1967

VICTORIA

COUNTRY ROADS BOARD

FIFTY-THIRD ANNUAL REPORT

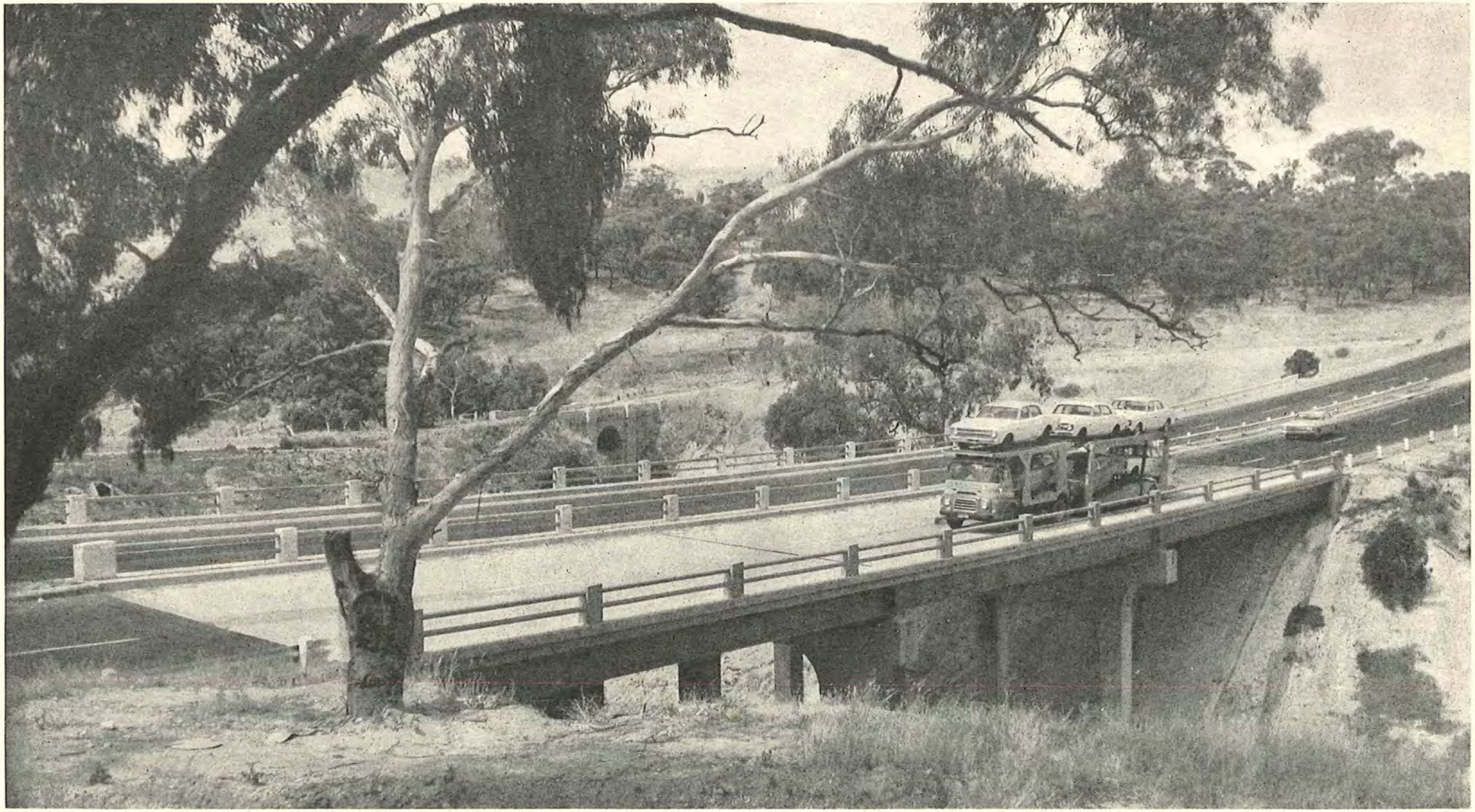
FOR YEAR ENDED 30TH JUNE, 1966

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

[*Approximate Cost of Report.*—Preparation, not given. Printing (225 copies), $1,950.00.]

By Authority:
A. C. BROOKS, GOVERNMENT PRINTER, MELBOURNE.

No. 2.—[75 cents]—11540/66.



FRONTISPIECE :—Dual carriageways on the Western Highway at Djerriwarrh Creek. The old bridge restored as a historic structure can be seen in the background.

COUNTRY ROADS BOARD.

Chairman .. .. .. I. J. O'Donnell.

Deputy Chairman .. .. R. E. V. Donaldson.

Member .. .. .. F. West.

PRINCIPAL OFFICERS.

Head Office.

Chief Engineer .. .. H. S. Gibbs.

Deputy Chief Engineer .. .. H. P. George.

Deputy Chief Engineers.

Works.	*Road Design.*	*Bridges.*	*Mechanical.*
C. C. Perrin.	J. H. Townley.	B. R. Abery.	G. M. Langham.

Secretary .. .. .. N. L. Allanson.

Deputy Secretary .. .. C. C. Liddell.

Accountant .. .. .. R. G. Cooper.

Deputy Accountant .. .. R. J. C. Bulman.

Divisional Offices.

Division.	*Divisional Engineer.*
Bairnsdale	W. H. Dolamore.
Ballarat	F. F. O'Brien.
Benalla	R. C. Handley.
Bendigo	L. Upton.
Dandenong	F. W. Docking.
Geelong	W. F. Neville.
Horsham	A. J. Pryor.
Metropolitan	J. R. Galbraith.
Traralgon	A. Jacka.
Warrnambool	J. W. C. Pascoe.

60 Denmark Street,
Kew,
4th February, 1967.

The Honorable M. V. Porter, M.L.A.,
Minister of Public Works,
State Public Offices,
Melbourne, C.2.

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, 1966.

The Board thanks you, Sir, for your continued 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 staff and employees throughout the year.

We have the honour to be,

Sir,

Your obedient servants,

I. J. O'DONNELL, O.B.E., E.D., B.C.E., M.I.E. Aust., F.A.I.M., Chairman.

R. E. V. DONALDSON, A.A.S.A., A.C.A.A., J.P., Deputy Chairman.

F. WEST, B.C.E., M.I.E. Aust., C.E., Member.

N. L. ALLANSON, A.A.S.A., A.C.A.A., J.P.,
Secretary.

COUNTRY ROADS BOARD

FIFTY-THIRD ANNUAL REPORT, 1965-66

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COUNTRY ROADS BOARD

FIFTY-THIRD ANNUAL REPORT

FEATURES OF THE YEAR'S WORK.

Roads (Special Projects) Fund.

One of the main features of financial year 1965–66 was the Board's participation in the construction of projects financed from the Roads (Special Projects) Fund.

The Roads (Special Projects) Act was proclaimed on 1st June, 1965, and came into operation on 1st July, 1965. Under the provisions of the Act a Roads (Special Projects) Fund was established into which is paid the additional revenue received from increased motor registration fees imposed as from 1st July, 1965. The fund is administered by the State Treasurer for the purpose of providing finance for special road projects.

Allocations from the fund have enabled the State's road construction programme to be accelerated beyond that which would have been possible from funds normally available to the Board.

During the year Orders in Council were issued to enable the Board to carry out works on eleven projects. Contracts amounting to $3·5 million were let for these projects throughout the State and an actual expenditure of $1,654,370 was incurred during the financial year.

The commencement of the construction of 4 miles of divided carriageway on the Hume Highway from Craigieburn to Donnybrook Lane in August, 1965, was the first Special Project undertaken by the Board. This work is part of Special Project No. 2 which provides for the extension of the 4-lane divided highway for 11 miles from Craigieburn to Wallan.

The distinctive blue and white signs erected at the location of the special projects to give a brief description and the estimated cost of the work are becoming well known to the motoring public.

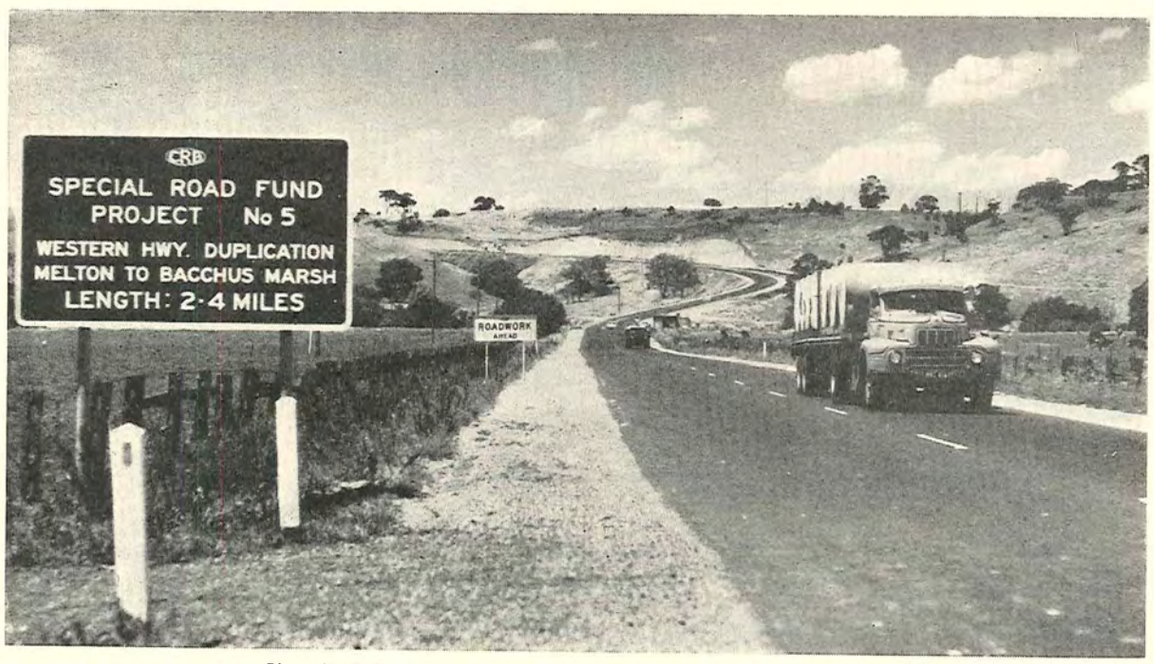

Plate 1.—Information sign indicating a Special Road Fund Project.

A brief description of the projects for which the Board will be responsible, together with the progress achieved to 30th June, 1966, is shown below :—

Special Project No.	Description and Estimated Cost.	Length.	Progress to 30th June, 1966.
		Miles	
2	Hume Highway—Extension of the 4-lane divided highway from Craigieburn to Wallan Estimated cost $1·8 M.	11	Work on the first 8·6 miles from Craigieburn to just south of Beveridge was well advanced. The 4·4 miles section to Donnybrook Lane should be completed by the end of 1966 and the 4·2 miles section from Donnybrook Lane to just south of Beveridge should be completed towards the end of financial year 1966–67
5	Western Highway—Extension of the 4-lane divided highway from Deer Park to west of Bacchus Marsh (including a by-pass of Bacchus Marsh) Estimated cost $4·12 M.	23·3	Approximately 2 miles east of Bacchus Marsh was almost completed. Work on further 7 miles west of Deer Park was proceeding
6	Princes Highway East—Extension of the 4-lane divided highway from Doveton to east of Narre Warren Estimated cost $740,000	4·6	The construction of approximately 2 miles of new carriageway was almost completed
7	Western Highway—Construction of a 4-lane divided highway from west of Myrniong to east of Ballan (including a new deviation at Pykes Creek Reservoir) and a second bridge over the reservoir Estimated cost $1·1 M.	4·0	Construction of the 2 miles east of the reservoir was proceeding
8	Hume Highway—Extension of the 4-lane highway north and south of Tallarook including a by-pass of Tallarook Estimated cost $1·36 M.	4·5	Construction of the sections north and south of Tallarook was well advanced
9	Princes Highway East—Construction of the Princes By-pass Road (Moe Section) Estimated cost $1·1 M.	3·6	Work was proceeding on two separate contracts
10	Princes Highway East—Construction of a 2-lane deviation and a bridge at Hospital Creek near Orbost. The deviation eliminates two level crossings from the highway Estimated cost $260,000	5·5	The bridge over Hospital Creek was completed and roadworks were well advanced
11	Maroondah Highway—Extension of the 6-lane divided highway from North Croydon to Brushy Creek Estimated cost $1·1 M.	2·0	Design work was proceeding
12	Taylor Bay Road—Construction of a new road from Taylors Lane to Maintongoon Road to link Eildon township with Bonnie Doon Estimated cost $240,000	10·0	A commencement was made on the first 4 miles from Taylors Lane to Haines Saddle
13	Nepean Highway—Extension of the divided highway from beyond the old Mornington Road to south of the turnoff to Manyung including a 4-lane by-pass of Mt. Eliza Estimated cost $880,000	2·0	Tenders had been invited and some preliminary work started by direct labour
14	Marlo–Cape Conran Road—Construction of a new road for tourists to Cape Conran Estimated cost $300,000	7·3	Tenders had been invited

Plate 2.—Special Project No. 7. Heavy rock work in the cutting near Pykes Creek on the Western Highway.

Other Works throughout the State.

Although the Board's participation in the programme of special projects was a definite advance in the State's road construction programme, the projects themselves represent only a small proportion of the work carried out by the Board throughout the State. An amount of over $61,000,000 was expended by the Board from its own funds.

There is evidence of this expenditure in the form of both major works and general improvements throughout the whole of the State.

Expenditure from the Board's funds in the Melbourne and Metropolitan Planning Area on roads and bridges excluding costs of administration amounted to $12,187,000. The corresponding figure in financial year 1964-65 was $12,066,000.

Some of the major works completed or in progress during the year in both rural and urban areas of the State are listed below :—

Burwood Highway.—Completion of 1·78 miles of 6-lane divided roadway between Greenwood Street, Box Hill and the Melbourne and Metropolitan Board of Works' pipe track east of Blackburn Road, Nunawading.

Nepean Highway.—Construction of a 6-lane divided roadway from White Street to McDonald Street in the City of Mordialloc, together with the construction of a new railway bridge in conjunction with the Victorian Railways.

Nepean Highway.—Duplication of 1·2 miles from Ithaca Road to the Old Mornington Road intersection in the Shire of Frankston.

Hume Highway.—Reconstruction of 1·7 miles north of Green's Pinch in the Shire of Kilmore, including the provision of climbing lanes.

Hume Highway.—Duplication of 4 miles between Broadford and Tallarook.

Princes Highway East.—Realignment, widening and sealing of 4·2 miles of the Princes Highway in the vicinity of Mt. Drummer. Sealing of this section during the summer of 1966-67 will complete the sealing of this highway between Melbourne and the New South Wales border.

Murray Valley Highway.—Completion of the reconstruction of 7·7 miles between Boundary Bend and Lake Powell to improve and raise a section of highway—often flooded in the past, and providing a sealed road connection between Swan Hill and Mildura via Robinvale and the Sturt Highway in New South Wales and Victoria.

Shire of Altona.—Millers Road—Reconstruction amd duplication of 0·4 miles from Kororoit Creek to Civic Parade.

City of Northcote.—Heidelberg-Eltham Road—Reconstruction of 0·7 miles between Merri Creek and Gillies Street as a 6-lane divided roadway.

Tullamarine By-Pass Road (*Tullamarine Freeway*).—Completion of 1·8 miles of 4-lane divided roadway together with commencement of the interchange at the airport entrance and various bridges and access roads.

Shire of Omeo.—Upper Kiewa Valley Road extension (Bogong High Plains Road)—Construction of a new access road approximately 17 miles in length from the Omeo Highway to Langford's Gap near the Rocky Valley Reservoir.

During the year work was commenced on the construction of the new Phillip Island Bridge. This is the largest bridge to be built under the supervision of the Board outside the metropolitan area and replaces the suspension bridge built in 1939. The new bridge will be 2,100 feet long, 28 feet between kerbs and is estimated to cost $2,600,000. John Holland and Co. Pty. Ltd. was the successful contractor.

Pedestrian Overpasses.

Under a scheme approved by the Government in which the Government, the Country Roads Board and the municipal council concerned each bear one-third of the cost, a start was made during the year on construction of the first of a number of planned pedestrian overpasses to serve students attending schools adjacent to heavily trafficked State highways. A contract was let during the year for construction of a pedestrian overpass over the dual carriageway section of the Western Highway adjacent to Braybrook State School. Locations were also approved and design commenced for the construction of overpasses in the following localities :—

Western Highway—Sunshine City, near the Braybrook High School.
Nepean Highway—Moorabbin City, near the Moorabbin State School.
Maroondah Highway—Blackburn, near the Blackburn School.
Maroondah Highway—Mitcham, near the St. Johns R.C. School.
Princes Highway—Kingsville, near the Kingsville State School and the Footscray Corpus Christi Denominational School.

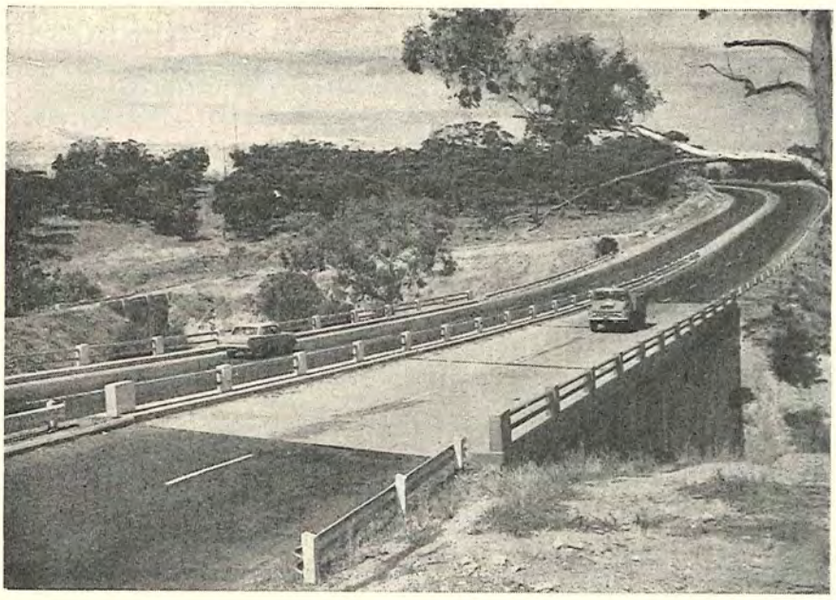

Plate 3.—Special Project No. 5.—New dual bridge and carriageway at Djerriwarrh Creek on the Western Highway.

Plate 4.—Completed divided highway.—The Burwood Highway in the Cities of Box Hill and Nunawading.

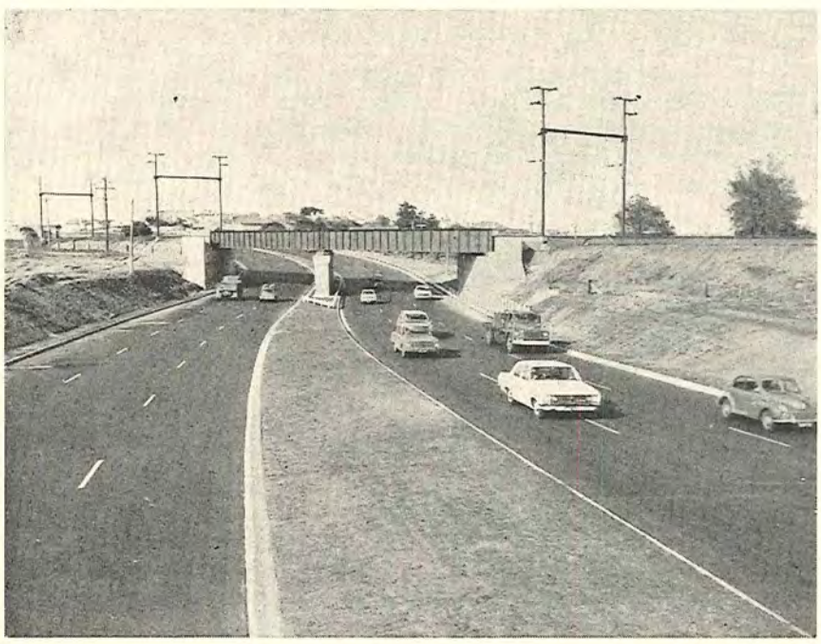

Plate 5.—The Nepean Highway.—New rail overpass and dual carriageways in the City of Mordialloc.

A standard design was developed during the year using prestressed and precast concrete elements. The design provides for the use of similar precast concrete elements at succeeding sites with consequent savings in time and cost.

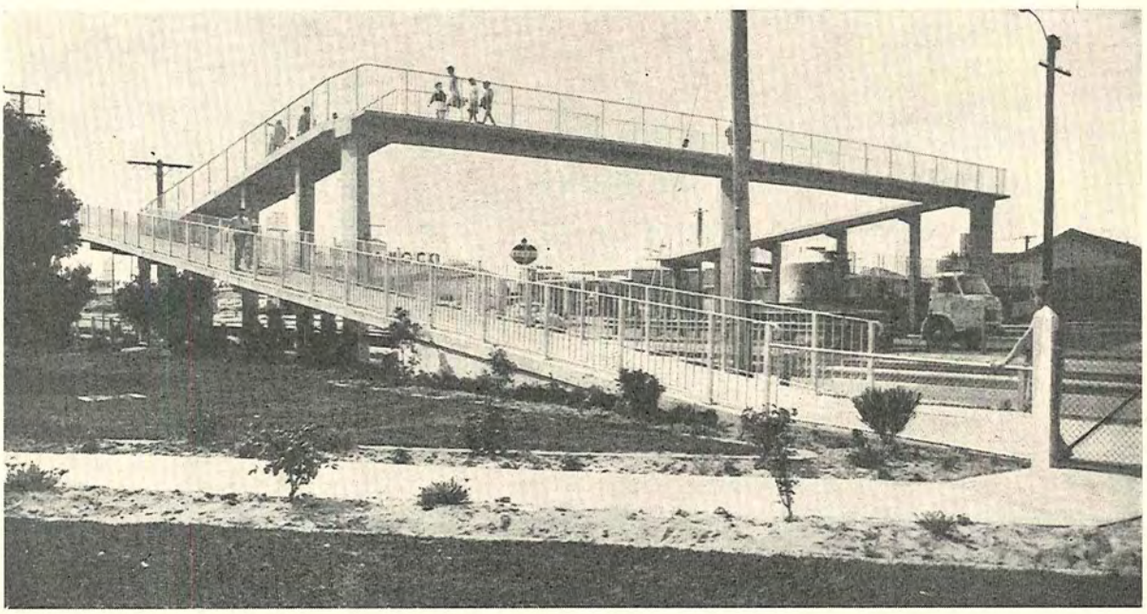

Plate 6.—Pedestrian overpass at Braybrook—Western Highway—City of Sunshine.

Commonwealth Bureau of Roads.

The *Commonwealth Bureau of Roads Act* 1964 provided for the establishment of the Commonwealth Bureau of Roads, consisting of a Chairman and two other members appointed by the Governor General.

The functions of the Bureau are stated in the Act as follows :—

(*a*) to investigate and from time to time to report to the Minister on matters relating to roads or road transport for the purpose of assisting the Government of the Commonwealth in the consideration by the Government of the grant of financial assistance by the Parliament to the States in connection with roads or roads transport ; and

(*b*) to investigate, and report to the Minister on, any matter referred to the Bureau.

During the year Mr. H. T. Loxton was appointed as full-time Chairman of the Bureau and Professor D. Cochrane and Mr. J. M. Collins were appointed as members in a part-time capacity.

The Bureau has indicated that its first task will be to survey road needs over the period 1969 to 1974. To achieve this task the Bureau will collate relevant information obtained from the State Road Authorities, commercial sources and motoring organizations.

The Board is giving the Bureau its full co-operation.

General.

During the year under the direct supervision of the Board's staff, or with the assistance of municipal councils where appropriate, the Board :—

1. sealed or resealed with bitumen 3,067 miles of road ;
2. extended the mileage of sealed roads by 797 miles ;
3. commenced the construction of 175 bridges including 112 under municipal control ;
4. planted over 40,000 trees and shrubs on State highways and by-pass roads ;
5. purchased land valued at $4,153,000 for road deviations and new roads ;
6. carried out an annual traffic census classifying traffic over a period of 12 hours at 1,997 stations, including 780 on State highways and 1,019 on other declared roads ;
7. maintained traffic line marking on 5,465 miles of road at a cost of $190,920 ;
8. increased the mileage of dual pavements on declared roads by 18 miles.

FINANCE.

During the year the Board issued a booklet entitled " Financial Facts 1966 ". The booklet indicates the sources of funds available to the Board and their allocation for expenditure on roads and bridges.

Receipts.

Funds are made available to the Board from two main sources :—

1. Money received from State sources.
2. Grants under the *Commonwealth Aid Roads Act* 1964.

Total receipts for the financial year 1965–66 amounted to $62,193,812. The following table compares receipts in 1965–66 with 1964–65 :—

—	1964–65.	1965–66.
State Sources.	$	$
Net receipts under the Motor Car Act (for details see below)	23,378,294	24,690,230
Commercial Goods Vehicle Act (ton mile tax)	5,926,284	6,378,508
Municipal Repayments on account of main road works	1,689,926	1,691,398
Loan Funds	762,000	1,019,600
Special Grant and Temporary Advance from State Treasury	1,200,000	768,000
General Receipts	388,832	470,893
	33,345,336	35,018,629
Grants under the Commonwealth Aid Roads Act.		
General Purposes	14,951,908	16,172,093
Rural Roads	10,230,252	11,003,090
	25,182,160	27,175,183
Total Receipts	58,527,496	62,193,812

Net receipts under the Motor Car Act which are available to the Board consist of—

(*a*) Motor registration fees less cost of collection. (Bus registration fees and increased fees imposed under the *Roads (Special Projects) Act* 1965 are excluded).

(*b*) Two-thirds of additional motor registration fees levied on first registration and subsequent change of ownership, less total cost of collection.

(*c*) One-quarter drivers' licence fees, less one-quarter cost of collection.

(*d*) Drivers' licence testing fees, less cost of collection.

(*e*) Examiners' licence fees—motor car roadworthiness examinations.

Expenditure.

Expenditure in the form of cash payments during the financial year 1965–66 amounted to $61,123,727, leaving a balance of $1,079,532 to be carried forward into financial year 1966–67. The full amount of the receipts under the Commonwealth Aid Roads Act was expended leaving the whole amount of the balance in the Country Roads Board Fund.

The following table compares expenditure in 1965–66 with 1964–65 :—

—	1964–65.	1965–66.
	$	$
1. Construction and maintenance of roads and bridges	50,752,184	51,660,383
2. Capital expenditure, e.g., plant, workshop, offices, &c.	1,125,102	1,582,506
3. Salaries, operating accounts and other administrative expenditure	3,957,592	4,482,626
4. Statutory payments to Tourist Fund, Transportation Regulation Fund and refund of Special Advance	702,248	1,341,884
5. Interest and sinking fund payments	1,988,118	2,056,328
	58,525,244	61,123,727

Sharing the Cost of Roadworks.

The Board bears the full cost of works carried out to cater for the needs of through traffic on declared State highways, tourists' roads, forest roads and by-pass roads.

With respect to declared main roads, the Country Roads Act provides that no more than one-half of the amount expended on permanent works and one-third of the amount expended from the Country Roads Board Fund 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 or permanent works, are taken into account in deciding the level of contribution by a council.

In September, 1965, expenditure on main roads in financial year 1964–65 was apportioned in accordance with the Country Roads Act resulting in the following distribution of expenditure :—

	$
Expenditure from Country Roads Board Fund	9,496,208
Expenditure from Commonwealth Aid Road moneys	3,391,463
Expenditure from proceeds of ton mile tax (Commercial Goods Vehicles Act)	1,846,010
	14,733,681
Amount apportioned to Councils	1,607,726

Municipal councils were therefore required to bear only 10·91 per cent. of the total expenditure on main roads.

The Board continued its usual policy of subsidizing councils for work on unclassified roads within the limitations of funds available. The expenditure incurred on unclassified roads from allocations made by the Board in financial year 1965–66 compared with 1964–65 was as follows :—

—	1964–65.		1965–66.	
	C.R.B.	Council Cont'bn.	C.R.B.	Council Cont'bn.
	$	$	$	$
Construction, &c.	9,737,778	2,591,360	11,174,704	3,254,149
Patrol Maintenance	1,392,980	632,846	1,515,946	680,076
Totals	11,130,758	3,224,206	12,690,650	3,934,225

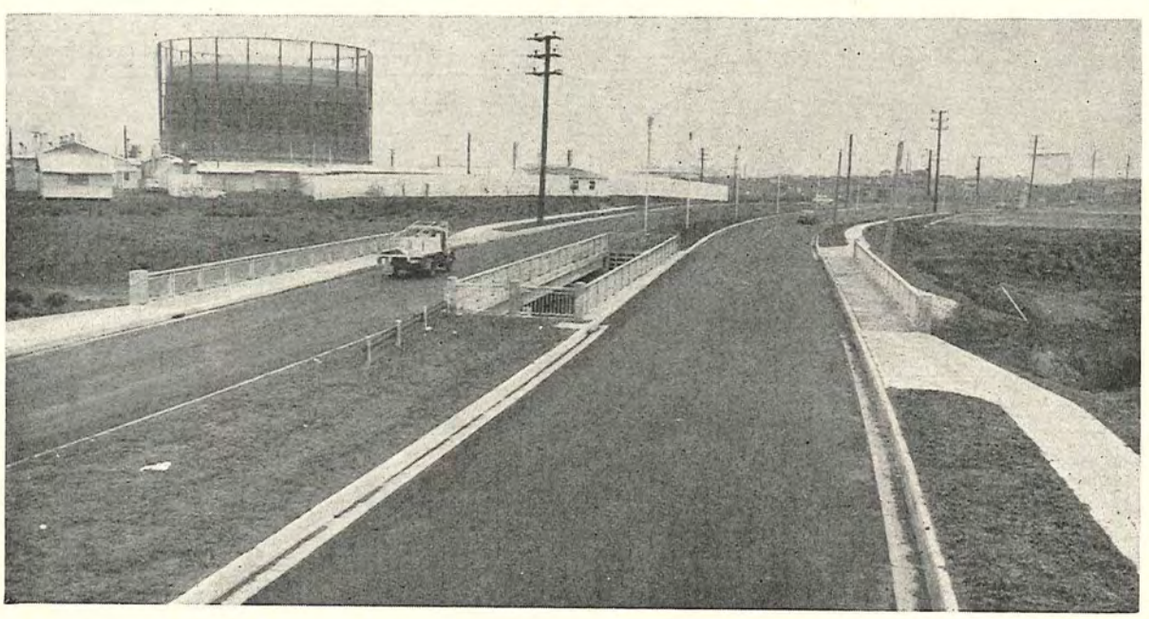

Plate 7.—New dual bridges over the Darebin Creek, Murray Road, City of Preston.

Forest Roads.

Forest roads are roads so proclaimed and are situated within or adjacent to any State forest or in areas which the Board considers to be timbered mountainous or undeveloped. At 30th June, 1966, there were 461 miles of forest roads on which the Board expended $699,209 during the year.

Details of the more significant works completed on forest roads during the year are contained in Appendix 2.

By-pass Roads.

By-pass roads are freeway-type roads having the distinguishing feature of access being denied from properties fronting on them or from side roads without the Board's consent.

At 30th June, 1966, there were 37 miles of by-pass roads in the State. During the year, $3,745,319 were expended on the construction of new by-pass roads and on the purchase of land for future by-pass roads, including $240,497 from the Roads (Special Projects) Fund.

The major construction activities during the year on by-pass roads were on the Tullamarine By-pass Road, and the Princes By-pass Road (Moe Section). Works actually completed during the year on the Princes By-pass Road in the Shires of Altona and Werribee are noted in Appendix 2.

As was the case last financial year, expenditure on land acquisition was incurred on the following projects :—

Healesville Freeway By-pass Road.
Hume By-pass Road (Craigieburn).
Mulgrave By-pass Road.
Scoresby By-pass Road.
Strathmore By-pass Road.
Tullamarine By-pass Road.
Frankston By-pass Road.
Mornington Peninsula By-pass Road.
Dingley By-pass Road.
Greensborough By-pass Road.
Calder By-pass Road.
Princes By-pass Road (Laverton).
Cranbourne By-pass Road.
Hume By-pass Road (Chiltern).
Princes By-pass Road (Moe).

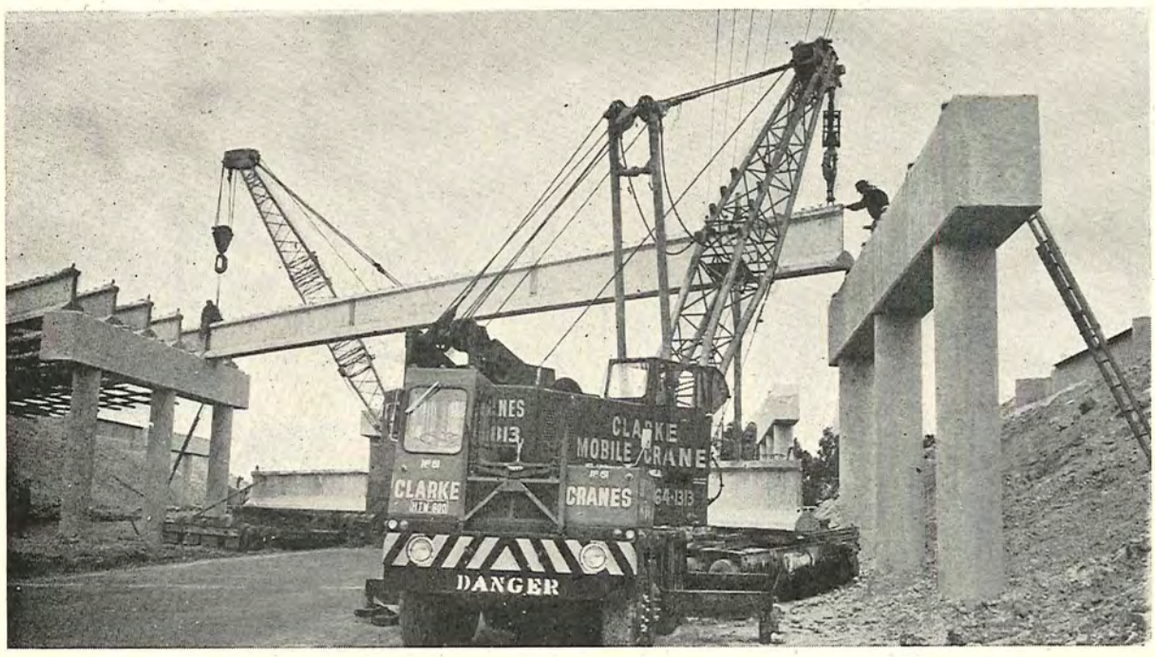

Plate 11.—Dual bridges under construction at the Mickleham Road intersection–Tullamarine Freeway—City of Broadmeadows.

Main Roads.

Main roads are roads linking centres of population with other centres or with areas of settlement.

At 30th June, 1966, there were 9,094 miles of main roads on which the Board expended $16,568,651 during the year.

As in previous years the Board was not able to allocate sufficient funds to satisfy the applications for funds received from municipal councils. The following table shows the applications, allocations and expenditure on main roads in the financial year 1964–65 and 1965–66 :—

—	1964–65.	1965–66.
	$'000s	$'000s
A Applications	30,772	31,091
B Allocations	21,668	22,129
C Expenditure	15,185	16,569
	%	%
B as percentage of A	70·4	71·2
C as percentage of B	70·1	74·9

A summary of important works completed on main roads during the year is contained in Appendix 3.

Plate 12.—New six-lane pavement on the Heidelberg–Eltham Road—City of Northcote.

Unclassified Roads.

Unclassified roads are under the care and management of municipal councils and are maintained by them.

Each year the Board assists municipal councils financially to carry out works of construction and maintenance on selected unclassified roads throughout the State. It is estimated that there are approximately 86,000 miles of unclassified roads in Victoria and the Board's allocations enable work to be carried out on approximately 20,000 miles of such roads each financial year.

Plate 13.—Sydney Road. The reconstructed section north of Bell Street—City of Coburg.

The following table shows the applications, allocations and expenditure on unclassified roads during the financial year compared with the position in 1964–65 :—

Unclassified Road Construction and Maintenance.	1964–65	1965–66.
	$'000s	$'000s
A Applications	35,632	37,709
B Allocations	15,360	16,254
C Expenditure	11,131	12,691
	%	%
B as percentage of A	42·4	45·8
C as percentage of B	68·4	78·1

A summary of the more important work completed on unclassified roads during the year is contained in Appendix 4.

Contracts Under Board's Direct Supervision.

The following groups of contracts were entered into by the Board during the year :—

—	No. of Contracts.	Value.
		$
Road Construction (Major works, i.e., over $60,000)	21	6,220,523
Road Construction (Minor works, i.e., under $60,000)	11	274,657
Supply of Roadmaking Materials	67	907,852
Bituminous Treatment and Supply of Materials	83	3,211,114
Bridge Construction	22	3,331,220
Manufacture of Bridge Components and Fabricated Steel	16	408,173
Supply of reinforced Concrete Pipes and Box Culverts	17	510,000
Supply of Road and Bridge Construction Equipment	33	1,014,513
Divisional Facilities	2	298,560
Miscellaneous Services and Stores	18	699,857
	290	16,876,469

Once again there was keen competition between tenderers for Board's works especially for the larger road and bridge works.

It is interesting to note that the 21 contracts let for major roadworks, i.e., works estimated to cost over $60,000, were shared between eighteen contractors. This fact tended to expedite the completion of works because in general, contractors did not attempt to perform several major contracts concurrently, which might have been beyond their resources.

Contracts under Councils' Supervision.

During the year the Board approved the acceptance by municipal councils of 518 tenders for a total amount of $5,833,110 for road and bridge work towards which the Board provided funds. The comparative figure for 1964–65 was $6,381,680. The Board also approved 121 municipal period contracts for the supply of materials for use on works financed from funds allocated by the Board. This compares with 92 such contracts in 1964–65. The Board notes a growing tendency for councils to rely on period contracts for materials supply rather than to invite tenders for individual works, and where conditions are suitable and economy is demonstrated approves this procedure.

Plate 14.—Contractor's plant in operation on the Foster deviation—South Gippsland Highway—Shire of South Gippsland.

Bituminous Surfacing.

The Board's 24 mobile bituminous surfacing units and one mobile asphalt plant, together with plant owned by municipal councils and contractors carried out the following work during the year :—

Total length of sealing work—3,067 miles.

Extension of length of sealed roads—

	Miles
State highways and By-pass roads	26
Tourists' roads, Forest roads	17
Main roads	138
Unclassified roads	616
	797

The above work included—

309 miles of widening of existing pavements ;

21 miles of duplication of carriageways ;

435 miles of restoration of seal coats on reconstructed sections ;

1,365 miles of maintenance retreatment.

The length of sealed pavements on Board's declared roads is now 86·7 per cent. of the total.

Plant mix machine spread work amounted to 83 miles and involved the manufacture, spreading and compacting of 156,632 tons of binder and surface course of bituminous concrete on the more densely trafficked roads.

The total quantity of bitumen purchased directly by the Board was 30,418 tons and this was distributed in bulk ; approximately 71 per cent. by rail and 29 per cent. by road vehicles. Contractors used a further 7,600 tons.

In addition to bitumen, the Board purchased approximately 11,800 tons of bituminous material such as cutback bitumen, tars and bitumen emulsion for surfacing and allied maintenance work.

The major portion of plant mix work was undertaken by contractors operating fixed asphalt plants but the Board's mobile asphalt plant produced and laid 13,920 tons on the more heavily trafficked roads in the vicinity of Shepparton, Mooroopna, Numurkah and Bendigo.

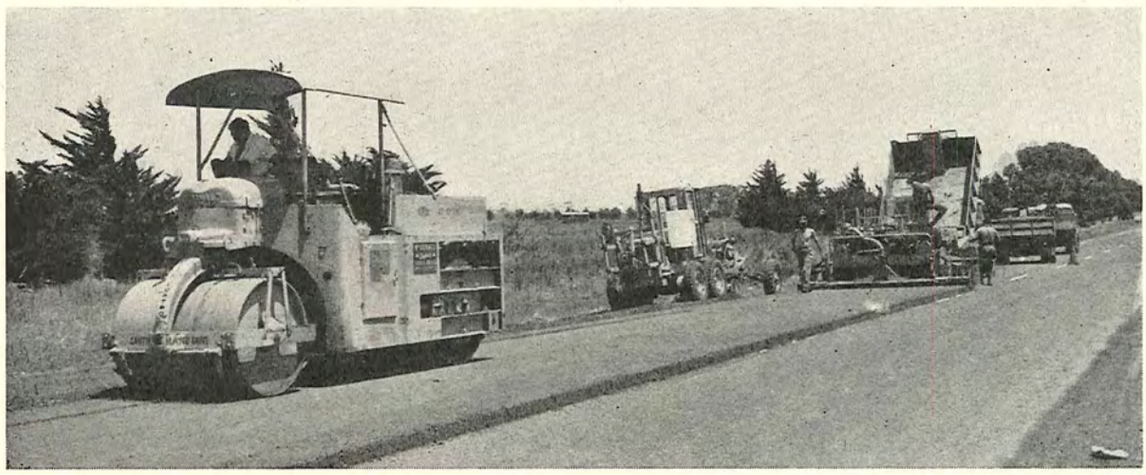

Plate 15.—Laying a wet mix surface preparatory to sealing—Western Highway—Shire of Melton.

Line Marking.

During the year the Board maintained line marking on 5,465 route miles of road consisting of 3,670 miles of State highways, 1,567 miles on other declared roads and 228 miles on unclassified roads. Of the total route miles marked 55·6 per cent. were reflectorized with glass beads.

The total mileage of equivalent standard 3-inch line painted during the year was 13,115 against 9,451 last year. The total cost was $190,920 at an average cost of $13·05 per mile excluding miscellaneous pavement marking.

BRIDGES.

New Work Commenced.

The construction of 175 new bridges estimated to cost approximately $5,060,000 was commenced during the financial year. Of these 63 bridges, estimated to cost $3,086,000 were commenced under the Board's supervision, and 112 bridges, estimated to cost $1,974,000, under municipal supervision.

Corresponding figures for the previous year were 54 bridges estimated to cost $2,960,000 under the Board's supervision, and 116 bridges estimated to cost $1,768,000 under municipal supervision.

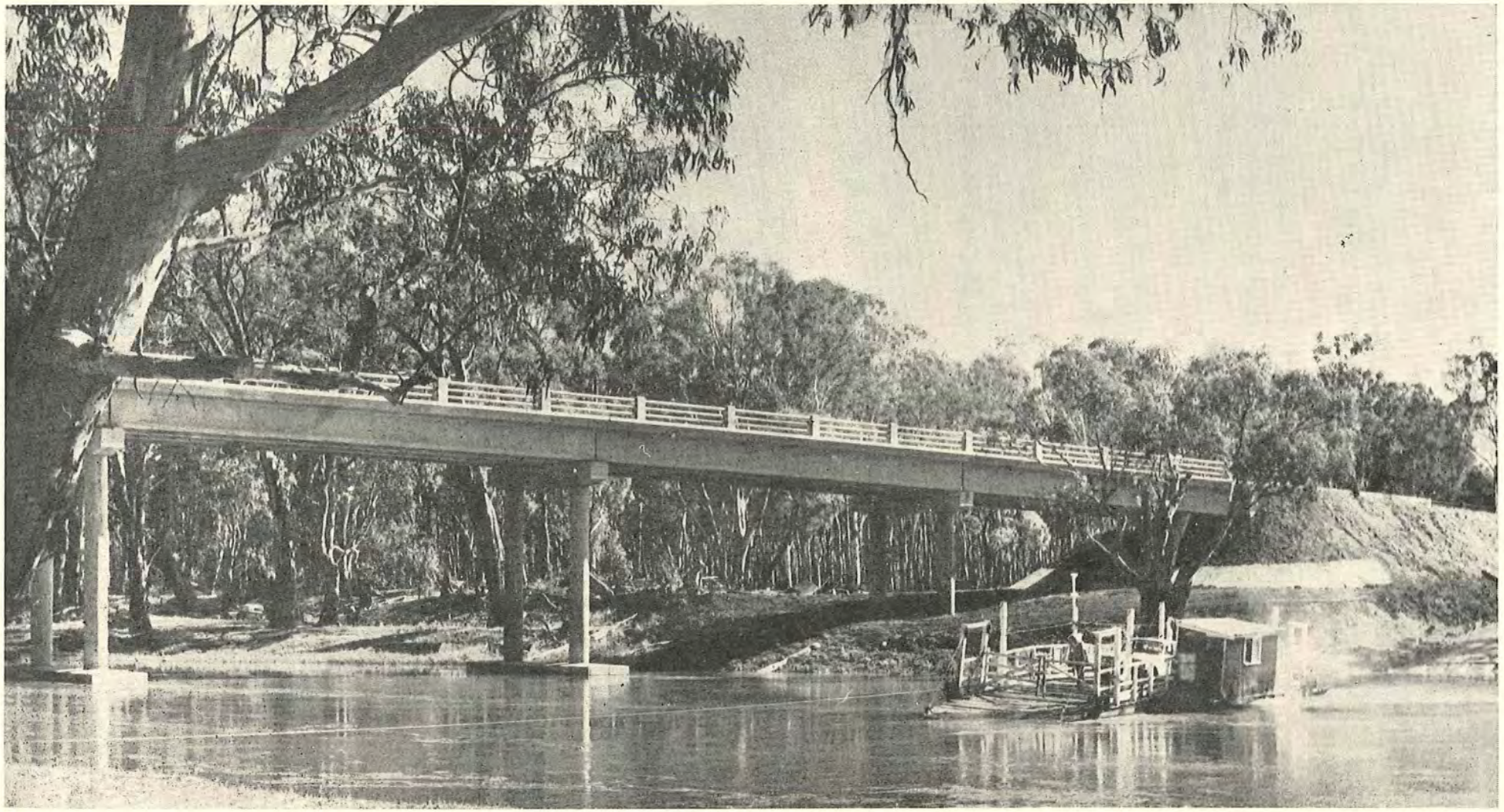

Plate 16.—The new bridge over the Murray River at Barmah, Shire of Nathalia ; also showing the punt it replaced.

Large Bridges Completed in Rural Areas.

Some of the larger bridges actually completed throughout Victoria during 1965–66 under the Board's supervision included :—

(*a*) *Barmah Bridge—Murray River—Shire of Numurkah.*—A prestressed concrete and reinforced concrete bridge 570 feet long by 24 feet between kerbs plus a 5-feet footway over the Murray River at Barmah, replacing the ferry which had previously operated at this point.

The bridge was officially opened by Mr. J. A. Lawson, M.L.A., Member for the electorate of Murray, N.S.W., at an opening ceremony on the 19th March, 1966, in the presence of the Hon. M. V. Porter, Minister of Public Works, Victoria, and the Hon. P. M. Morton, Minister for Local Government and Minister for Highways, N.S.W.

(*b*) *Axedale Bridge—Campaspe River—McIvor Highway.*—A composite steel girder and reinforced concrete deck bridge 383 feet long by 28 feet between kerbs, using the masonry piers of the previous bridge, over the Campaspe River on the McIvor Highway at Axedale.

(*c*) *Boggy Creek Bridge—Nowa Nowa—Princes Highway East.*—A rigid frame steel girder and composite concrete deck bridge, 182 feet long by 28 feet between kerbs plus a 5-feet footway, over the Boggy Creek on the Princes Highway East at Nowa Nowa.

(*d*) *Dadswell's Bridges—Mt. William Creek—Western Highway.*—Three reinforced concrete bridges respectively 100 feet, 60 feet and 120 feet long by 28 feet between kerbs over the Mt. William Creek on the Western Highway at approximately 164·5 miles from Melbourne.

(*e*) *Traralgon Creek Bridge—Traralgon—Princes Highway East.*—An 8-span reinforced concrete bridge 222 feet long by 28 feet between kerbs plus a 6-feet footway over the Traralgon Creek on the Princes Highway East in Traralgon.

Work was also started during the year, and substantially completed, on a new bridge to eliminate the railway level crossing at French Street in the City of Hamilton. The crossing is being replaced with a 3-span composite steel girder and reinforced concrete structure 164 feet long, with dual carriageways each 26 feet wide and a single 5-feet wide footway.

Included amongst the larger bridges constructed during the year under municipal supervision were :—

(*a*) *Lady Somers Bridge—Ararat–Hall's Gap Road—Shire of Ararat.*—A new prestressed concrete beam and reinforced concrete bridge 162 feet long by 26 feet between kerbs over the Mt. William Creek on the Ararat–Hall's G
the Shire of Ararat. The Board's Chairman, Mr. I. J. O'Donnell, officially opened the bridge at a ceremony on 8th June, 1966.

(*b*) *Merri River Bridge—Wollaston—Shire of Warrnambool.*—A composite steel girder and reinforced concrete bridge 158 feet long by 24 feet between kerbs over the Merri River at Wollaston in the Shire of Warrnambool. This bridge replaced an historic old suspension bridge constructed in 1890.

(*c*) *Plenty River Bridge—Diamond Creek Road—Shire of Diamond Valley.*—A reinforced concrete and prestressed concrete beam bridge 140 feet long by 28 feet between kerbs plus two 6-feet footways over the Plenty River on the Diamond Creek Road in the Shire of Diamond Valley.

(*d*) *Becks Bridge—Latrobe River—Shire of Narracan.*—A 4-span prestressed concrete beam and reinforced concrete bridge, 181 feet long by 22 feet between kerbs constructed by the Narracan Shire Council over the Latrobe River on the Becks Bridge Road.

Plate 17.—The Lady Somers Bridge over Mount William Creek—The Halls Gap Road—Shire of Ararat.

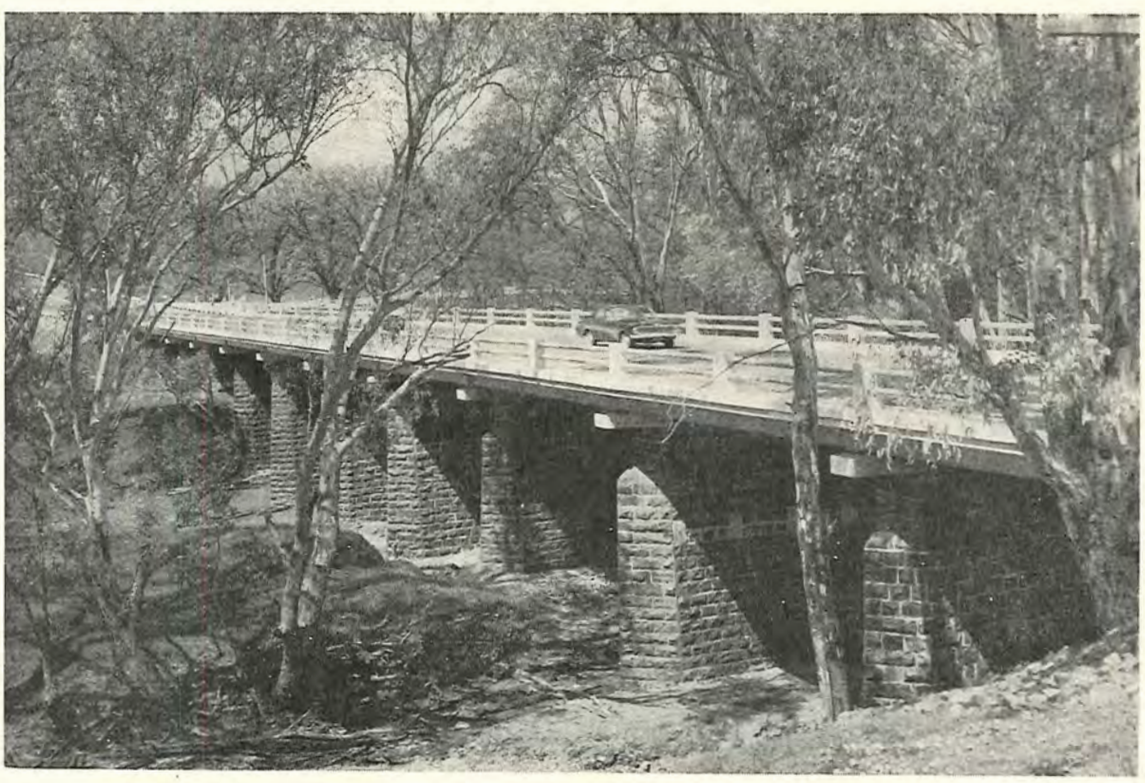

Plate 18.—New widened deck on the bridge over the Campaspe River at Axedale—McIvor Highway.

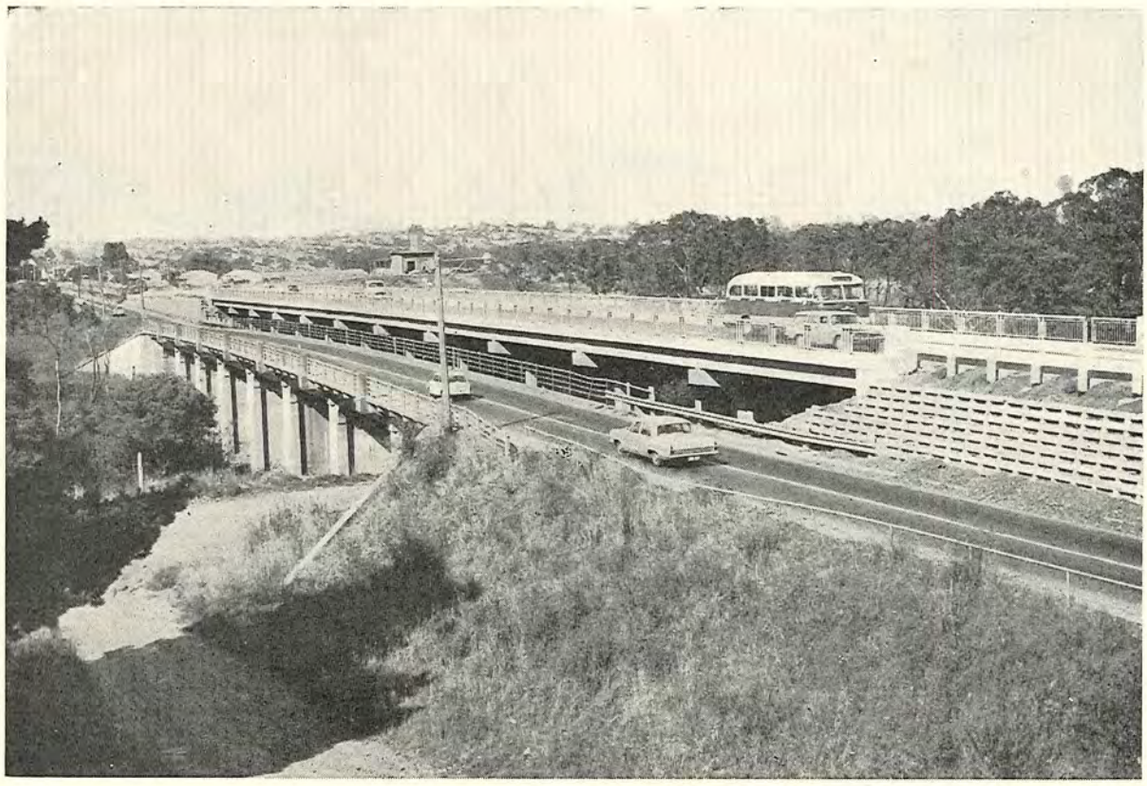

Plate 19.—New Duplicate Bridge over the Yarra River on Burke Road at the boundaries of the Cities of Camberwell, Kew and Heidelberg.

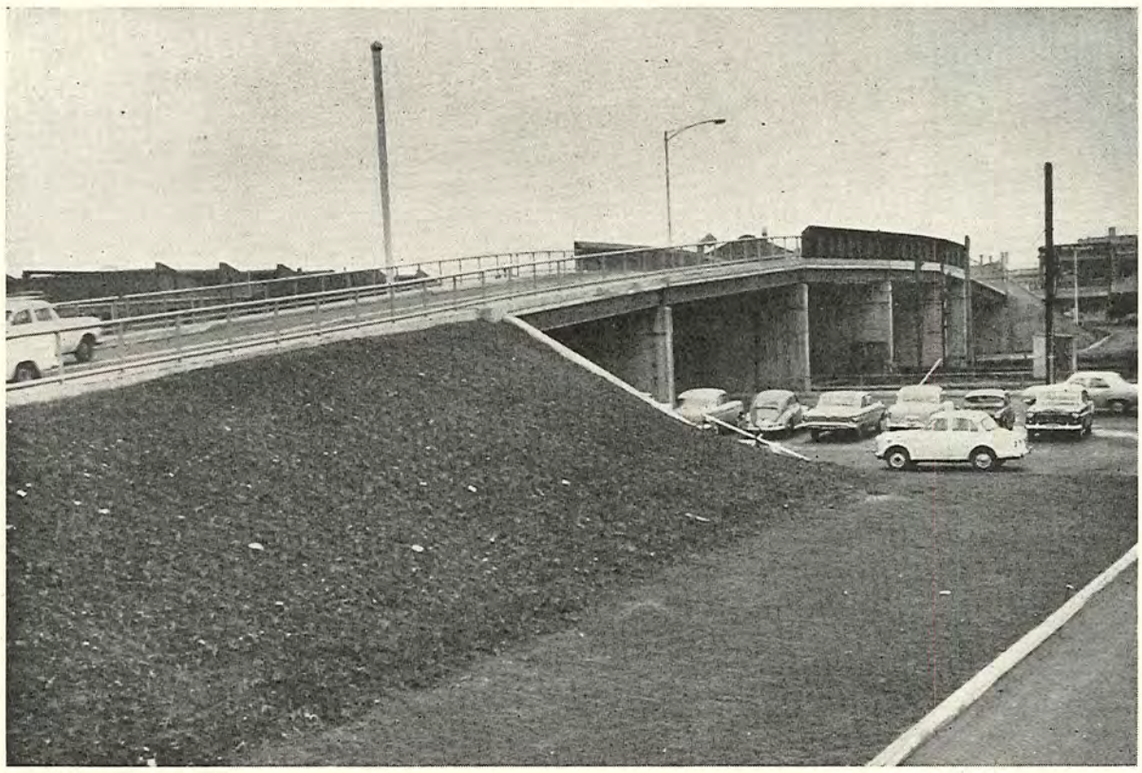

Plate 20.—Road over Rail Overpass at Burnley Street—City of Richmond.

Metropolitan Bridges and Overpasses.

The Board continued its work with the design and construction of many bridges and overpass structures in the metropolitan area.

An urgent programme for construction of the section of the Tullamarine Freeway north of the Essendon Airport involved the Board in the construction of seven overpass structures, expected to be completed early in 1967. These structures are :—

(*a*) duplicate composite steel girder and reinforced concrete bridges, each 251 feet long by 28 feet between kerbs, over the main Broadmeadows–Albion railway line ;

(*b*) duplicate overpass structures, each 256 feet long by 28 feet between kerbs, in pretensioned concrete beam and reinforced concrete, at the crossing of Mickleham Road ;

(*c*) duplicate interchange structures, each 82 feet long by 39 feet between kerbs, in composite steel girder and reinforced concrete construction, at the northern interchange roads at the Tullamarine Airport ;

(*d*) a 3-span, post tensioned concrete box girder overpass bridge, 235 feet long and 28 feet between kerbs, at the exit from the new airport terminal.

Four additional overpass structures are required on this section of the Tullamarine Freeway and these will commence during financial year 1966–67.

Construction of a new duplicate bridge over the Yarra River on Burke Road at the boundary of the Cities of Camberwell, Kew and Heidelberg was completed during the year. The bridge is 451 feet long by 26 feet between kerbs plus a footway 7 feet wide, consisting of ten 45-foot spans in prestressed concrete beam and reinforced concrete construction.

The intense heat of a fire, resulting from a loaded petrol tanker striking the Sims Street Overpass section of Shepherd Bridge in November, 1965, severely damaged the reinforced concrete, by deep spalling of the concrete around and behind the main steel reinforcement of the Overpass. Reconstruction of the Overpass was almost complete at 30th June, 1966. Provision had to be made during the reconstruction work for the very high traffic volume which used the bridge daily.

Two of the larger bridge projects completed in the metropolitan area under municipal supervision were :—

(*a*) duplicate bridges constructed by the Preston City Council over Darebin Creek on Murray Road to provide direct access to the new Northlands Shopping Centre. The bridges are each 121 feet long by 26 feet between kerbs plus a 6-feet footway and are of prestressed concrete beam and reinforced concrete construction ;

(*b*) a 3-span reinforced concrete bridge 74 feet long by 43 feet between kerbs plus two 6-feet footways over Gardiners Creek on Highbury Road in the City of Waverley.

Bridge and Culvert Materials.

The total length of various diameters of reinforced concrete pipes, supplied to satisfy Board and municipal orders, increased by approximately 30 per cent. over the length supplied in 1964–65, to 206,400 lineal feet valued at $370,800.

For the first time reinforced concrete pipes 96 inches in diameter were used. Hitherto the maximum diameter of reinforced concrete pipe used was 78 inches. The 96-inch diameter pipes were made in sections 6 feet long weighing 5 tons each. Little difficulty was experienced in transporting and laying the pipes.

The use of all sizes of precast rei
previous year by more than 20 per cent. to 28,900 lineal feet valued at $125,500. The Board's precasting yards increased production of precast high strength concrete " U " slabs by 9 per cent. to 6,400 tons valued at $198,000, and also produced 6,300 tons of precast reinforced concrete piles valued at $166,000.

Contracts totalling $288,700 were let during the year for the supply of approximately 5,700 tons of prestressed concrete bridge components.

Approximately 2,700 tons of reinforcing steel valued at $350,000 were used in bridges constructed with Board funds during 1965–66, and 600 tons of rolled steel girders. Ample supplies were available. Corrugated galvanized steel culverts of a total value of $94,000 and 58,000 lineal feet of corrugated steel guardrail valued at $40,000 were also supplied to Board projects.

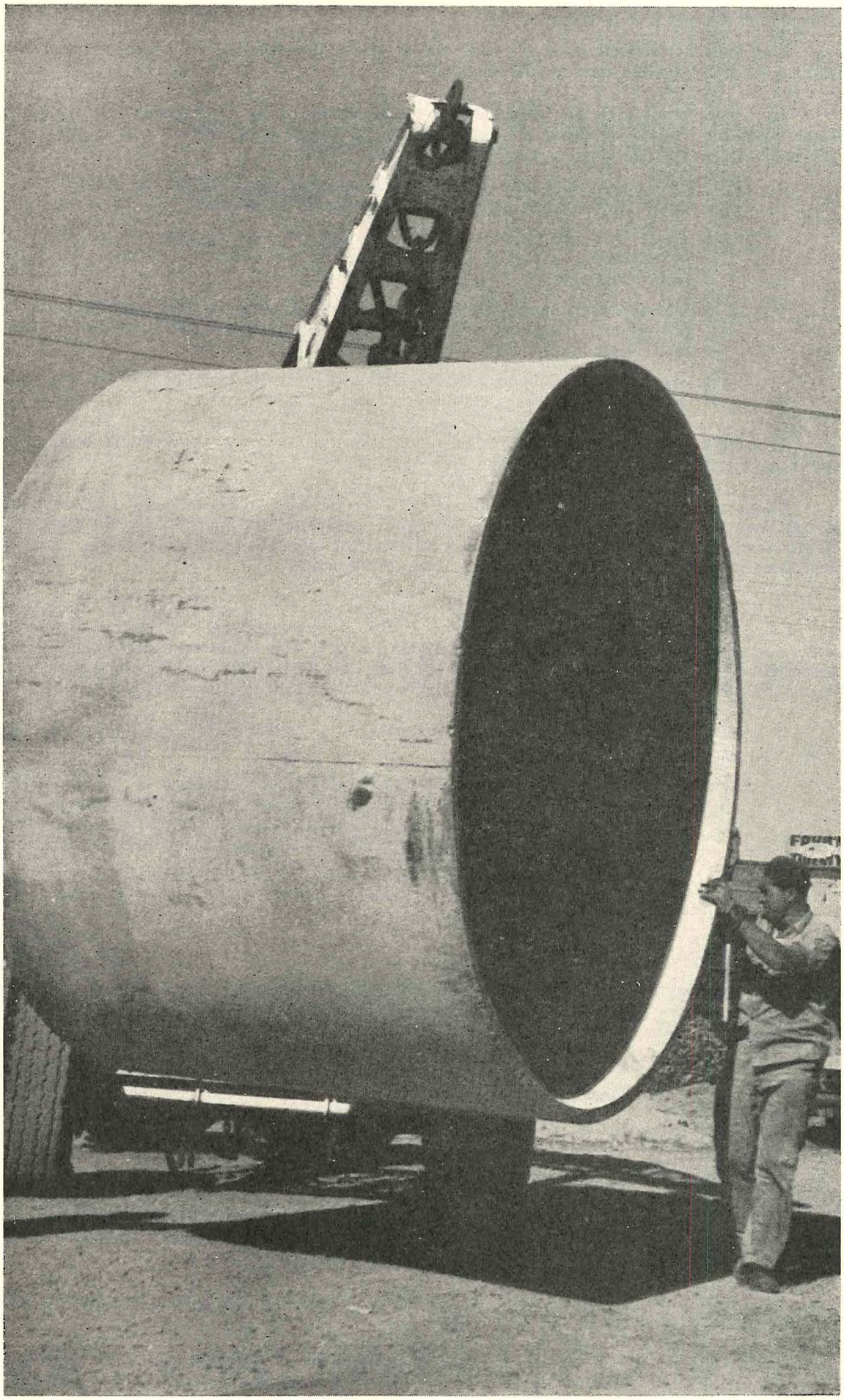

Plate 21.—96-inch culvert pipe being prepared for testing.

MATERIALS RESEARCH.

The Board's Materials Research Division continued to carry out routine tests of materials used in road and bridge works. Several field laboratories were established to assist in the control of materials used on larger works. These laboratories, in conjunction with inspection at the source of material, enable more effective quality control to be exercised. In the field of research and applied research as distinct from routine and quality control testing some of the projects undertaken during the year are as follow :—

It is becoming more difficult to find gravels which can be used for road building in the condition as excavated and more attention is being given to the possibilities of improvement by mixing two or more materials and to stabilization, using lime or portland cement.

A new field of research has been opened by the purchase of equipment to test stone for its tendency to polish and become slippery when used in the surface of a pavement under intensive motor traffic. The equipment will be used in long-term studies of slipperiness in accordance with British Standard Specification No. 812.

Some progress was achieved in the improvement of the standard type " Roughometer ", a machine for measuring the longitudinal roughness of road surfaces. Using the refined machine it is expected that it will be possible to set up warrants to establish the need or otherwise for improvement of the riding quality of any particular road. This work will be the subject of a paper at the 1966 Australian Road Research Board conference.

Apparatus is now available to enable the Board's metallurgists to undertake metallurgical investigations particularly those concerning welding procedures and special steel.

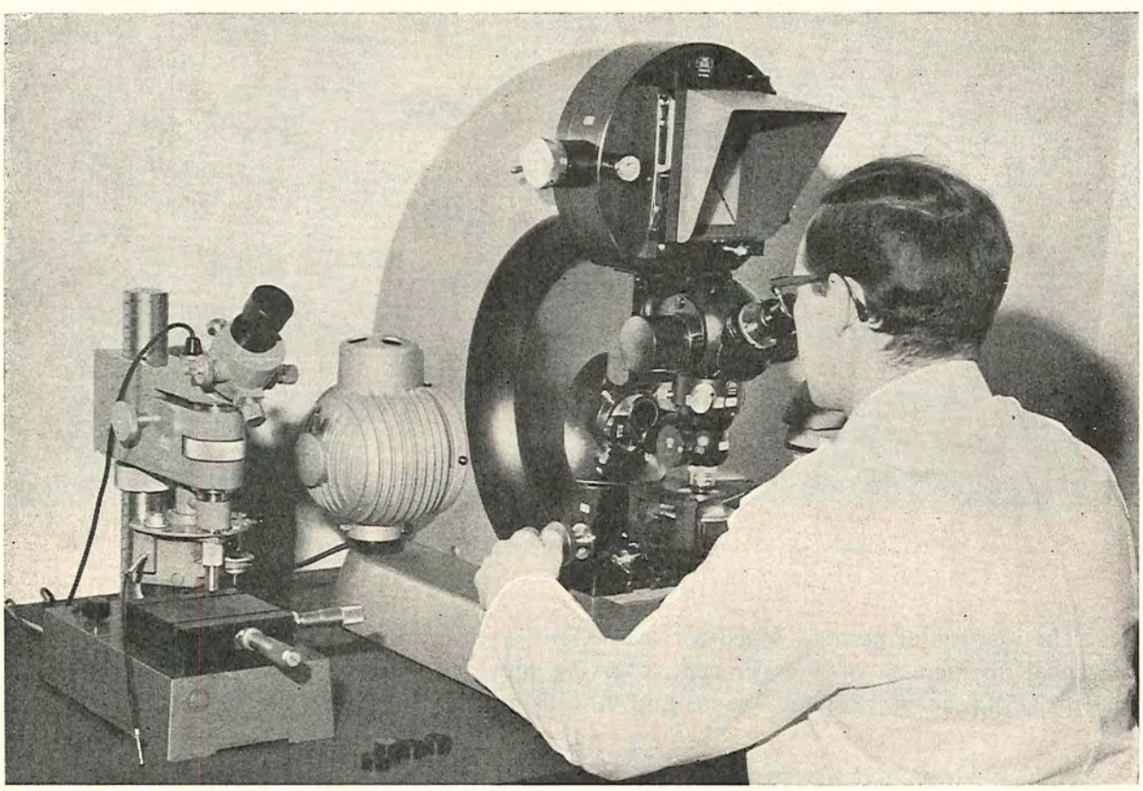

Plate 22.—The Board's metallurgist using new apparatus.

CONTROL OF HEAVY TRAFFIC.

For safety reasons, limits are imposed by law on the width, height and length of vehicles and their loads. Notwithstanding such general limits, which are provided for under the Motor Car Act, it is at times necessary to permit the movement of vehicles and loads which exceed the statutory limits. The Board is charged with the responsibility of controlling the movement of heavy extra-legal vehicles on the Board's declared roads. It meets this responsibility through its Traffic Section by issuing permits for heavy vehicles to use routes for travel at times when inconvenience to other traffic will be at a minimum and where the least damage will be done to the roads and bridges. Policing and enforcement is affected by a team of Traffic Officers based on Head Office and Regional Divisions.

During the year the Board's Traffic Officers reported 8,229 offences for overweight, excess speed and other actions contrary to the provisions of the Motor Car Act. This number was 896 less than the previous financial year which could indicate an improvement in the observance by road operators generally of the provisions of the Motor Car Act. Of the offences reported, over 90 per cent. were successfully prosecuted. Fines and costs imposed by courts during the year totalled $278,221.

Axle load limits of 5 tons imposed to protect weak pavements were removed from certain roads in the Shire of Otway. Such load limits in the shire were retained on the 9 miles of the Beach Forest–Lavers Hill Road between Ferguson and Lavers Hill and on the Ocean Road between Apollo Bay and Peterborough, a distance of 76 miles.

Plate 23.—Overweight and

The number of permits issued for overweight or over-dimensional loads was 22,102 which represented an increase of 4·6 per cent. over the previous financial year. The permits issued included 295 for loads between 70 tons and 90 tons and 54 for loads over 90 tons.

A new 50-ton weighbridge was installed at Seymour and a new 20-ton weighbridge was installed at Melton, and these facilities considerably assist in the work of checking vehicle loadings.

WORKS CARRIED OUT ON BEHALF OF OR IN CONJUNCTION WITH OTHER GOVERNMENT AUTHORITIES.

Tourist Development Authority.

The Government again provided $200,000 for expenditure by the Board in conjunction with the Tourist Development Authority on roads of tourist interest other than declared tourists' roads.

The funds available were expended on roads giving access to tourist resorts, picnic places, waterfalls and other places of scenic attractions including—

Seacombe-Sperm Whale Head Road in the Gippsland Lakes district.
Extension of the Mt. Buller Road towards the summit of Mt. Buller.
Wannon–Nigretta Falls Road in the Shire of Dundas.
Access to the Princess Margaret Rose Caves near Portland.
Halls Gap–Flat Rock Horsham Road in the Grampians.

In addition, allocations were made for the continuation of work on the Jerusalem Creek Road at Lake Eildon, the Upper Kiewa Valley Extension Road in the Shires of Bright and Omeo and the Dargo High Plains Road.

The assistance given by the Government since 1960-61 for this class of work has made a major contribution towards providing easy access for tourists to places of beauty and scenic attraction. Expenditure under the scheme to 30th June, 1966, amounted to $1,186,861.

As required by the *Tourists Act* 1958, the Board paid into the Tourist Fund, which is administered by the Tourist Development Authority, the sum of $467,566 during the year. This payment is based on 2 per cent. of the amount credited to the Country Roads Board Fund from receipts under the Motor Car Act.

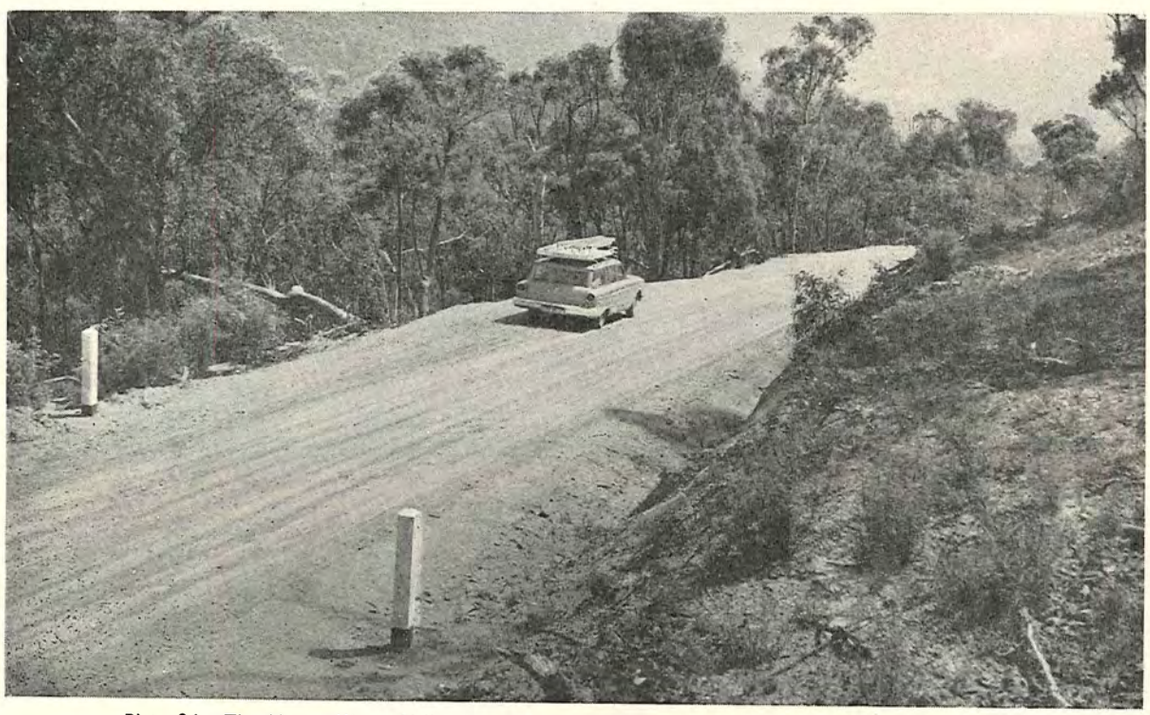

Plate 24.—The Upper Kiewa Valley Extension Road (Bogong High Plains Road) Shire of Omeo.

National Parks Authority.

For the third successive year the Government made $100,000 available for expenditure on roads in or adjacent to National Parks. Of this sum $83,220 was allocated with the approval of the National Parks Authority for works on roads in or near—

Port Campbell National Park
Frazer National Park
Kinglake National Park.

At 30th June, 1966, expenditure against the total provision of $300,000 since 1st July, 1963, was $197,999.

Plate 25.—New Road in the Heytesbury Settlement area.

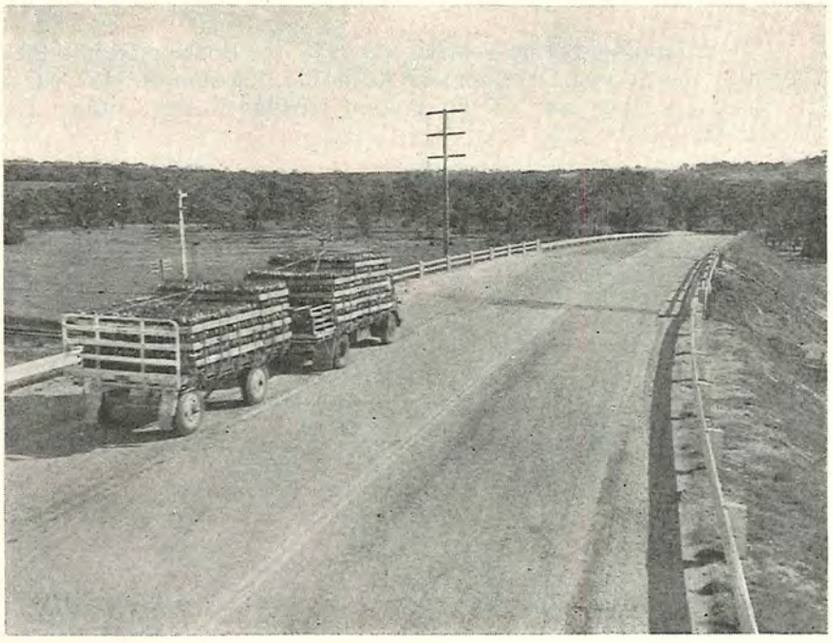

Plate 26.—Road over Rail Overpass on the Western Highway at Beaufort.

Plate 27.—Roadworks in progress on the Grampians Road—Lake Bellfield deviation.

Rural Finance and Settlement Commission.

Works carried out in conjunction with the Commission were continued in the Heytesbury Settlement Area and in the East Goulburn Irrigation Settlement Area.

The works in each case are being shared on the basis of Country Roads Board—three-eighths, Rural Finance and Settlement Commission—one-half, and the municipal council concerned —one eighth.

Expenditure during the year in the Heytesbury Settlement Area amounted to $265,183 which is subject to apportionment on the above basis.

The following types of work were carried out :—

	Miles.
Roads located	11
Roads cleared	7
Roads surveyed	4
Roads formed only	3
Roads gravelled to base course level	4
Roads fully constructed	6½

In the East Goulburn Settlement Area a sum of $41,942 was expended in respect of construction works on various roads.

Railways Department.

The Board and the Railways Department continued to perform work on the elimination of railway level crossings according to priorities allotted by the Inter-departmental Committee on the Abolition of Railway Level Crossings. The projects are financed on the basis of Country Roads Board 45 per cent., Railways Department 25 per cent. and Level Crossings Fund 30 per cent.

During the year 1965–66 the road over-rail over-pass at Burnley Street in the City of Richmond and the deviation of the roadway at Buangor to eliminate the railway level crossing were opened to traffic. The road over-rail over-passes on the Princes Highway West at Brooklyn and on the Western Highway at Beaufort and at Wail, which had previously been opened to traffic, were fully completed during the year.

Work was also carried out on the following large projects throughout the State :—

Glenelg Highway at Hamilton to eliminate a level crossing in French Street.
Midland Highway at Yapeen in the Shire of Newstead.
Princes Highway East at Kilmany in the Shire of Rosedale.
Canterbury Road, Canterbury.

Flashing lights were installed at fifteen level crossings.

Expenditure during the year amounted to $953,000 of which the Board contributed $421,000.

State Rivers and Water Supply Commission.

During the year the Board completed roadworks in the Grampians area to relocate the Grampians Tourists' Road as part of the Commission's Lake Bellfield project. Work has also started on a deviation of the Midland Highway made necessary by the construction of the Nillahcootie Reservoir.

Expenditure during the year on these works amounted to $87,850.

LEGISLATION AFFECTING THE BOARD.

The following legislation enacted during the financial year affected the Board :

San Remo–Newhaven Land Act 1965 (No. 7305).

Amongst other things, this Act made Crown land previously permanently reserved for public purposes available to the Board for use in connexion with the new bridge between San Remo and Newhaven.

Country Roads (*Collection Costs*) *Act* 1965 (No. 7313).

This Act provides for the Transport Regulation Board to be reimbursed by the Country Roads Board for expenses incurred in collecting road tax charged under the Commercial Goods Vehicles Act from owners of commercial motor vehicles. The full amount of the road tax is paid into the Country Roads Board Fund and is used for the maintenance of public roads.

Under the terms of the new Act an amount equal to 6 per cent. of the road tax collected must be paid to the Transport Regulation Board out of the Country Roads Board Fund.

Decimal Currency Act 1965 (No. 7315).

The purpose of this Act was to deal appropriately with £ s. d. references in State Acts and in statutory instruments and for other related purposes when the changeover to decimal currency took place on 14th February, 1966.

An Order in Council to amend all references to amounts of money in the old currency in the Board's By-laws and Regulations was made by the Executive Council under the provisions of this Act on 8th February, 1966.

Statute Law Revision Act 1965 (No. 7332).

This Act *inter alia* substituted the words " Minister of Lands " in lieu of " Commissioner of Crown Lands and Survey " in Sections 85 and 91 of the *Country Roads Act* 1958 (No. 6229) relating to the proclamation of tourists' and forest roads.

Country Roads (*Cadetships*) *Act* 1965 (No. 7347).

This Act gave the Board specific power to enter into cadetship agreements with persons undertaking or about to undertake courses of study at universities and other institutions providing tertiary education in Victoria.

FILMS AND DISPLAYS.

The Board's Photographic Section maintained its high standard of monochrome and colour photographs for display as well as for engineering purposes. The film unit produced a new two-part film showing the construction of the new superstructure on existing piers of the bridge over the Campaspe River at Axedale on the McIvor Highway. The film also shows the erection and dismantling of the temporary Bailey bridge by the Board's C.M.F. unit No. 104 Construction Squadron, Australian Army Supplementary Reserve.

Displays on the main theme of " Road Safety " were exhibited at the Royal Melbourne Show in September, 1965, and at the Motor Show in February, 1966. Suitable pamphlets were handed out to visitors. Colouring books were also presented to children at the Royal Show with the purpose not only of stimulating interest in roads and road safety in the young but indirectly bringing these matters to the notice of parents.

PERSONNEL.

At 30th June, 1966, the number of personnel employed by the Board was :

Salaried Staff	1,179
Depot and Field Supervisory Personnel ..	394
Employees	2,577
	4,150

Recruitment.

As was the case in the previous financial year some difficulty was experienced in obtaining the required number of qualified professional engineering staff and the desired quality of technical and administrative staff. Every endeavour is being made to employ good quality staff direct from secondary and tertiary institutions, so that, with appropriate training and experience these officers can provide in the future the necessary technical skills required to carry out the Board's functions.

In order to attract good quality personnel to the Board's staff, the Board continued its participation in Careers Nights and similar functions organized by Rotary Clubs, Apex Clubs and secondary and technical schools throughout Victoria. In addition, representatives of the Board addressed final-year students at both the University of Melbourne and Monash University and also those senior Technical Colleges in Victoria which provide full Diploma courses in Civil Engineering. These activities have been found to be a highly successful means of recruiting civil engineers to the service of the Board.

Students at many secondary schools have also been addressed on the possibility of a career with the Board. At each school visited, the Board's Cadetship scheme for study at the Universities and at the Royal Melbourne Institute of Technology (Land Surveying Diploma course only) was mentioned. This has proved to be an excellent method of bringing the Board before the notice of students and attracting staff to the Board.

No difficulty was experienced in the recruitment of field personnel for bridge and road construction and maintenance gangs. In order to overcome the shortage of metal tradesmen the Board increased its apprentice intake to 16 in 1966 and at 30th June, 1966, 54 apprentices were indentured to the Board.

Cadetships.

As a result of the above recruitment practices, over 600 applications were received for Cadetships offered by the Board to commence study in 1966. This greatly increased number of applications makes possible the selection of an extremely high standard of cadet.

In view of a decision made by the Land Surveyors Board of Victoria to require students who wish to become licensed surveyors to complete a full-time course in land surveying either at the University of Melbourne or the Royal Melbourne Institute of Technology, the Board decided, in an effort to offset an expected shortage of licensed surveyors, to offer for the first time cadetships for the diploma course in land surveying at the Royal Melbourne Institute of Technology. Four cadetships were granted for this course.

Nine civil engineering cadetships, two economics cadetships and one surveying cadetship were provided for full-time study at either Melbourne University or Monash University.

The following table shows the number of cadetships at the universities and the Royal Melbourne Institute of Technology in the 1966 academic year :

Cadets Under Training.	Civil Engineering.	Mechanical Engineering.	Commerce.	Economics.	Surveying.	Total.
First Year	3	..	..	1	3	7
Second Year	7	..	1	..	..	8
Third Year	9	1	2	1	..	13
Fourth Year	11	..	..	..	2	13
	30	1	3	2	5	41

The cadets report at regular intervals to the Board's training staff for guidance and counselling.

Staff Retirements.

The following officers with substantial service retired during 1965–66 :—

Mr. J. W. C. Pascoe	..	Divisional Engineer, Warrnambool, after 48 years' service with the Board.
Mr. H. R. Corrigan	..	Divisional Engineer's Clerk, Geelong Division, after 23 years' service with the Board.

The death of the following officers occured during 1965–66 :—

Miss M. E. Hamilton	..	Stenographer.
Mr. D. W. P. Haydon	..	Bridge Inspecting Engineer.
Mr. J. H. Pollard	..	Costing Officer.
Mr. W. R. Sizeland	..	Clerk.
Mr. M. C. Stuart	..	Senior Title Draftsman.

Industrial Activity.

There was considerable activity during the year arising out of logs of claims served on the Board by Associations representing salaried staff (excluding professional engineers) and supervisory personnel and unions representing field employees.

Following lengthy discussions with the various staff associations and with other Victorian State Authorities affected by similar logs of claims, an agreement was entered into between the Board and the Municipal Officers' Association, the Association of Architects, Engineers, Surveyors and Draftsmen, and the Association of Professional Scientists within the framework of the Commonwealth Conciliation and Arbitration Act. The agreement has a duration of two years from 30th March, 1965.

It is significant that prior to the Professional Engineers' Award of 1961 the Board's salaried and supervisory staffs were not covered by awards or salary agreements. Since then, however, most categories of personnel have been included in awards or agreements made under the Commonwealth Conciliation and Arbitration Act. This reflects the tremendous growth of salaried staff association activity in the professional and administrative fields during that period.

A new Australian Workers' Union Construction and Maintenance Award was made in April, 1966, after considerable negotiation. Some matters reserved for further arbitration including camping allowances and margins for plant operators are most important to the Board. The Board is one of the largest respondents to this Award and any rise in wages or allowances considerably affects its direct labour and contract costs.

New awards are currently being negotiated for.

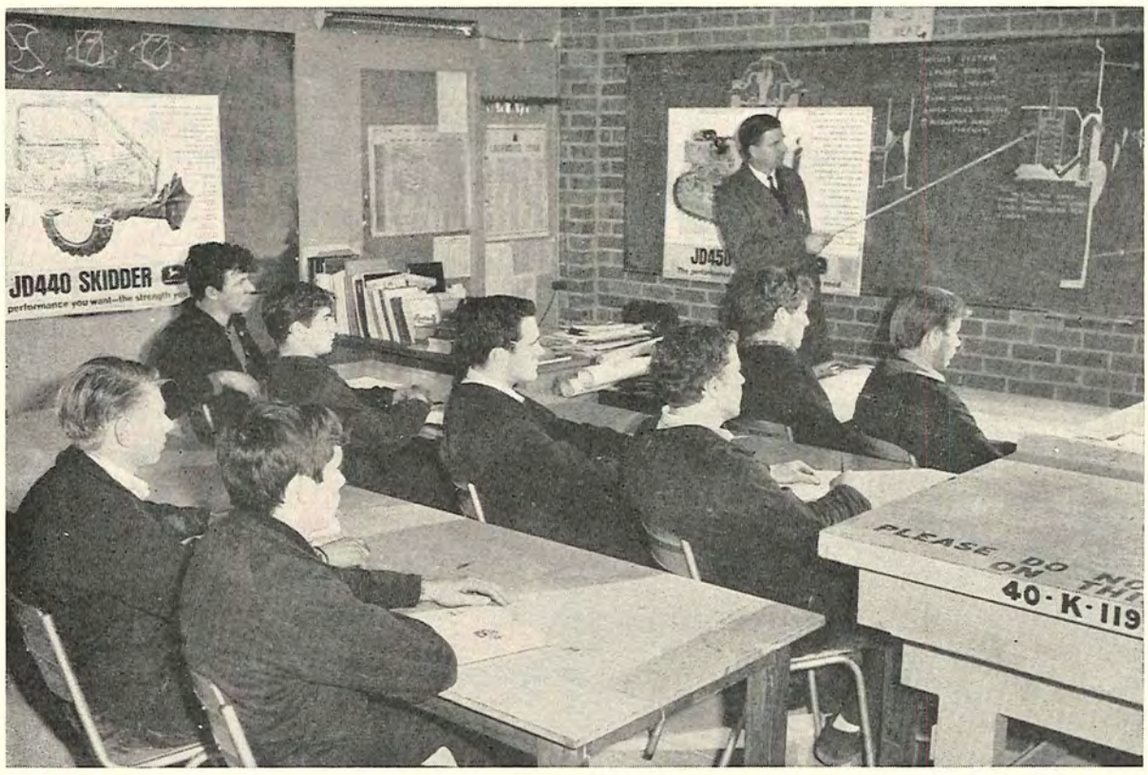

Plate 28.—Lecture in progress at the Apprentice Centre.

Training.

Training activities continued throughout the year to satisfy the needs of the Board's organization.

The practice of conducting programmes of induction at regular intervals throughout the year was continued, and a course for senior administrative staff was repeated for the third year in succession for a further group of officers.

An Appreciation Session was conducted for Branch Heads, their Deputies and Assistants, for the purpose of assessing suggestions for training in communication throughout the Board. As a consequence of this Session, a programme of appropriate training was prepared for introduction in the next financial year.

A Seminar on Critical Path Analysis was held at Head Office for selected Class 3 Engineers.

An Apprentice Centre, under the supervision of a specially appointed Supervisor of Apprentices, started operation at the beginning of 1966, as an annex to the workshops at Syndal. Only first-year apprentices use the facilities of the Centre on a full-time basis. These facilities have been designed both to supplement the tuition of technical schools and to provide practical experience preparatory to the entry of the apprentices to the workshops.

Negotiations were completed with the Royal Melbourne Institute of Technology, during the early months of 1966, for tuition by correspondence in the already existing attendance course for Road Foremen and Municipal Superintendents. The attendance course was introduced at the Institute on a pilot basis in 1965. This pilot course was sufficiently successful to justify the continuance of classes in 1966 and the organization of the correspondence facilities based on it.

Continued use was made of external institutions and organizations for the training of personnel in various aspects of the technical and administrative functions of the Board. In particular—

(*a*) Mr. H. S. Gibbs, Chief Engineer, attended a Seminar on Effective Top Management conducted by a prominent firm of Management Consultants ;

(*b*) Mr. N. L. Allanson, Secretary, attended a fortnight's residential Management Conference conducted by the Victorian Public Service Board ;

(*c*) Mr. F. G. Lodge, now Divisional Engineer, Warrnambool, and Mr. A. J. Waters, Engineer, Metropoliatn Division, attended the Civil Engineering Construction Management Course at the University of New South Wales ; and

(*d*) Mr. R. W. Angus, Assistant Divisional Engineer, Bairnsdale, Mr. B. Addis, Bridge Design Engineer and Mr. A. M. MacPherson, Engineer, Plans and Survey, attended a three month-course in Traffic Planning.

CONFERENCES.

Municipal Engineers.

The twenty-second Conference of Municipal Engineers convened by the Board was held on 23rd and 24th February, 1966, at the Boards' Head Office, Kew. Attendance was approximately 250, including engineers from most of the municipalities in the State, representatives from various Commonwealth and State Government Departments and Instrumentalities, Members of the Board and senior engineers of the Country Roads Board.

The Conference was officially opened by the Hon. J. F. Rossiter, M.L.A., Assistant Minister of Education, on behalf of the Minister of Public Works.

Papers were presented on a wide variety of topics ranging from technical engineering problems to administration in local government engineering. The subjects covered included patrol maintenance on rural highways, steel fabrication and testing, use of limestone as a road making material, landscape preservation and tree conservation, soil conservation in relation to road and bridge works, gravel pit reinstatement, responsibilities of local government engineers, public relations and business management pertaining to municipal engineers. Discussions were held on road signs, construction of lightly trafficked roads, bush fire control and prevention, camping equipment for road construction employees and general engineering problems.

The Board would like to record its thanks particularly to those engineers presenting papers and to all who contributed towards the success of the Conference.

To close the Conference on the morning of Friday, 25th February, a tour of the Melbourne Harbour Trust facilities by M.H.T. inspection vessel " Commissioner " was arranged by the Trust Commissioners. The excellent arrangements made for this inspection were much appreciated.

Municipal Association.

Representatives of the Board attended the annual conference of the Municipal Association of Victoria and the Annual District Conferences held throughout the State.

The following conferences were attended during the year :—

1. Municipal Association of Victoria	At Melbourne 13th and 14th October, 1965, attended by the Chairman and Board Members.
2. Western District Municipalities Association	At Koroit, 28th March, 1966, attended by Mr. F. West, Member.
3. Goulburn North East Municipalities Association	At Euroa, 31st March, 1966, attended by Mr. R. C. Handley, Divisional Engineer, Benalla.
4. Gippsland Municipalities Association	At Warragul, 1st April, 1966, attended by Mr. R. E. V. Donaldson, Deputy Chairman.
5. Northern District Municipal Association	At Echuca, 28th April, 1966, attended by Mr. I. J. O'Donnell, Chairman.
6. North Western Municipalities Association	At Stawell, 27th May, 1966, attended by Mr. F. West, Member.

Effective liaison and co-operation between the Board and local government is essential in the development of the State road system. The Board is grateful for the opportunity of attending these conferences which provide an avenue of direct contact between the Board and municipal councils.

MUNICIPAL INSPECTIONS AND DEPUTATIONS.

Municipal Inspections.

During the year Members of the Board and the respective Divisional Engineers officially visited 36 municipalities.

Inspections of roads and bridges were carried out in the Shires of Ararat, Bannockburn, Barrabool, Bellarine, Benalla, Cohuna, Corio, Deakin, East Loddon, Grenville, Heytesbury, Karkarooc, Kerang, Korumburra, Lexton, Mildura, Omeo, Otway, Portland, Rosedale, South Barwon, South Gippsland, Waranga and Warracknabeal ; the Town of Portland, the Boroughs of Eaglehawk, Kerang and Queenscliffe ; and the Cities of Ararat, Benalla, Camberwell, Coburg, Echuca, Essendon, Mildura and Preston.

The Board was pleased to have the opportunity of visiting the Borough of Kerang only 8 weeks after the municipality had been proclaimed.

With very few exceptions, all municipalities are officially visited by Members of the Board at intervals of 6 years. These inspections continue to be of great importance to the Members, in providing first hand knowledge of not only road conditions throughout the State but also the economic development of the State with which road construction programming is closely associated.

Personal discussions on road problems with councillors and their officers are mutually advantageous, and the Board is very grateful for the co-operation and hospitality extended by the municipal councils during the year.

Deputations.

Members of the Board are always prepared to receive deputations from municipal councils. Many problems, particularly those involving finance, are not capable of immediate solution but a discussion on a particular problem enables all facets to be considered.

During the year deputations were received from representatives of 24 municipal councils.

NATIONAL ASSOCIATION OF AUSTRALIAN STATE ROAD AUTHORITIES.

The thirtieth meeting of the National Association of Australian State Road Authorities was held in Darwin from 23rd to 27th August, 1965.

Representatives of each State Road Authority and the Commonwealth Department of Works attended. The Commonwealth Department of Shipping and Transport was represented when matters affecting the operation of road transport were under discussion.

There were 73 items on the agenda, including standard specifications for materials, plant and equipment, road signs, research projects, publications of the Association's " Guide for Design of Typical Urban Intersections " and the development of a computer program register. Mr. G. D. B. Maunder, Director-General, Commonwealth Department of Works, was appointed Chairman.

The thirty-first meeting was held in Canberra on 25th November, 1965, for the purpose of meeting the Hon. Gordon Freeth, Minister for Shipping and Transport, and the Chairman of the newly established Commonwealth Bureau of Roads, Mr. H. T. Loxton, and to examine ways in which the fullest co-operation between the Bureau and the Association might be achieved.

In the absence of Mr. Maunder, Mr. I. J. O'Donnell acted as Chairman of the thirty-second meeting held at Hawthorn on 6th May, 1966. Among the items discussed were priorities of matters referred to the Australian Road Research Board, symbolic road signs and signals, and the planning of a Road Needs Survey for the period 1969–1979.

AUSTRALIAN ROAD RESEARCH BOARD.

The third meeting of the Board of Directors was held in Alice Springs on 18th August, 1965, under the Chairmanship of Mr. G. D. B. Maunder, Director-General of the Commonwealth Department of Works. Reports on the progress of the research projects undertaken, including traffic engineering, road construction and structures, were submitted.

At the fourth meeting of the Board of Directors at Kew on 3rd, 4th and 5th May, 1966, matters discussed included progress on research projects, the planning of future research and its practical application.

Mr. J. A. L. Shaw, Commissioner for Main Roads, New South Wales, was elected Chairman of the Board and Mr. I. J. O'Donnell, Chairman of the Country Roads Board, was re-elected Deputy Chairman. At the conclusion of this meeting the Second Statutory Annual General Meeting of the Company was held.

On 15th June, 1966, the first meeting of the Staff Superannuation Fund Trustees was held at Kew, Mr. I. J. O'Donnell being one of the three trustees of the Fund.

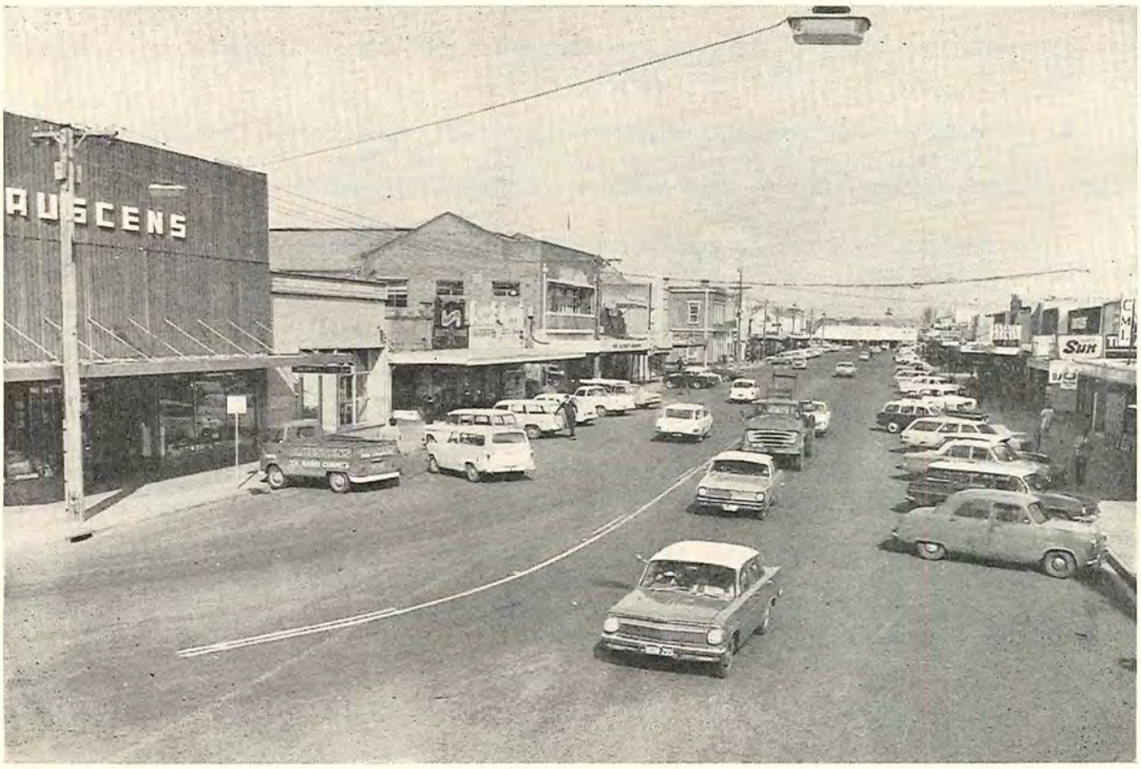

Plate 29.—Princes Highway East—Reconstructed section in the City of Traralgon.

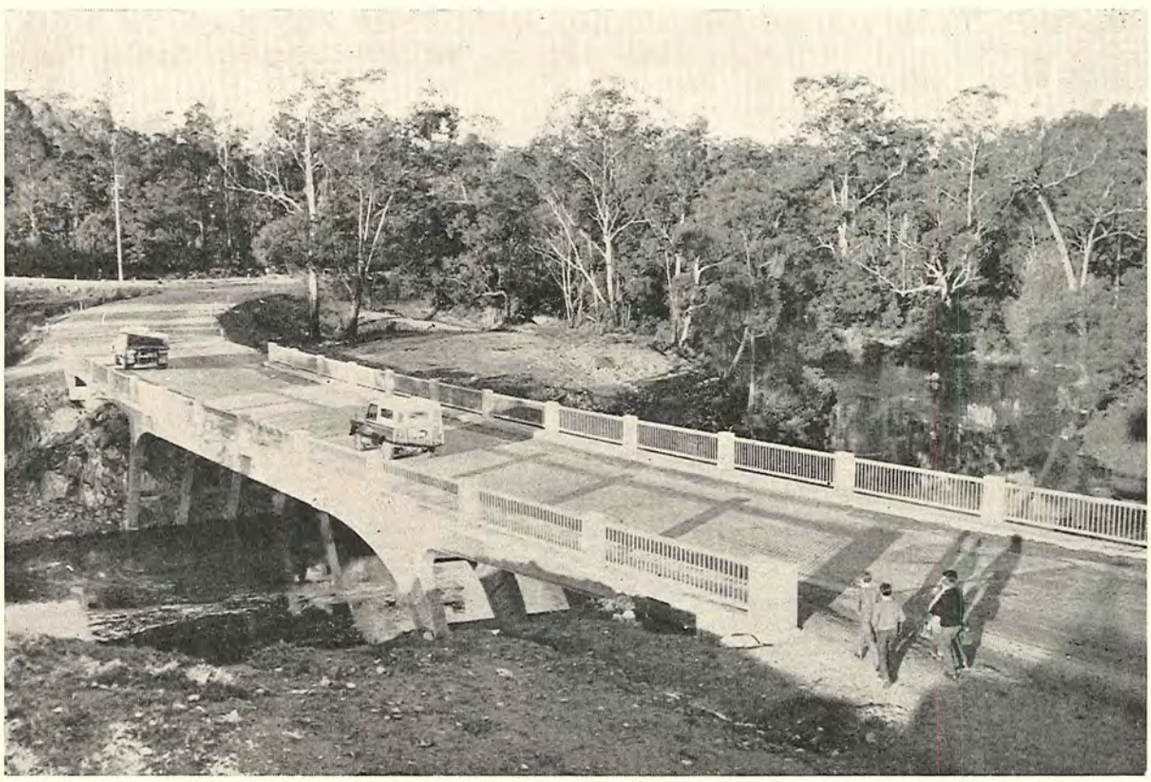

Plate 30.—New steel framed bridge with reinforced concrete deck over Boggy Creek at Nowa Nowa—Princes Highway East.

APPENDIX 1.

STATE HIGHWAYS.

SIGNIFICANT WORKS COMPLETED DURING FINANCIAL YEAR 1965–66.

Princes Highway West—		
City of Footscray	..	Reconstruction and duplication to provide six lanes between Geelong Street and Somerville Road.
Shire of Werribee	..	Widening 1·5 miles of the northern carriageway near Cherry Tree Creek.
		Strengthening the southern carriageway between mileages 33·8 and 36·7 by the application of 3 inches of bituminous concrete, and between mileages 36·7 and 37·5 by the application of 4 inches of wet mixed fine crushed rock with 1 inch of bituminous concrete.
City of Geelong ..	..	Channelization of the intersection with Railway Terrace.
Shire of Barrabool	..	Widening 2·5 miles at Waurn Ponds including the provision of a separate climbing lane.
Shire of Winchelsea	..	Construction of a new steel and concrete bridge 90 feet long and 28 feet wide over the railway at Armytage, including approaches on an improved alignment.
Shire of Heytesbury	..	Realignment and reconstruction to 24 feet sealed width of 3·15 miles through the Stony Rises west of Pirron Yallock.
Shire of Warrnambool	..	Construction at Garvoc of a 3-span reinforced concrete bridge 92 feet long, 28 feet wide, with a 5-feet wide footway, including reconstruction of the approaches.
Shire of Portland ..	..	Reconstruction east of Lyons of 2·8 miles with a sealed width of 24 feet.
Princes Highway East—		
Shire of Berwick ..	..	Reconstruction of the east-bound carriageway between Gloucester Avenue and Wheeler Street, Berwick.
		Reconstruction of 2·3 miles near Mt. Ararat, including the provision of climbing lanes.
Shire of Narracan	..	Reconstruction and sealing to 40 feet wide of 0·4 miles through the township of Trafalgar.
City of Traralgon	..	Reconstruction and sealing of a quarter of a mile of Franklin Street, Traralgon 70 feet wide.
		Construction of a new 8-span reinforced concrete bridge 221 feet long, 28 feet between kerbs over Traralgon Creek. This bridge is on new approaches on the alignment of the southern carriageway of an ultimate divided roadway through Traralgon.
City of Sale ..	..	Widening and strengthening to a sealed width of 24 feet of 1·2 miles immediately east of Sale.
Shire of Avon ..	..	Widening and strengthening to a sealed width of 24 feet of 1·7 miles west of Providence Ponds.
Shire of Bairnsdale	..	Construction of a 3-span reinforced concrete bridge 68 feet long, 28 feet wide between kerbs, together with a large culvert at Emu Creek.
Shire of Orbost ..	..	Construction of a steel-framed bridge with reinforced concrete deck 184 feet long, 28 feet between kerbs at Nowa Nowa.
		Complete reconstruction to a sealed width of 20 feet of 1 mile between West Wingan Road and Mt. Drummer Saddle, west of Mt. Drummer.
		Reconstruction to a sealed width of 20 feet of 3·16 miles east of Mt. Drummer between Second Saddle and Rankins.
Western Highway—		
Shire of Melton ..	..	Resheeting with wetmix crushed rock of 2·9 miles near the Exford turn-off and at Rockbank.
Shire of Bacchus Marsh	..	Erection of a weighbridge west of Melton near Bulman's Road.
Shire of Buninyong	..	Reconstruction and regrading to provide a 24 feet wide seal of 1·3 miles at Wallace.
Shire of Ripon ..	..	Reconstruction and widening from 18 feet to 24 feet wide seal of 3·6 miles west of Burrumbeet.
Shire of Ararat ..	..	Regrading and widening to 24 feet wide seal of 1·7 miles west of Mt. Langi Ghiran.
Shire of Wimmera	..	Construction of three bridges 101 feet long, 61 feet long and 121 feet long each 28 feet between kerbs over Mt. William Creek at Dadswell's Bridge on realigned approaches totalling 1·2 miles.
		Reconstruction of 1·7 miles between Green Lake and Burnt Creek.
		Widening of pavement to 24 feet sealed width and strengthening shoulders for 7·1 miles from Horsham to Dahlen.

Plate 31.—Edge lining on the Calder Highway in the Black Forest area—Shire of Gisborne.

Plate 32.—Roadside Plantation—North Western Highway—Shire of Kara Kara.

Calder Highway—

Shire of Bulla	Widening of the narrow pavement for 4·6 miles between Digger's Rest and the Gap Hill.
Shire of Gisborne ..	Construction of the intersection with the Bacchus Marsh and Melton main roads at Gisborne.
	Construction of a run-off bay for Transport Regulation Board inspectors north of Gisborne.
Shire of Metcalfe	Widening of an existing 2-span reinforced concrete bridge from 24 feet to 40 feet between kerbs over Bullock Creek at Ravenswood, including widening and sealing of approaches,
Shire of Marong	Realignment of the approaches to the level crossing over the Bendigo–Sea Lake railway line at Derby, a distance of 1·2 miles.
Shire of Korong	Realignment of the approaches to the Glenalbyn railway crossing.
Shire of Wycheproof ..	Widening and resheeting 3·4 miles to a sealed width of 24 feet south of Nullawil.
	Widening and resheeting 1·76 miles to a sealed width of 24 feet at Boigbeat.

Hume Highway—

Shire of Kilmore	Reconstruction of 1·7 miles at Green's Pinch including the provision of climbing lanes.
Shire of Broadford ..	Duplication of 4 miles between Broadford and Tallarook.
Shire of Seymour	Construction of a reinforced concrete bridge 65 feet long and 25 feet wide between kerbs over Whitehead's Creek.
City of Wangaratta ..	Construction of bridge approaches and divided roadway at the junction of the Hume and Ovens Highways at Wangaratta.
	Construction of a bridge 490 feet long and 28 feet wide between kerbs over Reedy Creek.
	Construction of 0·86 miles of a deviation 40 feet wide formation with 26 feet wide pavement between Reedy Creek and Boorhaman Road as part of a 2-mile deviation.

Maroondah Highway—

Shire of Alexandra ..	Realignment and reconstruction to a 24 feet wide sealed pavement of 1·5 miles south of Buxton.
	Reconstruction south of the Goulburn River at Alexandra to a 24 feet wide sealed pavement of 1·5 miles.
	Reconstruction of 1·5 miles and the provision of climbing lanes where necessary, from Josephine Cutting to west of Eglinton Hill.
	Reconstruction of 1·9 miles to sealed widths of 24 feet and 22 feet from Koriella Junction to Blakeney's Cutting.
	Reconstruction to a sealed width of 24 feet of 3·3 miles through Yarck.

Burwood Highway—

City of Box Hill	Reconstruction and widening between Warrigal Road and Edwards Street.
Cities of Box Hill and Nunawading	Duplication to six lanes and intersection treatment of 1·78 miles from Greenwood Street to the M.M.B.W. pipetrack east of Blackburn Road.

Nepean Highway—

City of Mordialloc ..	Construction of a 6-lane divided roadway from White Street to McDonald Street and construction of a new railway bridge in conjunction with Victorian Railways.
Shire of Frankston ..	Duplication of 1·2 miles from Ithaca Road to the Old Mornington Road intersection.

Bellarine Highway—

City of Geelong	Reconstruction of the intersection of Ryrie Street, Swanston Street and Sydney Parade with traffic islands and a short length of narrow median in front of Geelong Base Hospital.
Shire of Bellarine	Widening a short section between Wilson's Road and Nelson Street.

Borung Highway—

Shire of Donald	Widening and resheeting 3·1 miles east of Donald.

Plate 33.—Approach to new bridge over the Campaspe River at Axedale—Shire of Strathfieldsaye.

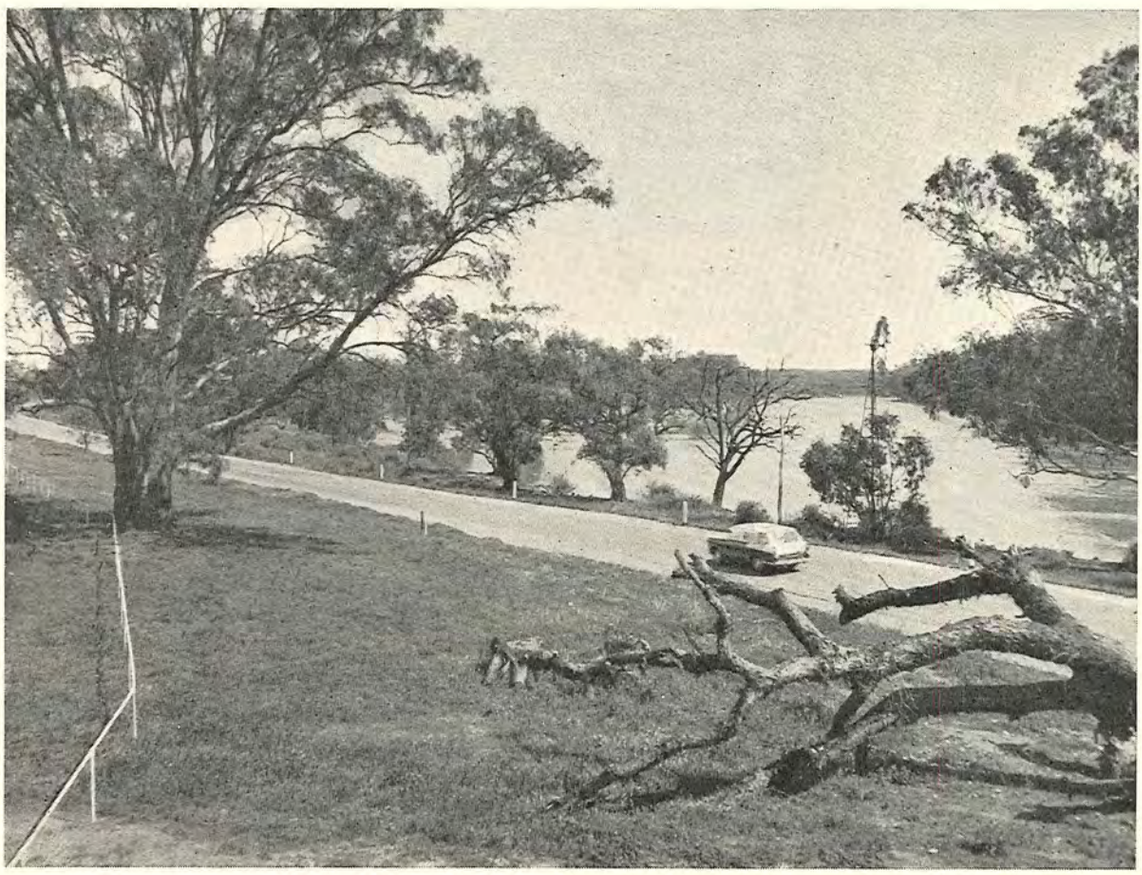

Plate 34.—Reconstructed section of the Murray Valley Highway near Boundary Bend—Shire of Swan Hill.

Glenelg Highway—

Shire of Mount Rouse ..	Reconstruction to a sealed width of 22 feet of 1·34 miles west of Dunkeld.

Goulburn Valley Highway—

Shire of Goulburn ..	Widening and resheeting to a sealed width of 24 feet of 4·78 miles south of Nagambie.
	Completion of widening and resheeting to a sealed width of 24 feet of 4·86 miles at Wahring.
City of Shepparton ..	Strengthening where necessary and plant mix seal of two 22 feet wide strips over 0·34 mile from Vaughan Street to Nixon Street in Shepparton.

Hamilton Highway—

Shires of Mount Rouse and Warrnambool	Reconstruction to a sealed width of 22 feet of 2·6 miles at Murton's Creek west of Caramut.
	Reconstruction to a sealed width of 22 feet of 0·5 miles and widening 5 miles west of Penshurst.

Henty Highway—

Shire of Warracknabeal ..	Reconstruction to a sealed width of 24 feet of 2 miles of the northern approach to Warracknabeal.
Shire of Karkarooc ..	Reconstruction and widening to a sealed width of 22 feet of 4·5 miles north of Goyura.

Loddon Valley Highway—

Shire of East Loddon ..	Widening and resheeting to a sealed width of 24 feet of 1·55 miles north of Bear's Lagoon.

McIvor Highway—

Shire of Strathfieldsaye ..	Construction of a deviation to a sealed width of 24 feet to replace steep and poor alignment to the approaches of the newly-constructed Campaspe River bridge at Axedale.

Midland Highway—

City of Geelong West ..	Construction of traffic islands at the intersection of Church Street and Ballarat Road.
Shire of Bungaree ..	Reconstruction and widening to a sealed width of 24 feet of 1·1 miles at Mt. Rowan south of Ballarat.
Shire of Creswick ..	Realignment and widening to a sealed width of 24 feet of 1·4 miles north of Blampied.
Shire of Newstead ..	Reconstruction and realignment, in conjunction with a railway level crossing elimination project of two sections at Yapeen, totalling 2·1 miles.
Shire of Rodney	Widening and resheeting to a sealed width of 24 feet of 1·35 miles east of Byrneside.
Shire of Benalla	Construction of a bridge 120 feet long 28 feet wide between kerbs over the floodway at Cowans Corner together with its approaches totalling 1·2 miles.

Murray Valley Highway—

Shire of Towong	Reconstruction to a sealed width of 18 feet of 1·2 miles of previously unsealed pavement between Burrowye Cutting and Mt. Alfred.
Shires of Numurkah and Nathalia	Resheeting to a sealed width of 20 feet of 6·34 miles between Strathmerton and Nathalia.
Shire of Deakin	Widening and resheeting to a sealed width of 24 feet on a lime-stabilized base of 3·75 miles near Murphy's Swamp.
Shire of Swan Hill ..	Reconstruction and widening to a sealed width of 24 feet of 3·73 miles between Nyah and Piangil.
	Completion of the reconstruction of 7·7 miles between Boundary Bend and Lake Powell to place the highway above flood level.

Ovens Highway—

Shire of Wangaratta ..	Reconstruction to a sealed width of 22 feet of 2·7 miles between Wangaratta and Tarrawingee.

South Gippsland Highway—

Shire of South Gippsland ..	Reconstruction to a sealed width of 22 feet of 1·4 miles of the substandard alignment between Meeniyan and Foster. The work will be extended in the 1966–67 financial year.

Wimmera Highway—

Shire of Kara Kara ..	Widening and resheeting to a sealed width of 20 feet of 4·8 miles between Marnoo East and Boyles Bridge.

Northern Highway—

Shire of Kilmore	Reconstruction to a sealed width of 24 feet of 0·77 miles between the Hume Highway and Kurkurac Creek.
Shire of McIvor	Reconstruction to a sealed width of 24 feet of 3·25 miles north of the McIvor Highway junction.

North Western Highway—

Shire of Lexton	Reconstruction and realignment to a sealed width of 24 feet of 3 miles east of and through Lexton.
Shire of Avoca	Widening of two narrow reinforced concrete bridges north of Avoca to 28 feet wide between kerbs.

Omeo Highway—

Shire of Towong	Reconstruction to a sealed width of 20 feet of 3 miles near Nooroongong.
Shire of Omeo	Widening and curve improvement to a formation width of 24 feet between Anglers Rest and Upper Kiewa Valley Road junction.

Ouyen Highway—

Shire of Walpeup ..	Construction of 1·76 miles of the deviation at Cowangie, eliminating two railway level crossings.
	Reconstruction of 3·8 miles and realignment of the approaches to the railway level crossing east of Murrayville.

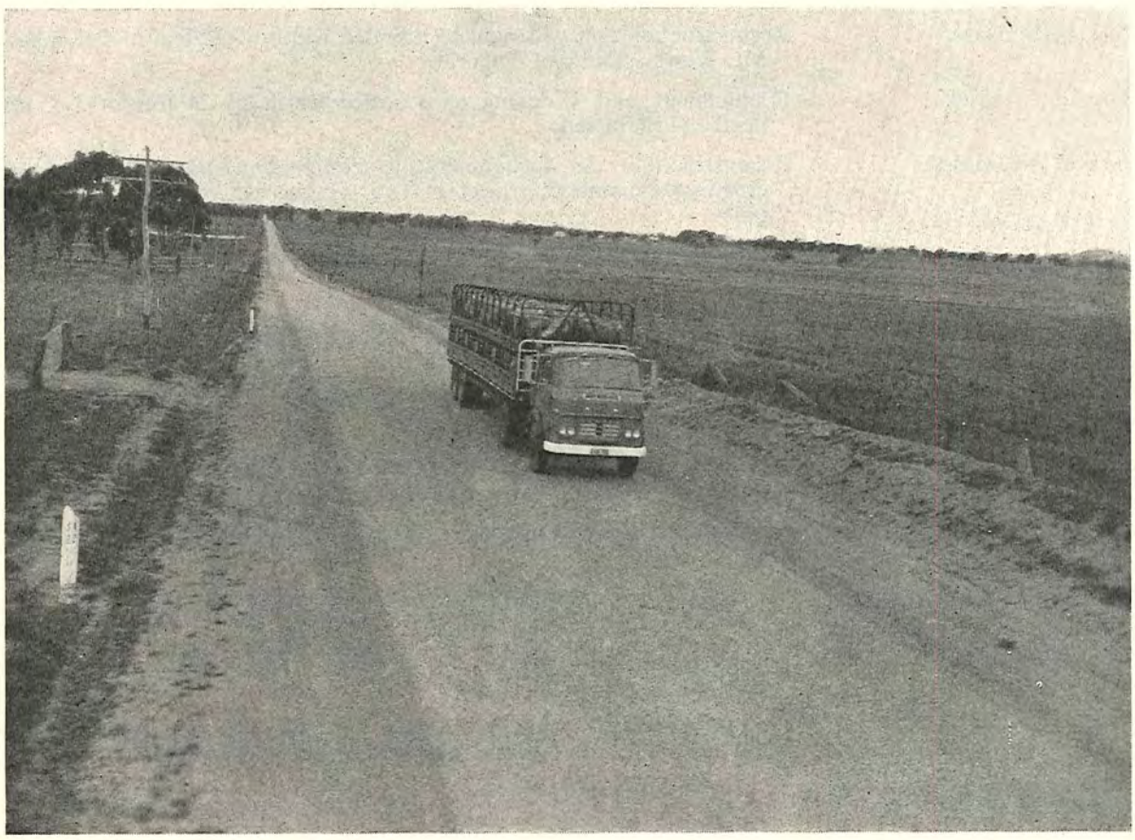

Plate 35.—Wimmera Highway—widened and resheeted section between Marnoo East and Boyles Bridge—Shire of Kara Kara.

APPENDIX 2.

TOURISTS' ROADS, FOREST ROADS AND BY-PASS ROADS.

Tourists' Roads.

Significant Works Completed During Financial Year 1965–66.

Great Ocean Road ..	Construction of two small bridges at Mt. Defiance and Godfrey Creek on improved approaches.
	Widening of two miles from Grey River to Carisbrook Creek. A sealed road is now complete between Lorne and Apollo Bay.
	Reconstruction and realignment of 2·9 miles at Yuulong.
Mt. Donna Buang Tourists' Road.	Sealing of 1·5 miles and widening of a further 1·25 miles between Cement Creek and the 10-mile turntable.
Grampians Tourists' Road ..	Realignment of 4 miles at Lake Bellfield.
Wilson's Promontory Road ..	Reconstruction and sealing of a further 1·7 miles at Darby River.
Mt. Buffalo Road	Improvement of curves, resheeting and minor realignment of 1·24 miles.
Mt. Buller Road	Reconstruction of the unsealed section to provide a 25 feet wide formation over 2·4 miles.
	Reconstruction through Mirimbah of 0·89 miles to provide a 26 feet wide formation.
Alpine Road	Realignment of 1·25 miles between Mountain Maid and Power Line Gully to provide a pavement width of 24 feet.

Forest Roads.

Significant Works Completed During Financial Year 1965–66.

Tatong–Tolmie Road ..	Reconstruction to a sealed width of 20 feet of 3·23 miles south of Tatong.
Walhalla Road	Widening from 10 feet to 24 feet and curve improvement of 1·2 miles north from the Aberfeldy River.
Warburton–Woods Point Road	Widening and sheeting of 1·7 miles between Matlock and Woods Point.
	Resheeting and part widening of 5 miles near Jordan Cutting.
Lavers Hill–Cobden Road ..	Reconstruction and sealing of 1 mile in Otway Shire under municipal supervision.
	Regrading, realignment and surfacing of 1 mile at Benwerrin.
Drummond–Vaughan Road ..	Reconstruction and realignment to a sealed width of 12 feet of 0·51 mile at Glenhue.
Bruthen–Buchan Road ..	Construction of a twin 96-inch Armco culvert on a new alignment over Canni Creek between Buchan South and Nowa Nowa, together with 0·8 mile of approaches.

By-pass Roads.

Significant Works Completed in Financial Year 1965–66.

Princes By-pass Road—

Shire of Altona	Laverton Section. Resurfacing 2·45 miles of the northern carriageway with 3 inches of bituminous concrete between Kororoit Creek Road and Little Boundary Road.
Shire of Werribee ..	Realignment of Cooraminta Avenue and connection to Point Cook Road, including the construction of a reinforced concrete bridge 90 feet long.
	Resheeting and sealing of a short section of the northern carriageway at Skeleton Creek.

Tullamarine By-pass Road (Tullamarine Freeway)—

Shires of Broadmeadows and Bulla	Construction of the 4-lane divided roadway from Mickleham Road to the Tullamarine Jetport Terminal area.

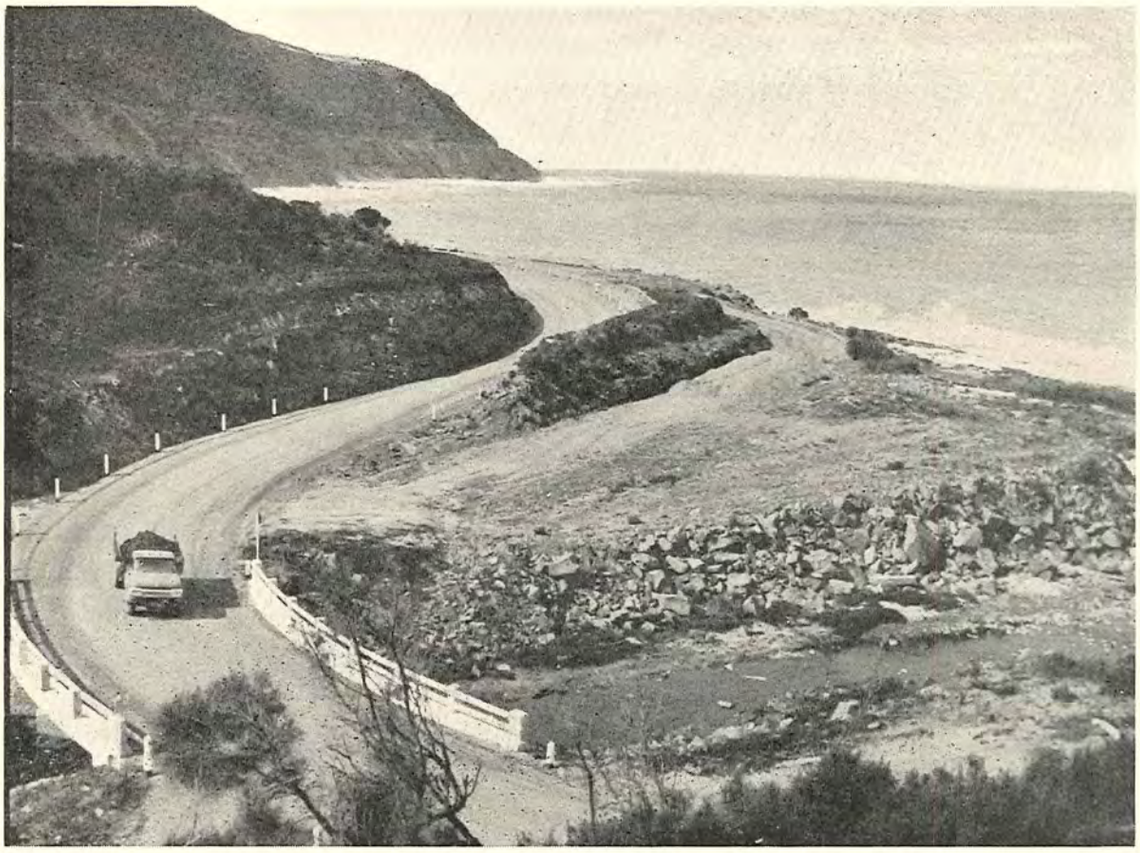

Plate 36.—Ocean Road in the vicinity of Grey River, 16 miles west of Lorne.

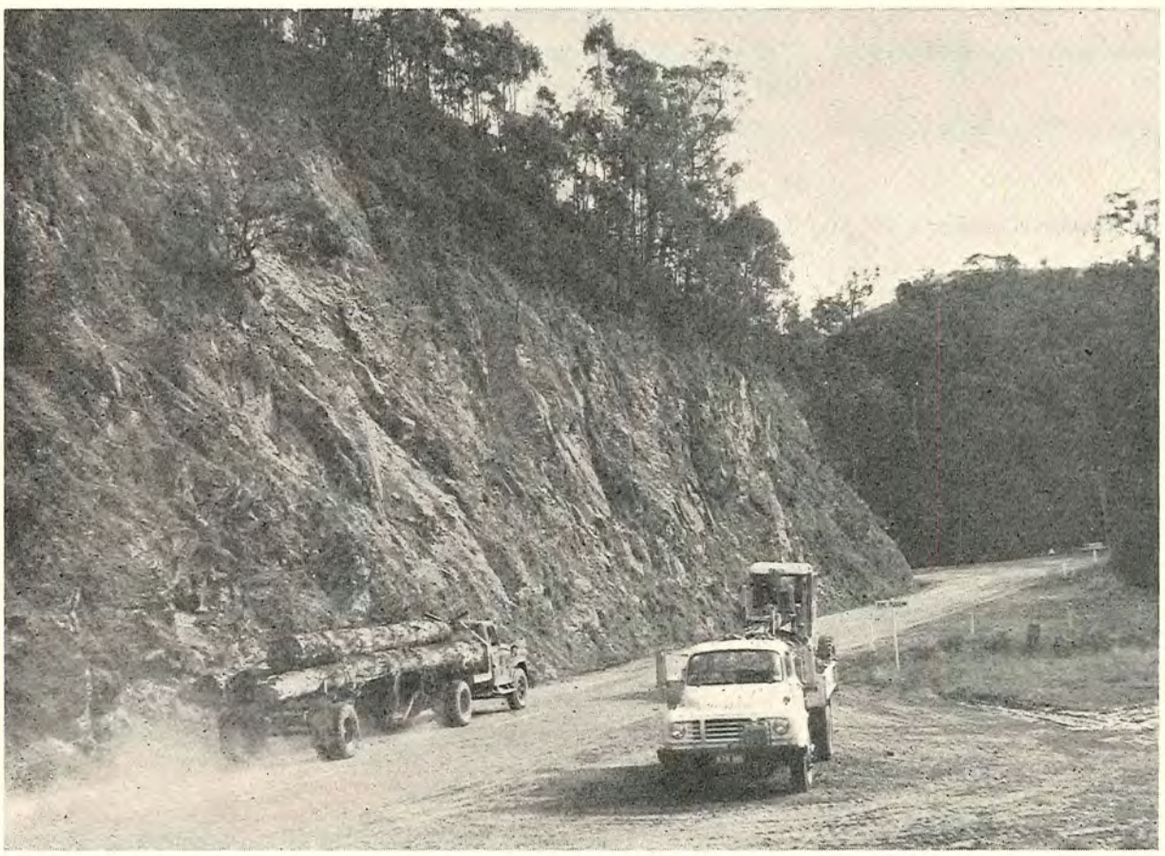

Plate 37.—Work under cutting—Warburton–Woods Point Road—Shire of Upper Yarra.

Plate 38.—Ballarat–Daylesford Road reconstructed and realigned near the "Gong" Reservoir—Shire of Bungaree.

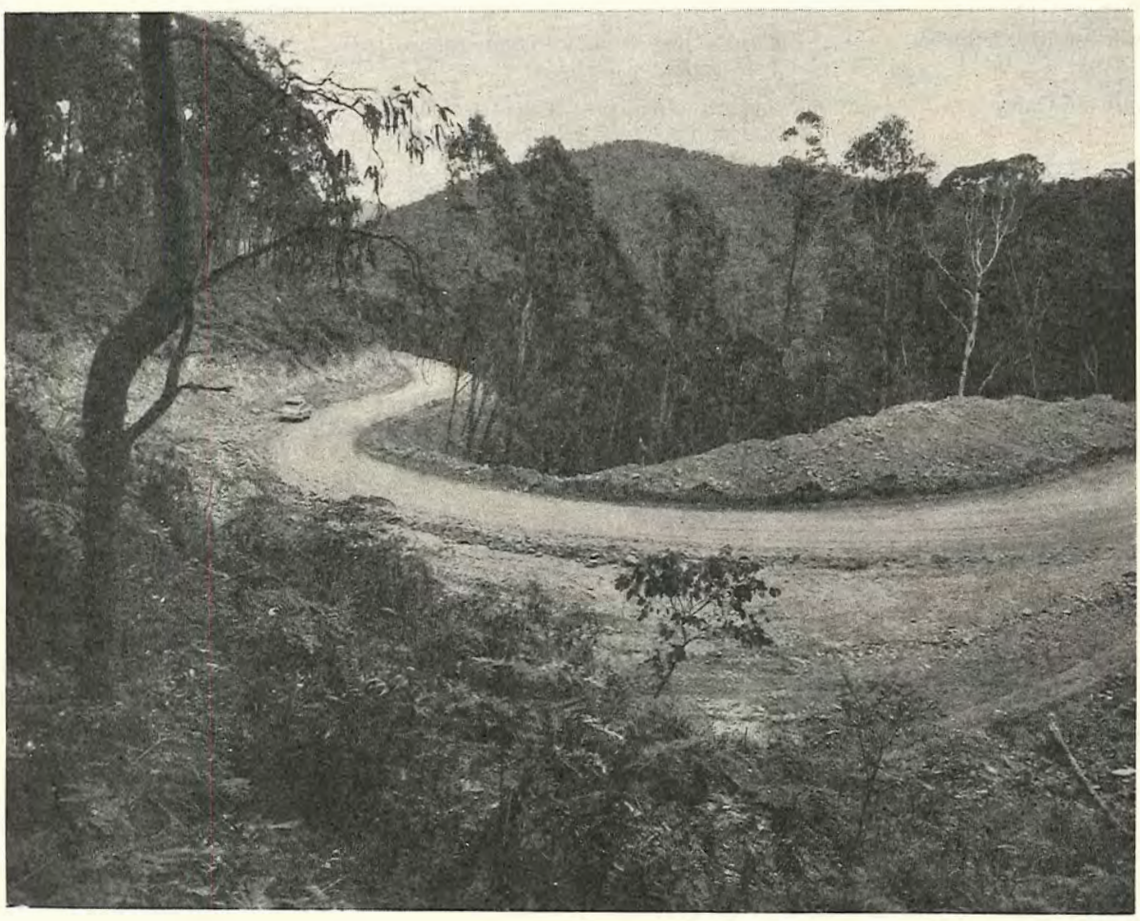

Plate 39.—Reconstructed section of the Bright–Tawonga Road—Shire of Bright.

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APPENDIX 3.

MAIN ROADS.

SIGNIFICANT WORKS COMPLETED DURING FINANCIAL YEAR 1965–66.

Bairnsdale Division—

Shire of Bairnsdale ..	Bairnsdale–Dargo Road. Construction and sealing of a new floodway at Skull Creek near Lindenow restoring a section of road closed to traffic by flooding some years ago.
Shire of Omeo	Swifts Creek–Omeo Road. Widening roadway and strengthening timber bridges between Tongio West and Upper Livingstone to cater for timber traffic.

Ballarat Division—

Shire of Ararat	Ararat–Hall's Gap Road—Construction of a 4-span reinforced concrete bridge 162 feet long and 26 feet wide between kerbs over Mt. William Creek.
	Maroona–Glenthompson Road—Reconstruction and realignment to a sealed width of 20 feet of 6·14 miles west of Willaura.
Shire of Bungaree.. ..	Daylesford–Ballarat Road—Completion of the reconstruction and realignment to a sealed width of 22 feet of 1·2 miles at the " Gong " Reservoir.
Shire of Buninyong ..	Colac–Ballarat Road—Construction of a 3-span reinforced concrete bridge 90 feet long and 28 feet wide between kerbs over Dog Trap Creek.

Benalla Division—

Shire of Benalla	Benalla–Tatong Road—Reconstruction to a sealed width of 18 feet of 3 miles.
Shire of Bright	Bright–Tawonga Road—Reconstruction of 2 miles.
Shire of Myrtleford ..	Buffalo River Road—Reconstruction to a sealed width of 20 feet of 1·18 miles.
Shire of Oxley	Wangaratta–Kilfeera Road—Construction of a 3-span rolled steel joist and concrete bridge over Fifteen Mile Creek.
Shire of Towong	Tallangatta–Corryong Road—Reconstruction of 4·2 miles and realignment and reconstruction of a further 3·72 miles.
Shire of Tungamah ..	Benalla–Tocumwal Road—Reconstruction to a sealed width of 18 feet of 2·5 miles.
Shire of Upper Murray ..	Tintaldra Road—Reconstruction of 3·5 miles to a sealed width of 18 feet. Upper Murray Road—Reconstruction of 3·3 miles to a sealed width of 18 feet.
Shire of Yackandandah ..	Running Creek Road—Realignment and reconstruction of 1·35 miles. Yackandandah–Wodonga Road—Reconstruction of 1·2 miles to a sealed width of 20 feet.

Bendigo Division—

Shire of East Loddon ..	Prairie–Borung Road—Replacement of an old timber bridge over Serpentine Creek with a reinforced concrete bridge 80 feet long and 24 feet wide between kerbs.
	Replacement of an old timber bridge over Loddon River with a rolled steel joist and reinforced concrete bridge 135 feet long and 24 feet wide between kerbs.
City of Echuca	Echuca–Cohuna Road—Widening four reinforced concrete bridges to 28 feet wide between kerbs together with approaches.
Shire of Gordon	Charlton–Durham Ox Road—Replacement of an old timber bridge over Bannogher Creek with a reinforced concrete bridge 120 feet long and 24 feet wide.
Shire of Kerang	Donald–Swan Hill Road—Reconstruction of 4·3 miles to a sealed width of 18 feet.
	Koondrook–Murrabit Road—Reconstruction of 5·7 miles to a sealed width of 18 feet.

Shire of Rochester ..	Bamawm North Road—Reconstruction of 1·88 miles to a sealed width of 20 feet.
Shire of Swan Hill ..	Ouyen–Piangil Road. Preparation and sealing of 9·09 miles to a width of 18 feet.
	Robinvale Road—Reconstruction of 2·75 miles to a sealed width of 20 feet.
Shire of Waranga ..	Goornong–Murchison Road—Widening of 3·69 miles to a sealed width of 20 to 24 feet.
	Heathcote–Rochester Road—Widening of 4·86 miles to a sealed width of 20 feet.

Dandenong Division—

Shire of Whittlesea (Joint Yea Shire)	Whittlesea–Kinglake Road—Realignment and reconstruction of 0·85 mile to a sealed width of 20 feet.
	Whittlesea–Yea Road—Reconstruction of 1·2 miles to a sealed width of 20 feet.
Shire of Healesville (Joint Yea Shire)	Yarra Glen–Yea Road—Preparation and sealing of 2·32 miles to a width of 20 feet.
Shire of Yea	Yarra Glen–Glenburn Road—Realignment and reconstruction of 1 mile on a 32 feet wide formation.
Berwick Shire	Gembrook Road—1·27 miles of realignment and reconstruction easterly from the Healesville–Koo-Wee-Rup Road.
Buln Buln Shire	Main Neerim Road—0·75 mile of reconstruction and installation of triple cell Armco pipe culvert at Tarago River.
Dandenong City (Joint Springvale City)	Cheltenham Road—0·5 mile of channelization at Chandler Road–Kirkham Road intersection.
Dandenong City (Joint Cranbourne Shire)	Dandenong–Frankston Road—Construction of 3-span reinforced concrete bridge and approaches at Eumemmerring Creek.
Flinders Shire	Mornington–Flinders Road—1·3 miles of reconstruction south of Arthur's Seat tourists' road.
Hastings Shire	Stony Point Road—1·1 miles of realignment and reconstruction—Crib Point to Stony Point.
Kilmore Shire	Broadford–Wallan Road—0·85 mile of reconstruction.
Knox Shire	Dorset Road—0·35 mile of widening and reconstruction north of Boronia Township between William Street and Olive Grove.
	High Street–Construction of multi-cell culvert and approaches at Blind Creek.
Korumburra Shire ..	Korumburra–Wonthaggi Road—1·2 miles of realignment and reconstruction between 1·60 and 2·8 miles south of Korumburra.
Lillydale Shire	Monbulk–Seville Road—1·1 miles of realignment and reconstruction approximately 4 miles south of Seville.
Nunawading City	Canterbury Road—0·5 mile of duplication including intersection treatment at Springvale Road.
Sherbrooke Shire	Monbulk Road—0·4 mile of widening and reconstruction at Tecoma.
Yea Shire	Whittlesea–Yea Road—2·5 miles of realignment and reconstruction at Flowerdale.

Geelong Division—

Shire of Bacchus Marsh ..	Geelong–Bacchus Marsh Road—Widening and sealing of 2 miles.
Shire of Bannockburn ..	Meredith–Mt. Mercer Road—Construction of Nolan's Bridge and 1 mile of approaches.
Shire of Barrabool ..	Barrabool Road—Widening and sealing 2 miles.
Shire of Bellarine	Geelong–Portarlington Road—Construction of the Pt. Henry Road intersection and widening and sealing of 2 miles of roadway.
	Portarlington–St. Leonards Road—Widening and sealing of the final 3 miles.
	Wallington–Ocean Grove Road—Widening 2·7 miles.
Shire of Bulla	Melbourne–Lancefield Road—Channelization, construction and sealing of the intersection with Sunbury Road.
City of Colac	Colac–Beech Forest Road—Reconstruction and sealing of 0·3 mile.

Shire of Colac ..	.. Colac–Beech Forest Road—Strengthening, regrading, surfacing and sealing of 1 mile.
	Corangamite Lake Road—Extension of the seal by 1 mile at the north end.
Shire of Corio ..	.. Geelong–Bacchus Marsh Road—Reconstruction and sealing of 1·5 miles.
	Geelong–Ballan Road—Widening and sealing 2·5 miles.
City of Geelong ..	.. Geelong–Portarlington Road—Reconstruction as a 4-lane divided road of 0·5 mile between Meakin Street and the City boundary.
Shire of Gisborne	.. Mt. Macedon Road—Reconstruction, realignment and widening of 1 mile at Macedon.
Shire of Kyneton ..	.. Trentham Road—Widening and sealing 1·3 miles.
Shire of Leigh ..	.. Rokewood–Shelford Road—Construction of Bell's Bridge over Ferrars Creek and widening 4·6 miles near Warrambine.
Shire of Melton ..	.. Coimadai–Diggers Rest Road—Construction of a new 4-cell 96-inch reinforced concrete pipe culvert to replace Burkes Bridge.
	Keilor–Melton Road—Widening 1·5 miles and provision of new culverts at mileage 4·3.
Shire of Otway ..	.. Beech Forest–Apollo Bay Road—Construction of a new reinforced concrete bridge near Paradise.
	Charley's Creek Road.—Sealing 5 miles south of Ferguson.
	Skenes Creek Road—Reconstruction and sealing of 1·3 miles.
Shire of South Barwon ..	Barrabool Road—Reconstruction and widening of 0·7 mile at Highton.
	Barwon Heads Road—Reconstruction, widening and sealing of 0·7 mile near Geelong.
	Reconstruction and widening of 2·5 miles near Barwon Heads.
	Widening of the bridge over the Barwon River at Barwon Heads together with the provision of a new footway.
Shire of Werribee	.. Duncan's Road—Realignment, reconstruction and sealing of 0·6 mile.

Horsham Division—

Shire of Birchip ..	.. Berriwillock–Birchip Road—Widening 5·1 miles of pavement to a sealed width of 18 feet.
Shire of Donald ..	.. Donald–Swan Hill Road—Widening 5·3 miles of pavement to a sealed width of 18 feet.
Shire of Kara Kara	.. St. Arnaud–Wycheproof Road—Widening 4·8 miles of pavement to a sealed width of 18 feet.
Shire of Karkarooc	.. Rainbow–Beulah–Birchip Road—Widening 6·04 miles of pavement to a sealed width of 18 feet.
Shire of Kowree ..	.. Apsley–Natimuk Road—Widening 7·25 miles of pavement to a sealed width of 18 feet.
Town of St. Arnaud	.. Bendigo–St. Arnaud Road—Construction of a 2-span bridge 50 feet long 24 feet wide over St. Arnaud Creek.
Shire of Stawell ..	.. Marnoo Road—Construction of a 3-span bridge 90 feet long and 24 feet between kerbs over Dog Trap Creek.
	Landsborough Road—Widening 5 miles of pavement to a sealed width of 18 feet.
Shire of Wimmera	.. Grampians Road—Widening 4·8 miles of pavement to a sealed width of 18 feet.
	Kalkee Road—Reconstruction and widening pavement for 5·25 miles to a sealed width of 18 feet.

Metropolitan Division—

Shire of Altona ..	.. Millers Road—Reconstruction and duplication of 0·4 mile from Kororoit Creek to Civic Parade.
City of Keilor ..	.. Lancefield Road—Construction of a new western carriageway northerly from Hawker Street to Parer Road.
City of Northcote	.. Heidelberg–Eltham Road—Reconstruction of 0·7 mile between Merri Creek and Gillies Street as a 6-lane divided roadway.

City of Oakleigh ..	Doncaster–Mordialloc Road—Reconstruction and widening of 0·8 mile between Princes Highway East and Ferntree Gully Road including channelization at Ferntree Gully Road.
City of Preston ..	Bell Street—Reconstruction of 0·6 mile between the railway level crossing and Gilbert Road.
City of South Melbourne ..	Beach Road—Reconstruction of the northern carriageway for 0·5 mile easterly from Phillipson Street.
City of Williamstown ..	Kororoit Creek Road—Reconstruction and duplication of 0·5 mile between Douglas Parade and North Williamstown railway line, including channelization of the intersection and installation of boom barriers at the level crossing.

Traralgon Division—

Shire of Maffra ..	Traralgon–Maffra Road—Construction of a new 3-span reinforced concrete bridge over Wickham's Creek 1 mile south of Tinamba township.
	Maffra–Newry Road—Construction of 1·7 miles of the Pine Hill deviation including a new 6-span reinforced concrete bridge 24 feet wide between kerbs.
Shire of Narracan..	Willowgrove Road—Construction of a 7-span reinforced concrete bridge over the Latrobe floodway.
	Mirboo North–Thorpdale Road—Realignment and reconstruction of 1·5 miles southerly from Thorpdale township. Sealing 18 feet wide will be completed during next financial year.
	Walhalla Road—Reconstruction of 2 miles north of Moe to a sealed width of 18 feet.
Shire of Rosedale ..	Traralgon–Maffra Road—Reconstruction of 1·4 miles to a sealed width of 20 feet.
Shire of Woorayl ..	Inverloch–Lower Tarwin Road—Reconstruction of 1·1 miles to a sealed width of 20 feet.

Warrnambool Division—

Shire of Glenelg ..	Casterton–Apsley Road—Realignment and reconstruction of 2·65 miles to a sealed width of 20 feet.
	Casterton–Edenhope Road—Realignment and reconstruction of 1·63 miles to a sealed width of 20 feet.
	Portland–Casterton Road—Realignment and reconstruction of 2·1 miles in Henty township to a sealed width of 20 feet.
Shire of Hampden ..	Camperdown–Ballarat Road—Reconstruction of 1·45 miles to a sealed width of 20 feet.
Shire of Heytesbury ..	Cobden–Port Campbell Road—Realignment and reconstruction of 2·34 miles to a sealed width of 20 to 24 feet.
Shire of Minhamite ..	Warrnambool–Penshurst Road—Reconstruction and widening of 6 miles to a sealed width of 20 feet.
	Hamilton–Port Fairy Road—Reconstruction and realignment of 3·7 miles to a sealed width of 20 feet.
Shire of Mortlake ..	Mortlake–Ararat Road—Construction of a 4-span precast bridge 104 feet long, 24 feet wide using the old piers at Salt Lake.
Warrnambool Shire ..	Cobden–Warrnambool Road—Reconstruction of 4 miles on a 30 feet wide formation.

APPENDIX 4.

UNCLASSIFIED ROADS.

SIGNIFICANT WORKS COMPLETED DURING FINANCIAL YEAR 1965–66.

Bairnsdale Division—	
Shire of Omeo	Upper Kiewa Valley Road extension—Construction of a new road 17 miles long connecting the Omeo Highway with the existing road on the Bogong High Plains at the Rocky Valley Reservoir.
Shire of Orbost	Jarrahmond Road—Construction of a new concrete and rolled steel joist bridge 45 feet long and 22 feet wide between kerbs over Major's Creek.
City of Sale	Raymond Street—Reconstruction and sealing of a 10 chain section between Macarthur and Stawell Streets.
Ballarat Division—	
Shire of Ararat	Kerr's Road—Reconstruction and sealing of 2·5 miles to a sealed width of 12 feet.
Shire of Ballarat	Ascot–Coghills Creek–Glendaruel Road—Reconstruction and sealing of 3·2 miles to a sealed width of 12 feet.
Shire of Grenville ..	Linton–Mannibadar Road—Realignment and re-sheeting of 1 mile to a sealed width of 12 feet.
Shire of Ripon	Beaufort–Carranballac Road—Reconstruction and realignment of 4 miles ready for a 12 feet seal width.
Shire of Tullaroop (Joint with Bet Bet Shire)	McKenzies Road—Construction of a new concrete bridge 90 feet long and 16 feet wide between kerbs over Bet Bet Creek.
Benalla Division—	
Shire of Nathalia	Nathalia–Barmah Road—Forming, gravelling and sealing 2·5 miles to a sealed width of 18 feet.
Shire of Rutherglen ..	Gooramadda Road—Forming and gravelling 2·8 miles and sealing 4 miles to a width of 12 feet.
City of Shepparton ..	Wyndham Street and High Street—Reconstruction and hotmix surfacing of parking lanes flanking the Goulburn Valley Highway and Midland Highway.
Shire of Shepparton (Joint Shire of Rodney)	Toolamba Bridge—Major repairs to the Toolamba Bridge over the Goulburn River.
Shire of Upper Murray ..	Briggs Gap Road—Replacement of Hansen's Bridge over Corryong Creek with a new bridge 146 feet long and 22 feet wide between kerbs.
Shire of Wodonga ..	Lawrence Street—Construction of a bridge with 30-feet long spans, 24 feet wide between kerbs and one 6-feet wide footway.
Bendigo Division—	
Shire of Cohuna	Cohuna Island Road—Reconstruction, gravelling and sealing of 2 miles to a sealed width of 18 feet.
City of Echuca	Annersley Street—Reconstruction, gravelling and sealing of 1 mile to a sealed width of 35 feet.
Shire of Kerang	Donald–Swan Hill Road—Reconstruction, gravelling and sealing of 1·95 miles to a sealed width of 18 feet.
Shire of McIvor	Heathcote–North Costerfield Road—Replacement of the existing timber bridge with a reinforced concrete bridge 120 feet long and 20 feet wide between kerbs.
Shire of Rochester ..	Nanneela–Echuca Road—Construction, gravelling and sealing of 1·9 miles to a sealed width of 12 feet.
Shire of Rodney	Kiota Road—Construction, gravelling and sealing of 2·4 miles to a sealed width of 20 feet.
	Murchison–Toolamba–Mooroopna Road—Reconstruction, gravelling and sealing of 2·4 miles to a sealed width of 22 feet.
Shire of Wycheproof ..	Dumosa–Birchip Road—Construction, gravelling and sealing 2·05 miles to a sealed width of 20 feet and 12 feet.
Dandenong Division—	
Shire of Alexandra ..	Eildon–Jamieson Road—Resheeting of 3 miles with a formation of 24–26 feet and a sealed width of 20 feet.
Buln Buln Shire (Joint Warragul Shire)	Main Neerim Deviation—1·3 miles of reconstruction approximately 7 miles north of Drouin.

Cranbourne Shire	Thompsons Road—1·4 miles of reconstruction easterly from Shire Boundary.
Doncaster and Templestowe Shire	Falconer Road—0·8 miles of realignment and reconstruction west from Warrandyte–Ringwood Road.
Frankston Shire	Young Street—0·25 miles of duplication.
Korumburra Shire ..	Anderson's Inlet Road—0·75 miles of realignment and reconstruction north-easterly from Korumburra–Wonthaggi Road.
Waverley City	Huntingdale Road—0·6 miles of widening and reconstruction—Outlook Road to Highbury Road. Highbury Road—Construction of reinforced concrete bridge and approaches at Gardiners Creek.
Geelong Division—	
Shire of Bacchus Marsh ..	Glenmore Road—Reconstruction, widening and sealing of 5 miles.
Shire of Bellarine	Point Henry Road—Construction of the intersection with the Geelong–Portarlington Road.
Shire of Bulla	Somerton Road—Extension reconstruction and sealing of 2 miles. Riddell Road—Construction and sealing of 0·8 mile on a new alignment.
Shire of Colac	Barpinba–Poorneet Road—Construction and sealing of 1 mile.
Shire of Corio	Woodstock Road—Construction and sealing of 2 miles between the Shell Refinery Pier and the Corio Overpass.
City of Geelong	Carr Street—Widening and sealing of 0·7 mile. Barwon Road—Reconstruction and sealing of 1 mile.
Shire of Kyneton	Kyneton–Baynton Road—Reconstruction and sealing of 3·5 miles.
Shire of Leigh	Shelford–Cressy Road—Construction and sealing of 2·5 miles.
Shire of Melton	Leakes Road—Construction and sealing of 0·9 mile. Coburns Road—Construction and sealing of 1 mile.
City of Newtown and Chilwell	Fyans Street—Construction and sealing of 1·2 miles.
Shire of Romsey	Woodend–Wallan Road—Construction and sealing of 0·52 mile. Bolinda–Darraweit Road—Construction and sealing of 1 mile.
Shire of South Barwon ..	Mount Pleasant Road—Construction, widening and sealing of 1 mile.
Shire of Werribee ..	Doherty's Road—Reconstruction, widening and sealing of 3·2 miles.
Shire of Winchelsea ..	Cape Otway Road—Reconstruction and sealing of 2·4 miles. Conns Lane—Reconstruction and sealing of 2·5 miles. Kildean Road—Construction of a low level culvert to replace an old timber bridge over the Barwon River at Kildean.
Horsham Division—	
Shire of Dimboola ..	Tarranyurk Bridge—Strengthening of the timber bridge over the Wimmera River west of Tarranyurk.
Shire of Donald	Watchem–Warracknabeal Road—Completion of the seal on this road with the construction and sealing of the final 1·5 miles to a sealed width of 12 feet.
Shire of Kara Kara ..	Carapooee Road—Construction of Evans Bridge, 90 feet long and 20 feet wide between kerbs over Carapooee Creek.
Shire of Kowree ..	Charam–Wombelano Road—Completion of the seal with the construction of the final 2·7 miles to a sealed width of 12 feet. Elderslie–Naracoorte Road—Completion of the seal to the South Australian border with the construction of 1·3 miles to a sealed width of 12 feet.
Shire of Stawell	Campbells Bridge–Greens Creek Road—Construction of Tyries Bridge over Heifer Station Creek, 140 feet long and 22 feet wide between kerbs.
Metropolitan Division—	
Cities of Camberwell, Heidelberg and Kew	Burke Road—Construction of a new duplicate bridge 455 feet long over the Yarra River.
City of Coburg	Reynolds Parade—Reconstruction between Bell Street and Reynard Street.
City of Footscray ..	Hopkins Street—Reconstruction and duplication between Moore Street and Moreland Street.

Plate 40.—Evans Bridge on Carapooee Creek on Carapooee Road—Shire of Kara Kara.

Plate 41.—Elderslie–Naracoorte Road—Shire of Kowree.

Plate 42.—Tyries Bridge over Heifer Station Creek on Campbells Bridge–Green Creek Road—Shire of Stawell.

City of Kew	..	Harp Road—Reconstruction and widening between High Street and Normanby Road.
City of Oakleigh	..	Centre Road—Reconstruction and widening between Clayton Road and the municipal boundary at Westall Road.
City of Richmond	..	Burnley Street—Reconstruction between Bridge Road and Victoria Street.
City of South Melbourne	..	Canterbury Road—Reconstruction and duplication between Fraser Street and Armstrong Street.

Traralgon Division—

Shire of Alberton	..	Jack's River Road—Construction of a new 2-span reinforced concrete bridge 52 feet long, 24 feet wide between kerbs over the Jack's River.
Shire of Narracan	..	Beck's Road—Replacement of a timber bridge over the Latrobe River 2 miles north of Moe with a 4-span reinforced concrete bridge 22 feet wide between kerbs.
Shire of South Gippsland	..	Harding–Lawson Road—Realignment and reconstruction of 1·5 miles.
Shire of Woorayl	..	Koonwarra–Inverloch Road—Reconstruction and sealing of 2·5 miles to a sealed width of 18 feet.

Warrnambool Division—

Shire of Dundas	..	Nigretta Road—Construction of a 5-span prestressed concrete and reinforced concrete bridge, 201 feet long and 24 feet wide over the Wannon River.
Shire of Minhamite	..	Kangertong–Glengleeson Road—Reconstruction of 5 miles to a sealed width of 12 feet, 7 miles south of Macarthur.
Shire of Portland	..	Portland–Nelson Road—Reconstruction of 3·96 miles to a sealed width of 20 feet east of Nelson.
Shire of Warrnambool	..	Wollaston Bridge—Construction of a 3-span rolled steel joist and concrete bridge, 159 feet long and 24 feet wide over the Merri River, together with approaches.
City of Warrnambool	..	Foster Street—Construction of 0·5 mile to a sealed width of 30 to 40 feet.

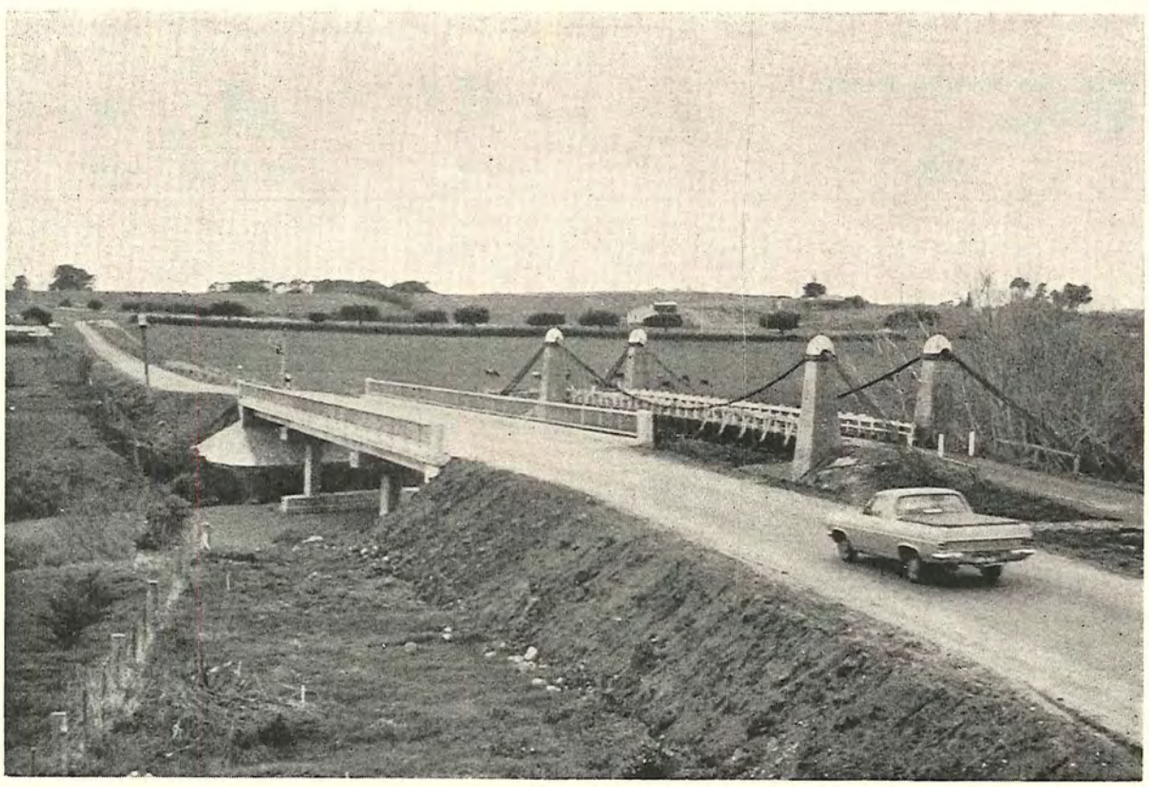


Plate 43.—Wollaston Bridge over the Merri River—Shire of Warrnambool.

APPENDIX 5.

MOTOR REGISTRATION.

Registrations effected during the year under the Motor Car Act totalled 1,167,839 an increase of 4·7 per cent. on the registrations effected during the previous year as compared with an increase in 1964/65 of 5·1 per cent. over the total for 1963/64.

Vehicle.	Financial Year 1964/65.		Financial Year 1965/66.		Increase.	Decrease.
Private—						
New	96,871		87,777		..	..
Second-hand—						
Reregistered	25,082		26,479		..	..
Renewals	758,848		815,738		..	..
		880,801		929,994	49,193	..
Commercial and Hire—						
New	14,728		13,876		..	..
Second-hand—						
Reregistered	4,178		3,912		..	..
Renewals	105,818		107,101			
		124,724		124,889	165	..
Primary Producers—Trucks—						
New	5,374		5,136		..	..
Second-hand—						
Reregistered	4,663		3,982		..	..
Renewals	68,739		72,179		..	..
		78,776*		81,297†	2,521	..
Licences under Motor Omnibus Act		832		792	..	40
Trailers		16,951		18,767	1,816	..
Motor Cycles		12,792		12,100	..	692
Total	..	1,114,876		1,167,839	53,695	732

* Includes 39,537 No Fee Tractors.
† Includes 40,797 No Fee Tractors.

APPENDIX 6.

COUNTRY ROADS BOARD.

STATEMENTS OF RECEIPTS AND PAYMENTS FOR YEAR ENDED 30TH JUNE, 1966.

(Adjusted to nearest dollar.)

		Country Roads Board Fund.		Commonwealth Aid Roads.					
		Act 6229.	Act 6222 Road Maintenance Account.	Act 1964 Sec. 5 (1).	Act 1964 Sec. 5 (2).	Act 1959 Sec. 7 (1).	Loan Funds.	Sub-Total.	Total.
RECEIPTS	$	$	$	$	$	$	$	$	$
Balance as at 1st July, 1965		9,447	..	..	..	..	..	..	9,447
Motor Car Registration Fees	24,642,890								
Additional Registration Fees	1,504,500								
Drivers' Licence Fees	714,522								
Drivers' Licence Testing Fees	188,467								
Examiners' Licence Fees	8,203								
	27,058,582								
Less Cost of Collection	2,368,352								
		24,690,230	..	..	..	..	..	..	24,690,230
Municipalities Repayments—									
Permanent Works—Main Roads	83,672								
Maintenance Works—Main Roads	1,607,726								
		1,691,398	..	..	..	..	..	..	1,691,398
Moneys provided by *Commonwealth Aid Roads Act* 1964		..	..	16,111,668	11,003,090	..	..	..	27,114,758
Moneys provided by *Commonwealth Aid Roads Act* 1959		..	..	..	..	60,425	..	..	60,425
Proceeds from *Commercial Goods Vehicles Act* No. 6222		..	6,378,508	..	..	..	..	..	6,378,508
Grant under *Public Works Loan Application Act* No. 7330		768,000	..	..	..	..	..	..	768,000
Receipts from *State Loan Funds Act* No. 6229		..	..	..	..	..	1,019,600	..	1,019,600
Fees and Fines under Country Roads Act		945	..	..	..	..	..	..	945
General Receipts		469,948	..	..	..	..	..	..	469,948
		27,629,968	6,378,508	16,111,668	11,003,090	60,425	1,019,600	..	62,203,259
PAYMENTS									
Main Roads—									
Construction and Reconstruction		8,237,945	..	3,634,737	..	..	428,357	12,301,039	
Maintenance		2,126,364	2,133,806	7,442	..	..	..	4,267,612	
									16,568,651
State Highways—									
Construction and Reconstruction		4,399,317	..	6,961,376	..	60,425	591,243	12,012,361	
Maintenance		51,526	4,244,702	..	..	..	..	4,296,228	
									16,308,589
By-pass Roads—									
Construction and Reconstruction		1,298,956	..	2,150,687	..	..	..	3,449,643	
Maintenance		55,179	..	..	..	..	..	55,179	
									3,504,822
Tourists' Roads—									
Construction and Reconstruction		349,990	..	561,024	..	..	..	911,014	
Maintenance		230,080	..	368,976	..	..	..	599,056	
									1,510,070
Forest Roads—									
Construction and Reconstruction		..	..	..	408,114	..	..	408,114	
Maintenance		82,537	..	..	208,558	..	..	291,095	
									699,209
Unclassified Roads—									
Construction and Reconstruction		..	..	2,262,518	8,373,308	..	..	10,635,826	
Maintenance		..	..	41,714	2,013,110	..	..	2,054,824	
									12,690,650
Murray River Bridges and Punts		140,133	..	..	..	..	..	..	140,133
Traffic Line Marking		200,888	..	..	..	..	..	..	200,888
Traffic Lights		37,371	..	..	..	..	..	..	37,371
Plant Purchases		1,148,854	..	..	..	..	..	..	1,148,854
Payment to Tourist Fund		467,566	..	..	..	..	..	..	467,566
Payment to Transport Regulation Board		177,788	..	..	..	..	..	..	177,788
Contributions—Australian Road Research Board		..	..	123,194	..	..	..	..	123,194
Contributions—Metropolitan Transportation Survey		73,336	..	..	..	..	..	..	73,336
Repayment of Advance—Public Account		500,000	..	..	..	..	..	..	500,000
Interest and Sinking Fund Payments		2,056,328	..	..	..	..	..	..	2,056,328
General and Administration Expenditure		4,916,278	..	..	..	..	..	..	4,916,278
		26,550,436	6,378,508	16,111,668	11,003,090	60,425	1,019,600	..	61,123,727
Balance at 30th June, 1966		1,079,532	..	..	..	..	..	..	1,079,532

NOTE.—Relief to Municipalities granted under Act 6229 Section 32, amounted in 1965–66 to $39,969.58.

In terms of *Commonwealth Aid Roads Act* 1959 Section 7 (3) the unexpended balance of $60,424.94 was not available for expenditure after 30th June, 1964, on works other than roadworks connected with transport by road or water. Authority was obtained for the expenditure of the unabsorbed amount on roads under Section 7 (1) of that Act.

R. G. COOPER,
Accountant,
3rd February, 1967.

AUDITOR-GENERAL'S CERTIFICATE.

The accounts of the Country Roads Board for the year ended 30th June, 1966, have been audited. In my opinion the above Statement of Receipts and Payments fairly presents in summary form the transactions during that period.

A. J. A. GARDNER,
Auditor-General,
3rd February, 1967.

APPENDIX 7.

COUNTRY ROADS BOARD.

LOAN LIABILITY AS AT 30TH JUNE, 1966.

—	Main Roads, &c.	Developmental Roads.	Total.
	$	$	$
Permanent Works—			
Main Roads	15,697,884.48	..	15,697,884.48
State Highways	14,439,221.88	..	14,439,221.88
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	579,755.64	544,091.84	1,123,847.48
Total Amount Borrowed	30,946,346.33	13,395,606.93	44,341,953.26
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	2,691,370.86	..	2,691,370.86
National Debt Sinking Fund	4,385,083.25	4,876,677.77	9,261,761.02
	7,818,268.98	6,279,616.52	14,097,885.50
Loan Liability at 30th June, 1966	23,128,077.35	7,115,990.41	30,244,067.76

APPENDIX 8.

WORKS EXECUTED ON BEHALF OF COMMONWEALTH AND VICTORIAN STATE GOVERNMENT AUTHORITIES FOR THE YEAR ENDED 30TH JUNE, 1966.

Authorities.	Particulars.	Expenditure.	
		$	$
Commonwealth—			
Department of Works	Roadworks—Access roads to various Commonwealth establishments and to Tullamarine Freeway	7,619.27	7,619.27
Victoria—			
State Rivers and Water Supply Commission	Construction of various bridges over Commission channels, roadworks in connection with Lake Bellfield and Lake Nillahcootie Deviation	87,850.57	
Rural Finance and Settlement Commission	Roadworks—Commission land settlement projects throughout the State	150,058.81	
Housing Commission	Roadworks—Seymour Housing Estate	42,916.20	
Lands and Survey Department ..	Roadworks in Dundas, Kaniva, Lowan, Orbost, Portland and Tambo Shires	59,031.40	
Public Works Department ..	Roadworks on Fruitfly Block at Barmah, Nathalia Shire	1,508.48	
Melbourne and Metropolitan Board of Works	Roadworks—Healesville Shire	782·01	
Latrobe Valley Water and Sewerage Board	Gould Deviation, Narracan Shire	8.52	
Railways Department	Realignment at Bloomfield Road bridge, Buln Buln Shire	6,790.62	
Premier's Department	Roadworks Wonderland and Sundial Roads, Stawell Shire	300.00	
State Electricity Commission ..	Refunds of expenditure on works previously completed	272.64 *Cr.*	348,973.97
State Treasury	Kings Bridge—Sundry expenditure less recoups and receipts from disposals and rental of properties acquired in connection with the construction of Kings Bridge	2,013.09 *Cr.*	
,, ,, ...	Coal Canal Bridge—Sundry expenditure incurred in connection with bridge over Coal Canal at West Melbourne	4,428.43	
,, ,, ...	Railway Level Crossings—Expenditure incurred on grade separation projects recouped from Level Crossings Fund ($125,990.02) and Railways Department ($357,135.54)	483,125.56	
,, ,, ...	Municipalities Forest Roads Improvements—Expenditure on improvements to various roads adjacent to State Forests to facilitate the transportation of timber and financed from the Municipalities Forest Roads Improvement Fund	30,410.09	
,, ,, ...	Special Projects—Expenditure on construction and improvement of roads and bridges financed from the Roads (Special Projects) Fund	1,654,374.06	2,170,325.05
			2,526,918.29

CHIEF ENGINEER'S REPORT

Country Roads Board,
Melbourne,
November, 1966

THE CHAIRMAN,

SIR,

I have the honour to report on matters of technical interest carried out during the year 1965–66. The report is divided into four major subdivisions corresponding to the four sub-branches of the Chief Engineer's Branch, followed by some matters of a general engineering nature.

WORKS SUB-BRANCH

1. ROAD CONSTRUCTION AND MAINTENANCE

Upper Kiewa Valley Road Extension (Buckety Plains)

During 1965–66 the construction of a link road traversing the Bogong High Plains from near Falls Creek to the Omeo Highway, approximately 26 miles north of Omeo, was completed. The length of the work was 18·7 miles. It commenced near the Rocky Valley dam at the end of the Electricity Commission's road. The first 9 miles traversed the High Plains at an altitude of approximately 5,000 feet in country which is under snow during winter and early spring. The remaining 9·7 miles descended to the Omeo Highway. The job extended from November, 1964, to February, 1966, with a forced suspension due to climatic conditions between June and October, 1965.

There were some special problems arising from the climatic conditions and the nature of the country. On the sections which were particularly vulnerable to the effects of snow, batters slopes were cut at 1 horizontal to 1 vertical. Elsewhere they were generally cut at $\frac{3}{4}$ to 1 slopes. On the flatter batters vegetation is already starting to grow.

An unusual problem was the necessity to cross extensive moss beds up to 8 feet in depth. On the advice of the Soil Conservation Authority, these beds were filled with large rock. This acted as a filter, and maintained as nearly as possible the natural drainage conditions, thus successfully avoiding erosion of the gullies.

The provision of surfacing material proved particularly difficult because of the lack of suitable and easily won materials on some sections of the work. In these cases, spalls were won from a basalt outcrop, then windrowed along the formation at a rate of approximately 10 cubic yards per 100 lineal feet. The spalls were then crushed with a mobile rock breaker of the type referred to in the 1963–64 Annual Report. The basalt had a Los Angeles abrasion loss value of 11 per cent. and the two passes of the rock breaker that could be made in the limited time while it was on hire, broke the spalls down to minus $2\frac{1}{2}$ inches gauge. This was somewhat larger than desirable for road surfacing but it had to suffice in the circumstances, as the alternative of installing conventional crushing plant would have been quite uneconomical for the quantity to be crushed.

The cost of the project was approximately $190,000, and was financed from State Electricity Commission, Forests Commission, and Country Roads Board—Tourist Development Authority Funds.

Camping Facilities for Bituminous Surfacing Units

The adoption of a new code of camp standards to provide improved amenities for the Board's direct labour staff, was referred to in the 1963–64 Annual Report. Broadly, the code aims at providing, on a planned area basis, camps of a relatively permanent type. From each camp, programmes of road and bridge work may be carried out at intervals over a period of two or three years.

Different considerations govern the provision of improved amenities for the Board's bituminous surfacing gangs, because these operate from one site or field depot for only a few weeks at a time. Accordingly a combination of mobile and fixed camp equipment caters for the needs of these gangs. The type of equipment used depends on the location and nature of the work being done.

Reference to the Board's Benalla Division shows how the system operates. In this Division, which has an area of 12,500 square miles, two mobile sealing units and a priming unit are employed to carry out the average of 380 miles of sealing work per year. All bituminous materials for use in the Division are received, stored, treated at, and distributed from a central depot in Benalla. The priming unit operates from this depot, from which it carries out work throughout the Division.

A permanent camp of high standard has been established at the depot. It consists of—

timber sleeping huts,

a combined kitchen, mess and recreation unit,

and

a combined ablution and toilet unit.

The camp is connected to S.E.C. power, and the town water and sewerage systems. Plate 1 shows the living quarters.

At the remaining sites, which are used by the mobile sealing gangs, only basic fixed facilities have been built, consisting of a kitchen unit and a toilet block connected to either a town sewerage system or to septic tanks. When gangs occupy these sites, the basic facilities are augmented with a mobile kitchen which operates in conjunction with the kitchen unit, and a mobile ablution unit complete with a hot water service. As the gangs stay at these sites for short periods, tents are provided as sleeping and messing quarters. S.E.C. 240-volt power is supplied to the overseer's and cost-clerk's cabins, the ablution, toilet, and kitchen units, and for security lighting. The S.E.C. power is transformed to 32 volts to light the tents.

The provision of these facilities has undoubtedly improved the morale of the bituminous surfacing gangs.

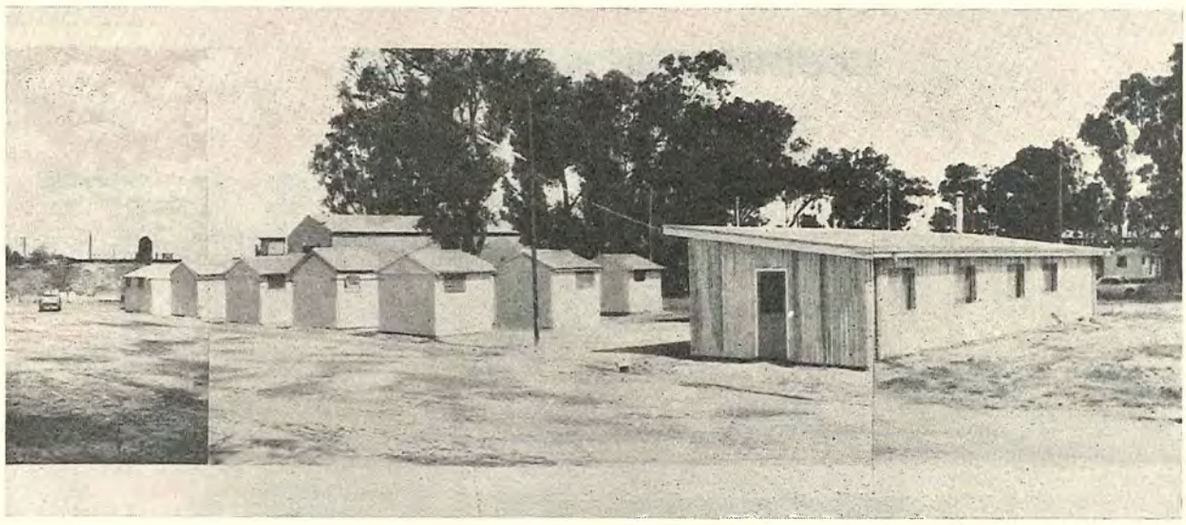


Plate 1.—Living quarters of the permanent camp at Benalla Depot.

Notes on Equipment and Methods

This section deals with recent improvements of plant and equipment used in roadworks.

Self Loading Powered Scraper

This scraper uses power driven elevator slats to lift material and move it into the scraper bowl. As the use of a push tractor is thus obviated, this scraper can be used singly rather than in a group, with greater flexibility in programming. It can be used on smaller jobs, and for final trimming and cleaning up on large jobs, where a group of push loaded scrapers would be uneconomical. The Board replaced four of its older 10 cubic yard push loaded scrapers with 8 cubic yard self-loading units during 1965–66.

Pneumatic Tyred Tractors for Roller Towing

Following satisfactory trials with a hired unit, four pneumatic tyred tractors have been purchased for use in towing heavy drawn drum rollers and grid rollers, instead of the crawler tractors formerly used. These new tractors enable the rollers to be towed at higher speeds, with consequent increased performance.

Power Graders with Rear Mounted Hydraulic Rippers

Successful trials were made in 1961 with a rear mounted hydraulic ripper fitted onto a grader. Six heavy graders fitted with this equipment were purchased during 1965 (Plate 2). The ripper beam has five ripper shank positions, but also provides for alternative mounting of up to eight standard scarifier tynes. Scarifying with the rear mounted ripper has proved quite satisfactory, and graders fitted with these are now purchased without the normal front mounted scarifier assembly.

Plate 2.—Hydraulic ripper mounted on rear of power grader.

Tree Lopping Unit

A tree lopping unit developed by a Dimboola contractor has been successfully used for overhead clearing on a number of highway sections (Plate 3).

This unit consists of an electrically powered chain saw adapted to a backhoe hydraulic linkage which is mounted on a 3 ton tray truck. The truck also carries the generator and requisite hydraulic equipment.

Full 360° rotation of the saw is provided plus angling in the vertical plane, and the boom can be extended to a maximum vertical or horizontal reach of 30 feet. All operations are controlled by the truck driver from the truck cabin, and assistance is required only for traffic control and for removal of lopped timber.

Trench Spreader

The Mechanical Sub-branch has recently modified a Board's "Power-Pak" side casting trench spreader to use the standard coupling (as used for bituminous surfacing aggregate spreaders), fitted on the delivery trucks (Plate 4).

This modification has proved much more satisfactory than the previous arrangement of cables hooked to the front bumper of the truck. The spreader has become a valuable tool for use on widening jobs where gravel and crushed rock are used.

The use of the spreader avoids the wastage and dust problems associated with the practice of grading material across from windrows on the pavement, and enables material to be spread in the trench in properly controlled lift depths.

Rock Drilling and Blasting

The trend mentioned in the 1964–65 Annual Report to the increased use of AN–FO mixtures for blasting work, has continued. It has been assisted by the greater availability of heavy track-mounted rock drills, which are normally hired from private operators on a footage basis.

The improved economy and speed afforded by these methods are reflected in the following unit costs for excavation by direct labour of a box cutting in weathered basalt at Dean's Hill deviation at Axedale :—

	cents
(*a*) Primary drilling cost per foot for 11,000 feet drilled	38·3
(*b*) Drilling and blasting cost per cubic yard for an estimated 20,000 cubic yards of rock excavated—	
Primary drilling	21·8
Primary blasting	17·3
Secondary drilling and blasting	7·1
Total	46·2

Direct Labour Road Construction Costs

Detailed cost analyses available for 91 road work jobs completed during 1965–66 at a cost of $4·94 million, indicate (as shown in Tables 1–4) :

(*a*) a decrease of overhead expenditure, relative to production costs,

(*b*) a considerable decrease in formation costs, and

(*c*) continued stability of pavement costs.

TABLE 1—DISTRIBUTION OF EXPENDITURE

—	1965–66.	Five Year Average 1961–62 to 1965–66.
	%	%
Plant	36·2	34·5
Labour	33·2	32·3
Materials	21·5	24·3
Stores	9·1	8·9

TABLE 2—WORKS OVERHEAD EXPENDITURE
(Percentage of Productive Costs)

—	1965–66.	Five Year Average 1961–61 to 1965–66.
	%	%
Construction expenses	9·2	8·0
On site expenses	15·1	18·4
	24·3	26·4

Plate 3.—Tree lopping unit, showing the hydraulic linkage and electrically operated chain saw.

Plate 4.—Side casting trench spreader coupled to delivery truck.

TABLE 3—FORMATION COSTS

(Including Distributed Overhead Expenditure)

—	Rock.		Earth Unclassified.		Total.	
	Quantity.	Unit Cost.	Quantity.	Unit Cost.	Quantity.	Unit Cost.
	cu. yds.	$	cu. yds.	$	cu. yds.	$
1965–66	141,382	1.01	1,262,903	0.93	1,404,285	0.94
Five year average 1961–62 to 1965–66	91,777	1.53	1,222,958	1.07	1,314,735	1.11

TABLE 4—PAVEMENT MATERIAL COSTS

(Consolidated in place including Distributed Overhead Expenditure)

—	Fine Crushed Rock.		Coarse Crushed Rock.		Gravel, &c.		Total.	
	Quantity.	Unit Cost.	Quantity.	Unit Cost.	Quantity.	Unit Cost.	Quantity.	Unit Cost.
	cu. yds.	$	cu. yds.	$	cu. yds.	$	cu. yds.	$
1965–66	56,797	4.54	24,053	4.33	887,453	2.10	968,303	2.30
Five year average 1961–62 to 1965–66	110,385	5.03	46,347	3.25	958,281	2.02	1,115,013	2.30

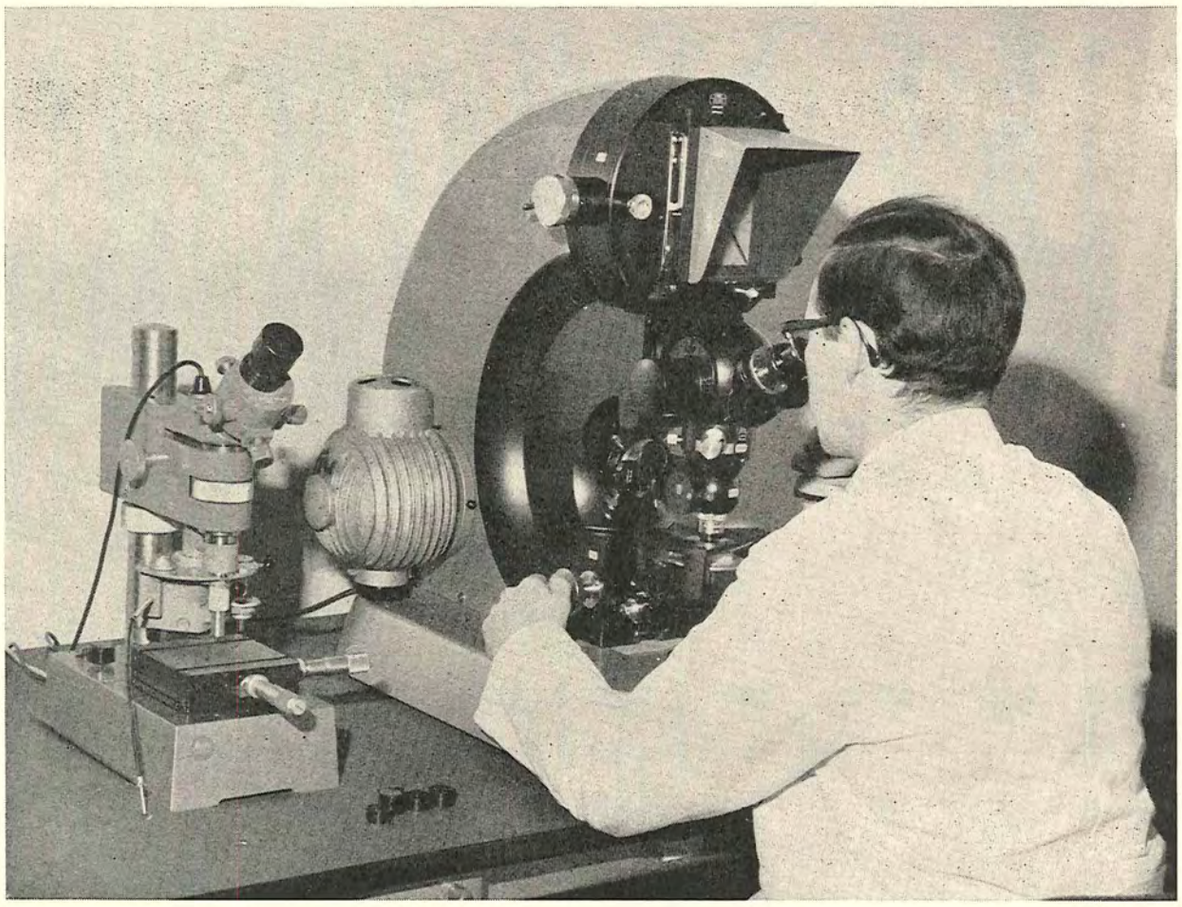


Plate 5.—Zeiss Ultraphot II microscope in use for metallurgical investigation.

2. Testing of Materials and Research

Metallurgical Investigation of Materials

The Materials Research Division is now more fully equipped to make metallurgical investigations. A Zeiss Ultraphot II microscope capable of magnifications up to 2,500 times actual size has been purchased during the year (Plate 5). Equipment for the preparation of samples, including a mounting press, abrasive cut off machine, belt grinder and grinding and polishing wheels, has also been obtained. A Pellini drop weight test rig has been constructed to determine the temperature at which steel becomes brittle in the presence of a notch.

This equipment together with equipment already available for tensile, bend and Charpy tests, and Vickers hardness tests will permit the evaluation of the properties of steel and other metals for a wide range of applications. Work has commenced on AS A135 Notch Ductile Class B steel for use in webs and tension flanges of bridge girders. Results obtained to date indicate that this steel has satisfactory notch ductility in all thicknesses up to two inches. Investigations will continue, however, in order to determine the range of properties which can be expected in any one thickness of plate from normal commercial deliveries. The weldability of this steel is being investigated and initial tests have shown that even with no preheat, the heat-affected zone of the weld shows no tendency to micro-cracking.

The metallurgical facilities of the division are also being used to investigate welding procedures proposed by steel fabricators for girder construction. The properties of steel for use in construction equipment are being investigated. The influence of the properties of the steel on the wear resistance of grader blades, is a continuing investigation ; and some studies have been made of the properties of cast steel grader tynes, steel tow hitch pins and other parts of mechanical plant.

Investigations of Pavement Conditions, Murray Valley Highway

A series of investigations of pavement conditions were carried out on the Murray Valley Highway between McCoy's bridge and Turrumberry in the vicinity of Echuca. The tests were performed at selected sites where re-sheeting, reconstruction or widening followed by bituminous sealing had been recently carried out and included both lime stabilized and mechanically stabilized pavements.

Test Sites

Twenty-three sites were tested. They were spread over six areas of essentially different construction, as follows :—

Murray Valley Highway Section 2

(i) 122·19 m–124·43 m. Six sites were selected in this length, which had been reconstructed to provide a 5 in. thick lime stabilized clay sub-base, and a top course of 2 per cent. lime stabilized

TABLE 5—PAVEMENT INVESTIGATIONS, MURRAY VALLEY HIGHWAY

Mileage.	Material.	Location in Pavement. (in. depth).	Grading Characteristics.			Plasticity Index.	Average Field C.B.R. (%)	Moisture Content. (%)	Average Dry Density (pounds/cubic foot).	—
			3/16 in.	36.	200.					
			Percentage passing—							
123·0–123·87 Sec. 2 (6 sites)	Lime stabilized clay and sand	½– 3½	97	49	26	11	120	5½	115	Reconstructed (1964) with 5 in. lime stabilized sub-base and lime stabilized sandy clay + sand mix topcourse
	Clay + 4 per cent. lime	3½–12	99	68	50	8	240	11	105	
	Brown silty clay	12 +	100	99	93	11	26	11	92	
132·46–132·48 Sec. 2 (2 sites)	Sandy loam	½– 6½	98	58	24	6	87	5	119	Re-sheeted (1959–61) with 5 in. sandy clay topcourse and 4 in. sandy loam base-course
	Silty sand	6½–10½	100	90	43	N.P.	45	9	115	
	Silty sandy loam	10½–13	100	89	41	5	55	..	..	
	Brown loam	13 +	100	98½	57½	7½	15	11	105	
134·5–134·7 Sec. 2 (2 sites)	Sand + loam mix	½– 4	98	55	30	8	50	4	112	Reconstructed (1959–61) with 3 in. sandy loam over 6 in. lime stabilized clay
	Clay + 3 per cent. lime	4 – 9½	97	87	72	18	40	11	101	
	Brown clay	9½ ..	100	97	92	22	17	13	100	
134·95–135·20 Sec. 2 (2 sites)	Lime stabilized sand + clay mix	½– 7½	97	76	56	16	73	7½	106	Reconstructed (1959–61) with sand mixed into lime stabilized layer
	Brown loamy clay	8½–30	99	97	88	15	20	8	101	
	Brown loamy clay	At approx. 20	..	..	..	..	27	10½	80	
135·70–138·25 Sec. 2 (5 sites)	Sandy loam	½– 5	98	40–70	20–23	5–6½	145	2½–5	116–129	Reconstructed (1959–61) with sand loam mixture
	Sandy loam	5 – 8	..	..	..	..	100	7	111–130	
	Silty clay loam	8 +	99	60–90	33–83	2–18	30–60	6½–12	110–115	
139·9 Sec. 2 (1 site)	Cement stabilized sand + clay	2 – 9	97	37	17	6	190	8½	99	Widening (1963–64) inside of curve
	Loam	9 –13	100	81	69	22	5	13	96	
	Silty clay loam	13 +	95	91	88	29	5	16	100	
142·75 .. Sec. 2 (1 site)	Sand + loam mix	1 – 4	85	42	20	9	65	3½	124	Fully reconstructed region (1963–64)
	Crushed rock + loam	6 –11	32	17	12	16	..	..	..	
	Brown clay	11 +	99	98	93	30	20	19½	93	
5·50–7·25 Sec. 3 (2 sites)	Lime stabilized clay + sand	1 – 4½	97	53	27	7	30–55	4	111	Widened (1964) 10 in. pavement with 6 in. of lime stabilized clay
	Lime stabilized clay + sand	4½– 9½	97	50	24	3	125	8½	101	Non plastic sand mixed with top 2 in. of stabilized layer
	Clay loam	9½–14	98	86	77	21	28	12	105	
5·50–7·25 Sec. 3 (2 sites)	Sandy loam	1 – 4½	100	35	20	4–7	55–80	1	113–117	Existing pavement
	Clay loam	6 –19	97	48	28	21	100–130	4	103	
	Clay loam	At approx. 18	..	..	..	..	35–50	4–10	90–100	

sandy clay and sand mix. Two of these sites were situated on a stretch which had been left open for three months before priming.

(ii) 132·46 m–137·79 m. There were ten sites in this section. Six of these were in an area where there had been a re-sheet of nominally 5 in. depth of sand-loam mix top course over 3 in. to 4 in. depth of sandy loam. The next two sites were in a reconstructed area which had a 3 in. layer of sand-loam over 6 in. of lime stabilized clay ; the last two were in another reconstructed area which had 2 in. of sand mixed into the surface of 6 in. of lime stabilized clay.

(iii) 137·79 m–138·88 m. One site was selected in a reconstructed and widened area, with a nominal 6 in. depth of sand and sand-loam mix top course over a variable depth of sandy loam.

(iv) 139·9 m. This test site was located on a widening strip in a short experimental section where a sand-clay mix had been cement stabilized.

(v) 142·25 m–143·25 m. One site was selected in this length, which had been fully reconstructed using 4 in. depth of sand over 6 in. depth of crushed rock.

Murray Valley Highway Section 3

(vi) 5·0 m–10·50 m. This length had a widening strip with a 10 in. pavement depth comprising 4 in. of lime stabilized clay above which was 4 in. of coarse sand mixed with 2 in. of the stabilized clay. Two sites were selected at each of two mileages, one test at each site being on the original pavement and the other on the widening strip.

Test Results

Typical test results are presented in Table 5 and are discussed below.

(*a*) Moisture Contents

The moisture content of all types of pavement material was generally quite low. This factor, and, presumably, a heavy compactive effort, have resulted in very high C.B.R. values in the stabilized materials. The moisture contents of the subgrade mostly were much higher and approached the optimum moisture contents for British Standard Compaction.

(*b*) California Bearing Ratio (CBR)

Generally the lime stabilized material was found to have a higher bearing value (CBR of about 150–200 per cent.) than mechanically stabilized material (CBR of about 80–100 per cent.), used in similar situations. There were only two exceptions to this, both in length (ii) where CBR's of 190 per cent. and 220 per cent. were recorded on extremely dry sand-loam pavements. Subgrade CBR values ranged from 4 per cent. to 20 per cent., depending to some extent on moisture content. CBR's estimated from static and dynamic cone results were found to be in fair agreement with the field CBR values, the cone penetrometer values tending to be higher.

(*c*) Field Densities

Pavement materials other than those which had been cement or lime stabilized gave densities which indicated adequate compactive effort. Three sites that did give low densities in the pavement were found to have low densities throughout the profile.

It was difficult to establish a comparable standard density for the stabilized material, as the method used for establishing such a standard for the unstabilized material was not suitable for the treated material. Further, not enough material, stabilized or unstabilized, could be sampled from each site to carry out an actual compaction test. From the densities obtained in the field, however, it was reasonable to assume that with the chemically stabilized material, relatively good compaction had been achieved particularly when the low moisture contents were taken into consideration.

Conclusions

(*a*) None of the pavements tested showed evidence of distress due to structural inadequacy. It appeared therefore that the materials used, and standards of compaction achieved, had resulted in adequate strength for the prevailing conditions.

(*b*) The lime stabilized layers in the pavement had generally reached a higher bearing strength than the sand-loam pavements used in similar situations.

(*c*) The compaction achieved in the pavement materials was mostly adequate. This was demonstrated in some cases by the densities measured, and in others by the condition of the bituminous seal which did not indicate any subsequent traffic compaction.

(*d*) Surface conditions were mostly good. The worst conditions encountered were in the sections of the original pavement of Murray Valley Highway Section 3 west of Echuca, where a 15 year old pavement showed evidence of shrinkage cracking and bituminous seal coat deterioration.

(*e*) The drainage was generally only fair. However there was no indication of this condition affecting the more recently reconstructed pavements.

(*f*) It was considered unlikely that the strength of the lime stabilized pavements would increase much more with further ageing. The sand-loam pavements could only increase in strength with further traffic compaction. This, too, was unlikely as in most cases the densities were already high.

(*g*) The sites left open before priming did not seem to have had their strengths or densities adversely affected.

(*h*) Widening trenches were found to be weaker than the adjacent old construction. Fill areas were also weaker than nearby at-grade areas.

(*i*) Tests in the laboratory prior to construction indicated that the fine grained materials in this area would respond successfully to stabilization. The tests carried out in the field (1–3 years after construction) to a large extent confirmed these indications.

Control of Compaction of Bituminous Concrete

The use of an Asphalt Paving Meter, for the purposes of assessing the degree of compaction of bituminous concrete, was mentioned in the 1963–64 report. This meter consists of a falling level pipette which measures the rate of flow of water required to maintain a constant pressure of 0·25 inches of water on an air reservoir. Air is

allowed to escape from this reservior through a pavement surface into the atmosphere. Connection to the pavement surface is made through a flat annular disc with an internal diameter of 4 inches. The disc is sealed to the pavement by a suitable sealant applied from a sealant gun.

The 1963–64 report indicated that a relationship appeared to exist between air voids in the compacted mixture, and the air permeability. Work has continued with this apparatus with two objectives :—

(i) the determination of rational standards of compaction of bituminous concrete,

(ii) the development of a reliable system of compaction or density control.

The work has involved air permeability tests of newly laid mats immediately after steel wheel rolling ; and subsequent coring and laboratory examination of the cores at a variety of periods of up to twelve months after completion of the work.

The data was represented by two regression lines as follows :—

$V = 0{\cdot}037\ P + 4{\cdot}2$ (sanded mixes)

$V = 0{\cdot}025\ P + 5{\cdot}6$ (crushed fines mixes)

where V = per cent. voids some weeks after construction

P = air permeability in cubic centimeters per minute immediately after steel wheel rolling.

It was found that the degree of compaction developed in 50 blows Marshall cylinder tests (i.e. 3–6 per cent. air voids) was rarely achieved on the road during rolling operations. In surface course work, voids ranged from 5 to 16 per cent., and in binder course work the range was from 4 to 16 per cent. Examination of the data indicated that 8 per cent. air voids (after steel wheel rolling) represented a standard of compaction which could be achieved by a well-trained spreading crew under average conditions, with a properly designed mix. A void content in excess of 10·5 per cent. was considered to represent an unsatisfactory standard of compaction which would result in a decreased service life for the pavement.

A sequential sampling system has been developed to utilize the results of this work, for compaction control immediately behind the paving machine. With the co-operation of the site supervisor, a decision with respect to the compaction achieved by the roller can be made about 20 minutes after the first pass of the steel wheel roller.

3. Roadside Development

The purpose of roadside development is to conserve, enhance and effectively display the natural beauty of the landscape through which a road passes and, having regard to road safety and utility, to provide adequate roadside stopping places where motorists may rest or view the countryside. The nature and extent of the Board's activities for the finanical year are described below.

Tree Planting

Approximately 40,000 trees were planted on roadsides during 1965–66, and extensive ground preparation was carried out in readiness for the next planting season. The trees were planted mostly in areas almost devoid of natural vegetation, such as occur in the Board's Horsham and Geelong Divisions. There was continued development on the Princes Highway West and the Maltby By-pass Road. The beneficial results of tree planting in the past along these roads, are now becoming evident.

Median Development

On all the divided highways leading from Melbourne, considerable developmental work has been done. For example, on the Princes Highway East, between Oakleigh and Dandenong, the whole length of the central median is now grassed.

Erosion Control

The control of erosion, by the method of covering steep slopes with straw secured by wire mesh, prior to planting permanent ground cover plants, has proved very effective. The protection of batter slopes using this method on the Nepean Highway south of Frankston has been extended to the new intersection treatment at the junction with the Old Mornington Road. The technique is also being applied on sand batters on the Nepean Highway west of Rye, and on main roads in the Flinders Shire.

Roadside Stopping Places

Roadside stopping places such as truck parking bays, rest areas, wayside stops and scenic viewpoints, continue to be provided by the Board for road users. Numerous sites are being developed, and for the three latter types of stopping places, fire places, table-bench units, and litter bins are being installed. Belts of trees are being established also, where necessary, to shelter the sites.

4. Bituminous Work

Extent of Work

Table 6 compares the mileages of all types of bituminous surfacing completed during the past two years and shows that the mileage treated in 1965–66 was slightly less than that in 1964–65. The length of sealed pavement on the Board's declared system of roads was increased by 181 miles in 1965–66 and the length of sealed pavement on unclassified roads was increased by 616 miles.

TABLE 6—BITUMINOUS SURFACING WORK, 1964–65 AND 1965–66

Type of Road and Plant Used.	Miles.	
	1964–65.	1965–66.
(*a*) Work on C.R.B. declared roads—		
(i) Board's Plant ..	1,769	1,788
(ii) Municipal Plant ..	79	63
(iii) Contractors' Plant ..	51	45
	1,899	1,896
(*b*) Work on undeclared roads to which the Board contributes—		
(i) Board's Plant ..	945	940
(ii) Municipal Plant ..	56	67
(iii) Contractors' Plant ..	32	24
	1,033	1,031
(*c*) Work done for other Authorities by Board's Plant—		
(i) Municipalities ..	140	134
(ii) State Instrumentalities	6	6
(iii) Commonwealth Works	1	..
	147	140
Totals	3,079	3,067

In 1965–66, 3 per cent. of the existing sealed pavements of the declared system were reconstructed to a higher standard and the seal coat restored, compared with 3·5 per cent. in 1964–65. The existing sealed pavements of the declared system which were retreated, amounted to 8·3 per cent., compared with 7·5 per cent. in 1964–65.

TABLE 7—BITUMINOUS WORK ON VARIOUS ROAD CATEGORIES, 1965–66

Type of Work.	State Highways.	By-pass Roads.	Tourists' and Forest Roads.	Main Roads.	Unclassified Roads.	Totals.
Initial Treatments—						
Extensions to sealed system—						
(*a*) Sprayed Work	23·8	2·3	16·8	138·1	612·9	793·9
(*b*) Plant Mix Work	..	..	..	..	3·4	3·4
Reconstruction of lengths of previously sealed pavements—						
(*a*) Sprayed Work	145·2	0·4	6·8	213·6	51·9	417·9
(*b*) Plant Mix Work	3·4	..	..	6·2	7·4	17·0
Widening of existing sealed pavements—						
(*a*) Sprayed Work	79·6	..	1·8	206·0	17·4	304·8
(*b*) Plant Mix Work	0·3	..	..	1·5	2·3	4·1
Duplication of existing sealed pavements—						
(*a*) Sprayed Work	7·7	..	..	3·3	..	11·0
(*b*) Plant Mix Work	5·9	..	..	2·6	1·4	9·9
Retreatments—						
(*a*) Sprayed Reseals	454·8	0·7	22·6	516·7	321·7	1,316·5
(*b*) Plant Mix Work	24·9	4·5	..	6·5	12·9	48·8
	745·6	7·9	48·0	1,094·5	1,031·3	2,927·3

Table 7 summarizes the lengths of different categories of bituminous work done on all types of roads to which the Board contributed funds during 1965–66.

Types of Work

Sprayed initial treatments and retreatments again predominated, and amounted to 97·1 per cent. of the work completed.

A total of 83 miles of plant mix work was completed during the year. This represented 2·9 per cent. of the annual bituminous surfacing programme, compared with 89 miles and 3 per cent. respectively in the previous year.

Cost of Work

Table 8 shows the average unit costs of sprayed work completed by the Board's mobile spraying units during the year. The average costs of sprayed work were approximately the same as those for the 1964–65 season.

Materials

(*a*) Aggregate

The total quantity of covering aggregate used in the sprayed work done by C.R.B. units was approximately 281,000 cubic yards.

Table 9 sets out the average costs of aggregate over the past five years and shows that the 1965–66 average cost rose by 2·6 per cent. over the 1964–65 average cost.

The 1964–65 Annual Report described some of the difficulties experienced in the use of limestone aggregates in north-western Victoria for sprayed work, and referred to trials aimed at improving the techniques of use. Further tests were made during 1965–66, in which limestone aggregates were precoated with

(i) one or the other of two makes of petroleum tar, or

(ii) an adhesion agent solution as a control.

The test sections have been inspected, but no conclusive results have been observed as yet. It is proposed to inspect these sections at regular intervals and to conduct further trials during 1966–67.

(*b*) Bitumen

The Board purchased directly 30,418 tons of bitumen in 1965–66. This material was supplied from the two refineries in Victoria and distributed by rail and road by three marketing companies. As usual, the Board's fleet of road tankers assisted in the distribution.

(*c*) Priming Materials

The 1964–65 Annual Report mentioned a petroleum tar, grade M 1·4 (Australian Standard Specification A63–1947) produced in New South Wales. This tar has been satisfactorily used in increased quantities for priming the soft absorptive limestones commonly used in the north-west of Victoria.

(*d*) Primerseals

Petroleum tar grade H.16 (Australian Standard Specification A63–1947), which is suitable for primer sealing in winter, has become readily available. The Board has accordingly used primerseals to a greatly increased extent for application during the winter months. Sound pavements thus treated are capable of carrying traffic until the following summer, when the final seal surface can be applied.

Plant Mix Work

Ninety-one per cent. of the bituminous concrete and bituminous macadam used in the plant mix work completed during 1965–66, was supplied and spread by contractors operating fixed plants near Melbourne and Geelong. The remaining 9 per cent. was supplied and spread by the Board's mobile asphalt plant on heavily trafficked highways remote from the contractors' plants.

TABLE 8—AVERAGE COST OF SPRAYED BITUMINOUS SURFACING DONE BY C.R.B. PLANT DURING 1965–66

(Cost in Cents per Square Yard)

Item.	Nature of Work.																			
	I.T.P. and S. ⅜-in. and Over.		I.T.P. and S. ½-in.		I.T.P. and S. ⅝-in.		I.T.P. and S. ¼-in. and Sand		Primerseals.		I.T. Two-Application Seal Only.		I.T.S.O. and Reseals ⅜-in. and Over.		I.T.S.O. and Reseals ½-in.		I.T.S.O. and Reseals ⅝-in.		I.T.S.O. and Reseals ¼-in. and Sand.	
Square Yards Costed	1,093,507		2,660,499		1,234,536		1,255,290		172,103		104,635		948,593		5,619,689		5,739,795		7,008,574	
	c	%	c	%	c	%	c	%	c	%	c	%	c	%	c	%	c	%	c	%
Material ..	16·6	49·1	16·3	53·1	15·8	57·6	13·0	50·3	7·6	43·6	12·7	56·4	14·7	57·9	14·1	59·5	10·5	58·7	8·4	60·9
Stores ..	1·0	3·0	0·7	2·3	0·7	2·6	0·5	1·9	0·4	2·3	0·6	2·7	0·5	1·9	0·4	1·7	0·4	2·2	0·3	2·2
Plant Hire ..	7·2	21·3	6·4	20·8	5·1	18·6	5·5	21·2	4·1	23·6	4·1	18·2	4·7	18·5	4·1	17·3	3·2	17·9	2·4	17·4
Labour ..	9·0	26·6	7·3	23·8	5·8	21·2	6·9	26·6	5·3	30·5	5·1	22·7	5·5	21·7	5·1	21·5	3·8	21·2	2·7	19·5
Totals ..	33·8	100·0	30·7	100·0	27·4	100·0	25·9	100·0	17·4	100·0	22·5	100·0	25·4	100·0	23·7	100·0	17·9	100·0	13·8	100·0

I.T.P.S. indicates "initial treatment prime and seal".
I.T.S.O. indicates "initial treatment seal only".

TABLE 9—AVERAGE PRICE FOR AGGREGATE FOR BITUMINOUS SURFACING

(In roadside stacks)

Material.	Prices per Cubic Yard.				
	1961–62.	1962–63.	1963–64.	1964–65.	1965–66.
	$	$	$	$	$
Screenings	4.66	4.49	4.81	4.92	5.04
Gravel	4.41	4.26	3.95	4.12	4.20
Sand	1.92	2.16	2.31	2.48	2.50
Scoria	3.13	3.27	2.98	2.90	2.78
Average price all aggregates	4.49	4.28	4.48	4.58	4.70

BRIDGE SUB-BRANCH

1. DESIGN

Barwon River Bridge

Rapid increases in the volume of traffic using the Princes Highway West at Geelong have resulted in an urgent need for improvement of the traffic capacity of the bridge over the Barwon River at Moorabool Street. A method has been devised for widening the bridge economically and rapidly, with a minimum of interruption to the traffic using the bridge. Generally, only one of the four lanes in the carriageway will be closed to traffic. The procedure is based on the use of the existing sub-structure and foundations.

Symmetrical widening from 33 ft. to 48 ft. between kerbs will be achieved without substantial alteration of the existing substructure by the use of post-tensioned concrete crossheads seated on the existing pier shafts and cantilevered from them to carry an additional single row of welded steel plate girders on each side of the bridge (Fig. 1–A).

Details of crosshead extensions are set out in Fig. 1–B. The elastic shortening effects of post-tensioning and shrinkage will be provided for by supporting the new sections on steel rocker bearings, and separating them from the existing work by means of fibreboard insertions.

The gaps left between the vertical faces of the new and existing sections will be filled with joint concrete not less than 28 days after post-tensioning has been completed.

Foundation work will be limited to the driving of a small number of piles adjacent to each abutment to provide for extensions of abutment crossheads.

Pedestrian Overpass at Braybrook State School—Western Highway

The existing signalized pedestrian crossing opposite Braybrook State School on the Western Highway is being replaced by a pedestrian overpass bridge which will eliminate the hazards of the traffic to school children, and will permit a smoother flow of traffic. This structure will be the first of a number of a similar design to be constructed by the Board over busy highways in the metropolitan area.

For economy and speed of erection, a combined precast, prestressed and reinforced concrete design was adopted.

The bridge consists of two main spans in precast, prestressed concrete of 51 feet and 43 feet 6 inches respectively, with a clear width of 6 feet between railings. The minimum clearance over the highway is 17 feet 6 inches.

The grade of the approach ramps, which are parallel to the carriageway (Fig. 2), is 1 in 8. The ramps consist of longitudinal precast reinforced concrete flat slabs 9 inches thick. The ramp slabs terminate at the lower end in a cast-in-place reinforced concrete ramp.

Precast reinforced concrete columns with cantilever arms, support the ramp and the main spans. These columns are fixed into cast-in-place footings. Steel safety guard rails are installed to prevent vehicles colliding with the columns.

Use of the Board's IBM 1620 Computer

Increased use was made of the Board's computer during the year to the extent of approximately 70 per cent. over the 1964–65 level.

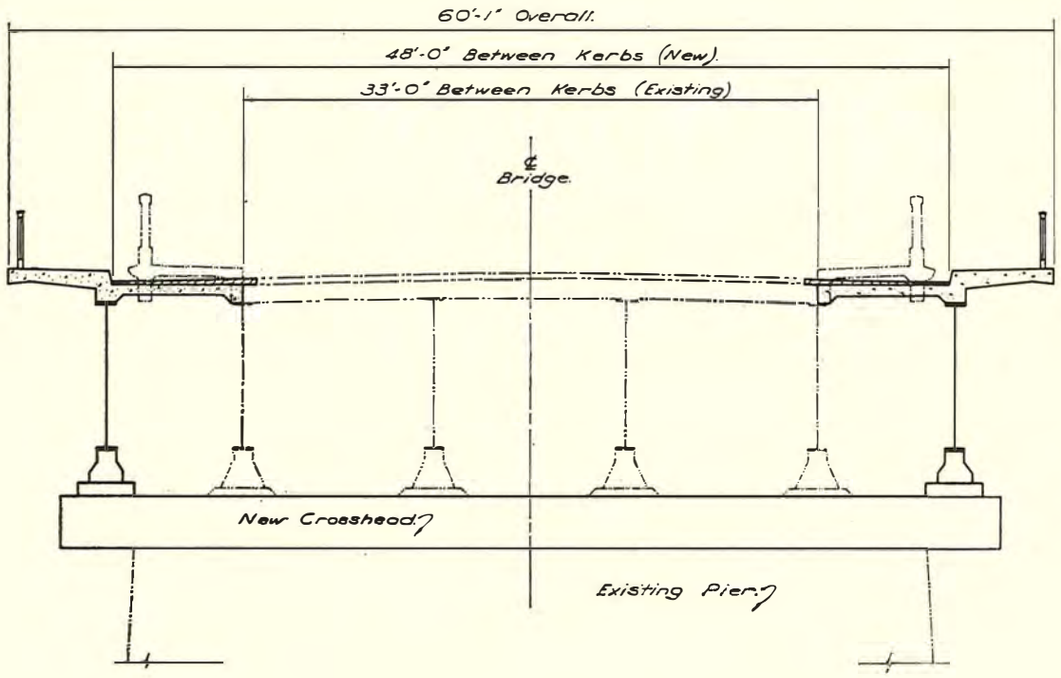
Development and Documentation of Library Programmes

Emphasis was placed on the completion, testing and documentation of the series of programmes already commenced and outlined in last year's report, viz. :—

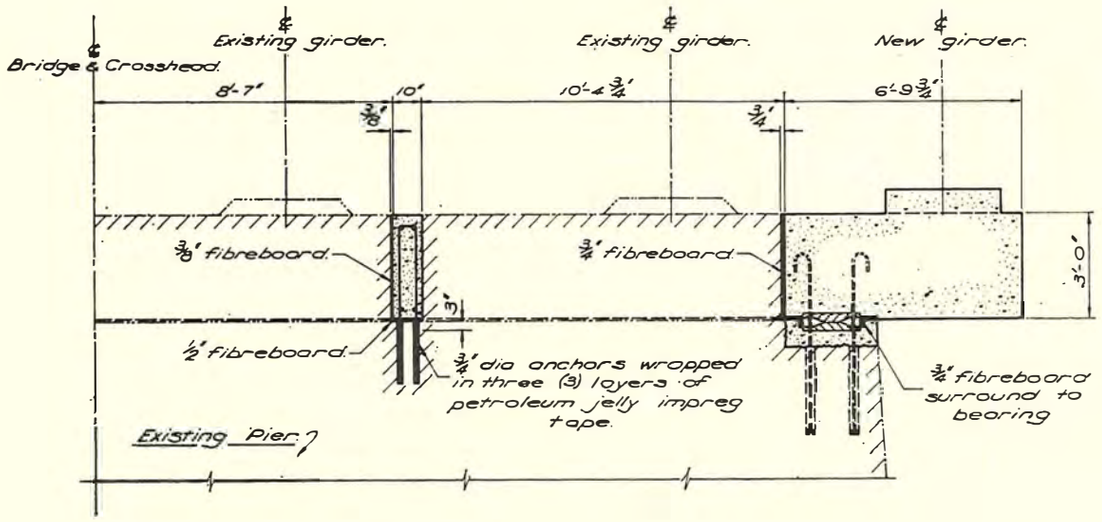
- Analysis of two-column bridge piers.
- Analysis of circular reinforced concrete columns.
- Analysis of rectangular reinforced concrete columns.
- Two-column pier pile loadings.
- Beam section properties.
- Deflections of continuous beams.
- Moments, shears and reactions for continuous beams.
- Composite steel beams.

Manuals containing a complete technical description of each programme were prepared and issued within the Sub-branch. Copies are available to all staff members through the Board's library.

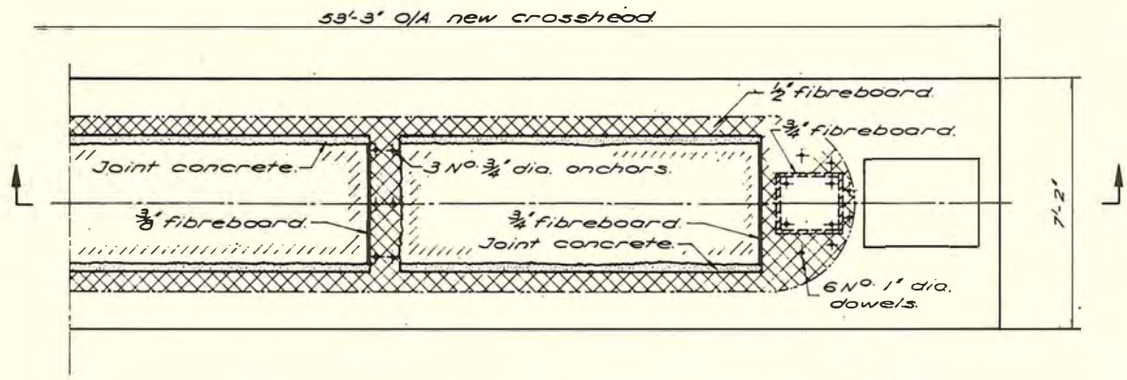
A library programme was developed during the year to assist in the scheduling of reinforcement from structual drawings. The numbers of bars and the dimensions of each are found in the normal way, and the computer programme then evaluates missing arc lengths at bends and slope lengths, adds the length of standard hooks, makes allowance for shortening of the bar centreline around bends, and thus determines the total length and weight of each bar in the schedule. The finished schedule is printed directly by the IBM 1443 printer attached to the computer, together with a summary of the total weight of bars of each type. After manually drawing in any special bar shapes, the schedule is ready for direct insertion in the associated plans and specifications.



TYPICAL CROSS SECTION—AT PIERS. A

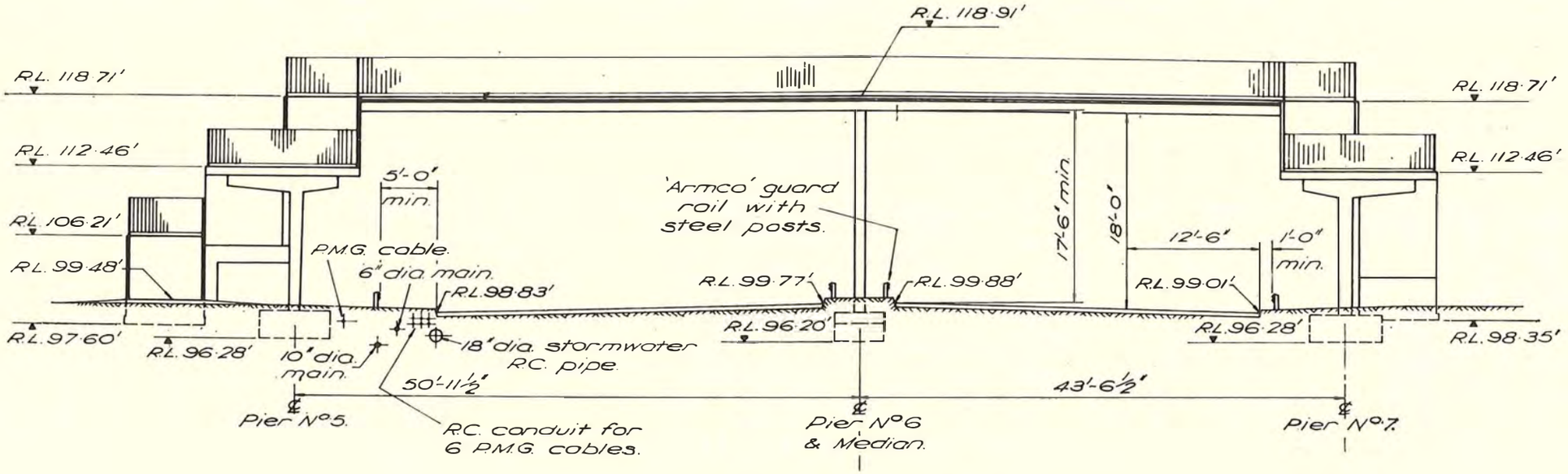


LONGITUDINAL SECTION A-A

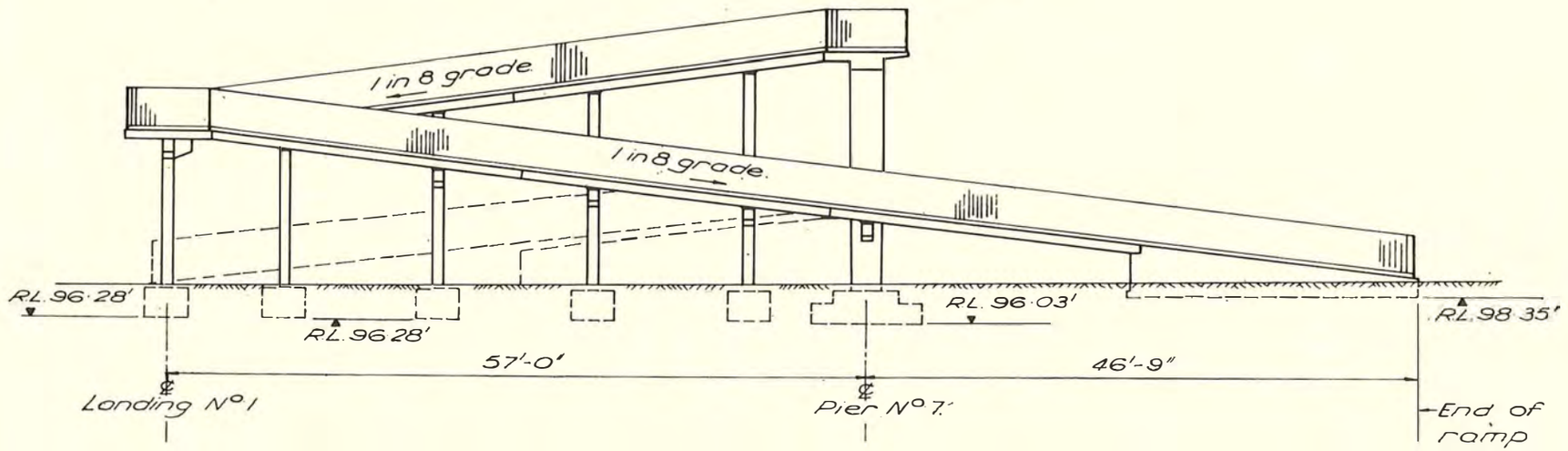


HALF PLAN — PIER CROSSHEAD. B

Figure 1.—Widening of Barwon River Bridge, Princes Highway West, Geelong.



FRONT ELEVATION



SIDE ELEVATION

Figure 2.—Construction details of proposed pedestrian overpass, Braybrook, Western Highway.

Programmes for bridge substructure design were developed. A system of programmes for the analysis of three-column bridge piers was operating productively by the end of the year. The programmes are generally similar to those already in use for two-column bridge piers, but the flexibility of the system has been considerably improved, permitting a wide range of alternative design assumptions and methods. The programming was carried out with a view to future integration with other programmes for both superstructure and substructure design.

A punch card system and associated computer programme to assist the Board's Architect in specification writing neared completion. Each line of specification is key-punched into a single card. The assembled deck of cards is processed by the computer and the specification is printed out on the 1443 printer, complete with index, page numbers and serial clause numbers for each section. The card system readily permits the substitution of alternative wording, the insertion of new clauses, or the deletion of inappropriate items.

Use of " One-Off " type Computer Programmes

Twelve programmes of varying complexity were developed during the year to assist designers with particular problems of computation. Although not intended for repeated use as library programmes, a number of them have already been used for several projects, and the experience gained from their use will be valuable in future programming. The most important programme of this type was used in the design of the Lancefield Road Bridge over the south-bound carriageway of the Tullamarine By-pass Road. Computation of influence lines for curved box girders continuous over point supports, taking due account of torsional effects, is a difficult and tedious problem when attempted manually. The use of the 1620 computer in this case permitted a rigorous analysis of the effects of curvature and torsion, and the completion of the design within a tight time schedule.

Other programmes of this type have included methods for calculating earth pressures by Coulomb's wedge theory, arcs, chords and off-sets for curved bridges, tabulations of reduced levels, and maximum spans of bridge beams.

Productive Usage of the Computer

The effective usage of the computer in the Bridge Sub-branch increased substantially as compared with last year. It was used to assist in the design of 55 bridges. Programmes were most useful in the fields of substructure design and geometry calculations, although the recently completed programmes for beam design were employed in the design of 9 bridges, and the programming effort has already been repaid. The two-column pier programme was used in the design of 42 piers during the year, including eight for other Australian highway authorities, who are investigating the use of this system.

2. Construction

Shepherd Bridge

On 25th November, 1965, an approach span of the Shepherd Bridge over the Maribyrnong River on Footscray Road was extensively damaged by fire, after a petrol tanker passing under the bridge, collided with the reinforced concrete rigid frame overpass spanning Sims Street.

The soffit of the deck slab was badly spalled leaving the bottom reinforcement exposed, and the concrete remaining in place behind the reinforcement showed evidence of further cracking. This condition extended over two of the three sections in which the frame was originally constructed—namely the centre and upstream sections (Plate 6). The walls of these sections were similarly affected, but to a lesser extent (Plate 7). Damage to the downstream section was limited to minor spalling of walls and deck.

After careful examination of the structures the centre section was shored up and the downstream section was subjected to load tests, using a vehicle of 66 tons gross weight, with bogie loads of 24 tons. These tests demonstrated satisfactory elastic behaviour, and accordingly, the centre and downstream sections were opened to traffic. Additional width was obtained by removal of the downstream footway, thus providing four narrow lanes.

The repair of the upstream section was then commenced. The work on the deck consisted of complete demolition and reconstruction. The work on the wall sections consisted of the breaking back of damaged concrete to a depth of 6 inches, and replacement with new concrete bonded to the existing material with an epoxy bonding agent.

Initially, it was intended that all reinforcement which had been affected by fire, should be replaced. However, laboratory loading tests on samples of bars removed from the structure revealed no detrimental effects to the properties of the material, which was therefore re-used.

The concrete was removed from the deck and the wall sections by the use of explosives. Vertical holes approximately 12 inches deep were drilled in the deck at 12 inch centres. One-third of a stick of gelignite was used in each hole, and firing was carried out in single rows transverse to the direction of the main reinforcement. These small charges fractured the concrete which was then removed by the use of air tools. This procedure caused negligible damage to the reinforcement.

A pattern of downward sloping holes, 5 inches deep on a 10 inch square grid was used to remove concrete from the wall faces. One-fifth of a stick of gelignite was used in each hole. Three adjacent horizontal rows of four holes were connected by " Cordtex " to delay detonators, the lowest row being fired first. Very little handwork was then required to clean the new surface.

The epoxy bonding agent set about one hour after mixing. Accordingly, the coating of the new face of concrete was done with the formwork in place. The formwork was placed in lifts of about four feet. The resin was applied with a stirrup pump, fitted with an extension nozzle, and connected to an air compressor. The compressed air " atomized " the jet of resin and a complete and reasonably uniform coating was obtained.

After completion of the upstream section, the central section was repaired in a similar way. The traffic was diverted into two lanes on each of the upstream and downstream sections during this stage.

The repair of the minor spalling on the downstream section was achieved by sandblasting and " guniting ". A " flash coating " (approximately $\frac{1}{8}$ in. thick) of gunite, was then applied to the structure to make the entire surface uniform in appearance (Plate 8).

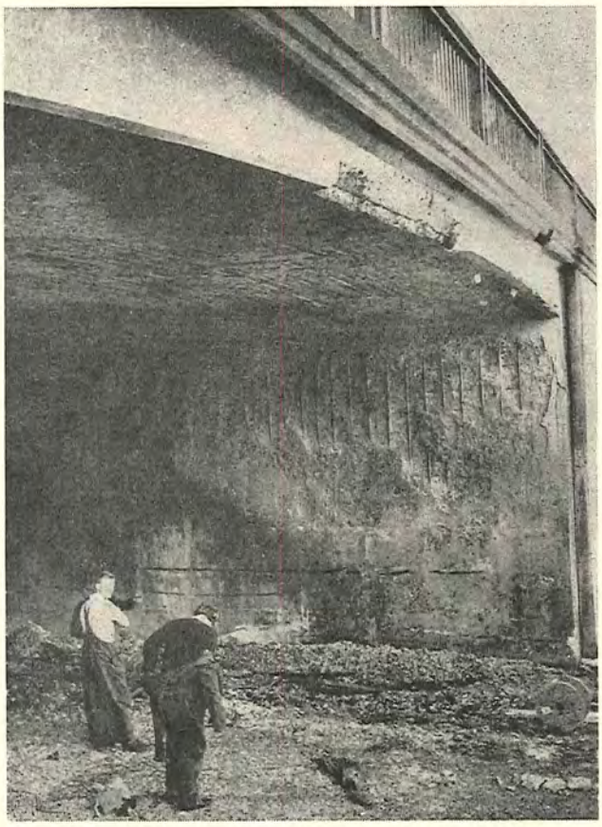


Plate 6.—Shepherd Bridge. General view of the upstream section, showing spalling damage caused by fire.

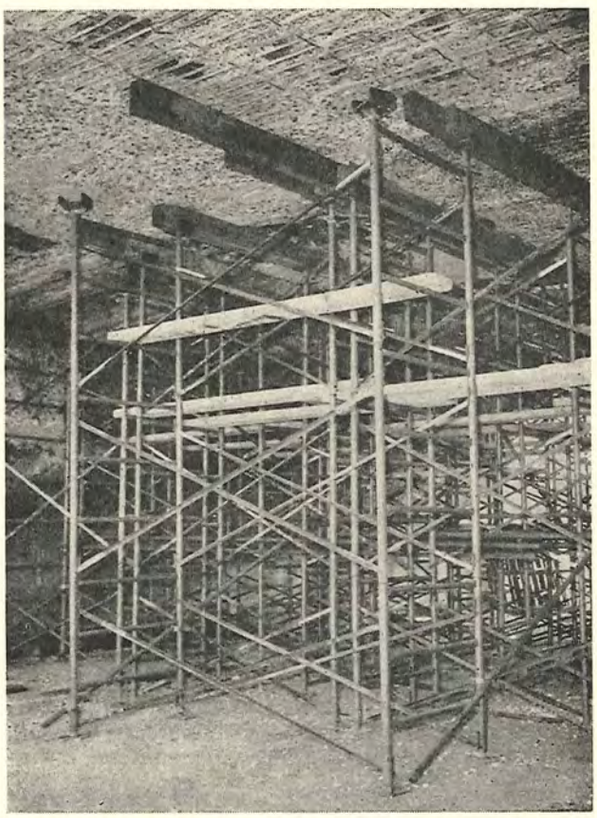


Plate 7.—Shepherd Bridge, showing spalling of deck soffit in upstream section, and shoring under the centre section.

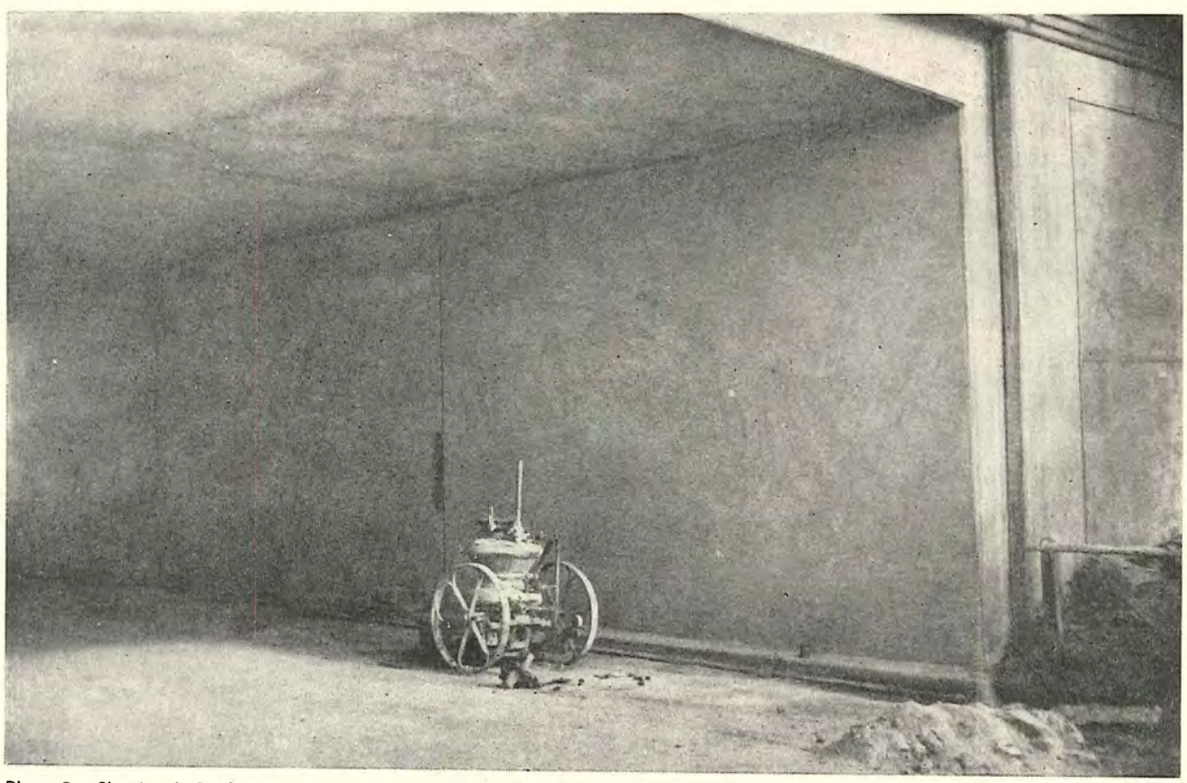


Plate 8.—Shepherd Bridge after completion of repairs. The equipment in the foreground was used for the guniting process.

Princes Highway East

Bridge over Boggy Creek at Nowa Nowa

The rigid frame plate girder bridge over Boggy Creek on the Princes Highway East at Nowa Nowa is the first of this type to be built by the Board. This design was adopted because of the difficulty of placing foundations on the base rock bottom through the 15 feet depth of permanent water, 90 feet wide, at the site. The existence of a rock outcrop on each side of the creek also lent itself to the adoption of this design.

Plate 9 shows the shape of the frames (and the old timber bridge in the background). The overall length of each frame is 182 feet and the span between the centres of the bearings supporting the sloping legs is 117 ft. 6 ins. In the cross-section of the bridge there are five frames supporting a 28 ft. roadway and a 5 ft. footway. The grade on the roadway is 1·32 per cent. and is combined with a horizontal curve of radius 934 ft.

The horizontal curvature of the bridge made it necessary to introduce small changes of direction at each field splice in the main girders, which thus followed three straight chords around the curve. These angular changes in turn produced lateral sway forces, necessitating special bracing between the legs and in the plane of the deck. The latter bracing was necessary only until the concrete deck had set and was capable of resisting external forces.

Each frame was fabricated in five sections and connected in the field by high tensile bolted splices. The steel for the tension flanges of the plate girder sections was to B.S.2762 class N D 2, and compression flanges and webs were to A.S. A33 Class D. The central 60 ft. of each frame consisted of a 36 in. x 12 in. x 150 lb. universal beam. Butt welds in tension flanges and webs, and fillet welds between tension flanges and webs, were welded with low hydrogen electrodes. All butt welds in the tension flanges and the tension portion of webs were subjected to radiographic inspection.

The use of a $\frac{1}{2}$-in. web plate obviated the need for most intermediate stiffeners. The increased cost of material was more than offset by savings in fabrication costs. The cutting of the web plates and the bending of the flange plates to the correct shape required considerable care and skill in fabrication. The girders were fabricated in the Board's steel fabrication shop at Syndal where high standards of quality (as revealed by radiographs), and accuracy, were achieved.

The total cost of the structure was approximately $96,000 or $16 per sq. ft. of deck surface (including the footway).

Raleigh's Road Bridge over Maribyrnong River

Settlements at Sunshine Abutment

The 1964–65 report described the special measures adopted in the preliminary construction stage of the Raleigh's Road bridge, to accelerate consolidation of the 40 feet thick compressible silt strata at the Sunshine abutment. The total consolidation under load was expected to be 2 feet, and settling in the first year, unless pre-consolidation was effected, was calculated to be 1 foot. Settling of this order could not be tolerated because—

(i) the structure was intended to carry tram traffic ;

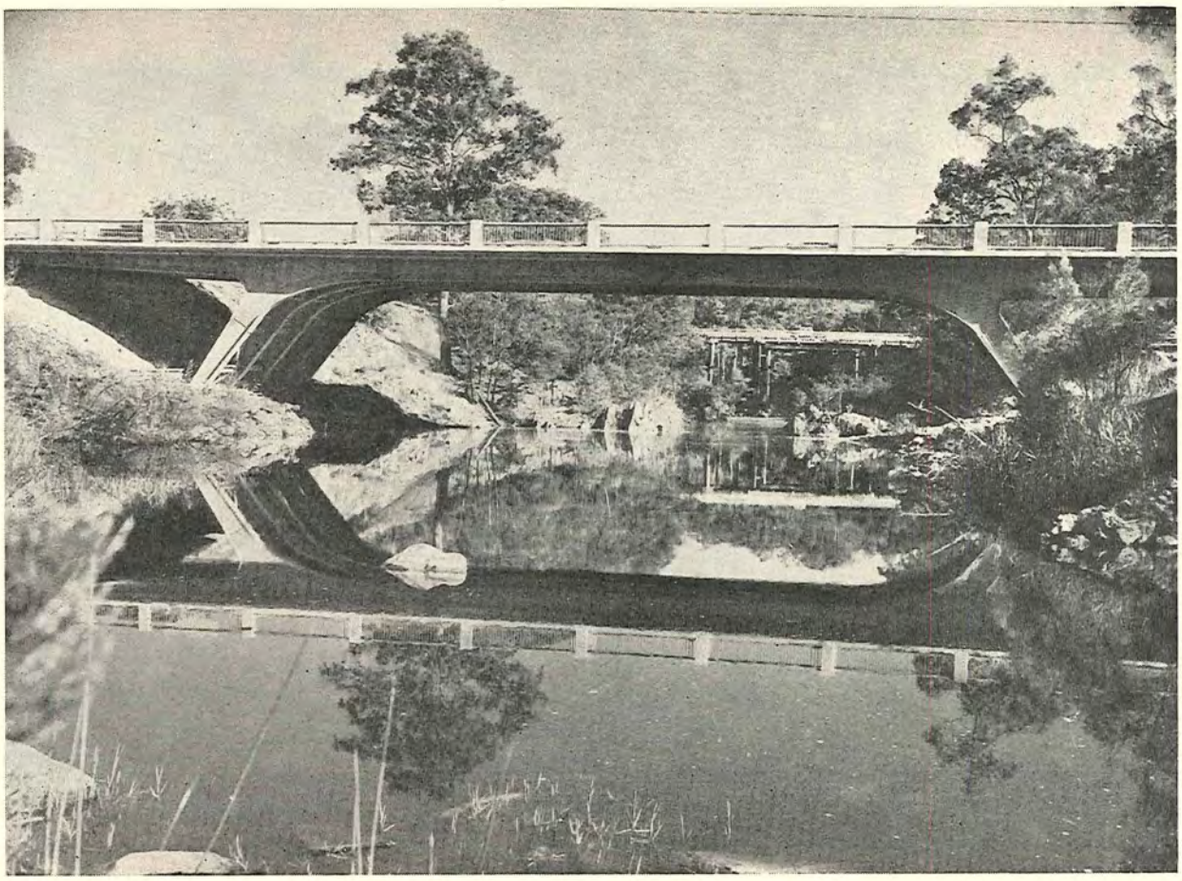


Plate 9.—Boggy Creek Bridge, Princes Highway East, Nowa Nowa.

(ii) it was thought possible that the vertical movement, by producing lateral earth movements, might affect the bridge abutment.

The special measures were—

(i) the placing of the 10 feet deep approach embankment, plus a surcharge of 5 feet above the final grade line at the abutment ;

(ii) extraction of water from the silt layers, by pumping from a well point sunk into the adjacent pervious layers.

Monthly readings were taken on three indicators placed in pipes sunk through the embankment and surcharge to the old natural surface. The indicators, thus independent of the filling, have shown total settlements of the old natural surface of between 16 inches and 27 inches, with little or no lateral movement.

Diagram 1 illustrates graphically how the rate of settlement was affected by the techniques employed. It will be observed that after 58 weeks of consolidation it appeared that settlement had stopped. However, pile driving operations at the abutment produced a further two inches of settlement, as shown. Following this experience, a $4\frac{1}{2}$ ton vibrating roller was operated at one location on the embankment for 11 hours. No further consolidation was produced by this treatment, and it was concluded that the system had reached near equilibrium.

Bridge over Murray River at Barmah

The main beams in the new bridge over the Murray River at Barmah are of pre-stressed reinforced concrete of segmental construction.

This is the first instance in which segmental construction has been used by the Board. The method was adopted by the contractor for reasons of economy.

Each main beam consists of two end segments, 9 feet 5 inches long, and three intermediate segments 19 feet 6 inches long. The end segments weigh 3·5 tons, and the intermediate segments, 5·2 tons. They were placed in position on temporary steel trusses spanning between piers, by a flying fox spanning the river (Plate 10).

A 3 inch width of joint concrete was provided between segments, the faces of which were coated with epoxy resin to ensure a satisfactory bond. The joint concrete was required to reach a strength of 6,000 p.s.i. before post tensioning of the beams was commenced.

The placing of the joint concrete and the pre-stressing were done while the beams were on the temporary trusses. The pre-stressing load was applied by three cables, each consisting of twelve $\frac{1}{2}$-in. diameter strands, using the Freysinnet multi-strand system. The maximum load in each cable was 310,000 lb.

The bridge is 550 feet long, and 24 feet between kerbs, with a 5 feet wide footway. It consists of seven spans each 78 feet 6 inches long. The total cost of the bridge and the sealed road approaches was $334,000.

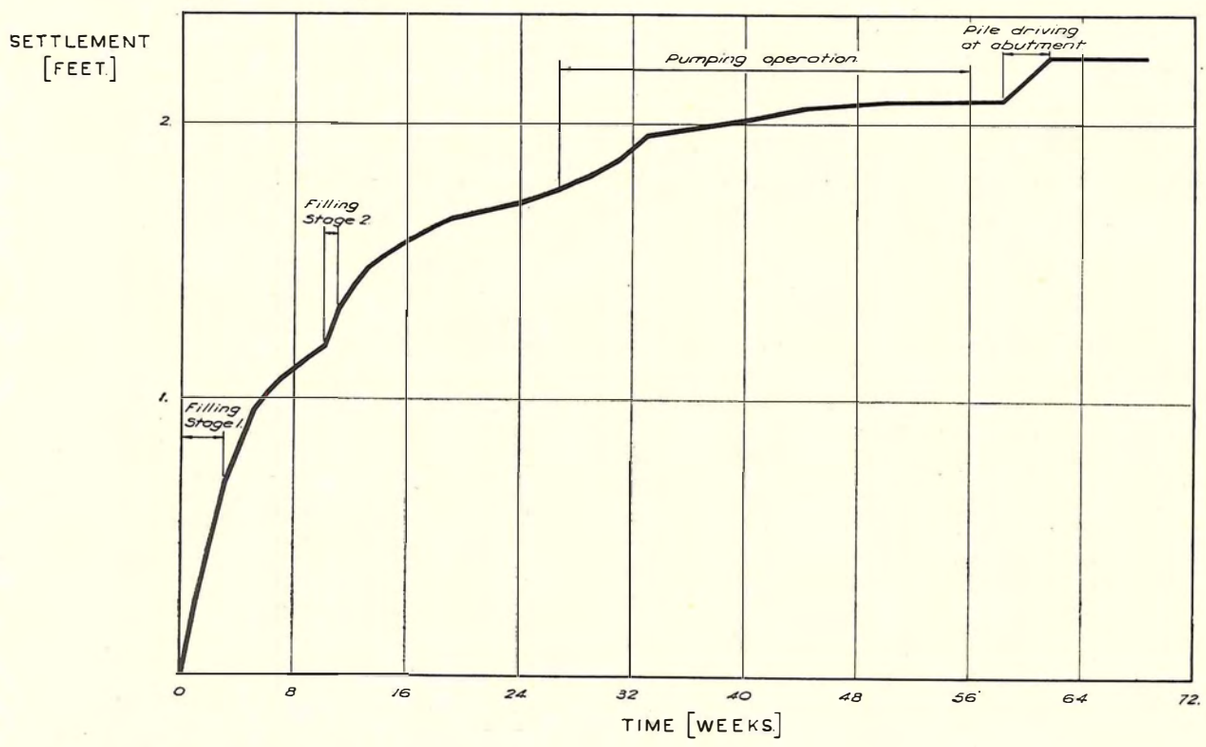


Diagram 1.—Raleigh's Road Bridge, Maribyrnong—Sunshine abutment. Settlement of old natural surface under various conditions of treatment.

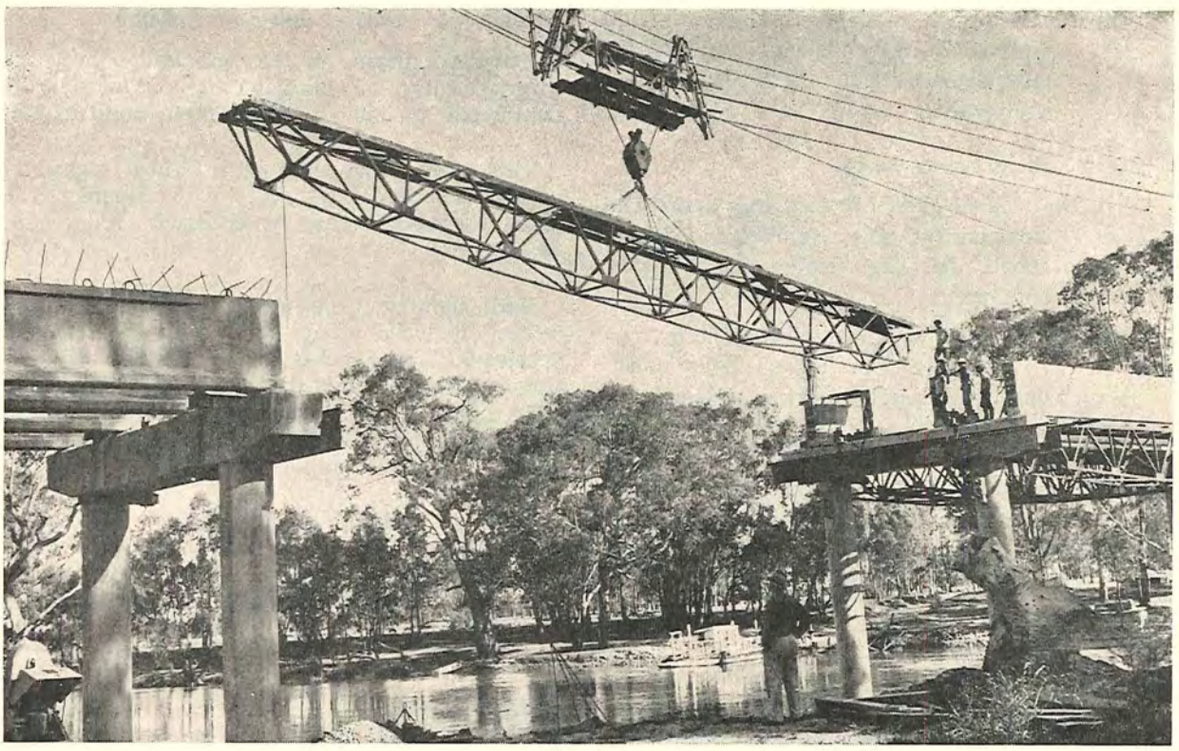


Plate 10.—Construction of the Barmah Bridge, Murray River.

ROAD DESIGN SUB-BRANCH

1. Linemarking

The Board maintained centre line markings on 5,465 route miles of road during 1965–66. The total comprised 3,670 miles on State highways, 1,567 miles on other declared roads, and 228 miles on unclassified roads. Municipalities requested, and paid for, the marking of the unclassified roads.

A total length of 13,115 miles of equivalent standard stripe (i.e., 10 feet x 3 in. line, 30 feet gap) was painted during the year. This was an increase of 39 per cent. over the 1964–65 distance. The main reason for the increase was the more efficient operation of the Board's two large line-marking units, arising both from the adoption of night time striping in the metropolitan area, and the reduction of time lost due to mechanical failure and wet weather.

The Board's small unit painted or repainted 1,336 pavement arrows, 45 sets of rail crossing markings, and a number of sets of intersection markings. In addition it removed 35·8 miles of standard stripe using chemical paint stripper, and was used for striping on short sections of new units were not available.

Two small " Dyco " Model V15 line markers were purchased early in 1965–66. Bendigo and Geelong divisions were each issued with one for trial. Their value was proved in such a variety of uses as—

striping on new seals,
intersection and railway crossing markings,
edge lining,
road paint removal,
spray painting of bridge handrails (using a hand spray gun).

More of the Board's regional divisions may be equipped with these machines in 1966–67, following the successful trial utilization in 1965–66.

The total cost of linemarking done in 1965–66 was $190,920 (this cost does not include the cost of the " Dyco " units). The average cost per mile of equivalent standard stripe painted, was $13.05, compared with $14.22 in 1964–65.

2. Traffic Studies and By-Pass Road Location

The following traffic studies were completed during 1965–66 :—

Traffic Counting

The annual traffic census was made on the 16th March, 1966. Twelve hour classification counts were taken manually at a total of 1,997 stations, 780 of which were on State highways, 1,019 on other declared roads, and 198 on unclassified roads.

The Highway Traffic Index (100 in the base year 1933) rose from 840 in 1965 to 881 in 1966, an increase of 4·9 per cent. In 1965 the Index increased by 9·3 per cent., thereby showing an upward departure from the 1959 prediction (Technical Bulletin No. 17). The 4·9 per cent. increase in 1966 supports the 1965 departure. However, the smaller rate of increase in 1966 is consistent with those of the years before 1965, and apparently indicates a steadying of the trend.

A five-yearly augmented census was conducted by the Board up to 1960. This has now been replaced by a yearly augmented census. One or two of the Board's regional divisions are to be dealt

with in each year of a five-year cycle. The Dandenong division was selected in 1966. Counts were made at 763 stations, over 100 per cent. more than would have been made in the division during the former type of augmented census.

At 21 sites on rural State highways, chiefly in the northern and western areas of the State, automatic traffic count stations have been set up. Fourteen of these stations record continuously for one week in each month. The other seven stations record without intermission. All the stations will be operated for at least one year. The object is to obtain detailed traffic volume data on both radial and circumferential rural State highway routes within 150 miles radius of Melbourne.

Two origin and destination surveys were made during 1965–66. The first was an interview study at three stations on highways leading to Wodonga. This study was to determine traffic desire patterns in the border area of Wodonga and Albury, and so facilitate investigations being made in co-operation with the New South Wales Department of Main Roads. The second survey was a postcard survey at the North Shore Road level crossing of Geelong. This was conducted to assess the need and location for a rail overpass in the area. Reply-paid postcards requesting details of origin, destination and trip purpose, were handed on site to all drivers. Forty-three per cent. of the post-cards distributed were returned correctly completed.

Several delay studies at level crossings were conducted. A computer programme has been developed for the rapid calculation and preparation of results from these delay studies.

On busy roads, vehicles passing one another at or near counting sites have seriously affected the accuracy of counters used in the past. A high speed non-recording axle counter has been developed by the Board's Electrical Maintenance Officer. This unit, by counting axles rather than vehicles, does not suffer from the above-mentioned defect of the earlier models. The unit also has the following desirable features :—

(i) the use of a carbon/silver diaphragm contact which does not require maintenance ;

(ii) avoidance of the double counting shown by earlier counters, of heavy, slow moving vehicles ;

(iii) the use of a transistorized circuit which affords greater accuracy than previous circuits, and does not require maintenance ;

(iv) increased battery life.

An application has been made by the Board to patent the device.

Road Signs

It was reported in 1964–65 that the Board had co-operated with the Traffic Commission in promoting a route numbering system in the metropolitan area. Most of the 45 urban municipalities are either co-operating in the project or have agreed to do so. Eighteen have completed or substantially completed the erection of route markers. The Board has continued to assist the Traffic Commission financially and technically in the implementation of the scheme. Commercially produced maps of the Melbourne area are now providing the necessary key to the interpretation of the routes system.

Traffic Control Devices

The Australian Committee on Road Devices (A.C.O.R.D.) was established during 1965–66 by the Conference of State Traffic Control Engineers in conjunction with the National Association of Australian State Road Authorities and the Standards Association of Australia.

The purpose of the committee is to prepare an Australian Manual of Uniform Traffic Control Devices. The manual is now being prepared with a view to it being submitted to the Standards Association of Australia, for endorsement as a national standard for the uniform use of traffic control devices throughout Australia.

The first meeting of the committee was held at Hobart in April, 1966. The Board was represented by its delegate to the Traffic Engineering Committee of N.A.A.S.R.A. The Board's representative is a member of sub-committees which have been formed to—

(*a*) investigate the position regarding the adoption by other countries of a recent draft United Nations Protocol on Road Signs ;

(*b*) prepare a draft section of the manual, on temporary warning signs for roadworks.

By-pass Roads

The following major projects and investigations were undertaken during the year :—

(*a*) Investigations of the approach routes to the proposed Lower Yarra Crossing, and of the horizontal and vertical alignment proposed by the Authority for the Crossing, were commenced. An interesting development used, was the preparation of perspective drawings using the Board's IBM 1620 computer.

(*b*) A layout for a proposed by-pass at Melton was approved during the year, and investigation of a by-pass at Bacchus Marsh continued. The Board also approved a by-pass at Wallace and Bungaree. All of these projects will ultimately form part of a by-pass road linking Melbourne and Ballarat.

(*c*) Agreement was reached with the Melbourne and Metropolitan Board of Works on the form of the interchange of the Strathmore By-pass Road with Bell Street and Pascoe Vale Road. The by-pass will join with Melbourne and Metropolitan Board of Works' Route 14, to form part of the proposed freeway to Tullamarine Airport.

(*d*) Layout plans for the Mulgrave By-pass Road and Eumemmerring By-pass Road are now complete from Warrigal Road to the Princes Highway East.

(*e*) Layout plans are being prepared for the Mornington Peninsula By-pass Road from the Nepean Highway at Dromana to Eastbourne Road, Rosebud.

Accident Investigations at Metropolitan Intersections

The systematic investigation of accidents at all unsignalized major urban intersections on Board roads was commenced, with the aim of determining—

(*a*) those intersections which have particularly high accident rates, and

(*b*) those at which an appreciable reduction in accidents can be achieved economically.

An examination of about 130 intersections has now been made. The project is expected to be completed early in 1967 with the assistance of students working in the Traffic and Location section during their summer recess.

The accident records of the Traffic Commission for the period 1960–64 inclusive, provide the accident histories required. Traffic counts to determine the number of vehicles entering an intersection are carried out where annual census figures are not available. By adjusting traffic volumes to the accident history yearly average, an average rate of accident occurrence is obtained. The average accident rate at intersections on Board's roads is similar to the average for the metropolitan area, but unusually high rates have been revealed at some locations.

In addition to the calculation of accident rates, accident records are also being used to determine the significance of accidents during darkness, and those involving a predominance of a particular type of accident. The existence of control measures (e.g., Stop signs) is considered in relation to accident types and rates. Where appropriate, the accident history is summarized on a collision diagram showing the type and orientation of the vehicle movements involved. For further reference, summaries of relevant data are filed individually for each intersection. These files contain the accident summaries, traffic counts, photographs taken from intersection approaches, data such as signs and markings collected from field examinations, and records of calculations.

After examination of appropriate remedial treatments, designs for improvements are drawn up. At many locations the collision diagrams show a predominance of a particular type of accident, and the means of reducing accidents of this type is sometimes as simple as a modification of the linemarking of intersecting roads. At some locations, improvements which have already been effected have permitted " before and after " studies to determine the efficacy of the treatments.

When the current investigations are completed, a relatively small amount of work will be needed in future years to update and expand investigations where necessary, and to examine the results of previous treatments.

3. Engineering Plans and Surveys

Engineering Surveys

Head Office engineering survey parties completed a total of 202 miles of survey during 1965–66, as follows :—

State highways	.. ..	120 miles
By-pass roads	.. ..	43 ,,
Photo control	.. ..	39 ,,

Divisional staff also completed a considerable mileage of engineering surveys for road and bridge works.

No engineering surveys were carried out by consultants during 1965–66.

Twelve geodetic bench marks were placed between Bendigo and Echuca on the Midland and Northern Highways during the year. Geodetic bench marks earlier established by the Board in the western part of the state were normally set on a concrete raft or on solid rock. In the Bendigo–Echuca area, however, soil conditions near the surface are somewhat unstable because of the variable high water table resulting from irrigation. For this reason, the special technique shown in Figure 3 was adopted to ensure stability.

Geodetic bench marks, for which final level values have been issued by the Department of Lands and Survey, have been established over approximately 700 miles of roads, covering an area generally south of the dividing range, and from Melbourne to Portland.

Third order bench marks have been established over about 3,400 miles of roads, covering all of the State except for parts of the south-west and the north-east. Provisional level values for many of these bench marks are available on request from the Department of Lands and Survey.

The extent of first order and third order levelling completed or now in progress is indicated in Figure 4.

Plans for Road Construction

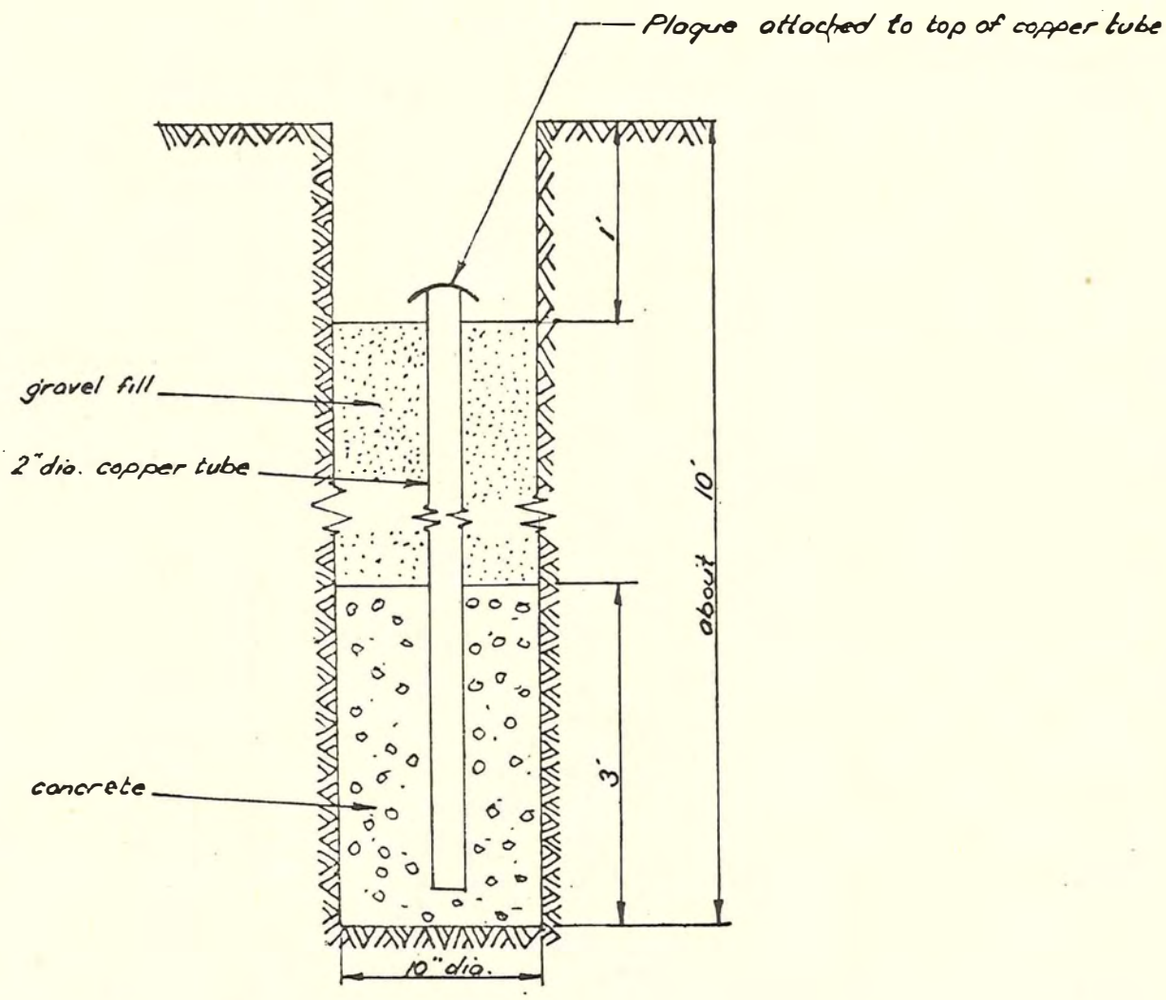
Final construction plans were completed for 82·9 lineal miles of road during 1965–66. The estimated cost of the roadworks was $11,300,000. A total of 1,611 final plan sheets for 53 separate projects were involved. Comparable figures for 1964–65 were 83·5 lineal miles, estimated cost of roadworks $7,600,000, 1,060 final plan sheets, and 52 separate jobs.

In 1965–66, consultants completed the design of two jobs, to the value of approximately $1,200,000.

Diagram 2 illustrates the trend over the last five years in the output of finished plans for roadworks.

Final plans completed for the larger jobs during the year included the following :—

Road	Description
Princes Highway East, Section 1	Duplication Doveton to Haliam (2·1 m.)
Princes Highway East, Section 4	Deviation at Hospital Creek (3·0 m.)
Princes By-pass Road (Moe)	Fowler-street to Gunn's Gully (2·0 m.)
Princes By-pass Road (Moe)	Princes Highway East to Truscott Road (1·0 m.)
Hume Highway, Section 1	Duplication Craigieburn to Kal Kallo (4·3 m.)
Hume Highway, Section 1	Duplication Kal Kallo to Beveridge (4·0 m.)
Hume Highway, Section 1	Duplication south and north of Tallarook (2·8 m.)
Hume Highway, Section 2	Duplication through Seymour (0·9 m.)
Western Highway, Section 1	Duplication Kororoit Creek to Deer Park (1·3 m.)
Western Highway, Section 1	Duplication west of Deer Park (1·2 m.)
Western Highway, Section 1	Deviation and duplication east of Pykes Creek (2·0 m.)
Maroondah Highway ..	Duplication Stirling Road to Brushy Creek (2·2 m.)
Burwood Highway ..	Extension of duplication to Morack Road (2·1 m.)
South Gippsland Highway, Section 1	Foster deviation (1·7 m.)
Nepean Highway ..	Old Mornington Road to Wooralla Drive (2·7 m.)
Glenelg Highway, Section 1	French Street overpass at Hamilton
Tullamarine By-pass Road	Completion of work north of Lancefield Road (6·5 m.)
Road through La Trobe University	



note: Standard Cover (set on bricks if required) placed over the bench mark.

Figure 3.—Construction details of geodetic bench marks placed between Bendigo and Echuca on the Midland and Northern Highways.

Plans for some of the larger jobs, which are well advanced, are as follows :—

Road	Description
Princes Highway East, Section 1	Waverley Road to Grange Road (0·5 m.)
Princes Highway East, Section 1	Hallam to east of Berwick (2·5 m.)
Hume Highway, Section 1	Deviation at Beveridge (2·0 m.)
Western Highway, Section 1	Duplication west of Pykes Creek (2·0 m.)
Burwood Highway ..	Extension of duplication to Lower Ferntree Gully (6·5 m.)
South Gippsland Highway, Section 1	Falls Creek to Foster deviation (4·0 m.)
Pyrenees Highway ..	Grade separation at level crossing, Maryborough
Warrigal Road ..	Grade separation at level crossing, Oakleigh
Somerville Road ..	Grade separation at level crossing, Yarraville

In addition to the production of final construction plans, a considerable amount of investigation and draft design was also carried out.

Specifications

Specifications were prepared for a total of 136 supply and construction contracts, the total value of the contracts being just over $10,000,000.

Included in these figures were 31 specifications for construction contracts, (27 prepared by Plans and Survey Section, four prepared by country divisions), totalling $8,800,000. Thirteen of the construction contracts were each worth more than $500,000.

Twelve of the construction contracts were financed by Special Projects funds, at a total cost of approximately $3,500,000. These twelve contracts were—

Special Project	Road	Description
2	Hume Highway	Craigieburn to Kal Kallo
2	Hume Highway	Kal Kallo to Beveridge
5	Western Highway	Deer Park to Rockbank (now being completed by direct labour)
6	Princes Highway East	Doveton to Hallam
7	Western Highway	East of Pykes Creek
8	Hume Highway	North of Tallarook
8	Hume Highway	South of Tallarook
9	Princes By-pass Road (Moe)	Fowler Street to Gunn's Gully
9	Princes By-pass Road (Moe)	Princes Highway East to Truscott Road
10	Princes Highway East	Hospital Creek deviation
13	Nepean Highway	Old Mornington Road to Wooralla Drive
14	Marlo – Cape Conran	(41,800 lineal feet)

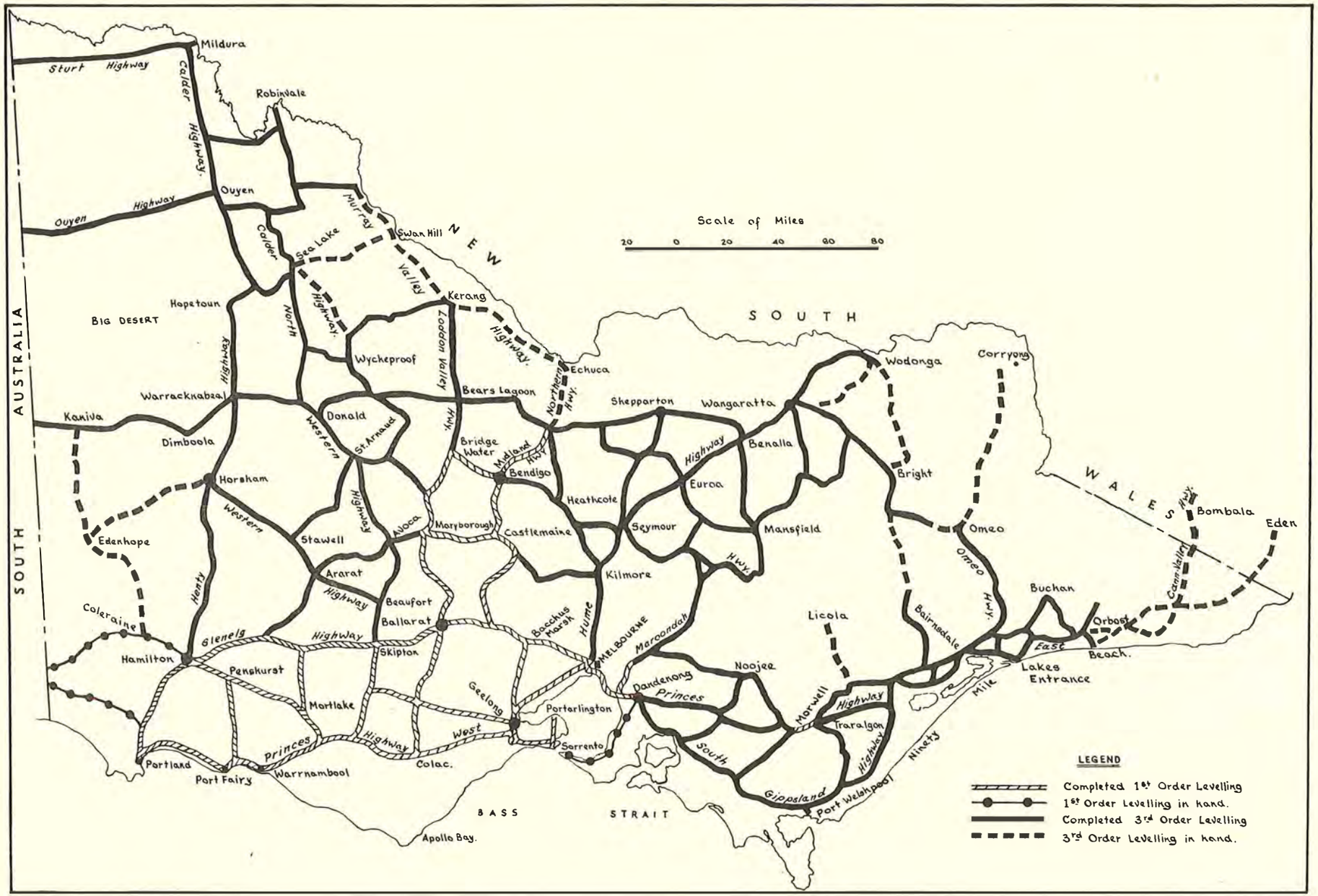


Figure 4.—Progress of first and third order levelling in Victoria.

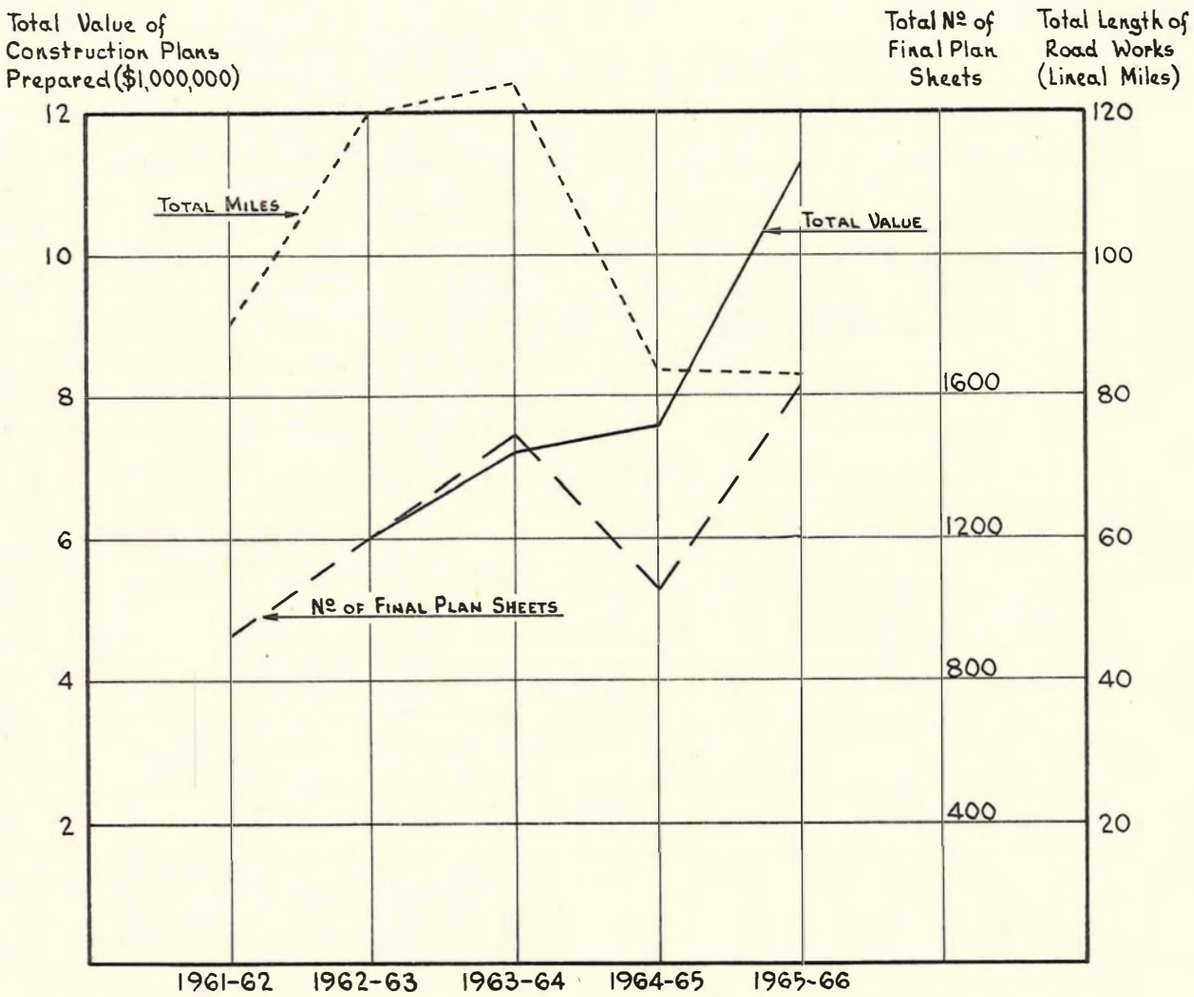


Diagram 2.—Trends in quantities and values of construction plans prepared.

Diagram 3 shows a comparison of the total value of contracts advertised, and the average value of construction contracts advertised, over the last five years. It clearly indicates the substantial increase in the average size of construction contracts in recent years.

4. Title Surveys and Plans

Title Surveys

A total of 438 survey plans were completed during the year of which 272 were produced by the Board's title survey parties. Fifty plans relating to by-pass roads were included in the total.

The Board's electronic computer was utilized to a much greater extent during 1965–66. A total of 200,252 survey lines were processed in this year, compared with 96,765 lines for 10½ months in 1964–65.

Plan and Offset Printing

The volume of production in the Printing Section was comparable to that of 1964–65, but the number of actual jobs completed (965) represented an increase of 88 per cent. Almost twice the number of photo direct plates were used, i.e., a total of 5,005 plates as against 2,708 last year.

Plan printing and Statfile production were maintained at the same level as last year.

5. Right of Way

The preparation of right-of-way plans on by-pass road projects is now well advanced, and the work is gradually being extended to metropolitan main roads and State highways. In addition, pictorial record plans are kept of progress on the various stages of land acquisition on all important road projects. The section is also responsible for the preparation of plans showing authorized points of access to declared by-pass roads.

The photogrammetric sub-section has completed 100 miles of highway record survey plans on the South Gippsland Highway and the remainder of 60 miles is nearly completed.

The aerial photography programme was expanded, and the following lengths were photographed :—

Princes Highway East ..	.. 126 miles
Princes Highway West ..	.. 119 miles
Western Highway ..	.. 128 miles
Calder Highway ..	.. 115 miles
Hume Highway ..	.. 184 miles

The work was co-ordinated by the Department of Crown Lands and Survey and flown at a contact scale of 600 feet to 1 inch and a 60 per cent. overlap for stereoscopic cover. Strip mosaics at a scale of 300 feet to 1 inch have been prepared for the above highways.

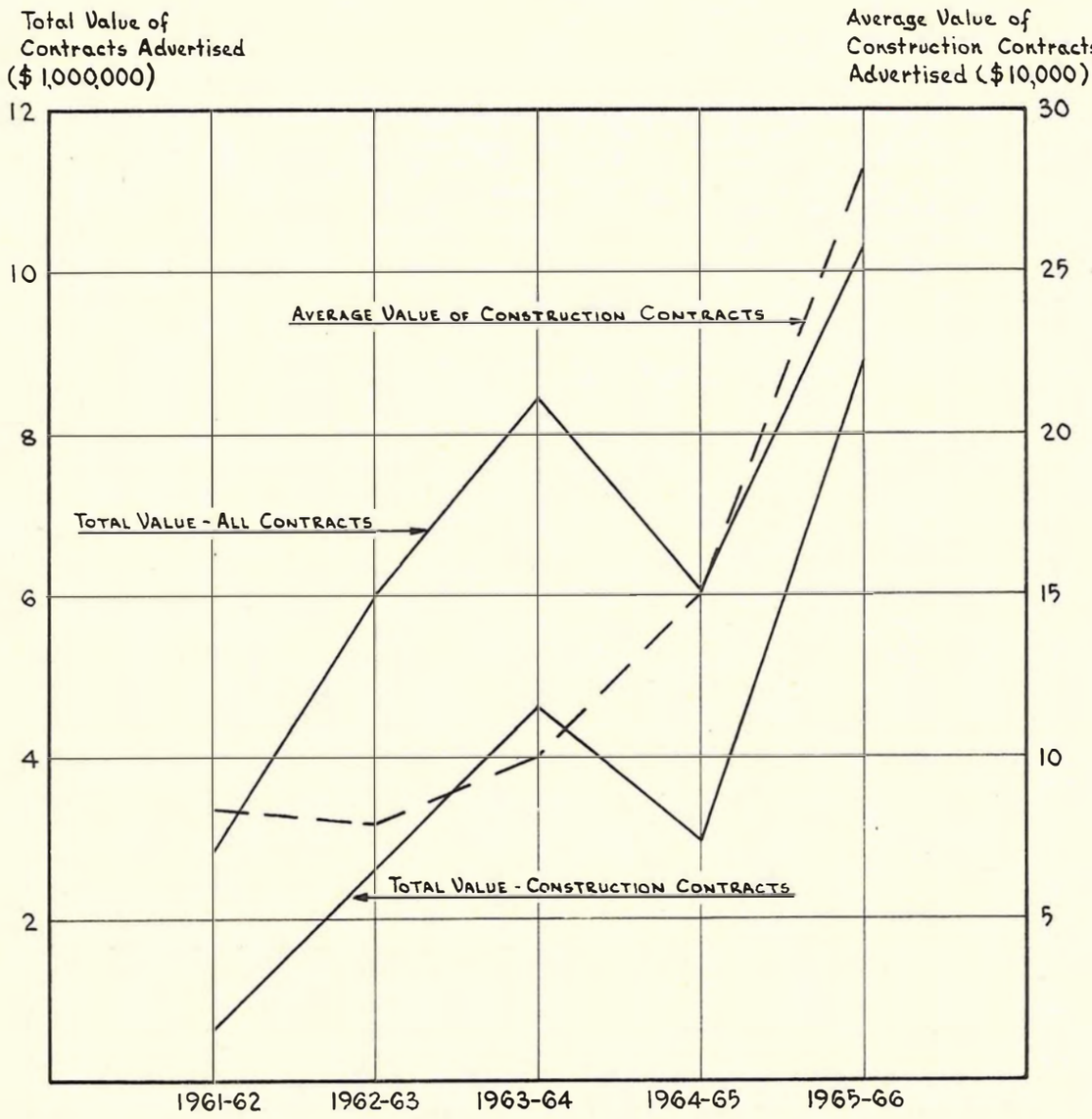


Diagram 3.—Trends in average values of construction contracts, and total values of contracts.

Arrangements will be made for a greater proportion of this work to be done in the future by the Department of Crown Lands and Survey. This will facilitate the routine production of highway record survey plans by the Board.

An odometer survey for the placing of mile posts was carried out on the Mansfield–Whitfield main road. The Board's divisions will be able to carry out this work in the future, by using Veeder–Root counters installed in divisional vehicles.

MECHANICAL SUB-BRANCH

1. The following design and developmental work was completed or is in progress :—

(*a*) Belt Spreader

The design of a new belt-type aggregate spreader which will enable the laying of aggregate carpets up to 12 feet in width has commenced, and should be completed during 1966–67. This spreader will enable coverage of a 24 feet pavement in two passes, resulting in lower costs and improved quality.

(*b*) Line Marking Machine

A line marking machine constructed by the Board was equipped with a paint heating attachment. This equipment has proved satisfactory in the utilization of paints with a wide range of viscosities, even at very low air temperatures.

(*c*) Sprayer Test Pit

Plans for a bitumen sprayer test pit installation at the Board's Syndal depot are nearly complete. The test pit should be put into operation during 1966–67 for the calibration of bitumen sprayers owned by the Board and other bodies.

(*d*) Dynamometers

A room with timber frame and plaster walls was erected to enclose the dynamometers in the Syndal workshop. This enclosure reduced to a considerable extent, the noise level in working areas adjacent to the dynamometers.

(*e*) Noise Level Measurements

Investigations into permissible noise levels associated with the conservation of the sense of hearing of plant operators

have been carried out during recent years. In view of the findings, maximum noise levels for Board's plant have been specified. Plant and machinery supplied to the Board is accordingly tested for noise output, to ensure agreement with the specifications. As a result, operators' hearing should remain undamaged after periods of service on machinery owned by the Board.

2. The following major types of plant and machinery not previously owned by the Board were purchased.

(*a*) Moore–Ferguson self-propelled pneumatic tyred 7-wheeled roller of a maximum ballasted weight of 35 tons. This roller has a tare weight of 13·4 tons. It is powered by a Ford 6-cylinder diesel engine of 96 h.p. and is driven through a 3 speed Allison torque converter power shift transmission. The unit is also provided with power steering. The pressures of all tyres can be simultaneously varied during operation.

(*b*) John Deere Model 5010 pneumatic tyred self-loading scraper of 8 cubic yard loaded capacity. The power unit of this scraper is a John Deere pneumatic tyred 4-wheeled heavy industrial tractor with a 129 h.p. diesel engine, driving through the rear wheels. The tractor has a mechanical transmission which provides eight forward and three reverse gears, enabling the unit to be driven at speeds up to 26 miles per hour. The machine has power brakes, power steering and a hydraulic differential lock. The scraper itself is powered by mechanical means from the tractor and loading is carried out by elevating slats carried on two chains. Push loading by a tractor is therefore not required.

(*c*) John Deere Model 5010 pneumatic tyred tractor for use in towing grid and drawn drum rollers. This is a similar unit to that used as the power unit of the self loading scraper described above.

(*d*) Davleco 6½ ton vibrating sheepsfoot roller with a drum width of 72 in. and welded feet placed on a 15° herringbone pattern relative to the axis of rotation. The unit is of a towed type and the vibrating eccentric shaft is powered by a Lister air-cooled 3 cylinder diesel engine of 30 h.p.

(*e*) Allis Chalmers Model HD 11 EP crawler tractor fitted with hydraulic angled dozer and hydraulic rear ripper. The tractor is powered by a 6-cylinder diesel engine developing 137 h.p., and the tracks are driven through a two speed torque converter power shift transmission.

(*f*) Pacific Model G.P. 215 GRIZZLY-PAC crushing and compacting grid roller with a tare weight of 6½ tons and a maximum ballasted weight of 14½ tons. The rolling width is 70 in. provided by 2 drums on a single axle. The grid, which forms the periphery of the drums, is made of cast alloy steel 1½ in. thick with square holes 3½ in. x 3½ in. at 5 in. centres.

(*g*) Bedford Model KELC 3 forward control truck chassis and cab for use as prime mover with semi-trailer bitumen sprayer. This chassis is powered by a 300 cubic inch swept capacity engine developing 133 h.p., which drives through a conventional 4-speed gear box and 2-speed differential.

(*h*) Dodge Model AT4/760 chassis and cab for use as prime mover for semi-trailer type 2,000 gallon capacity bitumen road tanker. The chassis is powered by a Chrysler V8 petrol engine of 183 h.p., which drives through a 5-speed conventional gear box and 2-speed differential.

(*i*) Ford Model F normal control truck chassis and cab for use as a prime mover for 2,000 gallon semi-trailer type water sprayer. The chassis is powered by a 6-cylinder 150 h.p. engine which drives through a conventional 4-speed gear box and 2-speed differential.

(*j*) Lunching caravan made by Viscount Caravans. The unit is a completely enclosed caravan in which up to fourteen men can eat together. It has wall mounted tables on the two side walls and the front wall, and seating is provided by folding mess forms which are carried in the unit. Five large windows fitted with wire screens provide ventilation and adequate daylight, whilst artificial light is supplied by the use of a 12 volt battery system. A toilet is also incorporated into the vehicle.

(*k*) Electric generating set providing 10 KVA at 240 volts A.C. powered by a Deutz model F2L–812 air cooled 16 h.p. diesel engine. The set is for use in the accommodation hut provided for snow removal plant operators on the Alpine Road at Mt. St. Bernard.

(*l*) Trailer made by J. W. George and Sons for the cartage of collapsible huts in the assembled condition. The unit is a welded tubular frame structure which is sufficiently long to accommodate two huts. The necessary auxiliary equipment, e.g., legs and hoists, is provided for loading and unloading the huts.

(*m*) Offset rotary slasher-type mower supplied by A. V. Page Pty. Ltd. for use with multi-purpose tractors attached to road patrols. In operation, the mower is supported on a 3-point linkage and driven from the tractor power take-off. A trailer wheel and a second 3-point linkage connection are also provided, to enable the mower to be towed lengthwise between jobs, with a width less than the 8 feet statutory maximum allowable.

3. The following items relate to staff and personnel activities :—

(*a*) A Mechanical Engineer was appointed to the Bendigo Division. This engineer is responsible to the Divisional Engineer for the work carried out by the divisional workshop personnel, while the technical policy of the divisional workshop remains under the control of the Deputy Chief Engineer—Mechanical.

(*b*) An apprentice school under a newly appointed Apprentice Supervisor commenced operation at Syndal. At this school, apprentices will be given basic training in workshop training to suit the Board's needs.

(*c*) Overhead Crane Appreciation and Safe Lifting Practice courses were given to all workshop and stores personnel at Syndal during the year. These courses will be extended to pre-cast yards and divisional workshops also.

PLANNING RESEARCH IN CONJUNCTION WITH MATERIALS RESEARCH

Use of the Roughometer in Determining Pavement Serviceability Index

The degree of roughness of roads has for many years concerned the travelling public in general, and road engineers in particular, because of its effect on the economy, safety, and comfort of travel. Many devices to measure this feature of roads have been produced over the years, with results of varying value.

About 1930, the Board began using a device fitted to the front axle of a car to assess pavement riding quality by summing the upwards movement of the axle relative to the chassis. This was operated until about 1940. It was discontinued principally because of the difficulty of obtaining consistent measurements. In 1946 a Bureau of Public Roads, U.S.A. (B.P.R.) type of roughometer was built for the Board from drawings supplied from the U.S.A. This machine was mainly used (as had been its predecessor) to indicate to the responsible engineers the need for action to improve the riding quality of road pavements. A roughness index of about 150 inches per mile was the level used to indicate the need to consider such action. The use of the roughometer for this purpose lapsed in the early 1950's.

The main factor which inhibited the wider use of the roughometer at this time was the lack of knowledge of any relationship which might exist between roughness measurements, and pavement condition and performance. This link seems to have been supplied successfully by the Present Serviceability concept which was developed in the U.S.A. during the A.A.S.H.O. Road Test. Present Serviceability is defined as " the ability of a specific section of pavement, on the day of observation, to serve (as a structural unit) the requirements of road users ". This concept rekindled interest in the use of the roughometer and caused some thought to be given to the possible future use and value of the machine.

During 1964, some preliminary pavement measurements were made with the roughometer, and it became apparent immediately that all aspects of operation of such an instrument would require careful study if results of value were to be obtained. Since the device affords only an empirical method of evaluating pavement riding quality, it was also considered that a second machine should be obtained and kept as a standard by which to judge the consistency of performance of the working unit. For this purpose the Board bought a new machine made to the requirements of the Road Research Laboratory, England (R.R.L.).

The work performed since 1964 has been directed to the assessment of the suitability of the roughometer as a tool for—

(i) the long term study of the performance of a comparatively small number of test pavements to evaluate design methods, materials, and construction practices, and

(ii) the comparative study of large lengths of pavements, over a short time period, to assess their condition as a road system.

The roughometer provides a measure of the work done by a vehicle suspension in traversing a road and hence an indication of the cost to the travelling community caused by roughness. It also provides a measure of riding quality, or passenger comfort, although this is not absolute as the roughometer tends to show high response on those irregularities that are " ironed out " by its springs (large spring movement) and low response on those not ironed out by its springs (small spring movement). The device offers a rapid means of measuring roughness and in addition work in fast traffic does not present the hazard of other slower devices. Consistent results are obtained if the unit is operated correctly and the simple numerical output is easy to handle for long lengths of road where a graphic output is tedious to evaluate.

Some 800 miles of State highways were measured during a four month period in 1965. It was considered desirable in the initial stages to measure the " roughness " along the four wheel paths on two lane roads and the survey was carried out on this basis. Using manual recording, 12 miles per day were completed and the handling and reducing of the results was tedious. With automatic recording an estimated 30 miles per day of four wheel paths will be covered and reduction of the day's results should take about $1\frac{1}{2}$ hours. It is expected that several thousand miles of road can then be covered annually.

In April, 1965, a preliminary study was begun to determine whether present serviceability ratings and roughometer measurements would provide a means of assessing the condition of pavements as part of a projected road adequacy rating scheme. This work was mainly exploratory in nature and depended greatly on the results of the A.A.S.H.O. investigations, particularly in relation to differences in rating between classes of road users, size of rating panel and design of experiment. Its main object was to determine whether or not the mean opinion of a group of Board engineers about the present serviceability of road pavements could be reproduced using roughometer measurements alone.

The rating panel consisted of eleven engineers working in various divisions of the Board. Eight of the eleven engineers had at some time during the previous ten years worked on the supervision of roadworks. The average age of the panel was just over 40 years with a range of ages roughly from 30 to 60 years. All were experienced drivers whose annual mileage driven averaged about 15,000 compared with the population average of about 7,500 miles.

The panel made ratings for the present serviceability of 43 test pavement sections on the Maroondah Highway. The ages and condition of the pavements varied widely but all consisted of crushed rock or river gravel with bituminous surface seals.

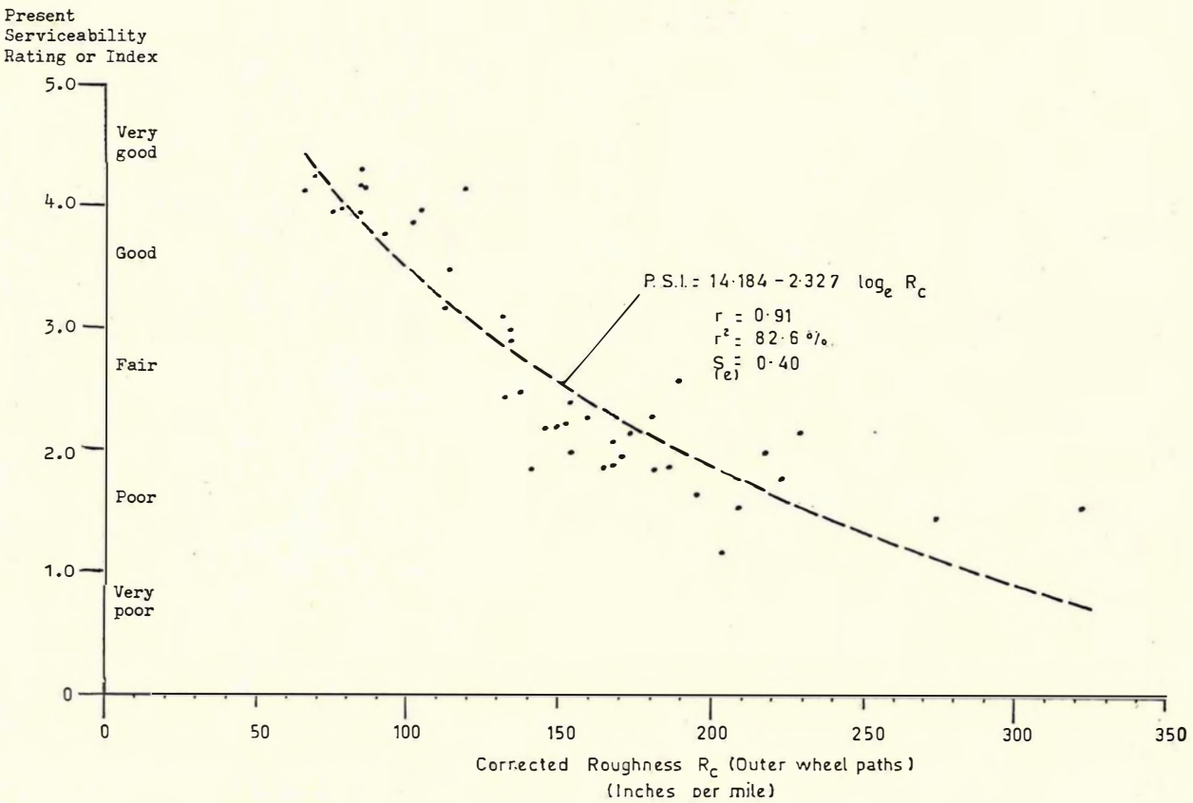


Diagram 4.—Scatter diagram for R_c (outer wheel path) with Present Serviceability Index curve.

The ratings, measured on a scale from 0·0 = impassable to 5·0 = perfect, were compared with roughometer measurements, recorded in inches per mile, on a series of scatter diagrams. These showed that a strong relationship existed between the two. Certain variations, caused by the roughometer recording roughness from the seal aggregate in otherwise almost perfect pavements, were allowed for by developing a "texturemeter" to read the average surface texture depth and applying a correction to the roughness recordings.

Using the corrected roughness readings in the outer wheelpaths only, the following expression was obtained for Present Serviceability Index.

$$P.S.I. = 14 \cdot 184 - 2 \cdot 327 \log_e R_c$$

where R_c = corrected roughness in inches per mile (Diagram 4).

This relationship explains about 83 per cent. of the variation of the ratings between the different pavement sections. The residual variation, that not explained by the regression equation, is not due to variations between individual raters and is probably caused by some factor or factors other than those already considered.

Although it is considered that further work is required to determine the actual effect of differences in surface texture on roughness readings, the roughometer has been developed into a reliable and fairly precise instrument.

It can now be confidently used for pavement evaluation work and the Present Serviceability Index as developed could be used to help assess the average present serviceability of a series of pavements or the difference between groups of pavements. It is doubtful whether the P.S.I. could yet be used to help choose which of two pavements should be included in an annual works programme. However, a better knowledge of the techniques of subjective rating scale design and the elimination of systematic errors reported to be present in subjective ratings could give the fairly small increase in precision required for the latter work.

ENGINEERING COMPUTER SECTION

An IBM 1443 on-line printer with a speed of 150 lines per minute was attached to the Board's IBM 1620 computer in May, 1966. Data preparation equipment has been increased to three key-punches and two verifiers. An IBM 082 Card Sorter with a sorting speed of 600 cards per minute was installed in March.

The volume of work processed by the computer increased during the year.

Programming work performed by the Section consisted of—

(i) Bituminous Surfacing Statistics Programmes for the Asphalt Division. These programmes were used during the spraying season to produce statistics regarding mileages and costs of bituminous work carried out.

(ii) An Origin and Destination Survey Analysis Programme for determination of traffic volumes, for use by the Traffic and Location Section.

(iii) A Wages Calculator for decimal currency, for use by the Accounts Branch.

(iv) Plant Statistics Programmes for the Mechanical Sub-branch were substantially completed.

Utilization of the IBM 1620 Computer During 1965–66

(*a*) *Computer Usage* (*hours*)

The total computer time used by sections of the Board during the year is shown in the following table :—

Table 10—1620 Computer Usage by Sections of Board

Sub-Branch or Section.	Production.	Development.	Total.
	hours	hours	hours
Bridge	384	189	573
Plans and Survey ..	275	32	307
Title Survey	157	..	157
Traffic and Location ..	113	42	155
Materials Research ..	66	28	94
Planning Research ..	36	18	54
Engineering Computer	8	184	192
Methods	10	2	12
Totals	1,049	495	1,544

(*b*) *Details of Utilization by Sections of the Board*

Details of the work processed for the Bridge Sub-branch and Title Survey Section are given elsewhere in this report.

(i) The Plans and Survey Section developed five new programmes to supplement the library programmes already in use. In addition a programme was written to permit the plotting of road cross-sections utilizing the C.D.C. 3600 computer and incremental plotter located in Canberra with the C.S.I.R.O. The visual representation is good and provides a quick check on the design proposal.

In addition to usage of the Digital Terrain Modelling, and Cut and Fill programmes, a large number of geometric problems were processed, including survey traverses, photo-control surveys, co-ordinates for major construction projects, and shifted curves.

In the twelve month period, approximately 11 miles of roadworks were processed by the D.T.M. system, including works for the Tullamarine By-pass Road, Beveridge Hill on the Hume Highway, and Killara Hill on the Warburton Highway.

The Cut and Fill programme was employed in the design of 15 miles of roadworks, including the Foster deviation on the South Gippsland Highway, the Omeo Highway near Bairnsdale, and the Taylor Bay Road (Special Project).

(ii) Use by the Traffic and Location Section included the preparation of transition curve tables for use in curvilinear alignment, and the processing of data from automatic traffic counters. Programmes developed were :—

(*a*) Curvilinear alignment programmes.

(*b*) A perspective drawing programme which utilizes horizontal and vertical geometry together with the observer's eye position to produce a co-ordinate grid which is joined up graphically to produce a perspective view.

(iii) The Planning Research Division completed a series of programmes to analyse data from the Fisher and Porter traffic counters. These programmes were used to process twelve full year counts and about thirty partial year counts. Analyses of regression and curve fitting using Chebyshev Polynomials were performed in connection with a study of pavement present serviceability, and the prediction of future fuel consumption and motor registrations.

(iv) The Materials Research Division used the computer for the following :—

Research Projects—

(*a*) Analysis of data on air permeability and air voids of bituminous concrete.

(*b*) Analysis of data from compaction trials at the Tullamarine Freeway By-pass Road.

(*c*) Analysis of roughometer data for Present Serviceability Index of pavements.

(*d*) Analysis of data from Benkelman beam investigations of pavements.

Investigation Work—

(*a*) Calibration of nuclear moisture density meter.

(*b*) Comparison of performance of nuclear moisture density meters. Programming development was mainly confined to documentation of programmes written during 1964–65.

(*c*) *Investigation for Mechanical Sub-branch*

A complete investigation of means whereby the Mechanical Sub-branch could be aided by electronic data processing was undertaken in co-operation with the Sub-branch. It was found that the production of electronic data processing reports would be of material assistance. The major portion of the programming work has now been completed and it is planned to implement the new system early in the financial year, 1966–67.

(*d*) *Use by Bodies other than the Board*

Three hundred and thirty-five hours of computer time was hired by the Department of Lands and Survey, the Department of the Army (Survey), and the Australian Road Research Board.

STAFF TRAINING

Selected members of the Chief Engineer's Branch attended the following training courses during 1965–66 :—

External Courses—

- Civil Engineering and Construction Management Course—University of New South Wales
- Traffic Planning and Control Course—University of New South Wales.
- Course in Structural Stability—University of Melbourne.
- Summer School in Soil Mechanics—University of Melbourne.
- Lectures in Mathematics for Scientists—University of Melbourne.
- Engineering Research Colloquia—Monash University.
- Scaffolding Regulations—Bairnsdale Technical College.
- " Basic Hydraulic Servo Mechanisms "—R.M.I.T.
- Basic Industrial Hydraulics—R.M.I.T.
- " Deflection of Pavements "—Australian Road Research Board.
- Visit to Tullamarine Airport—Commonwealth Department of Works.
- Explosives Course—S.E.C.V.
- Planning for Growth in Road Transport—Australian Institute of Management.
- Operator Training Course—Australian Institute of Management.
- Engineering Inspection—R.M.I.T.
- Computer Conference at Canberra—Australian National Committee on Computation and Automatic Control.
- Vehicle Braking—Institution of Automotive and Aeronautical Engineers.
- Maintenance Controls Course—Institute of Industrial Engineers.
- Human Factor in Administration—16th Annual Conference of the Royal Institute of Public Administration.
- Computer Personnel Symposium—Institute of Personnel Management.
- Conference of Municipal Superintendents of Works.
- Metallurgy Seminar (Port Kembla)—Broken Hill Pty. Co. Ltd.
- Seminar on Effective Top Management—Dr. Koontz—Beckingsale and Company (Sydney).
- Spectro-Chemical Instruments and Analytical Methods—Astronic Industries, Melbourne.
- Chamberlain Tractor Service School.
- Cranvell Service School.
- Fiat Tractors' Service School in Hydraulic Equipment.
- Service School, Queen's Bridge Motor and Engineering Co.
- P.E.R.T. Cost Course—IBM.
- Welding Clinic, Sydney—Lincoln Electric Co.
- Flexible Pavements—Institution of Engineers, Australia.
- National Conference at Newcastle—Institution of Engineers, Australia
- Road Foreman and Municipal Superintendent's Course—R.M.I.T.

Internal Courses—

- Seminar—Critical Path Analysis
- Overseers' Conference—Warrnambool Division
- Overseers' Conference—Traralgon Division
- Explosives Training—Bairnsdale Division
  Ballarat Division
  Benalla Division
- Patrolmen's Conference—Traralgon Division Patrolmen
- Communication—Appreciation Session (Inter-Branch)
- Apprentice Centre—Syndal
- Crane Operators' Course—Syndal
- Theory and Practice of Traffic Engineering.

Other organizations were also assisted to train personnel. These included the Department of External Affairs (Colombo Plan Fellows, Thai engineers, Asian students), Commonwealth Department of Works (a Middle Management Conference group) and the Victorian Education Department (Technical Teachers Scheme).

MANUALS

As the Board's organization continues to grow there is an increasing requirement to provide manuals of design and procedure to consolidate standard instructions and practice.

Action has been taken to meet this need, and good progress is being made both with the revision of old manuals and the preparation of new manuals covering a number of different fields as follows :—

(*a*) The following manuals :—

(i) Instructions relating to the Handling and Use of Explosives,

(ii) Instructions to Patrolmen—

were revised and reissued.

(*b*) Drafts of the following manuals have been completed :—

Manual for Engineers.

Road Design Manual.

Road Drafting Manual.

Engineering Survey Manual.

(*c*) Work is proceeding on the revision of the standard specifications for roadworks, and on preparation of the following new manuals :—

Notes on the Standard Specifications for Roadworks.

Manual for Municipal Engineers.

Freeway Design Manual.

Title Survey Manual.

Manual of Lifting Gear.

(*d*) Staff of the Board also co-operated with staff from other State road authorities in the preparation of the N.A.A.S.R.A. manual " Highway Bridge Design Specifications " published during this year.

PUBLICATIONS

The following papers were presented during 1965–66, in connection with the Board's engineering work :—

Paper.	Author.
Some Aspects of Steel Fabrication and Testing Presented at the Twenty-second Conference of Municipal Engineers, 23rd February, 1966	B. R. Abery, M.C.E., C.E., A.M.I.E. (Aust.)
Slipperiness of Roads Presented to the Highway and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia, 13th April, 1966	A. H. Gawith, M.C.E., M.I.E. (Aust.)
Landscaping in Relation to Road Construction Published in " Victoria's Resources ", Vol. 8, No. 1, March–May, 1966	D T. Hewson, B.C.E., A.M.I.E. (Aust.), C.E.
Organization, Equipment, and Methods for Patrol Maintenance on Rural Highways Presented at the Twenty-second Conference of Municipal Engineers, 23rd February, 1966	F. Hopwood, B.Sc., A.M.I.E. (Aust.)
Roadside Development Published in " Victoria's Resources ", Vol. 8, No. 1, March–May, 1966	J. R. Joyce
Landscape Preservation and Tree Conservation Published in " The Local Government Engineer ", March, 1966	J. R. Joyce
Specifications as Applied to Natural Materials Presented to the Highway and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia, 8th June, 1966	K. G. Moody, B.C.E., M.Eng. Sc., Ph.D. (III.), A.M.I.E. (Aust.)
Low Volume Rural Y Junctions Published in " Australian Road Research ", Vol. 2, No. 8, June, 1966	R. T. Underwood, M.E., A.M.I.E., (Aust.), M.A.P.I., A.M.I.T.E.
Tolerances in Construction. Part of a Symposium on " Tolerances in Structural Engineering " Presented to the Structural Engineering Branch of the Melbourne Division of the Institution of Engineers, September 6th, 1965	B. A. Watson, B.E. (Hons.), A.M.I.E. (Aust.)
The Use of Computers as an Aid in Highway Bridge Design Presented at the 1966 Annual Conference of the Institution of Engineers, Australia, in Newcastle, 23rd March, 1966. The paper was published in pre-prints of the Conference	C. A. Wilson, B.C.E., A.M.I.E. (Aust.)

One issue, No. 80, of " Engineering Notes " was published, concerning " Spreading Materials in Widening Trenches ". Five issues of " Construction News " were published, containing 24 items on a wide range of matters.

STAFF

Total staff of the Chief Engineer's Branch was 866 at 30th June, 1966.

Total Board's funds expended by the Board on direct works and by municipalities on works financed partly by the Board totalled $58,127,000 for the financial year 1965–66.

It is desired to thank the staff for the able way in which the demands of this increasing works programme have been met. Special acknowledgment is made of the long and loyal service of Mr. J. W. Pascoe (Divisional Engineer, Warrnambool), who retired during the year after over 47 years' service with the Board.

H. S. GIBBS,
Chief Engineer.

By Authority: A. C. Brooks, Government Printer, Melbourne.