

The materials tested, and their polished stone values (PSV) were:

Material	PSV
Toscanite	43
Newer basalt	49
Scoria	53

During the past two years, periodic checks on the skid resistance of the surfaces were made at selected locations, but it was not possible, with the equipment then available, to obtain an overall assessment of skid resistance and its variation with traffic behaviour. This is now possible with the use of the Sideways-force Coefficient Routine Investigation Machine (SCRIM) shown in Plate 13. A typical plot of results from the test sections is shown in Figure 11.

For the test sections, the average sideways force coefficient (SFC) (the value of the road surface skid resistance as measured with SCRIM) after two years under a total traffic volume estimated at 5.4 million vehicles, is as follows:

Chainage (metres)	SFC x 100		
	Scoria aggregate	Newer basalt aggregate	Toscanite aggregate
0 - 200		65.9	
200 - 460			56.3
460 - 570	62.6		
570 - 780			54.6
780 - 960		69.7	
960 - 1080	75.1		

The effects of braking and turning traffic are reflected in the lowering of the SFC, as shown in Figure 11, at the median openings at Cottage Street, Surrey Road and Chapel Street.

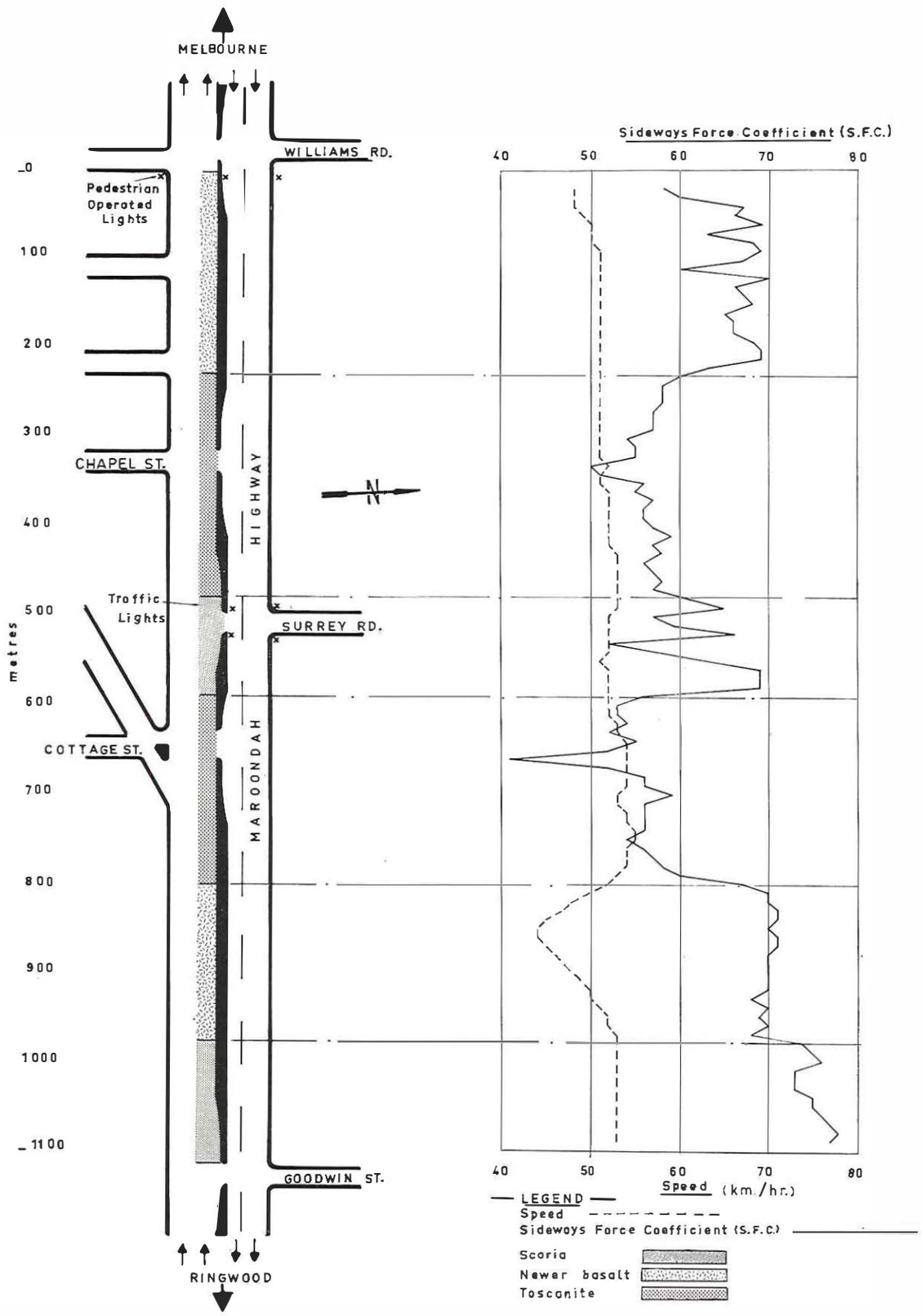


Figure 11—Plot of results from use of SCRIM.

Plate 13—Sideways-force Coefficient Routine Investigation Machine (SCRIM) with inclined test wheel in non-operating position behind the cab and spare test wheel attached at rear of vehicle.

Field Laboratory Accommodation

The use of field laboratories is becoming more common on larger construction jobs, where the increasing work output rates, and the consequent need for testing on a regular basis, require the full-time attendance of one or more testing officers. The Materials Research Division is currently operating six field laboratories on Metropolitan and Dandenong Division jobs, and three on Major Projects Division jobs.

Over the past decade field laboratory accommodation has advanced from single Stanley huts equipped with perhaps only a portable gas burner, a small balance and a set of sieves, to demountable, modular construction buildings eight squares or more in area, equipped with a full range of modern soil testing equipment.

In recent years, jobs which required one or two testing officers were supplied with double Stanley huts fitted out as laboratories. These laboratory buildings had a floor area of 16 ft by 12 ft, and with some effort they could be arranged to provide adequate accommodation. Their main disadvantages were that all equipment had to be removed from them for transport from one site to another, and frequently they had to be dismantled and then re-erected.

Approximately two years ago a new type of fully transportable laboratory was designed to replace the double Stanley huts. This unit has the same floor area, but provides a much higher standard of accommodation. The main advantage is that it is constructed on a steel sub-frame which enables it either to be lifted by a crane on to a conventional semi-trailer or to be jacked up so that a low-loader can be driven under, for transport from site to site (Plate 14). The laboratory can be moved fully equipped. Unloading and levelling at a new site takes less than half an hour. The sub-frame is designed also to act as a pair of skids which allows the laboratory to be towed from place to place at a particular site.

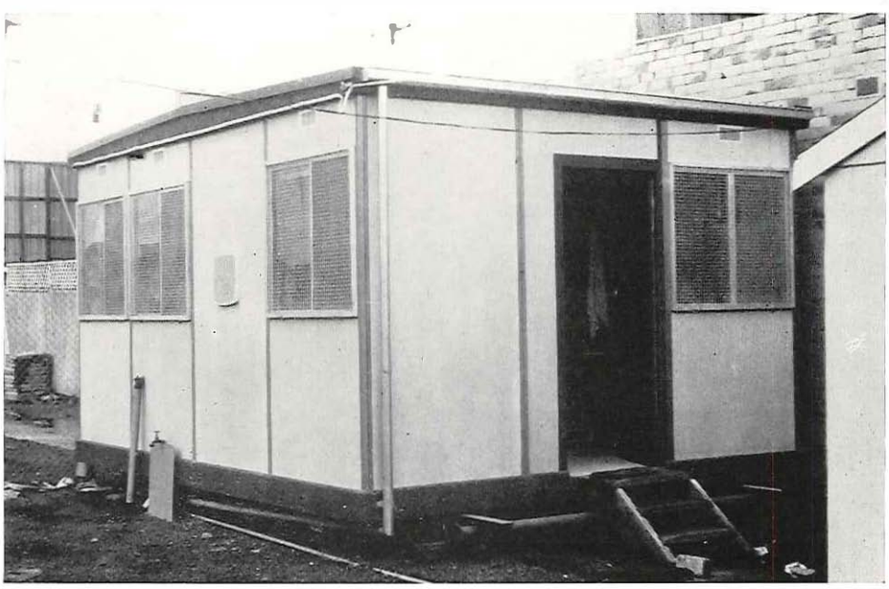


Plate 14—Exterior view of fully transportable laboratory, showing steel sub-frame.

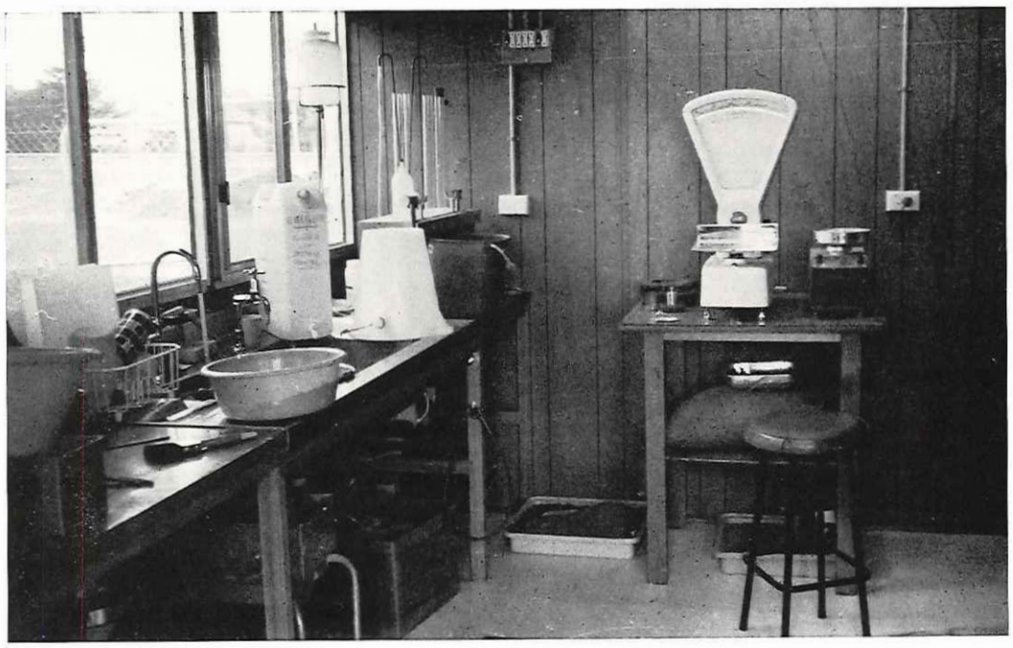


Plate 15—Interior of fully transportable laboratory, showing bench and sink.

The unit costs about $1800 for the basic building, including a bench and floor tiles. Electrical and plumbing work, including the provision of two exhaust fans and a stainless steel sink, costs an additional $700. The total cost of $2500 is only about half that of a caravan-laboratory of comparable floor area.

The laboratory is equipped with a forced-draught oven, a sieve shaker, a soil mill, two balances and other apparatus required to perform laboratory compaction, plasticity index, sand equivalent, grading, and field density testing (Plate 15).

Four fully transportable units have been purchased to date, and another has been ordered for initial location at Noorinbee in Bairnsdale Division.

Standard Compaction of Oversize Material

Earthworks and pavement materials must be compacted during construction to such a degree that they are able to withstand the stresses imposed on them by traffic during service, without failure or appreciable deformation.

The conventional method of assessing the degree of compaction of earthworks and pavement materials is to measure the density in pounds per cubic foot of the compacted material in the field, and to compare the measured value with the maximum density obtained in a compaction test performed on a sample of the material under standardized conditions in the laboratory.

There are two basic types of laboratory compaction tests, one for soils used in earthworks and another for pavement materials. For soils, the compactive effort, expressed in terms of the energy expended per unit volume of material, is 12,375 ft lbf/ft^3, while for pavement material, which must withstand the much higher stresses imposed by traffic, the compactive effort is 56,520 ft lbf/ft^3.

In the case of soils the Standard Compaction test is performed in a 4 in. diameter mould, on material which passes a $\frac{3}{4}$ in. sieve. Compaction is achieved by subjecting each of three layers of soil to 25 blows of a 5$\frac{1}{2}$ lb hammer which falls on the soil from a height of 12 in. The test has been extended to cover gravelly or rocky soils up to 1$\frac{1}{2}$ in. maximum size by increasing the mould diameter to 6 in. and increasing the number of blows per layer to 56.

Unfortunately, no test was available for gravelly or rocky soils having a maximum particle size greater than 1$\frac{1}{2}$ in., and when these soils were encountered during construction there could be no quantitative assessment of compaction.

On the Wallan-Broadford Section of the Hume Freeway, much of the material to be used in the earthworks has a maximum size of about 3 in. Because of the importance of this job and the large quantity of material involved, the Materials Research Division has evolved a compaction test which will produce a maximum density comparable to that produced by the Standard Compaction test on the smaller sized soils. In this new test, the material is compacted in a mould 12 in. diameter and 12 in. deep in three layers, each of which receive 122 blows from a 27.5 lb hammer falling through 12 in. The energy input per unit volume is identical to that for the Standard Compaction test, and field trials have shown that the maximum density produced corresponds very well with that which is required during construction to ensure adequate strength in the earthworks.

Although this new test can be performed manually, it does require considerable physical effort on the part of the testing officer, as between three and five moulds need to be compacted in a test on a single sample, and frequent testing can be required when variable soils are encountered. Two men are needed if a test is to be completed in a reasonable time.

To overcome these disadvantages, the workshop staff of the Materials Research Division converted a compaction machine which was purchased for the Standard Compaction test some years ago but which was never entirely satisfactory and had, in fact, become unserviceable. This new machine (Plate 16) automatically raises the hammer and allows it to drop through the required 12 in. The mould is rotated by hand to ensure uniform coverage of the soil by the hammer. The compaction test can now be performed easily by one man.

Texas Ball Mill Test

In the last decade the Board has used considerable quantities of sedimentary rock in pavement construction, especially in the north-west of Victoria. It was found that a test was required to provide a measure of the ability of the material to withstand degradation in roads.

During 1968, an investigation of the Texas Ball Mill Test (Texas Highway Department—Test Method TEX-116-E) was commenced. It has been found that the test gives an indication of the hardness of the rock and of its ability to withstand degradation in the presence of water. The test is generally applied to sedimentary rocks rather than those of igneous or metamorphic origin, and it is intended to be applied to rock, not to sand or gravel.

The apparatus (Plate 17) consists of a watertight steel cylinder, approximately 10 in. diameter and 10 in. long. A steel baffle is fixed on the internal circumference, projecting radially approximately 3 in. The cylinder is set so that it may be rotated about its axis in a horizontal position. The test procedure is as follows:

A test sample of rock is made up to a set sieve grading in which all passes the 2 in. sieve and 20% to 25% passes the No. 36 sieve. A quantity of approximately 3,500 gm is immersed in water for one hour and then placed in the cylinder together with a set volume of water and six steel spheres of the type used in the Los Angeles Abrasion Test. The cylinder is sealed and rotated for 600 revolutions at approximately 60 rev/min, after which the sample is washed over a No. 36 sieve and the dry weight of the material retained is determined.

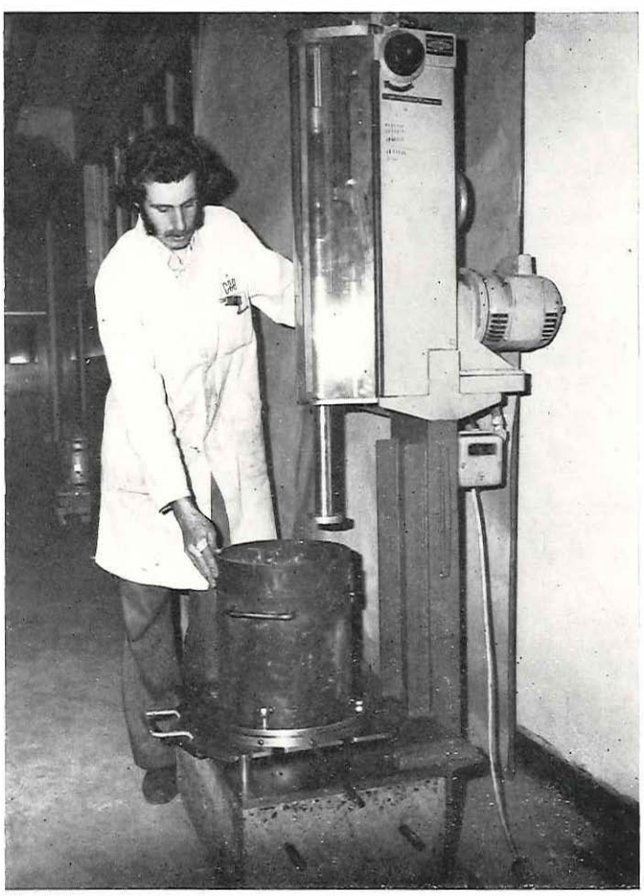


Plate 16—Modified Farnell compaction machine for compacting 3 in. maximum size material.

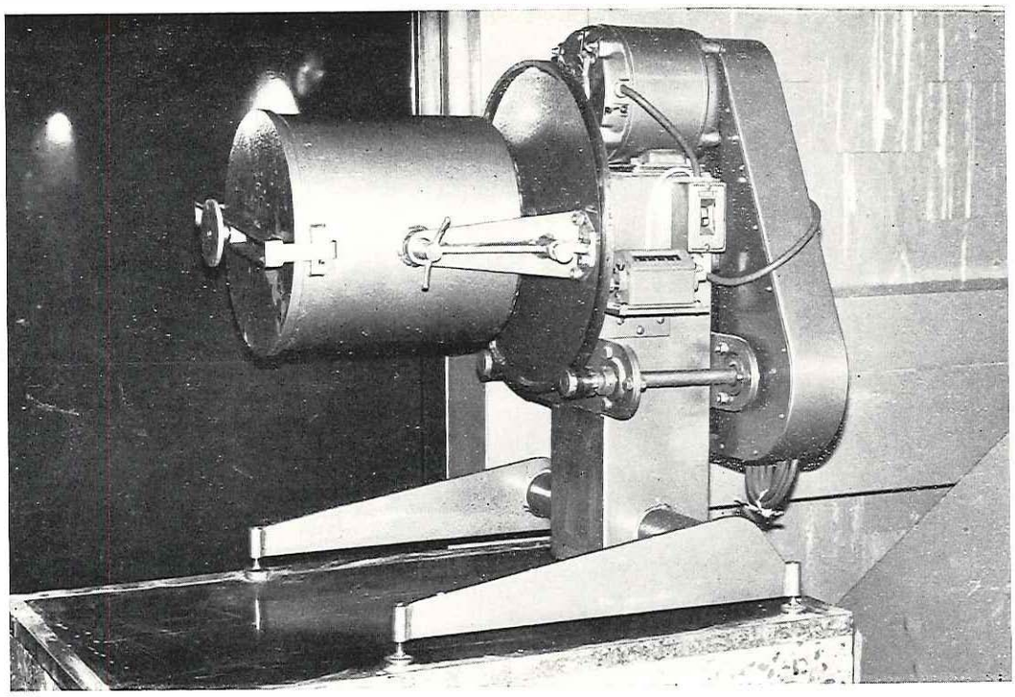


Plate 17—Texas Ball Mill test apparatus.

The Texas Ball Mill value (TBM) is calculated from the expression.

$$TBM = \frac{A - B}{A} \times 100$$

where A = the dry weight of the total sample.

B = the dry weight retained on the No.36 sieve after test.

The lower the TBM value, the more resistant is the rock to degradation in roads. Generally, materials with test values less than 40 would require crushing and could, in fact, be suitable for sealing aggregates. Materials with values of 40 to 55 could be useful pavement materials of the type requiring treatment such as grid rolling for their successful incorporation into pavements. Materials with values of 55 to 75 are useful for base construction in conditions of good drainage and low rainfall, and for general use as a subbase material. Materials with values greater than 75 would probably be classed as cemented silt or sand.

The test is proving useful for the assessment of soft rocks of sedimentary origin and is now in regular use for assessing these rocks as a source material for pavement construction. Siltstone has been adopted for use in minor roads associated with Hume Freeway (Wallan to Broadford), and the Texas Ball Mill apparatus has been installed in the project site laboratory for routine testing of the material.

Additives to Fine Crushed Rock

With hard, tough rocks such as certain basalts, insufficient fines are produced in the crushing process, and the compaction process produces very little additional fines. The lack of fines results in compaction difficulties and inability of the pavement material to "set". The pavement is also much more permeable than would be the case with a graded material, ponding moisture on the subgrade rather than shedding it.

During recent years two materials have been investigated for their ability to provide fines suitable for addition to the abovementioned materials. One is flue dust from cement works at Geelong and the other is flue dust from the combustion of brown coal at the State Electricity Commission of Victoria power stations in the Latrobe Valley.

The cement works flue dust comprises mainly unchanged limestone dust (calcium carbonate) and silica. About 10% to 15% of the material is water soluble. Overall it appears that the dust has slight cementing properties.

The main components of the flue dust from combustion of brown coal are calcium and magnesium sulphates, and silica. The testing to date has considered only the material from an electrostatic precipitator, which is finer than that from the mechanical dust collectors.

The addition of up to 2% to 3% of either of these additives to fine crushed rock has no deleterious effect on properties as determined by strength or quality control tests. The cement works flue dust is in general use throughout the metropolitan area as an additive to the fine crushed rock produced there, but to date no use has been made of the brown coal flue dust. The cement works flue dust has also been used as a filler for asphalt. However, the higher water solubility and high alkalinity of the brown coal flue dust indicate that if this material were used in aggregate in asphalt, stripping of bitumen from the aggregate might result.

3. ASPHALT DIVISION

Extent of Work

Table 12 shows that 3,242 miles of all types of bituminous surfacing were completed in 1972/73, compared with 3,274 miles in 1971/72.

Table 13 indicates that in 1972/73 the length of sealed pavement on the Board's declared road system was increased by 67 miles and the length on unclassified roads was increased by 509 miles.

Reconstruction of existing sealed pavements and restoration of the seal coats amounted to 356 miles of the declared road system, equal to 2.4% of the sealed length, compared with 2.8% in 1971/72. Retreatments totalled 991 miles, equal to 6.7% of the sealed length, compared with 8.1% in 1971/72.

Types of Work

Sprayed work (initial treatments and retreatments) again predominated, and represented 96.8% of the total length of work completed.

The remaining 3.2% consisted of 99 miles of plant mix work, a reduction of eleven miles from 1971/72. The plant mix work represented 7% of the total area of the year's bituminous surfacing work and its value was equivalent to 30% of the expenditure in 1972/73 on bituminous surfacing. A total of 274,000 tons of bituminous concrete for the plant mix work was supplied and spread by contractors.

Costs of Work

The average unit costs of sprayed work completed by the Board's seventeen bituminous surfacing units are shown in Table 14. The average overall cost of all types of sprayed work was 26.5 cents per square yard compared with 25.0 cents in 1971/72.

The average cost per ton of bituminous concrete supplied and spread was $13.82 compared with $13.38 in 1971/72.

Materials

(i) Aggregate

Approximately 284,000 cu. yd of covering aggregate was used by Board plant on sprayed work and 38,000 cu. yd on sprayed work by municipalities and contractors.

Table 15 sets out the average cost per cubic yard for aggregate over the past five years and shows that the 1972/73 level was $0.22 higher than the 1971/72 level.

(ii) Bitumen

The Board purchased some 28,800 tons of bitumen from four marketing companies. The bitumen was produced from Kuwait petroleum.

(iii) Experimental Work

The following trials were conducted in conjunction with the Australian Road Research Board during March 1973 for the purpose of evaluating the relative performances of paving bitumens:

(a) a reseal on Northern Highway north of Elmore between mileages 100.55 and 101.00, using a $\frac{3}{8}$ in. one-size diabase aggregate. Class R90 bitumens of various "vispen" index values were used over different lengths.

The aim of this trial is to determine if class R90 bitumen with a low "vispen" index can be used successfully for sprayed sealing work in hot weather. Information on the long-term performance of this bitumen will be obtained.

(b) an initial treatment final seal on Epping Main Road in the Shire of Whittlesea, north of Wollert, between mileages 16.95 and 17.79, using $\frac{1}{2}$ in. one-size basalt aggregate. Seven different bitumens were used, on various lengths within the trial section.

(c) a wearing course of dense $\frac{3}{8}$ in. nominal sized bituminous concrete compacted to a depth of approximately 1 in., on the southern carriageway of Burwood Highway between Lynne Street and Lewis Road, mileages 16.44 to 16.87. Seven bitumens and one tar were used as the binders in various lengths in the section. The bituminous concrete was produced and laid by City of Camberwell plant and personnel. The aim of trials (b) and (c) is investigation of the relationship between the long-term performance of paving bitumens in surfacing, and the laboratory testing procedure proposed by the Australian Road Research Board for prediction of performance.

All the trials were completed satisfactorily and all the surfaces were in very good condition as at 30th June 1973. Periodical inspections will be made and sampling and testing will be done over the next ten or more years.

TABLE 12—BITUMINOUS SURFACING WORK COMPLETED

Category of Road and Plant Used	1971/72		1972/73	
	Miles		Miles	
Work on roads to which the Board contributed funds:				
(a) C.R.B. declared roads:				
(i) Board's plant	1,593		1,458	
(ii) Municipal plant	55		81	
(iii) Contractors' plant	195		236	
		1,843		1,775
(b) Unclassified roads:				
(i) Board's plant	1,108		1,115	
(ii) Municipal plant	117		142	
(iii) Contractors' plant	102		118	
		1,327		1,375
Sub-totals				
Work done for other Authorities by the Board's plant (no Board contributions for these works)				
(i) Municipalities	99		80	
(ii) State instrumentalities	4		12	
(iii) Commonwealth works	1		—	
	—		—	
		104		92
Totals		3,274		3,242

TABLE 13—BITUMINOUS SURFACING WORK ON VARIOUS ROAD CATEGORIES

(On roads to which the Board contributed funds during 1972/73)

Type of Work	State Highways	Freeways	Tourists' and Forest Roads	Main Roads	Total Board's Declared System	Unclassified Roads	Totals
Initial Treatments:	Miles	Miles	Miles	Miles	Miles	Miles	Miles
Extensions to sealed system—							
(a) Sprayed work	2.50	12.69	4.97	41.70	61.86	507.68	569.54
(b) Plant mix work	—	5.01	—	—	5.01	1.45	6.46
Reconstruction of lengths of previously sealed pavements—							
(a) Sprayed work	107.16	8.24	11.91	210.39	337.70	116.10	453.80
(b) Plant mix work	5.69	—	—	12.72	18.41	15.97	34.38
Widening of existing sealed pavements—							
(a) Sprayed work	28.58	23.22	1.60	81.19	134.59	61.27	195.86
(b) Plant mix work	2.91	4.21	—	0.38	7.50	0.63	8.13
Duplication of existing sealed pavements—							
(a) Sprayed work	16.93	2.13	—	1.77	20.83	—	20.83
(b) Plant mix work	0.83	—	—	7.37	8.20	2.54	10.74
Final seal—							
(a) Sprayed work	88.80	22.60	4.00	57.76	173.16	86.63	259.79
(b) Plant mix work	11.21	3.50	—	2.12	16.83	3.02	19.85
Retreatments:							
(a) Sprayed work	362.19	34.76	25.03	554.32	976.30	575.27	1,551.57
(b) Plant mix work	6.31	0.39	0.03	7.61	14.34	4.63	18.97
Totals	633.11	116.75	47.54	977.33	1,774.73	1,375.19	3,149.92

TABLE 14—AVERAGE COSTS OF SPRAYED BITUMINOUS SURFACING DONE BY C.R.B. PLANT

(On roads to which the Board contributed funds during 1972/73)
(Costs in cents per square yard)

ITEM	NATURE OF WORK																			
	I.T.P. & S. ⅛ in. and Over		I.T.P. & S. ¼ in.		I.T.P. & S. ⅜ in.		I.T.P. & S. ½ in. & Sand		Primer-seals		I.T. Two-application Seal		I.T.S.O. & Reseals ⅛ in. & Over		I.T.S.O. & Reseals ¼ in.		I.T.S.O. & Reseals ⅜ in.		I.T.S.O. & Reseals ½ in. & Sand	
Square Yards Costed	3,033		1,698,893		1,626.078		184,816		1,287,973		56,720		—		2,517,648		7,418.672		8,692,144	
	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%
Material	22.4	59.1	20.4	51.8	20.5	54.9	15.4	54.2	13.0	50.2	32.7	61.1	—	—	16.2	50.8	13.1	50.7	10.6	53.5
Stores	1.6	4.2	1.5	3.8	1.4	3.7	1.3	4.6	1.2	4.6	1.5	2.8	—	—	1.1	3.4	1.0	3.9	0.8	4.0
Plant hire	5.0	13.2	6.9	17.5	6.0	16.0	4.6	16.2	4.6	17.8	8.1	15.1	—	—	5.8	18.2	4.4	17.1	3.2	16.2
Labour	8.9	23.5	10.6	26.9	9.5	25.4	7.1	25.0	7.1	27.4	11.2	21.0	—	—	8.8	27.6	7.3	28.3	5.2	26.3
Totals	37.9	100.0	39.4	100.0	37.4	100.0	28.4	100.0	25.9	100.0	53.5	100.0	—	—	31.9	100.0	25.8	100.0	19.8	100.0

I.T.P. & S. indicates "Initial Treatment Prime & Seal".
I.T.S.O. indicates "Initial Treatment Seal Only".

TABLE 15—AVERAGE PRICE OF AGGREGATE FOR BITUMINOUS SURFACING

(In roadside stacks)

Material	Prices per cubic yard				
	1968/69	1969/70	1970/71	1971/72	1972/73
	$	$	$	$	$
Screenings	5.01	5.12	5.08	5.15	5.36
Gravel	4.30	4.61	4.86	4.97	5.17
Sand	2.13	2.82	2.32	1.57	2.02
Scoria	2.93	2.90	3.30	3.41	3.90
Average price all aggregates	4.79	4.93	4.93	5.00	5.22

SAFETY

The field testing of red-orange acrylic fibre jackets for patrolmen and traffic controlmen was finalized during the 1972/73 financial year, and the present plastic jackets will be replaced during 1973.

During 1972/73 there was again an increase in the number of lost time injuries, compared with the preceding year, as shown in Table 16.

TABLE 16—INJURIES TO BOARD'S EMPLOYEES

Type of Injury	1971/72	1972/73	Changes from 1971/72	
			Decrease	Increase
Back strains	46	59	—	13
Burns and scalds	26	27	—	1
Burns to eyes	10	8	2	—
Fatal injuries	0	0	—	—
Foreign bodies in eyes	28	32	—	4
Fractures	15	20	—	5
Head injuries	21	20	1	—
Lacerations and wounds	47	59	—	12
Miscellaneous	49	45	4	—
Multiple injuries	0	0	—	—
Occupational diseases	28	27	1	—
Sprains and strains	44	58	—	14
Totals	314	355	8	49

The previous downward trend in lost time accidents appears to have been reversed temporarily, as shown in the tabulation below. However, there is a continuing, slightly downward trend in days lost per million manhours worked, after excluding the effects of fatal accidents, each of which is assessed in accordance with Australian Standard CZ6-1966 as being equivalent to 6,000 days lost.

	1968/69	1969/70	1970/71	1971/72	1972/73
Total manhours worked	8,423,000	8,757,000	8,966,000	9,077,000	9,050,000
Lost time accidents	375	369	294	314	355
Accident frequency rate/mil. manhours	44.5	42.1	32.7	34.6	39.2
Days lost	*22,113	2,058	*7,794	2,113	2,051
Days lost/mil. manhours	2,563	235	869	233	226

* Includes one or more fatal accidents.

METRIC CONVERSION

The Chief Engineer's Branch is actively proceeding with the conversion to metric units of measurement. The Board approved the adoption of the timetable of the National Association of Australian State Road Authorities (NAASRA) as an objective and guideline for conversion, and progress has been generally in accordance with this timetable. Liaison has been established with Municipal Engineers through the Board's Divisional Engineers, and a Metric Conversion Committee has been set up at Head Office. Matters of joint interest are discussed with representatives of the Local Government Engineers' Association and the Road Safety and Traffic Authority. The Board is represented at the meetings of the Victorian Government Interdepartmental Metric Conversion Committee by an officer from the Secretary's Branch and an officer from the Chief Engineer's Branch.

NAASRA has published a series of guide policies in metric units, and these have generally been adopted by the Board. The largest tasks still to be achieved within the Chief Engineer's Branch are:

(i) the conversion of road signs and road furniture,

Active preparation is proceeding for the changeover, which is programmed to take place during the month of July 1974 as part of an Australian-wide changeover in that month.

(ii) the conversion of manuals,

The target date for the publication of converted manuals is January 1974 and the most important for conversion are:

Road Design Manual
Engineering Survey Manual
Drafting Manual — Roadworks
Road Furniture Manual.

(iii) the conversion of road and bridge specifications.

Municipalities have been informed that roadworks plans in metric units would be acceptable now, and that all roadwork and bridgework plans would be preferred to be in metric by January 1974.

All Sub-branches and Divisions within the Chief Engineer's Branch are involved in conversion. The Mechanical Sub-branch has a three-year conversion and training programme, and the first year's programme has been completed on schedule. All cadastral surveys are now being carried out in metric units, and some engineering surveys in metric units have been completed. It is anticipated that all engineering surveys will be done in metric units by 1974.

It is expected that construction work in imperial units will continue for a number of years. Where plans have been prepared but construction has not yet started, plans will not be altered to show metric units. For major projects involving a long design period, any design which has already commenced in imperial units will continue in those units.

PUBLICATIONS

In connection with the Board's engineering work, the following papers by Board's officers were presented or published during 1972/73:

Paper	Author
The Stabilization of Coastal Sand Dunes Presented to, and published in the Proceedings of the First Australian Conference on Coastal Engineering, organized by the National Committee on Coastal and Ocean Engineering of The Institution of Engineers, Australia, Sydney, May 1973.	P. F. B. Alsop, Dip. C.E., Grad. I.E. Aust.
Hydrostatic Transmissions in Vehicles Presented to a joint meeting of the Society of Automotive Engineers, Australia, and the Melbourne Chapter of the Fluid Power Society, Melbourne, February 1973.	J. B. Armitage, Dip. Mech. Eng., Dip. Elec. Eng.
Construction of Full Depth and Deep Strength Asphalt Pavements Presented to the Second National Conference of the Australian Asphalt Association, Melbourne, April 1973.	J. D. Bethune, Dip. C.E., C.E., M.I.E. Aust.
The Design and Construction of Full Depth and Deep Strength Asphalt Pavements Report on Overseas Mission, 1972.	J. D. Bethune, Dip. C.E., C.E., M.I.E. Aust.
The Selection, Maintenance, Calibration and Metric Conversion of Laboratory Equipment Presented to the National Association of Testing Authorities' Symposia on Laboratory Management, in Sydney, Melbourne and Brisbane.	D. T. Currie, B.C.E., Ph. D., C.E., M.I.E. Aust, and A. F. Griffiths, B.E., Grad. I.E. Aust.
The Capacity of Bored Piles in Dense Sand Published in the Proceedings of the Third South-east Asian Conference on Soil Engineering, Hong Kong, November 1972.	H. R. Ellis, B.E., Grad. I.E. Aust., and A. F. Williams, B.E., M.Eng. Sc., Grad. I.E. Aust.
Fracture Mechanics and Its Impact on Ultrasonic Inspection Presented to the Non-Destructive Testing Association—Victorian Branch, November 1972.	R. S. Gilmour, B.Sc., A.R.C.S.T.
Research on Performance of Soil Penetrometers Report on Churchill Fellowship Study Tour, 1971.	J. C. Holden, Dip. C.E., B.E. (Civil), M. Eng. Sc., Ph. D., M.I.E. Aust., A.M.A.S.C.E.
Effect of Climatic Factors on Benkelman Beam Deflections in the Melbourne Area of Victoria, Australia Published in the proceedings of the Third International Conference on the Structural Design of Asphalt Pavements, London, September 1972.	A. B. Ratnarajah, B.Sc.
Provincial Urban Transportation Studies Presented to the Transportation and Highways Branch, Victoria Division, The Institution of Engineers, Australia, August 1972.	W. H. Saggers, B.E., Dip. C.E., C.T.P.C.
Paint for Guide Posts Presented to and published in the Proceedings of the Sixth Biennial Conference of the Australian Road Research Board, Canberra, August, 1972.	H. D. Taskis, B.Sc., Dip. Ed.

A Review of Freeway Lighting Practice Presented to the Sixth Biennial Conference of the Australian Road Research Board, Canberra, August 1972.	R. T. Underwood, M.E., B.C.E., Dip. T. & R.P., C.H.T. (Yale), C.E., A.M.I.T.E., M.R.A.P.I., M. Inst. H.E., M.I.E. Aust.
The Spacing of Openings in Medians on Urban Roads Technical Note, Australian Road Research, Vol. 5, No. 2, June 1973.	R. T. Underwood, M.E., B.C.E., Dip. T. & R.P., C.H.T. (Yale), C.E., A.M.I.T.E., M.R.A.P.I., M. Inst. H.E., M.I.E. Aust.
The Stabilization of a Large Moving Rock Slide with Cable-Anchors Published in the Proceedings of the Third South-east Asian Conference on Soil Engineering, Hong Kong, November 1972.	A. F. Williams, B.E., M.Eng. Sc., Grad. I.E. Aust. and A. G. Muir, B.Sc.

Reference to the following paper was inadvertently omitted from the 1971/72 Report:

Design Standards for Freeways in Australia Published in Traffic Engineering, Volume 42, No. 2, November 1971.	N. S. Guerin, B.C.E., C.E., Cert. H.T. (Yale), M.I.E. Aust., A.M.I.T.E.

One Engineering Note, No. 101, "Australian Road Research Board Research—Pavements", was published.

The Road Furniture Manual was issued in a draft edition of the first seven chapters and production of the remaining seven chapters is proceeding. The Road Design Manual was revised and issued in imperial units.

TRAINING

Internal Training

The Young Engineers' Training Scheme, in which young engineers of the Board are given training in various work areas, has been reorganised and extended from a 12 months' to an 18 months' programme, with very satisfactory results.

During 1972/73 courses were held in road design, materials test methods, bituminous plant mix work, freeway planning procedures, traffic engineering, contract administration, communications, job instruction and report writing.

A course of 5 weeks' duration was conducted by the Board, on behalf of the National Association of Australian State Road Authorities and the Department of Foreign Affairs, for senior African and Asian engineers. The theme of the seminar was "Management aspects of road and bridge engineering within Victoria". Seventeen engineers from twelve different countries attended.

A senior management conference, attended by senior officers of the Board, was conducted at the Australian Administrative Staff College at Mt. Eliza over a two-day period.

External Training

Selected engineers attended external courses on administration, construction management and traffic engineering.

STAFF

During 1972/73, Mr T. Ashcroft retired as Assistant Mechanical Engineer after 19 years' service with the Board, and Mr S. B. Deany retired as Asphalt Engineer after 48 years' service. Mr Deany's term of service was one of the longest achieved by a staff member. Both of these officers made valuable contributions to the Board's work.

The total cost of work performed in 1972/73 by the Board on its own direct works and for other authorities, and by municipalities with funds provided by the Board, was $91,072,000. At 30th June 1973 the total staff of the Chief Engineer's Branch was 1,288.

I wish to thank all the staff of the Branch for their hard work and loyal service to the Board.

W. S. BRAKE, B.C.E., C.E., C.T.P. & C., M.I.E.Aust.
Chief Engineer.

Brown Prior Anderson Pty Ltd 5 Evans Street Burwood 3125