1961

VICTORIA

COUNTRY ROADS BOARD

FORTY-EIGHTH ANNUAL REPORT

FOR YEAR ENDED 30TH JUNE, 1961

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

[*Approximate Cost of Report.*—Preparation, not given. Printing (200 copies), £743]

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

No. 16.—[4s. 3d.]—9984/61.

FRONTISPIECE : Country Roads Board Head Office, 60 Denmark Street, Kew, 1961.

COUNTRY ROADS BOARD

FORTY-EIGHTH ANNUAL REPORT, 1960-61

CONTENTS

COUNTRY ROADS BOARD

FORTY-EIGHTH ANNUAL REPORT

60 Denmark Street,
Kew, E.4,
1st December, 1961.

The Honorable H. R. Petty, 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, 1961.

1. DEVELOPMENT OF VICTORIA'S ROADS.

The financial year 1960–61 saw the completion of some major projects which will always be looked upon as milestones, both in the Board's history as Victoria's State Road Authority, and in the general development of the State. These completed major projects include the Board's new head office, the Maltby By-pass Road and Kings Bridge.

For many years the Board's head office staff has been dispersed in makeshift quarters and hutments. The occupation of a new building specially designed and equipped for the Board's requirements and including much needed conference rooms and staff amenities is enabling many improvements to be developed in staff groupings and office procedures resulting in increased efficiency and *esprit de corps* and provides opportunities for improved public relations.

The addition of by-pass roads to the State's declared road system represents a completely fresh approach in efficient and safe handling of high volumes of traffic between important centres of population. The frequent intersections with side roads which occur on an ordinary road are absent on a by-pass road, access being permitted only at properly designed interchanges located several miles apart; direct access is not allowed from properties alongside by-pass roads; no animals on the hoof are permitted on a by-pass road; thus the interruptions and hazards to motorists of intersecting traffic and wandering stock are eliminated. The main streets of townships by-passed are not subject to through traffic, thus providing safer conditions for shoppers and for local business people, whilst local tradesman are protected, as no shops are permitted with frontages onto a by-pass road. The greater convenience and security with which motorists can travel along by-pass roads will make these facilities extremely popular with all sections of the travelling public and will effect marked economies in road transportation.

The Maltby By-pass Road, which was appropriately so named after Sir Thomas K. Maltby, E.D., M.L.A., Minister of Public Works from 1955 to 1961, by-passes the township of Werribee and forms $6\frac{1}{2}$ miles of 45 miles of continuous four-lane divided highway between Melbourne and Geelong. The Whitelaw By-pass Road, also completed in this financial year, provides a direct link between Bena and Korumburra. Details of these by-pass roads and of other projects of this category will be found on page 20 of this report.

The £4,000,000 Kings Bridge was planned and constructed to provide a new connexion between the City of Melbourne and suburbs south of the Yarra river and to relieve congestion on existing bridges. Already 35,000 vehicles per day are using the new river crossing. The capabilities of the Board's organization for initiating, planning and

supervising the largest and most difficult types of road and bridge projects were well recognised by the Government and by Parliament in the nomination of the Board as constructing authority for this project which incorporates the latest engineering development in layout, design and construction, and is the largest work of its kind ever undertaken in Victoria. Details of the project are on page 42 of this report.

2. FINANCE: COMMONWEALTH AID ROADS ACT 1959.

With the current scales of its revenues the Board is not able to carry out a sufficient volume of road and bridge construction, reconstruction and maintenance to keep pace with the growth of traffic. It has been estimated that by 1970 the present total of 838,000 motor vehicles registered in Victoria will be doubled. Commercial vehicles are becoming larger and heavier. Roads which were adequate for lower volumes of lighter traffic urgently require strengthening and widening and in many sections duplicating in order to cope with the increased traffic volumes and preserve the road pavements and shoulders from failure and at the same time to make conditions more suitable for safe operation of all classes of vehicles. Uncongested and efficient roads are essential to the economy of transport and communications in both primary and secondary production and in both rural and urban areas.

In 1959, the Board again applied engineering procedures in reviewing its estimate of a ten year programme required in order to overtake arrears of work, and to expedite the provision of a more adequate network of public roads of all categories.

The revised estimate revealed that owing to the insufficiencies of past and current programmes of work, present scales of revenue leave a large gap below the average annual requirements, the deficiency for 1960–61 being approximately £13 million while the further deficiency for 1961–62 is estimated at approximately £16 million (See table 1). Deficiencies are thus still accumulating. For the remaining eight years of the estimate, the increase required for public roads of all categories is now of the order of one-third.

TABLE 1.—VICTORIA.
(£ million.)

Year.	Road Needs.	Estimated Revenue.	Deficiency.
1960–61	48·4	34·9	13·5
1961–62	52·9	36·7	16·2
1962–63	57·9	38·5	19·4
1963–64	57·9	40·3	17·6
1964–65	57·1	42·2	14·9
1965–66	57·6	44·1	13·5
1966–67	56·6	46·0	10·6
1967–68	58·2	48·2	10·0
1968–69	60·4	50·4	10·0
1969–70	63·1	52·7	10·4
Totals	570·1	434·0	136·1

The most recent estimate of Australia's public road needs prepared by the National Association of Australian State Road Authorities not including town streets amounts to £2,340 million for the decade 1960–70. The Board's estimate of Victoria's needs included in this amount is approximately £560 million, i.e., 24 per cent. of the total.

The *Commonwealth Aid Roads Act* 1959 provides for a distribution by the Commonwealth of £50 million amongst all the States in 1961–62. Victoria's share will be approximately 20 per cent., i.e., £10 million. This is only of the order of 19 per cent. of the estimated road needs of this State for the particular year 1961–62. The State for its part devotes almost the whole of the revenue derived from taxation of motor vehicles to road works. The Local Government bodies of the State devote a very high proportion of revenues to road works. On the other hand the Commonwealth in 1959–60 derived £142 million in taxes from motor vehicles owners and operators and distributed for roads in that year only £42 million, £100 million being in that way retained by the Commonwealth. The receipts for customs and excise on motor fuels alone were £60 million. For 1961–62

the estimated deficiency in Australian road needs is £48·7 million, again much less than the amount of taxation, approximately £148 million, received by the Commonwealth from motor vehicle owners. At the State level, as in most countries, it is recognised that direct application of road user taxes for public road purposes is logical and appropriate. It is of particular merit in a Federal situation where State taxes on commercial motor vehicles are disallowed in the case of interstate operation, and the imposition of a simple fuel tax has not been available to the States.

Whilst some improvement in the percentage of distribution of Commonwealth aid for roads to Victoria has been conceded following strong representations made in 1959, there is still a very large difference between Victoria's present percentage (approximately 20 per cent.) and the contribution of something like 30 per cent. made to the relevant sections of Commonwealth revenues by Victorian motor vehicle owners. There is scope for a more appropriate proportion of distribution which might allow at least 24 per cent. to Victoria in accordance with the estimate of national road needs.

The stipulation in successive Commonwealth Acts since 1954 that 35 per cent. and later 40 per cent. of the money is to be spent on rural roads other than State highways and main roads is in the nature of an intrusion on the discretion which the States should be free to exercise. The stipulation has the effect of developing many lightly trafficked subsidiary roads to a high standard while main roads carrying more traffic still await reconstruction to suitable standards. The Board has had very many requests for declaration of important unclassified rural roads as main roads, but has been unable to recommend such reclassification since it would throw a further burden on the finance available for classified roads and would accentuate the tendency to disparity in the comparative standards.

In the survey of road needs the requirements for rural unclassified roads approximate 22 per cent. of total needs. If more main roads were created that percentage would be reduced. The elimination of the stipulation would enable proper discretion to be exercised by the State. The importance of the remaining subsidiary roads is scarcely likely to be overlooked in Victoria where their great value in promoting productivity has for so long been a major factor in formulation of road programmes year by year.

There are thus very sound and just reasons for action to revise the relevent Commonwealth statute so as :

(*a*) to distribute increased amounts to the States above those provided in the current Act, certainly at least up to the total received from taxes on fuel used in motor vehicles in each year ;

(*b*) to amend the basis of distribution to the States so as to provide a quota to Victoria at least approximating to its proportion of national road needs ; and

(*c*) to eliminate the exclusion of State highways, trunk roads and main roads in rural areas from participation in the expenditure on rural roads.

3. RECEIPTS AND PAYMENTS.

The Board received £10,366,378 from motor registration fees and fines, half the drivers' licence fees, drivers' testing fees and municipality repayments, an increase of £248,995 over the amount of £10,117,383 received from these sources during 1959–60.

Proceeds of the ton-mile tax under the Commercial Goods Vehicles Act amounted to £2,254,421 as compared with £2,117,494 received in the previous financial year.

State loan funds at the disposal of the Board in 1960–61 totalled £283,000 as compared with £160,000 in 1959–60.

The State of Victoria received in 1960–61 under the provisions of the *Commonwealth Aid Roads Act* 1959, £9,183,415. Of this amount £8,983,776 was received by the Board and the balance of £199,639 allocated for other works connected with transport by road or by water. In 1959–60 the Board received £8,460,574 from Commonwealth Aid Roads.

The total funds available to the Board for expenditure during the year amounted to £22,582,441 as compared with £21,592,432 during 1959–60, an increase of £990,009.

Full details of the Board's receipts and payments for year ended 30th June, 1961 are shown on the statement certified by the Auditor-General on page 62 of this report. In addition Figures 1 and 2 illustrate the Board's receipts and payments under various headings.

The following table shows the relative proportions of expenditure in 1960–61, on road works as between Board and Councils, by contract and by direct labour:

	£'000	%	£'000	%
Board's Expenditure—				
Contract Works	4,303	32		
Direct Labour	9,209	68		
	—	—	13,512	65
Council's Expenditure—				
Contract Works	2,624	36		
Direct Labour	4,746	64		
	—	—	7,370	35
			£20,882	100

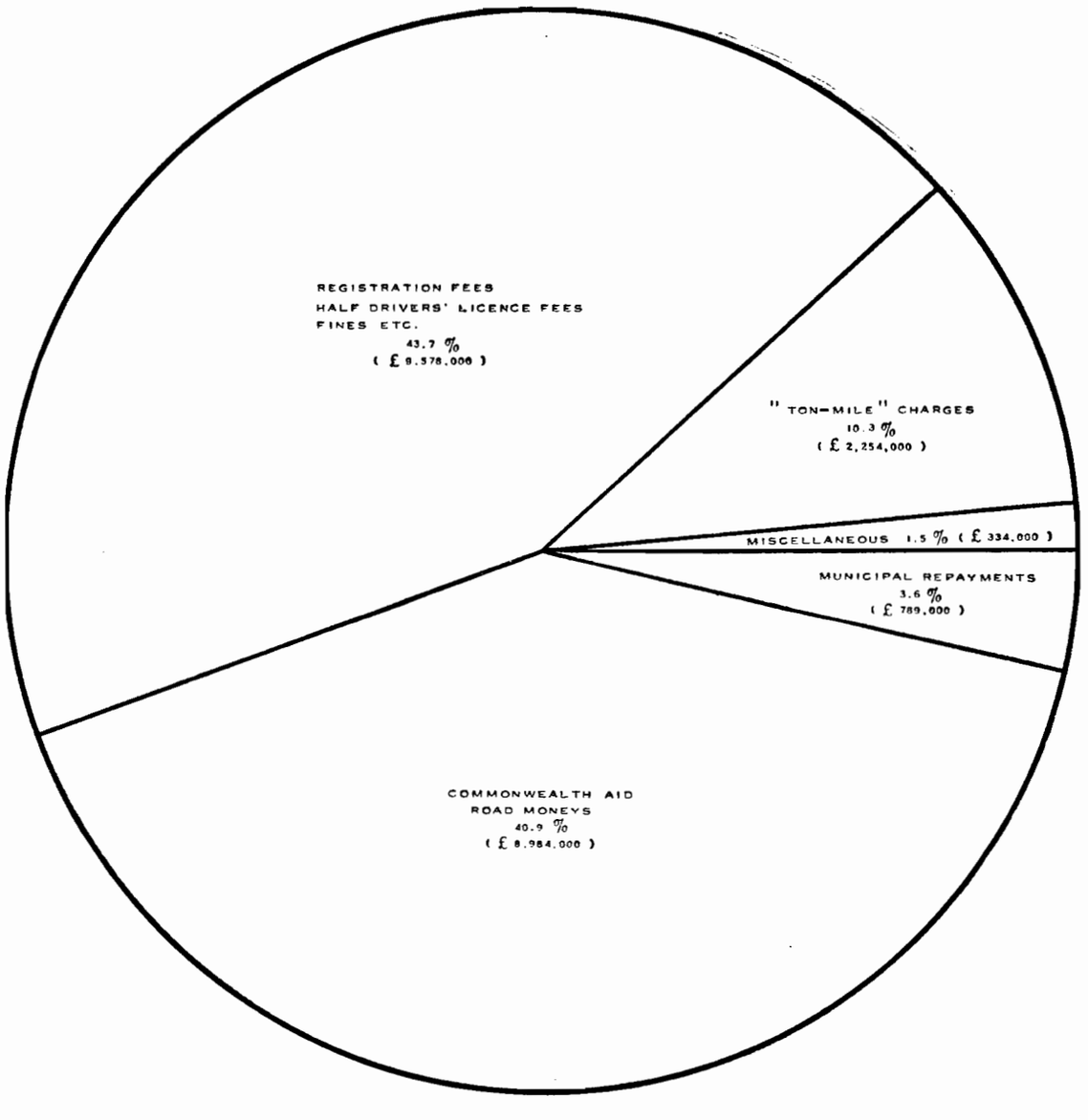


Fig. 1.—Receipts, 1960-61.

4. ALLOCATION OF FUNDS FOR ROAD AND BRIDGE WORKS.

The Board maintains a system of budgetary control of its finances and keeps its estimated and actual receipts and expenditures under constant review. Accordingly, early in July, 1960, the Board examined its financial estimates for the year 1960–61 including the total of the commitments outstanding at 30th June, 1960, and in the middle of July, 1960, as soon as details of commitments were available, proceeded to allocate funds for the forthcoming year's programme of works, in accordance with applications for construction and maintenance received from councils and from its own engineers.

In making its general allocation in July each year, the Board provides for commitments carried forward at the close of the previous year and for any revotes of grants previously made but not committed which have been again requested. The Board then provides for further expenditure on works being undertaken on a progressive basis and for fresh works to be completed or at least started prior to receipt by the Council of the further annual allocation to be made twelve months later.

With the increasing development of the State's road system occasioned by its growing population and rapidly increasing traffic, the individual items of work are growing in number each year, thousands of such items now being distributed over the road system of the State. Every item applied for by each council is considered by the Board with the divisional engineer. The Board's knowledge based on its systematic inspections and the local knowledge of divisional engineers and their awareness of present and future needs of their districts are of great value in determining grants and priorities.

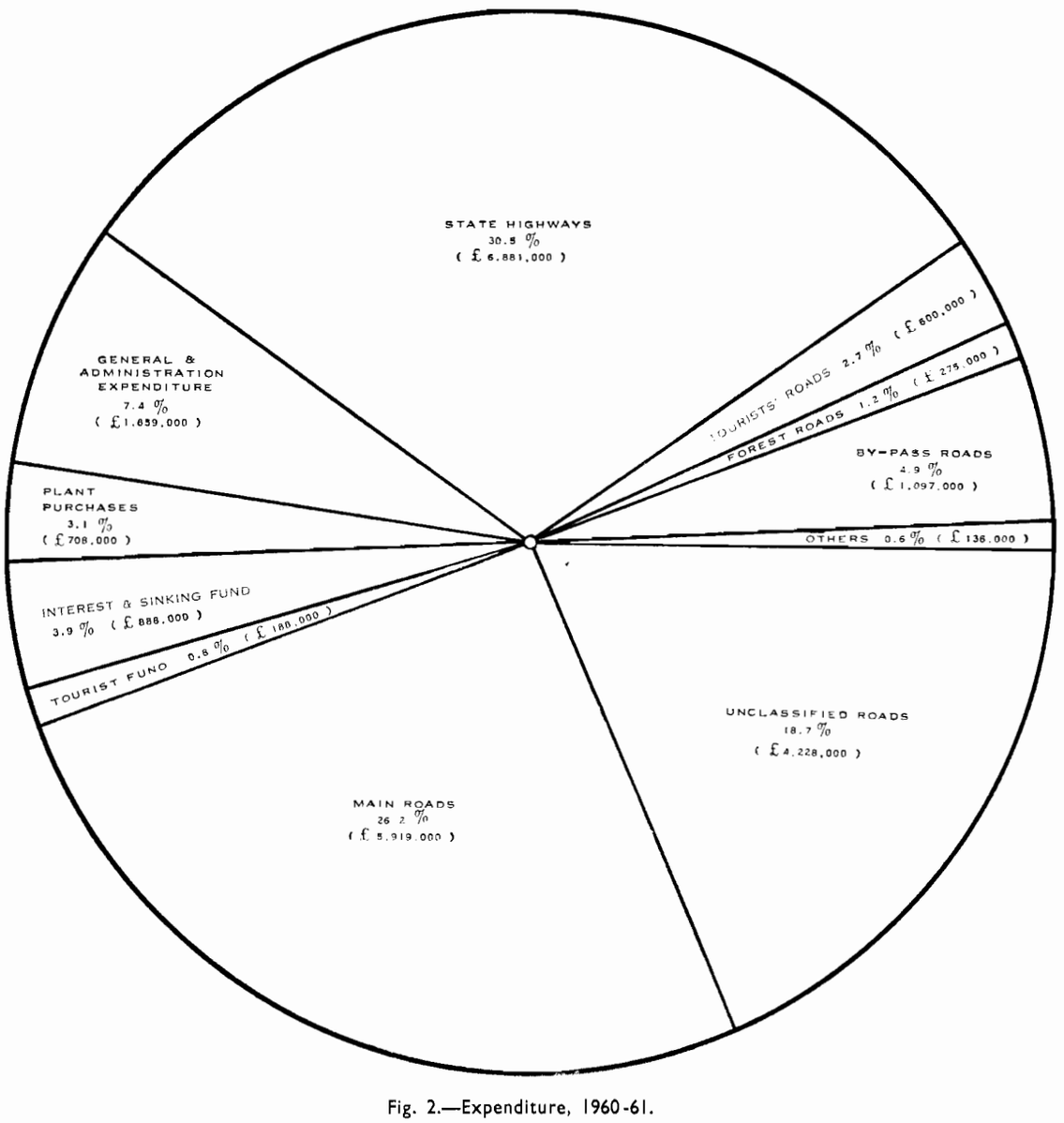


Fig. 2.—Expenditure, 1960-61.

Applications for grants for works on all categories of roads received by the Board in respect of 1960–61 totalled £44,692,640 which greatly exceeded the funds available to the Board. In exercising its statutory powers in preparing works programmes the Board must use its discretion in determining appropriate allocations of funds for various items of work. In carrying out this function the Board considers each council's financial position and capacity for work and many other circumstances either as described in the applications or as derived from the knowledge of local conditions gained by the Board in its regular scheduled inspections of the State or from the most recent data in the possession of the Board's officers. Information made available to the Board by councils in letters and deputations is again considered at this time.

5. APPORTIONMENT OF COST OF ROAD WORKS.

It is provided in the Country Roads Act that not more than one-third of the amount expended from the Country Roads Board Fund on the maintenance of main roads shall be apportioned to municipalities. However, it is also provided that municipalities' contributions may be reduced below one-third where the cost of maintenance is deemed to be excessive and where such cost is due to motor traffic not of local origin or to timber traffic.

In contrast with this principle the entire cost of work on State highways, tourists' roads, forest roads and by-pass roads is borne by the Board.

In September, 1960, the Board apportioned to councils £756,289 of the expenditure in 1959–60 from the Country Roads Board Fund on main roads amounting to £4,671,022. In making this apportionment the Board considered among other things the revenue, valuation, rating and any special characteristics of each municipality in turn.

The Board also provided as special grants free from additional contributions by the councils, the amount of £1,460,839 from Commonwealth Aid Roads moneys towards reconstruction projects on main roads. The Board thus apportioned to councils not one-third but only 16·19 per cent. of the expenditure from the Country Roads Board Fund which equals 12·33 per cent. of the total expenditure including the special grants. The relief to the Councils is thus very considerable.

Following the pattern set by the statutory requirements for main roads the Board has always considered that, in general, councils should be called upon to make a contribution towards grants for maintenance and construction of roads of a local character, usually termed " unclassified " roads, the care of which is one of their principal responsibilities as local government authorities. As for main roads the proportions are moreover quite properly varied with particular circumstances item by item. For example, in more intensively occupied urban areas the local contribution is generally greater than in rural areas ; larger items deserve more liberal terms than smaller items and major construction or reconstruction items than routine maintenance items ; for works in remote areas not of local benefit there may be no local contribution at all, a case which should be exceptional and certainly not the general rule as has sometimes been suggested. Whilst absolute justice can never be expected in such a complex matter, greater justice results by allowing exercise of discretion based on qualified and informed knowledge than by the use of a strict formula, and this is really the principle embodied in the original statute.

Regard must be paid to the relative requirements of the several classes of roads or sectors of work, to the types of districts and local government units, and to the appropriate rates of progress from road to road or sector to sector, and to consequent changes in priorities or group totals year by year. It must be stressed that the funds which are made available to the Board and which are already inadequate for the economic development of the State's road system ought not to be regarded as a means of enabling councils to reduce rate revenues.

6. CONTRACTS UNDER BOARD'S DIRECT SUPERVISION.

During 1960–61 the Board continued its policy of doing work by contract whenever practicable in order to reserve its direct labour force for projects difficult to specify and estimate and for works of a special character calling for state-wide organization in conjunction with municipalities or experimentation in materials, processes and plant

development. Four hundred and forty-six contracts were entered into by the Board for a total liability of £4,989,300. The following table shows the main categories and their respective values:—

Type of Contract.	Number of Contracts.	Value.
		£
Road construction and Supply of Roadmaking Materials	167	1,819,100
Bituminous Surfacing Materials	118	1,411,600
Bridge Construction	31	286,900
Manufacture of Bridge Components and Supply of Fabricated Steel ..	25	343,400
Supply of Reinforced Concrete Pipes and Box Culverts	19	227.000
Supply of Roadmaking Equipment	48	672,700
Depot Facilities and Workshop Equipment	17	115,400
Miscellaneous Services and Materials	21	113,200
Totals	446	4,989,300

Included in the contracts for road construction were eighteen for works of the larger type, the average cost of which approximated £47,400. The invitation of tenders for such large works which included a high content of earthworks promoted a desirable degree of competition among contracting organizations suitably equipped with major earthmoving machines. In consequence of this competition reasonable prices were obtained.

Contracts entered into for supply of bridge components, concrete pipes and culverts covered not only the requirements of the Board's direct labour force but also those on contracts together with the similar requirements of councils for works subsidized by the Board.

Contracts Under Councils' Supervision.

In the past year the Board approved of the acceptance by municipalities of 878 tenders for a total liability of £2,938,300 for road and bridge works for which the Board had provided funds. The Board also approved of the utilization of 159 municipal period contracts for supply of materials and services incorporated in direct labour works carried out under council supervision with funds provided by the Board.

7. STATE HIGHWAYS.

New declarations of State highways made in August, 1960, extended the length of the system to 4,502 miles. For the maintenance and improvement of State highways in 1960–61 the Board's Divisional Engineers applied for £10,798,000 and allocations totalling £7,912,000 were made, representing 73 per cent. of the applications.

During the year the benefit of a sealed surface was extended for about 42 miles on the Murray Valley, Omeo, Ouyen, Goulburn Valley, North Western, Pyrenees, Henty and Midland Highways, and allowing for the unsealed sections on the newly declared Goulburn Valley, North Western and Cann Valley Highways, 470 miles of the State highways system were unsealed at the close of the year, some five miles more than for the previous year, and representing 10½ per cent. of the total length of the system.

In pursuance of its policy of direct control of maintenance and improvement of State highways where it is economical so to do, the Board has assumed control of these operations on the new State highways in country areas. In respect of new declarations of State highways in provincial cities and the metropolitan area arrangements have been made for councils to continue supervision of these operations for the time being. The total number of Board's employees engaged on patrol maintenance work on State highways has increased by approximately 70 during the year.

The maintenance operation involving the greatest expenditure is that of retreatment of bituminous surfaces, and during the year 456 miles were so treated, consisting of 409 miles of sprayed retreatment and 47 miles of bituminous concrete. The sprayed work was done mostly by the Board's own mobile plants and the bituminous concrete, which was confined to the more heavily trafficked sections, by contract. Retreatment was effected on 10 per cent. of the total sealed length, which is identical with the figure for the previous year.

In all of the ten divisions of the Board sections of State highways which had failed or which were inadequate for present needs were reconstructed and improved. The total number of projects of this nature was approximately 200 and the mileage treated approximately 212 miles.

The funds remaining for State highway purposes after provisions for maintenance and reconstruction were devoted to improvements consisting of extensions of divided highways, including intersection treatments, major deviations, elimination of sections prone to flooding and construction and sealing to extend the sealed system. Details of the principal works of all types are given in the following paragraphs.

Princes Highway West.—A divided highway was constructed between Somerville Road and Cemetery Road, West Footscray, including the intersection with Somerville Road. Between Winchelsea and Colac several sections were reconstructed and widened, involving great improvement to alignment and visibility. At Terang the carriageway on the south side of the plantation was constructed as a State highway, enabling one-way traffic to be introduced.

McKinnon's bridge between Camperdown and Terang was widened and new road approaches provided, and a wider superstructure placed on Bucknell's Creek bridge at Cudgee. North of the Henty Highway junction at Bolwarra $3\frac{1}{2}$ miles of highway was widened and strengthened as a first stage in the improvement of this section through to Heywood. A defective bridge over the railway at Dartmoor was replaced by a new structure on improved alignment.

Princes Highway East.—Work was started on channelized intersections at Clayton Road and Wellington Road to be linked by a 6-lane divided highway, incorporating where practicable the existing 4-lane road. Duplication was continued from Foster Street to Quinn Street at Dandenong, and an intersection with Dandenong–Frankston Road constructed. Extension of this facility to link up with the divided highway further east is in progress. Sharp curves at Pink Hill, Beaconsfield, and at Garfield were eased and approaches constructed to a new steel and concrete bridge over the Bunyip River which was completed early in the year (Plate 1). A major deviation $4\frac{3}{4}$ miles in length was constructed between Hernes Oak and Morwell (Plates 2 and 3). The section from Hernes Oak to McDonalds Track south of the railway line was constructed as a deviation of the Princes Highway and the remainder as a by-pass road (see Section (8)). At Sale further progress was made on creating an all-weather road at the Thompson River crossing, four bridges having been completed with a fifth in progress and the main Thompson River bridge to be commenced next year. This project should be completed before June, 1962. Considerable progress was made on the deviation south of Club Terrace, a length of 3·4 miles involving heavy earthwork being practically finished (Plate 4) and the bridge over the Bemm River well in hand. It is anticipated that this major project will be completed next financial year.

Western Highway.—In the City of Sunshine the first stage in completing a divided highway between Ashley Street and the Albion railway crossing was achieved by the construction of a concrete carriageway on the northern side from Ashley Street to Duke Street. A temporary central median has been provided pending completion of the southern carriageway next financial year. The realignment at Djerriwarrh Creek west of Melton involving a new bridge was completed and opened to traffic (Plate 5), and the realignment and regrading of the Anthony's Cutting section was in progress at the end of the year. The earthwork on both these sections has been designed and executed for conversion to 4-lane divided section by the future construction of a second carriageway. Reconstruction involving improved alignment and width was carried out at Bungaree, between Windermere and Burrumbeet, and east of Beaufort, these sections totalling 6 miles in length. Near Armstrong a section 2·7 miles in length was reconstructed and realigned, and the clearance beneath the railway underpass bridge increased to 15 feet. The narrow and badly aligned Oddfellows overpass bridge south-east of Stawell was replaced with a new structure (Plates 6 and 7), and considerable improvement works carried out on the adjoining road sections.

Calder Highway.—On the recently declared section on old Bulla Road dual concrete pavements were constructed. Between Bridgewater and Inglewood a 4-mile section of road was reconstructed and widened, and a new bridge constructed over Bullabul Creek near the centre of the section (Plates 8 and 9). Between Warne and Boigbeat several sections totalling $14\frac{1}{2}$ miles, which had failed, were reconstructed and provided with a wider seal than formerly.

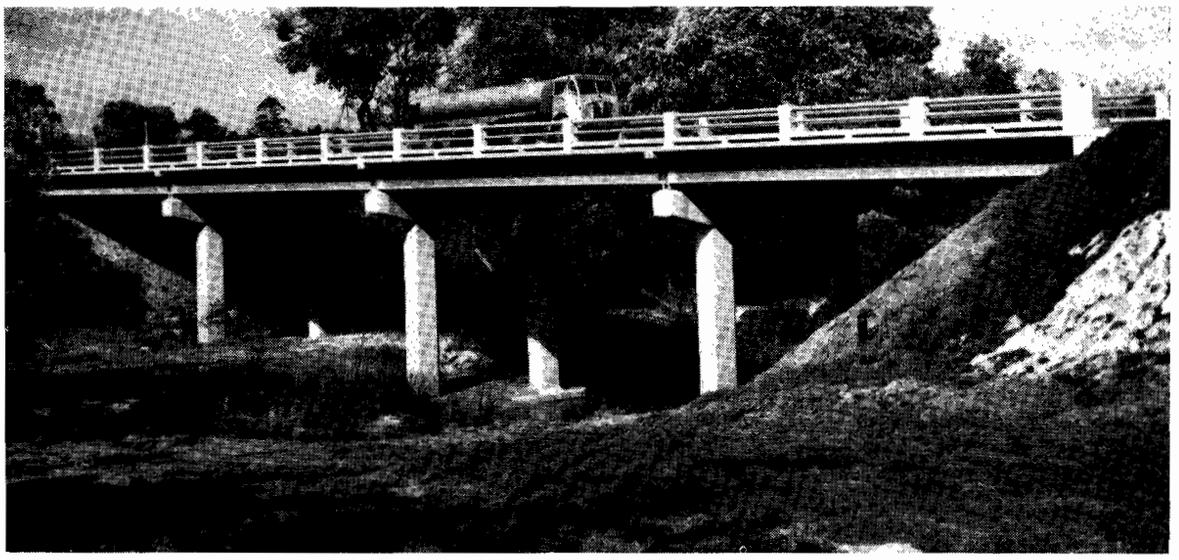


Plate 1.—Princes Highway East. New bridge over Bunyip River.

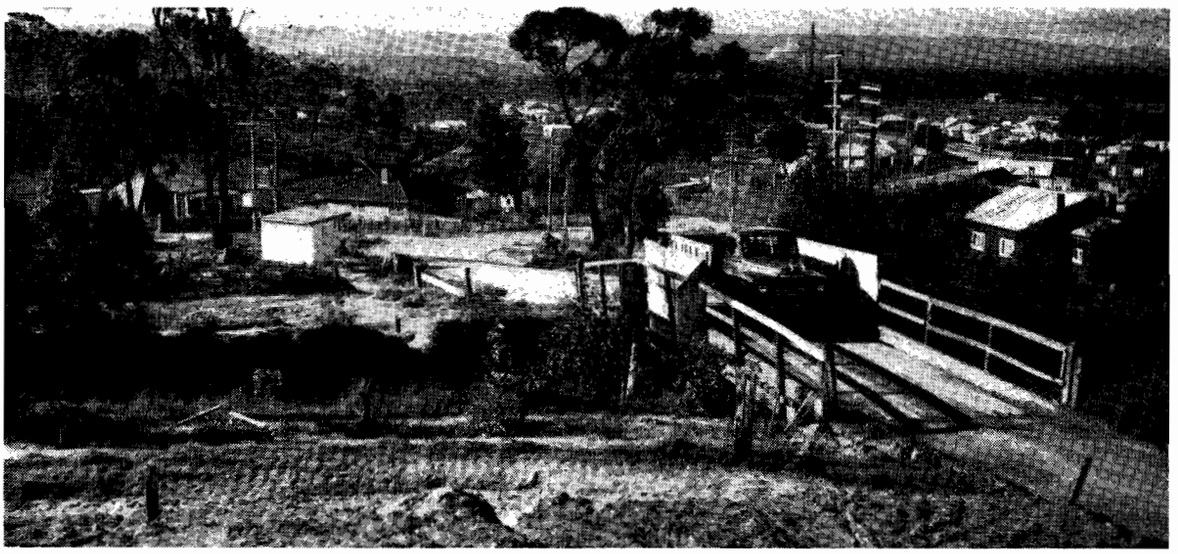


Plate 2.—Princes Highway East. Site of new crossing over railway on deviation at Hernes Oak prior to construction.

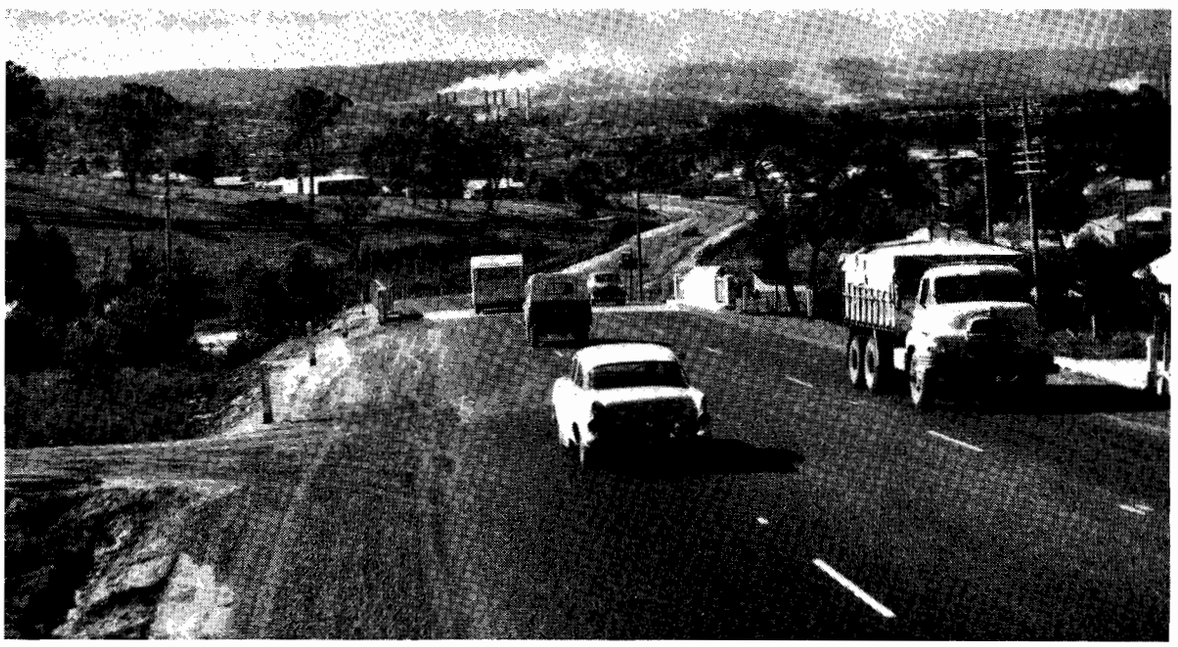


Plate 3.—Completed deviation and bridge at Hernes Oak at site depicted in Plate 2.

Plate 4.—Cutting—Depth 58 ft. at Donalds Knob—Club Terrace Deviation.

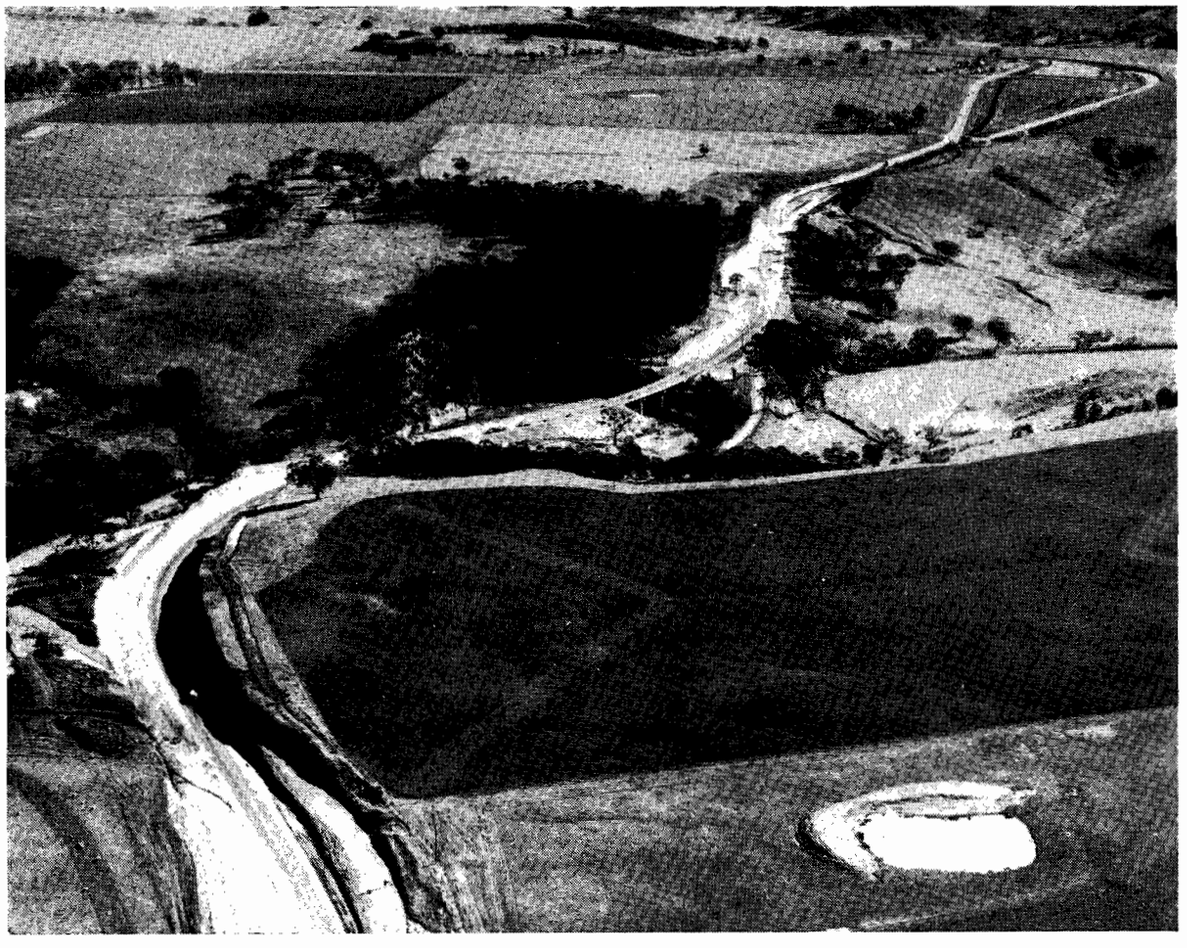


Plate 5.—Western Highway—Realignment and regrading with new bridge at Djerriwarrh Creek.

Hume Highway.—At the close of the year the work of continuing the duplicate highway northerly from Camp Road to link up with a previously constructed section at Campbellfield was in progress. The duplicate carriageway will be of concrete on a granular base. Also in progress is the construction of a 4-lane deviation with paved median at the crest of Pretty Sally Hill, north of Wallan. In continuation of pavement widening three sections totalling almost 14 miles were completed north of Balmattum, south of Baddaginnie (Plate 10) and north of Winton. Elimination of the flooding problem adjacent to the Ovens River at Wangaratta was carried a stage further by the construction of a deviation nearly two miles in length with pavement above flood level and including two new reinforced concrete bridges. A bridge on the River Murray flood plain was widened and road approaches completed to this bridge and to the new Union Bridge constructed by the Department of Main Roads, New South Wales, over the main channel of the River Murray (Plate 11).

Omeo Highway.—Realignment of a narrow and tortuous 2-mile section of the Omeo Highway near Ensay, known locally as the Devil's Backbone, was commenced and considerable improvement to width and alignment was effected over a length of about 3 miles near Christmas Creek, north of Glen Wills. Similar work was carried out between Lightning Creek and Mitta Mitta and a 2-mile section at Tallandoon, subject to frequent flooding, was raised above normal flood level. Between Noorongong and Tallangatta a $5\frac{1}{2}$-mile section was reconstructed and the seal extended.

Murray Valley Highway.—The sealed length of this highway was increased by almost 3 miles at Koetong and $2\frac{3}{4}$ miles on the outskirts of Wodonga which is subject to dense traffic, was widened. Between the Hume Highway and Yarrawonga the narrow seal was widened on three sections totalling 3 miles. Westerly from Cohuna a section $2\frac{3}{4}$ miles in length was constructed and widened, the new pavement being of an experimental nature involving stabilization of a local fine sand with Portland cement. The seal coat north of Nyah was extended a length of $4\frac{1}{2}$ miles to Piangil.

South Gippsland Highway.—The highway in the eastern part of Korumburra has been reconstructed incorporating a median while considerable progress has been achieved in the improvement of the Korumburra to Leongatha section by the completion of $5\frac{1}{2}$ miles of new road.

Midland Highway.—On the recently declared new section between Ballarat and Daylesford 1 mile of reconstruction was completed near Eganstown and 3 miles south of Daylesford, involving a recent deviation, was completed, as was a length of 1·3 miles south of Campbells Creek. A new reinforced concrete bridge 120 feet long was completed over the main Waranga irrigation channel at Corop, while west of Stanhope a section of 4 miles in length was raised above flood level; this work incorporated the construction of seven pre-stressed bridges and eliminates conditions which have hindered traffic greatly in the past. Further relief from flooding was brought about by the construction of a new bridge over Sheepwash Creek between Shepparton and Benalla. South of Benalla the sealed surface was extended a length of 1 mile near Lima South.

Sturt Highway.—The narrow 12-ft. sealed pavement was widened to 20 feet over a length of 10 miles near Lake Cullulleraine.

Henty Highway.—A further section $3\frac{1}{2}$ miles long between Turriff and Speed was sealed. This work incorporated realignment and a great improvement in visibility (Plate 12).

Goulburn Valley Highway.—At and north of Nagambie reconstruction was carried out over a length of $3\frac{1}{2}$ miles including widening of the seal to 22 feet.

Ouyen Highway.—The sealed pavement on this highway was extended from Torrita to west of Underbool, a distance of over 7 miles, and the approaches to the level railway crossing near the South Australian border were realigned and sealed.

Nepean Highway.—Duplication of this highway from Moorabbin to Mordialloc was commenced and two sections totalling 1·5 miles from Moorabbin to Wickham Road and from Oak Avenue to Warrigal Road were completed. The work consisted of a new eastern carriageway with temporary median separating it from the existing road which will serve as the western carriageway (Plate 13).

STATE HIGHWAYS.

Plate 6.—Western Highway. Old Oddfellows bridge over railway line 141·5 miles.

Plate 7.—Western Highway. New concrete bridge at same location.

STATE HIGHWAYS.

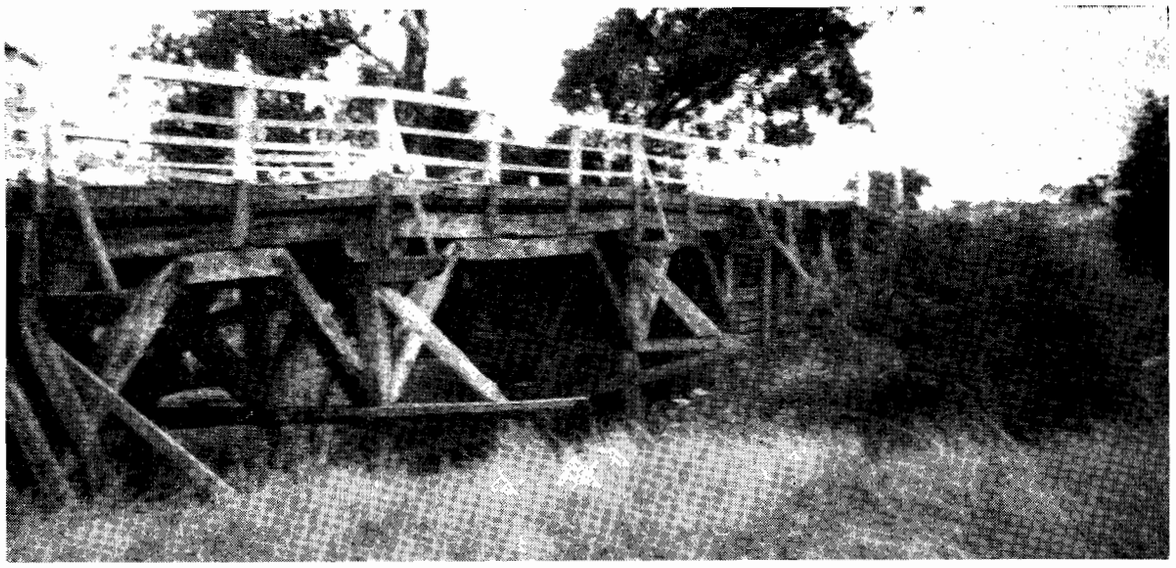


Plate 8.—Calder Highway. Old bridge over Bullabul Creek west of Bridgewater.

Plate 9.—Calder Highway. New bridge over Bullabul Creek.

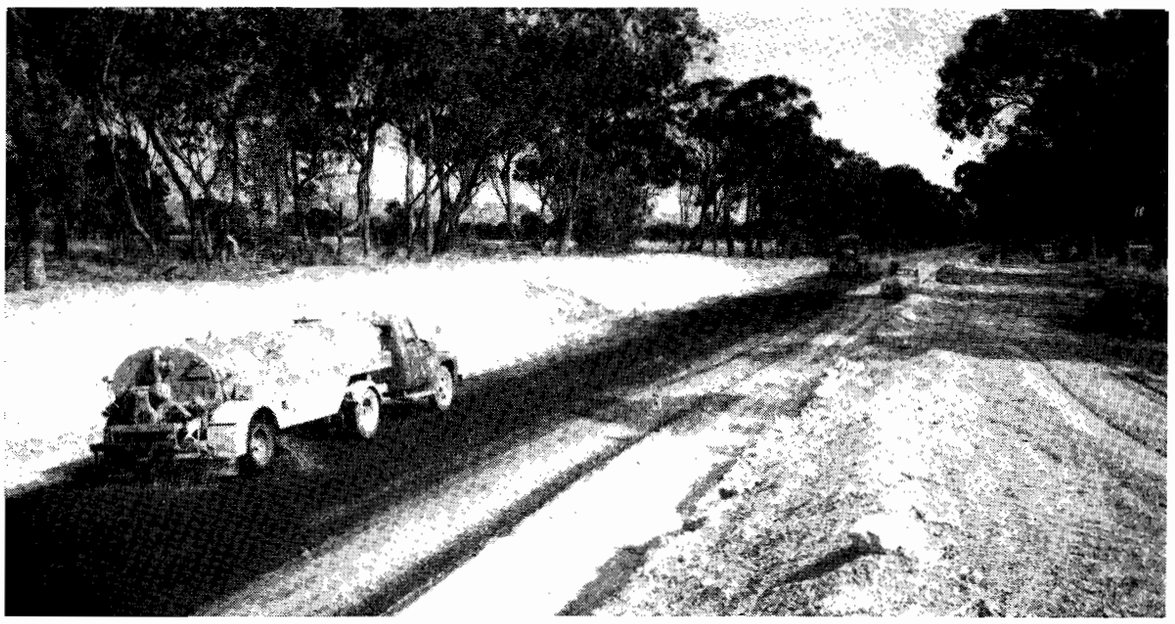


Plate 10.—Hume Highway. Reconstruction in progress south of Baddaginnie.

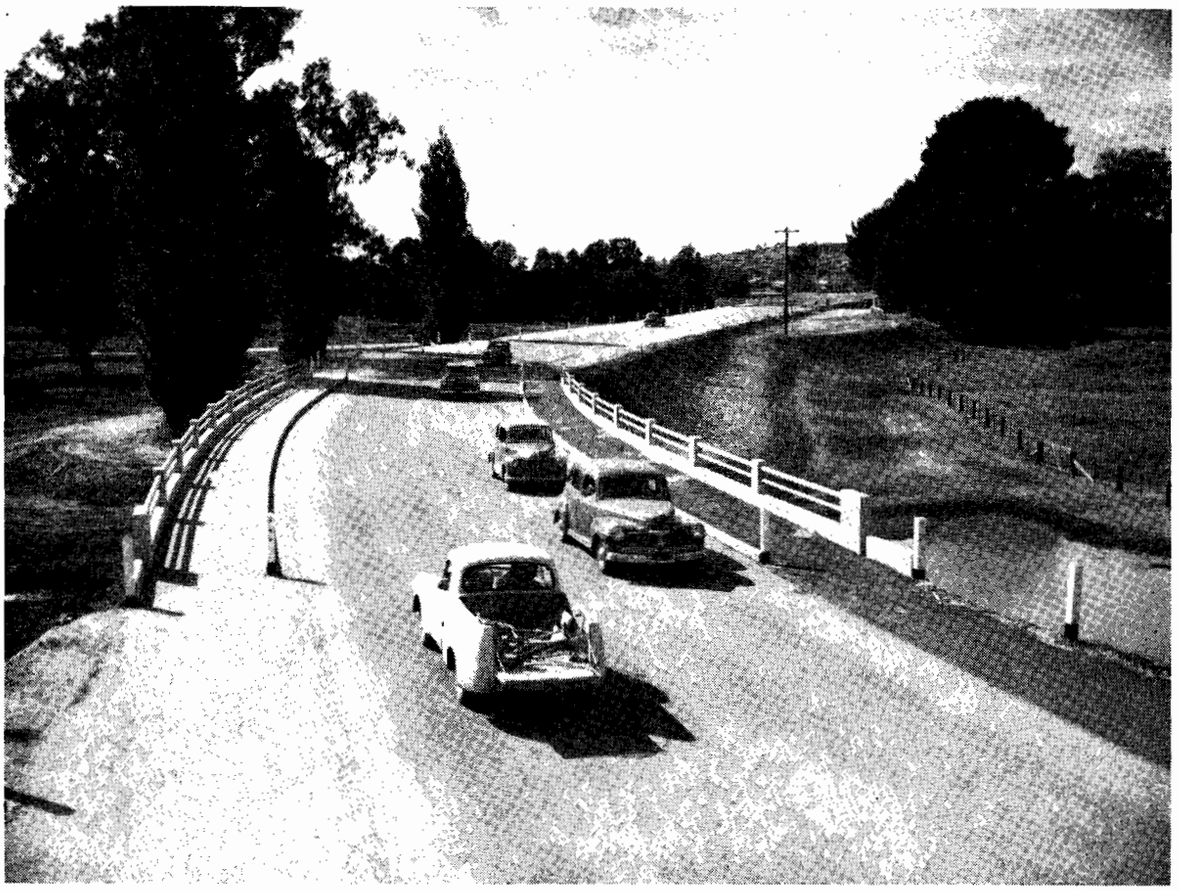


Plate 11.—Hume Highway. Widened bridge—Murray River flood plain between Wodonga and Albury.

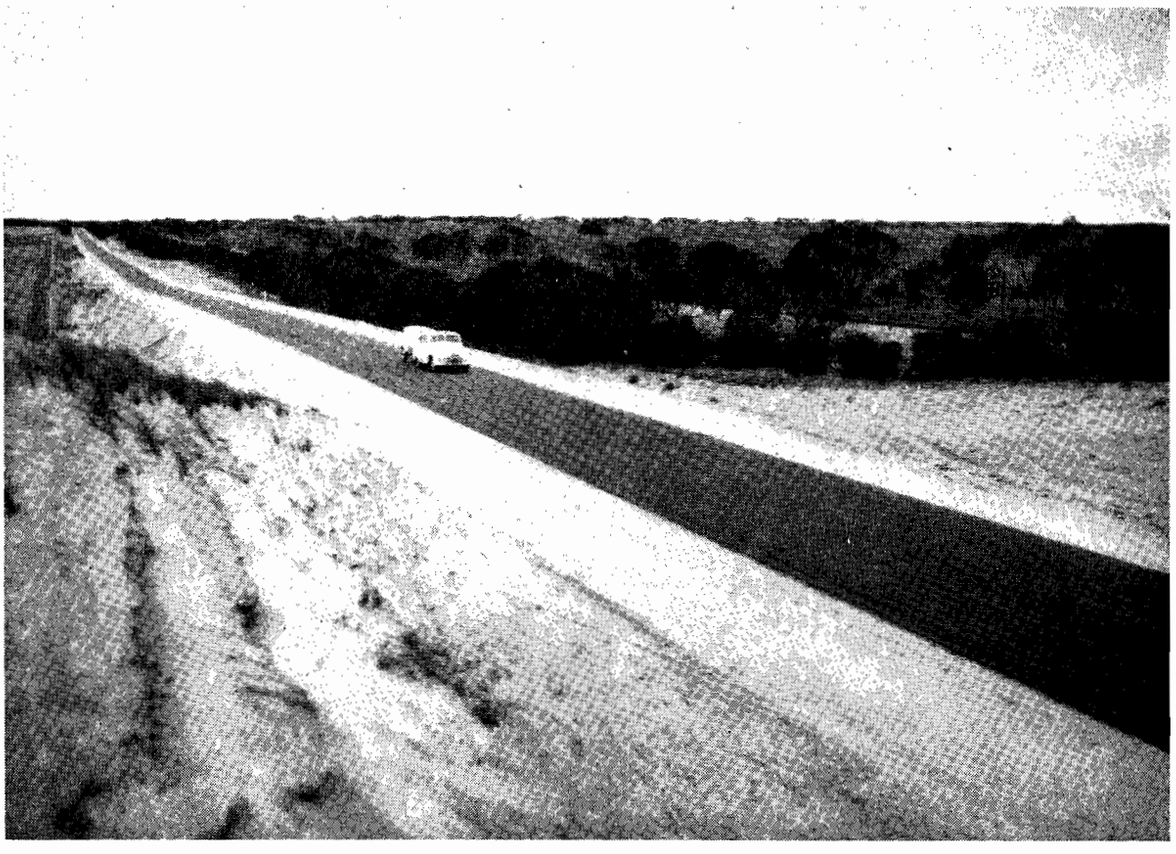


Plate 12.—Henty Highway—After reconstruction through sand hills south of Speed.

NEPEAN HIGHWAY.

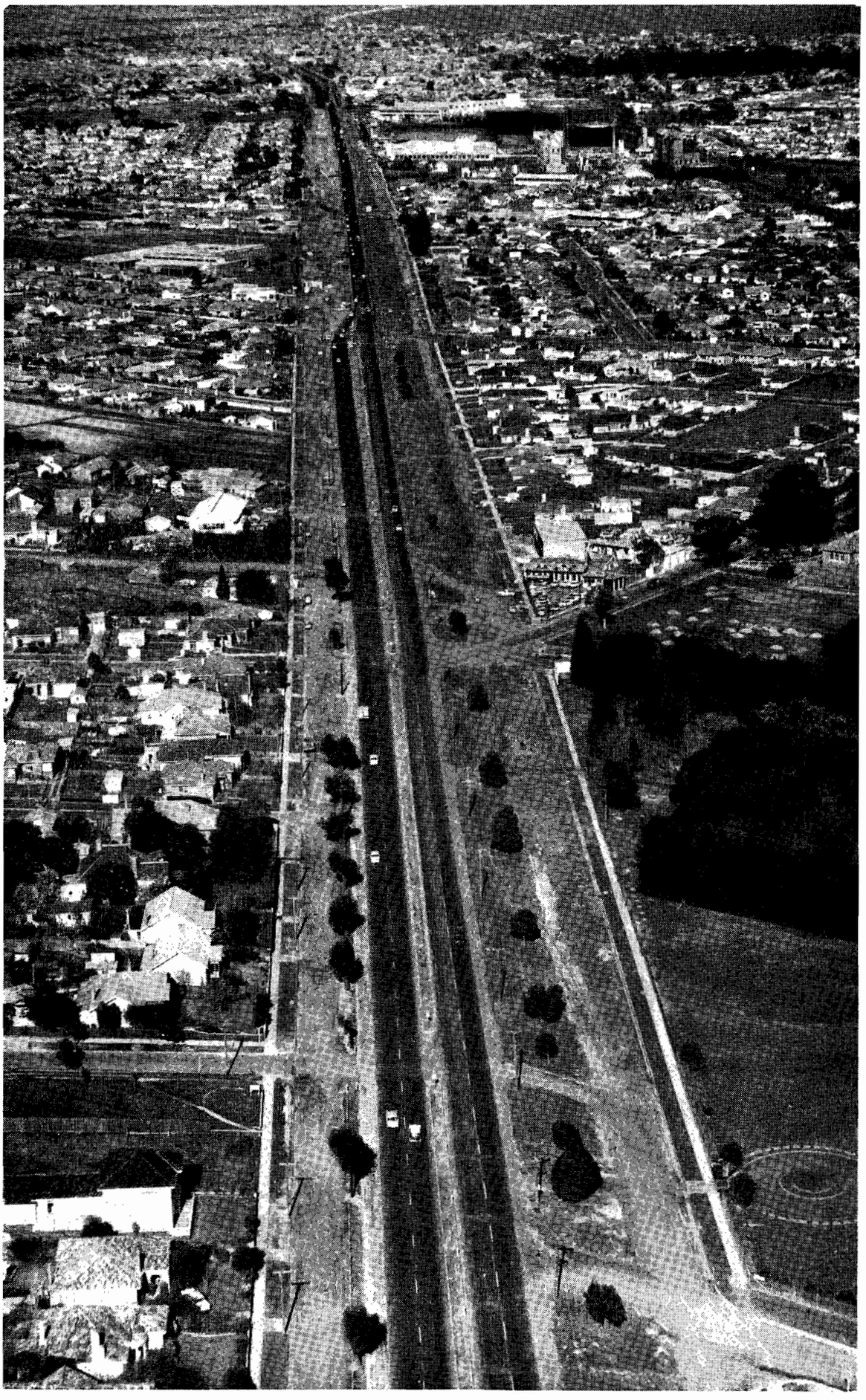


Plate 13.—Nepean Highway. Divided highway south of Moorabbin.

Glenelg Highway.—Realignment and regrading of the eastern and western approaches to Cherry Tree Hill near Linton was commenced and over 3 miles of highway was reconstructed between Lake Bolac and Wickliffe. The highway through the township of Dunkeld was reconstructed and the alignment improved and widening work was carried out east of Hamilton and west of Coleraine.

Ovens Highway.—Widening and reconstruction was carried out on approximately 6 miles of the highway east of Wangaratta and involved raising a section subject to flooding. Improvement was effected to a length of 1·8 miles south of Myrtleford.

Borung Highway.—West of Donald a 3-mile section was reconstructed and widened while a length of 9 miles between Carron and Werrigar was widened thereby completing the widening between Donald and Warracknabeal.

North-Western Highway.—A New bridge on improved alignment was completed at Stuart Mill and 3 miles near Swanwater reconstructed and widened.

Maroondah Highway.—The creation of a divided highway between Box Hill and Ringwood was advanced by the construction of a channelized intersection at Middleborough Road and 1 mile of new divided highway to link up with the completed section at Blackburn. At Coldstream a new deviation 1½ miles in length has been constructed while a very sub-standard section at Narbethong has been replaced by a new road, the length of this project being approximately 1 mile.

Wimmera Highway.—Following declaration during the year improvements included widening of approximately 6 miles between Natimuk and Edenhope and reconstruction of 3½ miles in two sections near Miga Lake and Mundarra. A new reinforced concrete bridge 240 feet long over the Wimmera River at Quantong was completed. The pavement was widened between Marnoo and St. Arnaud over a length of approximately 4 miles (Plates 14 and 15).

8. BY-PASS ROADS.

The Board has continued its planning to cater for future traffic in the outer Melbourne metropolitan area and certain country areas by selecting routes for development as by-pass roads under the provisions of Part VII. of the Country Roads Act, i.e., roads having " freeway " characteristics.

During the year the Board adopted a plan to provide for future traffic to and around the rapidly developing city of Dandenong. The future road network will consist of a series of freeways ringing the city business and industrial area and connecting with the Princes Highway East, the South Gippsland Highway, the future south-eastern freeway route from Melbourne, the Dingley By-pass Road and connecting with Ringwood and the eastern suburbs by a new route through the Scoresby area (Fig. 3). Planning of the system is in progress and some properties have already been acquired.

The route for a freeway to serve the Tullamarine Airport has been selected and partly surveyed.

As new sections of roads are opened up and constructed as deviations from important State highway or arterial routes, the Board is taking the opportunity to construct such sections as by-pass roads. Examples of these are the deviation of the Princes Highway East between Hernes Oak and Morwell around the new State Electricity Commission open cut brown coal area (Plate 16) and the over-pass bridge (with approaches) on the Hume Highway over the north-eastern railway line at Craigieburn (Plate 17).

Other projects are being investigated as staff is available with a view to reserving land or protecting it against development by inclusion in planning schemes or using the fixation of alignment provisions of Section 114 of the Country Roads Act.

Progress achieved on by-pass roads mentioned in the last Annual Report is reported below.

Maltby By-pass Road.—The by-pass road near Werribee which was under construction by contract and direct labour during the previous year was officially opened to traffic on the 16th June, 1961, by the Hon. Sir Thomas K. Maltby, E.D., M.L.A., Minister of Public Works, after having been named the Maltby By-pass Road by the Premier of Victoria, the Hon. H. E. Bolte, M.L.A. It is a 4-lane divided highway 6½ miles in route length, with no access from adjoining property or cross roads over its entire length. There are interchange facilities for traffic with the existing Princes Highway West at both ends. Sneydes Road, Duncans Road (C.R.B. Main road) and Farm Road are carried over the by-pass road on elevated bridges. The total cost of the project was approximately £950,000 (Plates—18, 19, 20).

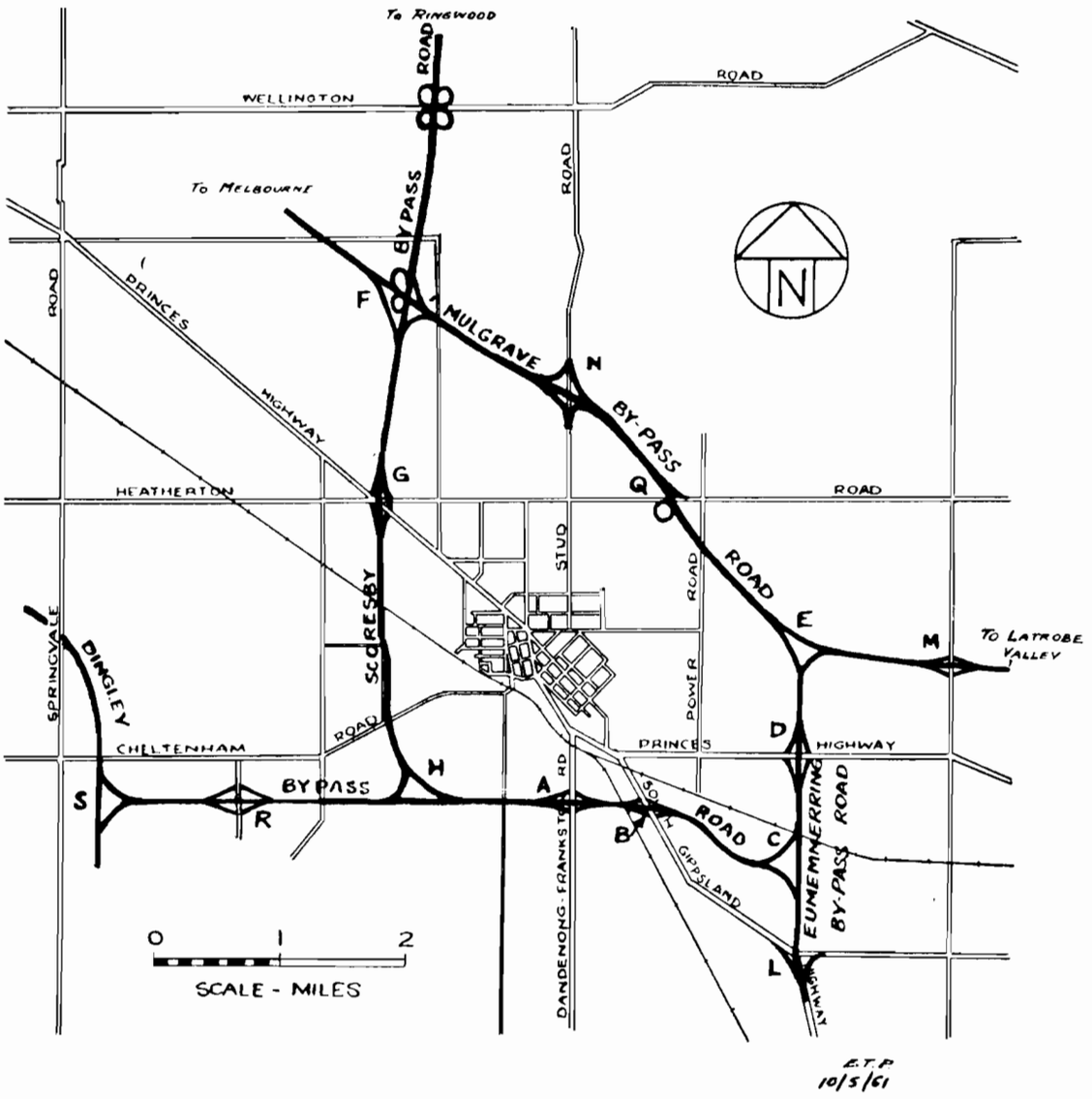


Fig. 3.

Whitelaw By-pass Road, Korumburra Shire.—This road, 2½ miles in length.which forms portion of the South Gippsland route immediately north of the town of Korumburra was completed as a 2-lane road and opened to traffic. For through traffic it replaces a narrow winding route 3½ miles long consisting of portions of the Bena-Korumburra and Warragul-Korumburra main roads which involved two level railway crossings. The total cost of this project was £65,000.

Frankston By-pass Road.—This road will ultimately provide a divided highway connecting Wells Road near William Street, Frankston, with McMahons Road and the Frankston-Flinders Road. The first stage consisting of two lanes between William Street and the Dandenong-Frankston Road, a distance of 4,600 ft., has been completed, the cost being approximately £22,500

Hume By-pass Road.—This by-pass road consists of two sections, the first being 8½ miles in length commencing at the level crossing of the north-eastern railway line south-west of Chiltern and joining up with the existing Hume Highway on the Wodonga side of the rail crossing north-east of Barnawartha, and the second 4 miles in length commencing near the rail crossing some 4 miles east of Barnawartha and ending at the existing Hume Highway immediately east of the underpass beneath the railway on the existing route. Land is in process of aquistion for the easterly section and construction of the 2-lane road was well advanced at the end of the year (Plate 21). Planning of the westerly section, which incorporates grade separation at the Chiltern-Beechworth main road, is well advanced with a view to acquiring the necessary right-of-way and completing the construction of both sections at the end of 1961, when the Victorian Railways Department estimates the standard gauge line between Melbourne and Wodonga will be in operation.

WIMMERA HIGHWAY.

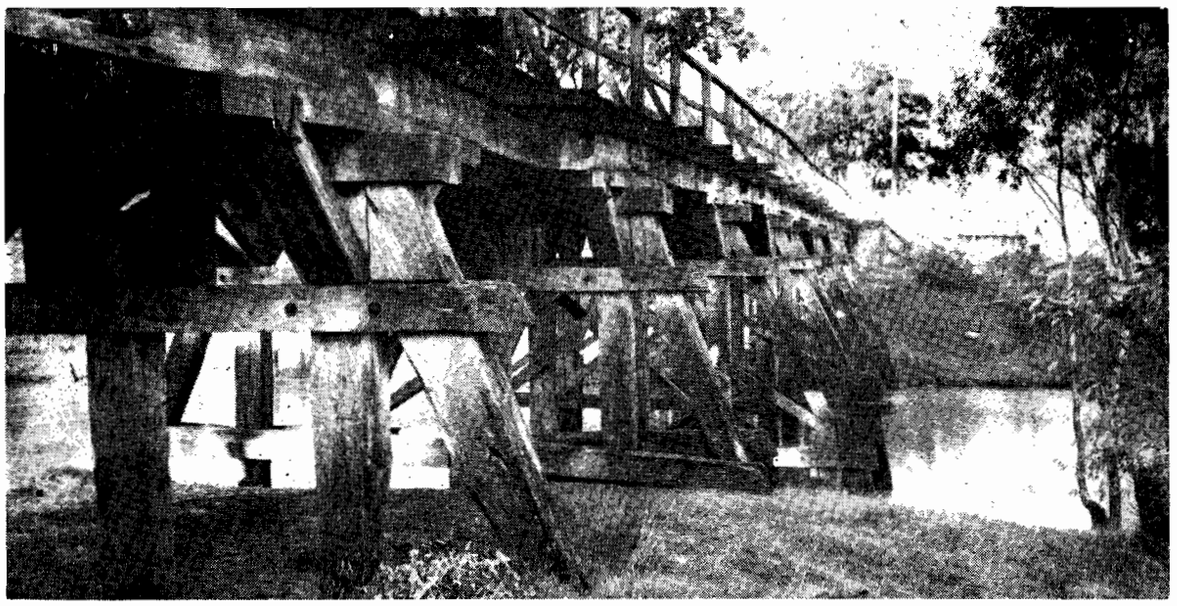


Plate 14.—Wimmera Highway. Old bridge over Wimmera River at Quantong.

Plate 15.—Wimmera Highway. New concrete bridge over Wimmera River at Quantong.

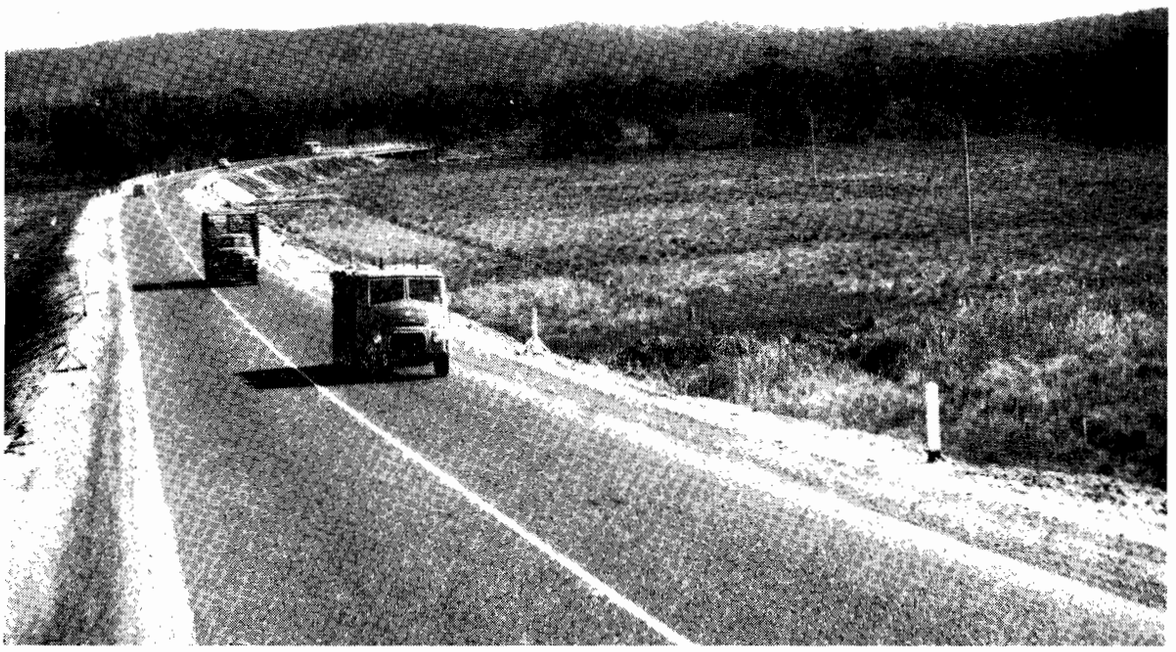


Plate 16.—Princes Highway. Deviation between Hernes Oak and Morwell.

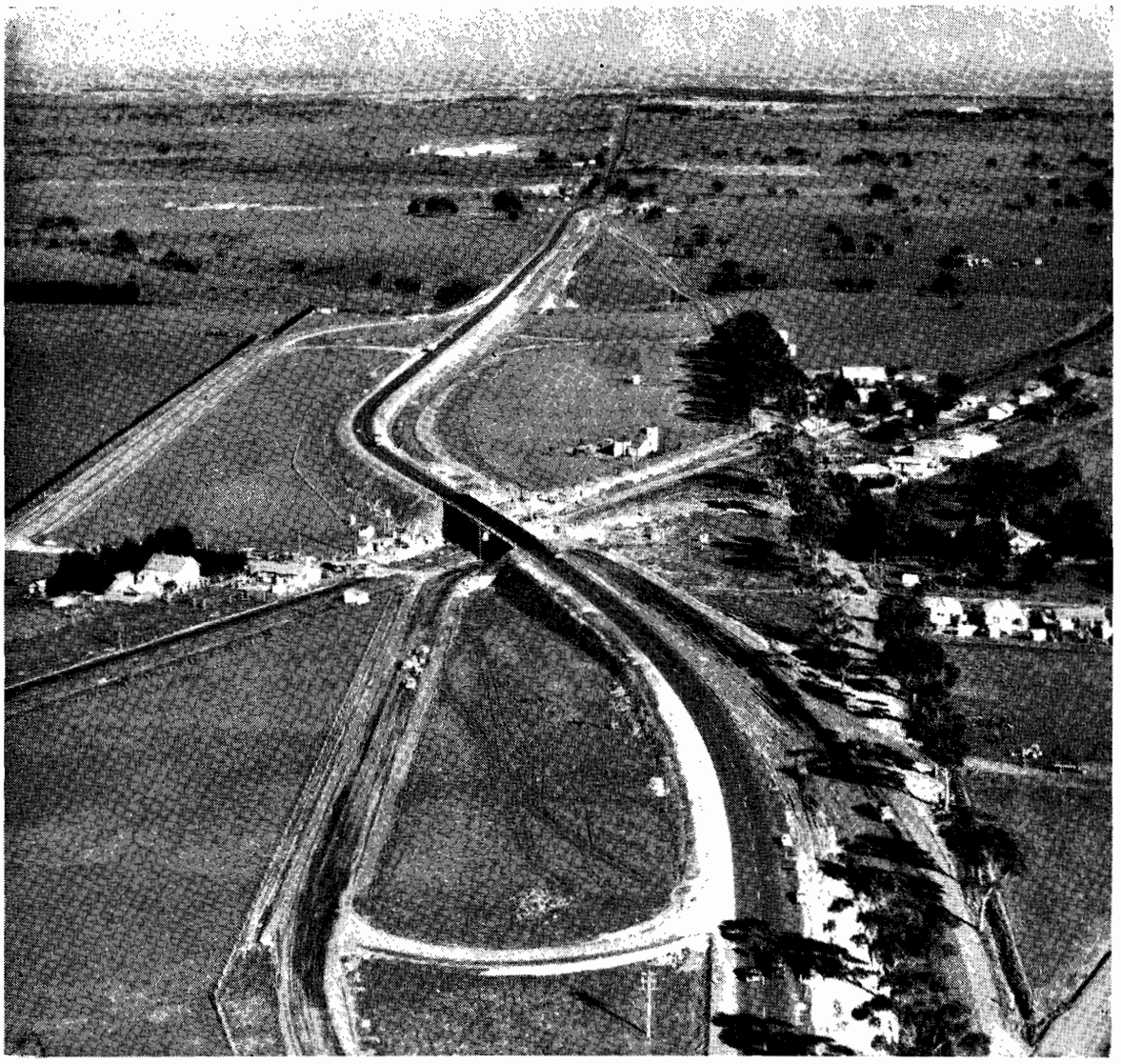


Plate 17.—Craigieburn Over-pass. Hume Highway. Aerial view of over-pass and road connections.

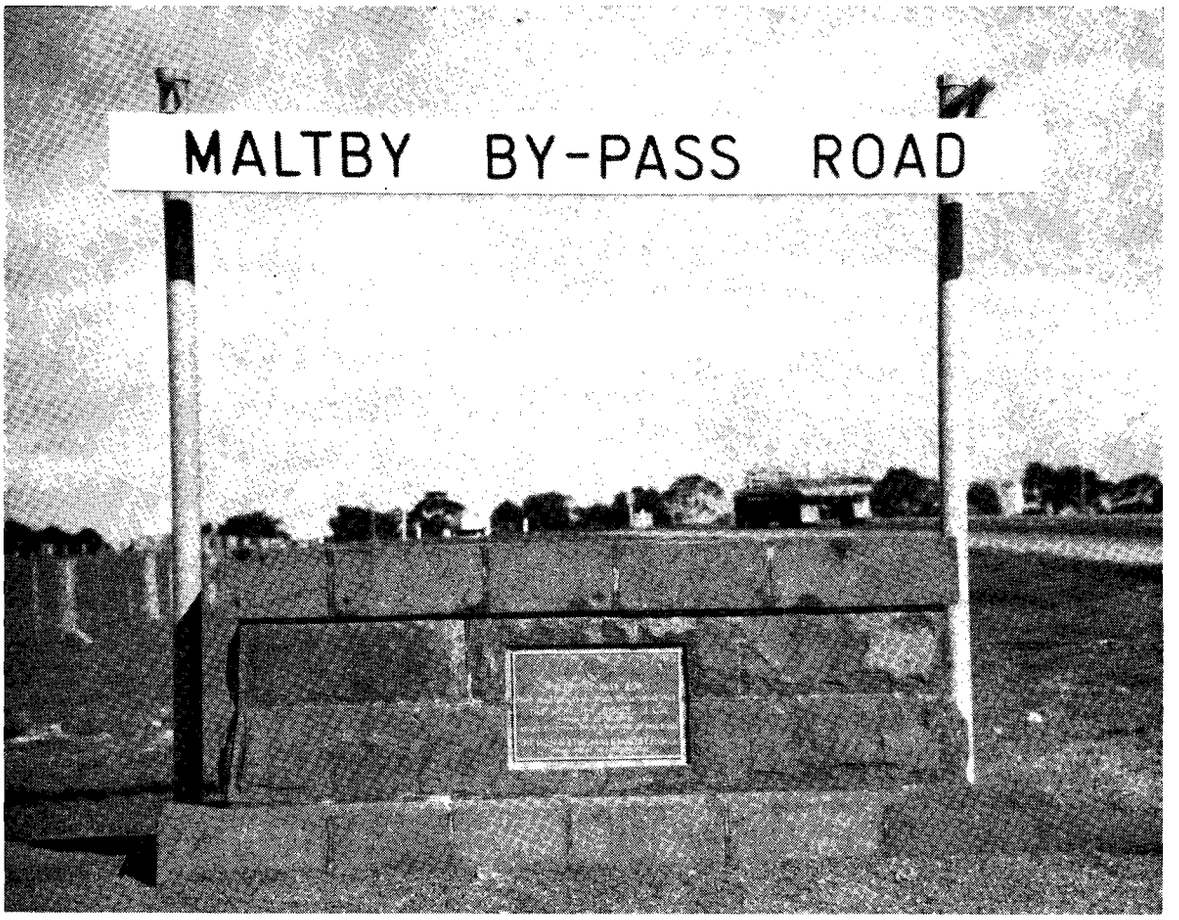


Plate 18.—Maltby By-pass. Commemorative Plaque.

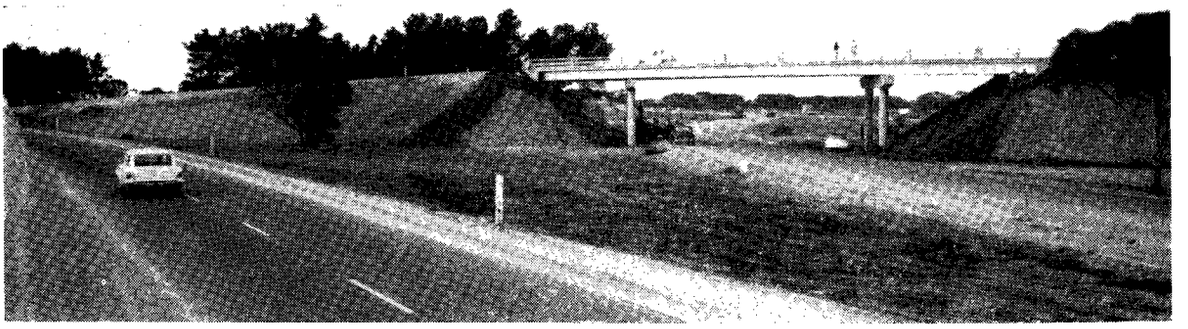


Plate 19.—Maltby By-pass showing western interchange.

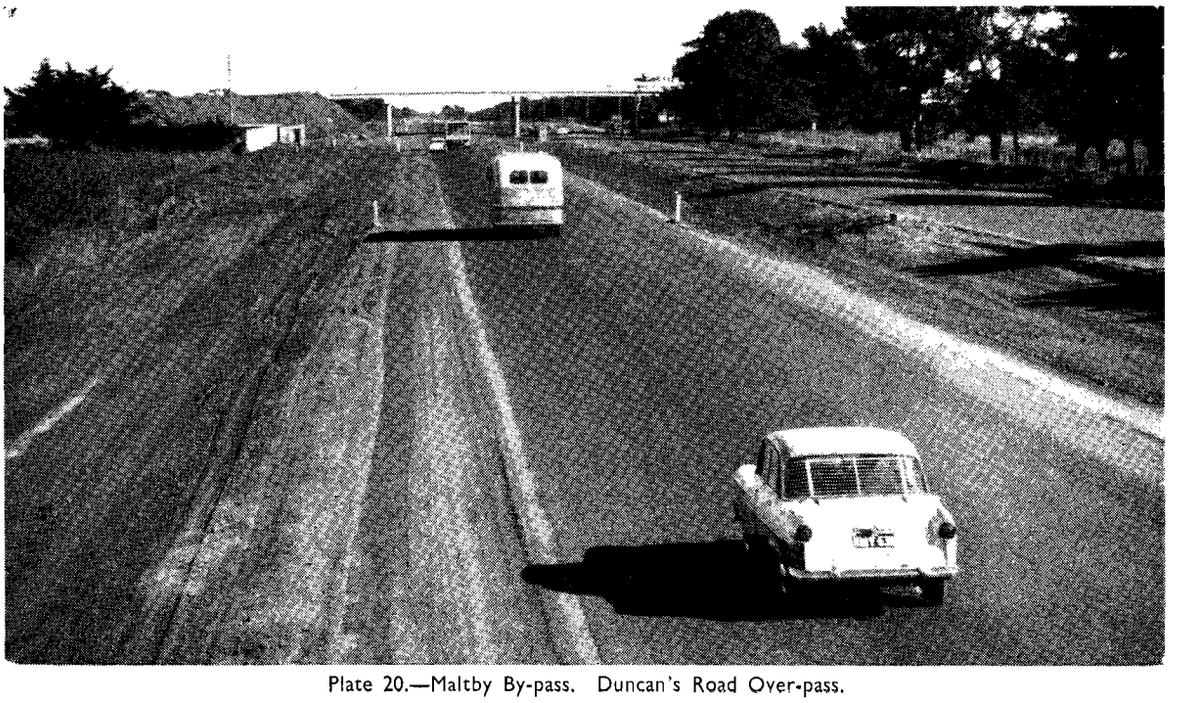


Plate 20.—Maltby By-pass. Duncan's Road Over-pass.

Plate 21.—Hume By-pass Road. Work in progress north of Barnawartha.

MAIN ROADS

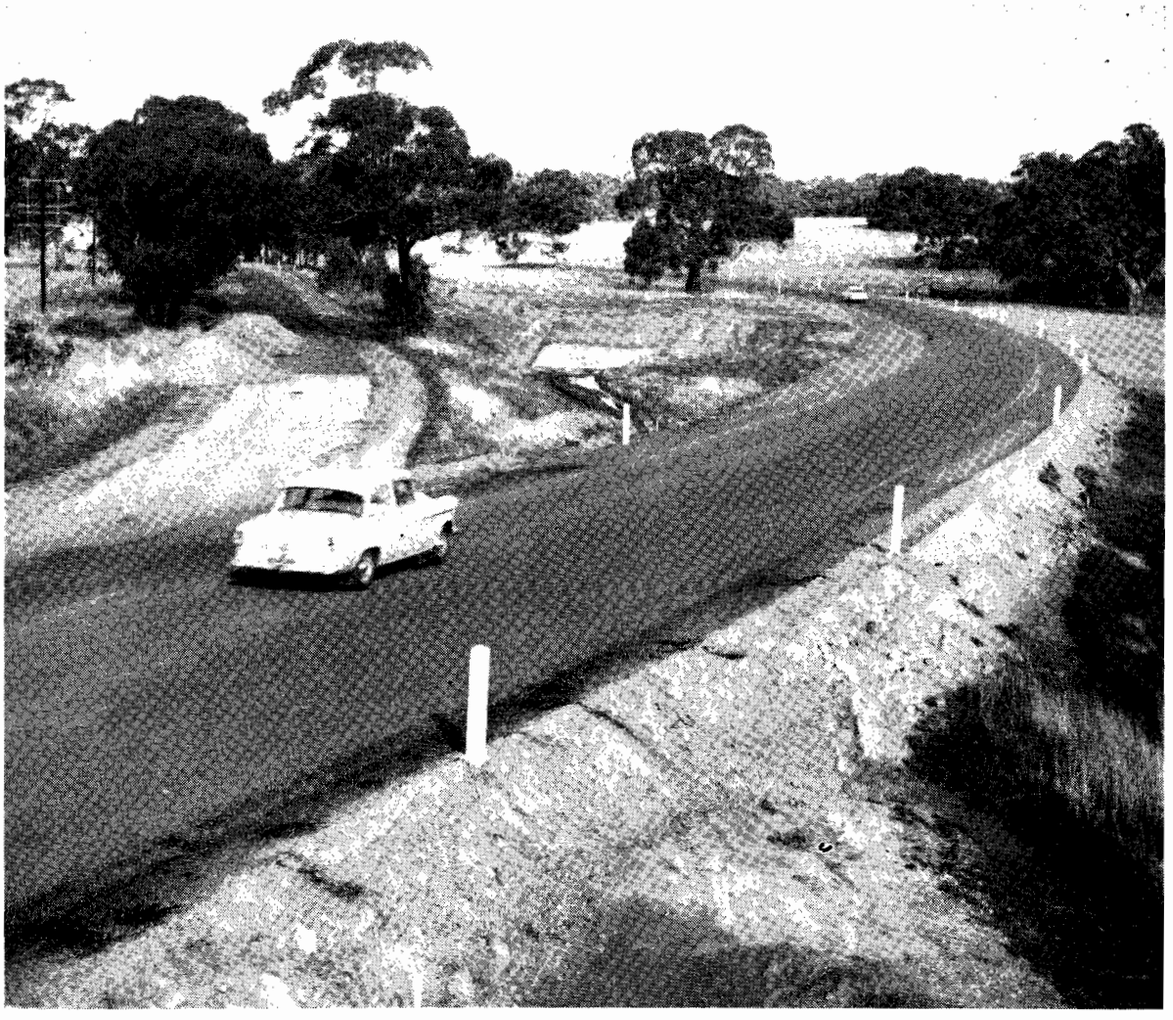


Plate 22.—Shire of Ararat. Ararat-Warrnambool Road. Reconstructed, realigned, and sealed section, south of Ararat.

9. MAIN ROADS.

In framing the programme of main road works for 1960–61, the Board in March, 1960, invited applications from 206 municipal councils and from the Board's engineers in respect of works under its direct supervision. In due course, as shown in the following table, the total of the allocations which the Board was able to make was approximately two-thirds of the total of the applications, whilst the actual expenditure for the year was approximately 61 per cent. of the allocation. Percentages for the previous year as shown are of similar order. This is indicative of the " carry over " inherent in planning and executing works.

The initial allocation for maintenance construction and reconstruction of main roads amounted to £9,560,410. Following the declaration of 651 miles of main roads as State highways, 31 miles of main roads as forest roads and 14½ miles of main roads as tourists' roads, allocations of £768,329 were transferred to State highways, £48,273 to forest roads and £4,100 to tourists' roads.

Additional allocations of £322,454 made for 96 miles of new main roads then brought the total allocation to main roads to £9,062,162. Further allocations during the year increased this total to £9,728,457 this latter figure including works on railway level crossing elimination and items for land purchase.

—	1959–60.	1960–61.
	£'000s.	£'000s.
A. Applications	14,653	14,708
B. Allocations	9,416	9,728
C. Expenditure	6,258	5,923
	%	%
B. as percentage of A	64·3	66·1
C. as percentage of B	66·5	60·9

Particulars of typical major works and improvements on main roads undertaken during the year are as set out hereunder :—

Bairnsdale Division.

Avon Shire.—Dargo " B " road—Reconstruction and sealing 1 mile near Dargo, 12 feet wide.

Bairnsdale Shire.—3·1 miles of bituminous surfacing extension on main roads throughout the shire. Bairnsdale–Paynesville Road—Widening and sealing from 12 feet to 18 feet for approximately 1 mile. Bengworden Road—Reconstruction and sealing of 1·6 mile, 12 feet wide. Bullumwaal Road—Construction of Wy Yung bridge—a reinforced concrete bridge 240 feet long and 24 feet between kerbs plus a 6-ft. footway—at a cost of £70,000. Lindenow–Meerlieu Road—Reconstruction and sealing of 1 mile, 12 feet wide.

Omeo Shire.—Benambra Road—1·2 mile of bituminous surfacing extension carried out 12 feet wide. Ramrod Flat Road—An additional 2·1 miles reconstructed and sealed 18 feet wide.

Orbost Shire.—Buchan–Orbost Road—Reconstruction, realigning and sealing of ·7 mile at Bete Bolong ; widening and realigning ·4 mile and construction of a new 48-in. diameter culvert at Bete Bolong North. Combienbar Road—Widening formation of ·9 mile to 24 feet. Marlo Road—Reconstruction and sealing of ·8 mile, 18 feet wide.

Tambo Shire.—Buchan–Orbost Road—Sealing 2·3 miles, 12 feet wide. Tambo Upper Road—Reconditioning old seal near Bruthen for ·9 mile, 18 feet wide ; reconstructing, realigning and sealing ·9 mile at Cunningham's Hill, 12 feet wide ; and sealing 1·1 mile near Bridle Creek 12 feet wide.

Ballarat Division.

Ararat Shire.—Ararat–Warrnambool Road—Reconstruction and realignment of a further 3 miles (Plate 22) including the diversion of a stream and the construction of two bridges and a large culvert. Ararat–Halls Gap Road—Reconstruction and sealing of a further 5 miles generally 14 feet wide and sealed 12 feet wide, except through Pomonal and Moyston townships, where reconstruction was 20 feet wide and sealing 18 feet wide.

Avoca Shire.—Ararat–St. Arnaud Road—Reconstruction of a concrete bridge over Wattle Creek, together with approaches.

Grenville Shire.—Cressy Road—A further length of 3 miles was constructed, and this section, together with a section of similar length previously reconstructed, making 6 miles in all was sealed 12 feet wide.

Lexton Shire.—Lexton–Talbot Road—2 miles were reconstructed and sealed 12 feet wide and 1 mile reconstructed in preparation for sealing in 1961–62. Beaufort–Lexton Road—The balance of 2 miles was reconstructed and sealed 12 feet wide, and the road is now sealed throughout.

Newstead Shire.—Newstead–Guildford Road—The 2-span R.C. bridge (each span 20 feet) over Limestone Creek was completed, and 2 miles were reconstructed and sealed 12 feet wide completing the sealing of the road throughout to this standard.

Ripon Shire.—Beaufort–Carngham Road—A 45-ft. span composite R.S.J. and concrete bridge over Baillies Creek was constructed, and an additional 1·8 mile was reconstructed in preparation for sealing. Beaufort-Amphitheatre Road—A commencement was made on the reconstruction of the last 2·4 miles.

Tullaroop Shire.—Eddington Road—A commencement was made on the widening of the pavement of the Eddington Road to 20 feet and 4 miles were completed.

Benalla Division.

Bright Shire.—Harrietville Road—Reconstruction of 1·4 mile.

Mansfield Shire.—Mansfield–Tolmie Road—Widening and sight benching of selected curves between the Broken River and Tolmie. Construction commenced of a 3-span reinforced concrete and steel beam bridge 211 feet long by 24 feet between kerbs over Broken River. Tolmie–Whitfield Road—Widening rock cutting 7 miles from Whitfield to formation width of 24 feet from 16 feet. Sight benching of curves and erection of 700 feet of cable guard fencing.

Myrtleford Shire.—Buffalo River Road (Joint Oxley Shire)—A very old timber truss bridge was replaced by a bridge 201 feet long by 22 feet between kerbs. The new bridge has composite steel girders, reinforced concrete superstructure, and reinforced concrete piers and abutments.

Nathalia Shire.—Echuca–Nathalia Road—Reconstruction of 6·5 miles. Nathalia–Katamatite Road—Sealing of 3·2 miles, 18 feet wide.

Oxley Shire.—Bright Road—3 miles of reconstruction. King Valley Road—Construction of a 3-span rolled steel joist and concrete bridge, 121 feet by 22 feet between kerbs over the King River.

Towong Shire.—Tallangatta–Corrying Road—Construction on a new alignment of a 168-in. diameter multiplate Armco pipe culvert over Koetong Creek with forming and gravelling extending over 1 mile. Yabba Road—Installation of a five-cell 75-in. diameter reinforced concrete pipe culvert at Bullhead Creek and reconstruction and realignment of 1 mile.

Tungamah Shire.—Tungamah–Peechelba Road—Reconstruction between mileages 0·0 to 4·75 and aggregate supplied for sealing this section during 1961–62 financial year.

Violet Town Shire.—Violet Town–Dookie Road—Widening and strengthening, prior to sealing of 3·7 miles and sealing of 6 miles, 12 feet wide. A 60-ft. pre-stressed concrete bridge was constructed over Stony Creek.

Yackandandah Shire.—Kiewa East Road—Two bridges were replaced with seven 20-ft. span pre-stressed slabs and approaches were constructed. Dederang Road—2·8 miles of reconstruction and realignment.

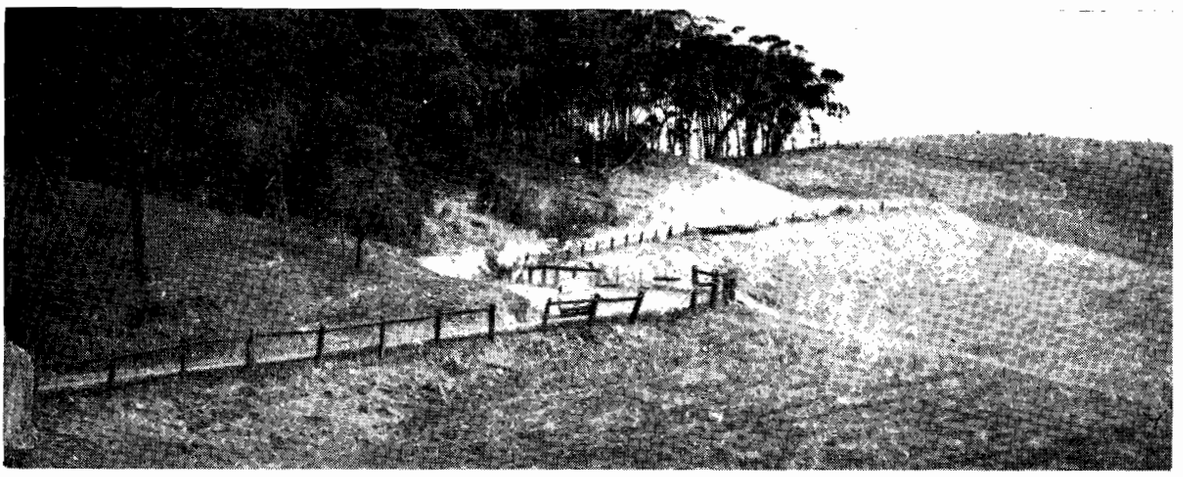


Plate 23.—Shires of Chiltern and Wodonga. Before reconstruction and realignment of Wodonga–Beechworth Road approaching Indigo Creek.

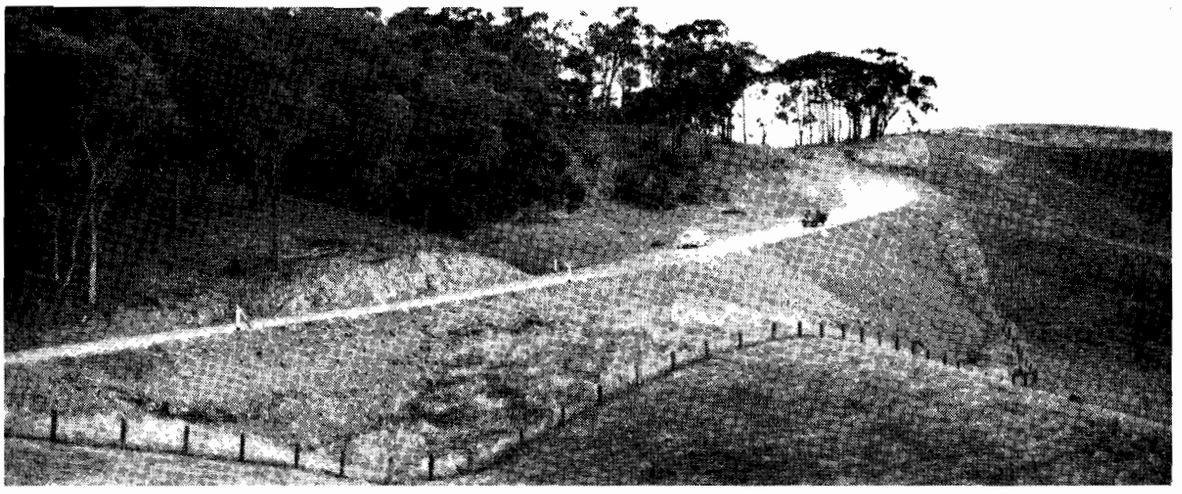


Plate 24.—After reconstruction and realignment of Wodonga-Beechworth Road approaching Indigo Creek.

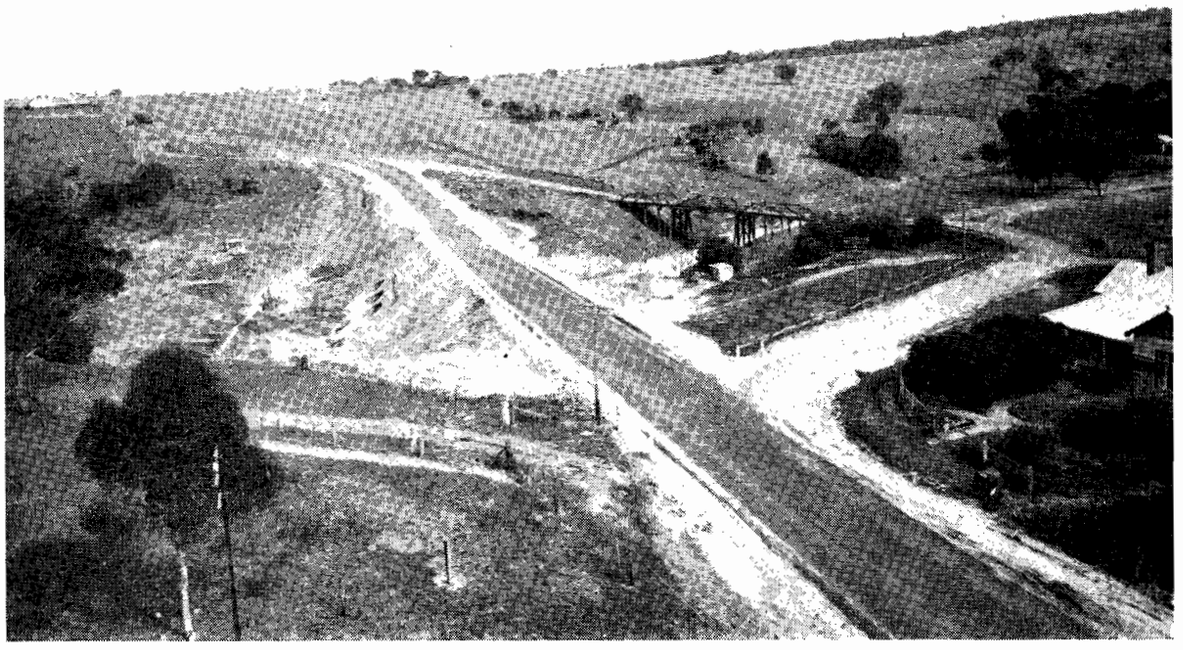


Plate 25.—Shire of Bacchus Marsh—Balliang Road, Parrwan Creek culverts.

Plate 26.—City of Oakleigh—North Road. Duplication of pavement between Warrigal Road and Huntingdale Road.

Plate 27.—Shire of Portland. Dartmoor–Hamilton Road. New bridge under construction over Crawford River.

UNCLASSIFIED ROADS.

Plate 28.—South Gippsland Shire. Fish Creek-Yanakie Road. Reconstruction eliminating sharp bends south of Fish Creek.

Wodonga, Chiltern, Yackandandah, and Beechworth Shires.—Wodonga–Beechworth Road—Work on this road commenced last year was continued (Plates 23 and 24). The total length of reconstruction in the vicinity of Leneva Gap and Indigo Gap is 5·25 miles and involved heavy earthworks, together with the replacement of an old timber bridge by a triple 75-in. "Z" class concrete pipe culvert.

Bendigo Division.

Deakin Shire.—Echuca–Kyabram Road—3 miles of resheeting 16 feet wide and sealing 12 feet wide.

East Loddon Shire.—Dingee Road—4·5 miles of pavement strengthening 14 feet wide and sealing 12 feet Tide.

Kerang Shire.—Kerang–Quambatook Road—4 miles of pavement strengthening and sealing 18 feet wide.

Rochester Shire.—Echuca–Serpentine Road—3·75 miles of reforming and sealing 12 feet wide.

Swan Hill Shire.—Donald–Swan Hill Road—Resheeting and sealing of a further 4 miles, 12 feet wide.

Wycheproof Shire.—Berriwillock–Woomelang Road—3·8 miles of reconstruction and sealing 12 feet wide. Sea Lake–Robinvale Road—4 miles of sealing 12 feet wide.

Dandenong Division.

During the year the length of sealed main roads in the Division was increased by approximately 36 miles. The sealed surfaces of approximately 30 main roads were extended by lengths ranging from 0·3 to 2·37 miles. The sealing work was done on lengths of road which were generally strengthened or reconstructed in the preceding financial year. For example the seal on the Whittlesea–Yea Road, Yea Shire, was extended by 2·37 miles, the seals on the Seymour–Tooborac Road in Pyalong Shire, and the Noojee–Powelltown Road in Upper Yarra Shire by 2·0 miles on each road, whilst the seals on the Balnarring Road, Flinders Shire, Lancefield—Tooborac Road, Pyalong Shire, Terip Terip Road, Alexandra Shire, Whittlesea–Kinglake Road, Whittlesea Shire, and Old Sale Road, Warragul Shire, were each extended by 1½ miles.

Work on the following major projects was commenced or completed during the year.

Cranbourne Shire.—Baxter–Tooradin Road—0·75 miles between South Gippsland Highway and Warneet Road were reconstructed, realigned, and surfaced with crushed rock.

Doncaster and Templestowe Shire.—Heidelberg–Warrandyte Road—Construction of McDougall's deviation was commenced, earthworks were completed and base course of crushed rock laid. The deviation is approximately 1 mile in length and will eliminate a winding section of the Board's road on a poor alignment in hilly country west of Warrandyte.

Eltham Shire.—Hurstbridge–Kinglake Road—Reforming and realignment between mileages 5·60 and 7·28 and replacement of timber bridge over Ironbark Creek.

Ferntree Gully Shire.—Ferntree Gully Road—Construction of bridge over Dandenong Creek.

Flinders Shire.—Rosebud–Flinders Road—0·8 mile of reconstruction and sand surfacing commencing ·75 mile south of Nepean Highway and continuing southerly; formation 36 feet wide, pavement 22 feet wide.

Frankston Shire.—Baxter–Tooradin Road—0·82 mile easterly from Frankston–Flinders Road was reformed, resheeted and sealed. Cranbourne–Frankston Road—0·5 mile of reconstruction and crushed rock surfacing of south traffic lanes of an ultimate divided carriageway between the Frankston–Stony Point railway line and McMahon's Road in the township of Frankston, pavement width 36 feet. Moorooduc Road—0·5 mile of reconstruction, realignment, crushed rock surfacing, and construction of traffic islands at junction with Frankston–Flinders Road. Formation 40 feet wide, pavement 28 feet wide. 0·5 mile of reconstruction and crushed rock surfacing commencing 1 mile south of Frankston–Flinders Road, formation 40 feet wide, pavement 26 feet wide.

Healesville Shire.—Healesville–Kinglake Road—2 miles of reconstruction, realignment and gravelling in the vicinity of Castella ; formation 26 feet wide, pavement 19 feet wide.

Healesville and Yea Shires.—Yarra Glen–Yea Road—On the new route via Dixons Creek the formation has been completed between the old Dixons Creek Road and the Healesville–Kinglake Road at the top of the Dividing Range.

Kilmore Shire.—Broadford–Wallan Road—Clearing, forming, draining, and crushed rock surfacing between mileages 6·175 and 7·30 including approaches to new railway bridge at Wandong.

Korumburra Shire.—Bena–Kongwak Road—Reconstruction of 5·7 miles.

Nunawading City.—Canterbury Road—Reconstruction and duplication of 1 mile, east of Middleborough Road, and reconstruction of 1,150 feet west of Springvale Road.

Warragul Shire.—Warragul–Korumburra Road—Reconstruction, realignment, and crushed rock surfacing from mileage 8·85 to 10·21 between Lardner's Track and Wharton's Road ; formation 28 feet wide, pavement 20 feet wide.

Waverley City.—Springvale Road—0·83 mile of reconstruction from Wellington Road to Princes Highway East.

Geelong Division.

Bacchus Marsh Shire.—Diggers Rest–Coimadai Road—A new reinforced concrete bridge was constructed over Coimadai Creek, together with a deviation and regrading of the road approaches. Balliang Road—A multi-pipe Armco structure to replace Collies Bridge together with the necessary approaches were completed (Plate 25).

Bannockburn Shire.—Meredith–Mt. Mercer Road—A multi-pipe Armco structure over Woodburn Creek was completed, together with a deviation and regrading of the approaches and a further reconstruction and extension of sealing by a mile to a point west of Bamganie Road. Fyansford–Gheringhap Road—Reconstruction and sealing 18 feet wide was completed and this road is now sealed throughout. Geelong–Ballan Road—A length of 4 miles was reconstructed and a light temporary seal applied to it late in the season, with a view to applying the permanent seal after the 1961 winter. This leaves only 2·2 miles of this road to be sealed between Geelong and Ballan.

Barrabool Shire.—Anglesea Road—The work of widening and strengthening of this road for coal traffic continued and, at the close of the year, the bridge over Freshwater Creek was in process of being widened to 28 feet between kerbs.

Bellarine Shire.—Portarlington–Queenscliffe Road—The work of widening the 12 feet seal on this road to 20 feet was completed. Geelong–Portarlington Road—Further reconstruction and widening completed.

Corio Shire.—Geelong–Bacchus Marsh Road—A further 4 miles of widening, strengthening, and sealing of the old narrow pavement was completed.

Leigh Shire.—Colac–Ballarat Road—Reconstruction, widening, and sealing 18 feet wide was completed for a length of 3 miles. Cape Clear–Rokewood Road—Further extension of sealing by 12 feet wide.

South Barwon Shire.—Torquay Road—A new reinforced concrete bridge was constructed over Thompsons Creek and this will eliminate delays due to flooding in the past. Further widening, reconstruction, and sealing 22 feet wide on this road was also completed but there is still a very extensive programme of widening and reconstruction required on this road to meet present traffic requirements. Barwon Heads Road—Replacement of decking on the long and rather narrow timber bridge over the Barwon at Barwon Heads was commenced late in the year. This became necessary because of deterioration of the timber decking. As provision of a new permanent structure of at least 28 feet between kerbs is expected to become necessary within a few years no widening of the old structure is being undertaken at this stage.

Horsham Division.

The length of main roads in this Division is now 1,034·5 miles of which 899·25 miles are sealed, including a considerable mileage 12 feet wide.

Arapiles Shire.—Apsley–Natimuk Road—9 miles of widening of 12-ft. seal to 18 feet.

Birchip Shire.—Berriwillock–Birchip Road—3 miles of reconstruction and sealing. Birchip–Warracknabeal Road—3·5 miles of reconstruction and sealing.

Dimboola Shire.—Rainbow Rises Road—3·5 miles of construction and sealing. Warracknabeal–Rainbow Road—6 miles of construction and sealing 12 feet wide. This completes the sealing of all the main roads in Dimboola Shire to at least 12 feet width.

Dunmunkle Shire.—Horsham–Lubeck Road—3·6 miles of construction and sealing 12 feet wide. This completes the sealing of the main roads in Dunmunkle Shire to not less than 12 feet width.

Kara Kara Shire.—St. Arnaud–Wycheproof Road—5 miles of construction and sealing 12 feet wide. Navarre Road—3·6 miles of construction and sealing 12 feet wide. A seal coat now exists on all main roads in Kara Kara Shire.

Karkarooc Shire.—The sealing was extended on 15 miles of main roads in this Shire, the width on 15 miles being 12 feet.

Kowree Shire.—Kaniva–Edenhope Road—6·6 miles of construction and sealing 12 feet wide. Casterton–Edenhope Road—4·6 miles of construction and sealing 12 feet wide.

Lowan Shire.—Goroke Road—2 miles of sealing. There is now a sealed surface on all main roads in the Shire.

Stawell Shire.—Two bridges over the Wimmera River at Joel Joel and Campbell's Bridge almost completed. Marnoo Road—3 miles of sealing 12 feet wide. Navarre Road—2·8 miles of similar sealing. The construction of a bridge over the Richardson River at Marnoo was also commenced.

Wimmera Shire.—Horsham–Lubeck Road—2·1 miles of reconstruction and sealing 12 feet wide. Kalkee Road—6·2 miles of construction and sealing 12 feet wide.

Metropolitan Division.

Brighton City.—South Road—Construction of new northern pavement for divided roadway between Hampton Street and Cummins Road.

Heidelberg City.—Bell Street—Reconstruction of divided roadway between Skeffington Street and Oriel Road. Heidelberg–Warrandyte Road (Banksia Street)—Completion of construction of bridge over Yarra River.

Moorabbin City.—Warrigal Road—Reconstruction and widening of pavement from Kingston Road to South Road. South Road—Continuation of construction of divided roadway between Nepean Highway and Warrigal Road.

Oakleigh City.—North Road—Reconstruction of pavement between Warrigal Road and Huntingdale Road (part as divided highway) (Plate 26). Warrigal Road—Completion of reconstruction and widening of pavement from Kangaroo Road to North Road.

Sandringham City.—Beach Road—Widening of pavement between New Street and Sandringham, and between Black Rock and Ricketts Point.

Traralgon Division

Alberton Shire.—Balloong Road—Construction of a 2-span reinforced concrete bridge over Bruthen Creek, together with 1·25 mile of construction and sealing approaches on a section subject to flooding.

Mirboo Shire.—Grand Ridge Road—Construction of a 3-span reinforced concrete bridge 100 feet long over the west branch of the Tarwin River, replacing an old timber structure known as Dykes Bridge, which had become unsafe for traffic. Mirboo–Leongatha Road—1·6 mile of reconstruction, realignment and sealing 18 feet wide.

Morwell Shire.—Boolarra-Foster Road—2·3 miles of realignment near Boolarra South.

Rosedale Shire.—Gormandale–Stradbroke Road—1·75 mile of construction and extension of sealing. Traralgon–Maffra Road—2 miles of reconstruction and sealing 20 feet wide near Cowwarr. Willung Road—1·5 mile of extension of sealing to complete sealing throughout.

Traralgon Shire.—Flynn's Creek Road—2·0 miles of extension of sealing. Traralgon-Maffra Road—Construction of multi-cell reinforced concrete culvert on floodway near Latrobe River.

Woorayl Shire.—Leongatha-Mirboo Road—Construction of 3-span rolled steel joist and concrete bridge on floodway of Tarwin River. and 1·15 mile of reconstruction and sealing 18 feet wide.

Warrnambool Division

Glenelg Shire.—Casterton-Apsley Road—4 miles of reconstruction and sealing 12 feet wide. Casterton-Penola Road—Crushing and stockpiling of 10.000 cubic yards of dune limestone for reconstruction in the forthcoming year.

Heytesbury Shire.—Timboon-Nullawarre Road—3 miles of realignment and reconstruction.

Minhamite Shire.—Woolsthorpe–Heywood Road—4·2 miles of reconstruction and sealing 12 feet wide.

Mount Rouse Shire.—Victoria Valley Road—1·5 mile of reconstruction and sealing.

Portland Shire.—Dartmoor–Hamilton Road—1·6 mile of reconstruction and sealing 12 feet wide. A new 3-span timber and steel girder bridge 12 feet wide by 122 feet long on reinforced concrete piers and abutments was completed. The bridge is designed for ultimate widening to 22 feet with a reinforced concrete deck (Plate 27).

Warrnambool Shire.—Warrnambool–Caramut Road—2 miles of reconstruction and sealing 20 feet wide. Peterborough Road—1·5 mile of reconstruction and sealing 20 feet wide.

10. UNCLASSIFIED ROADS.

In Victoria there are approximately 90,000 miles of unclassified roads and streets under local government jurisdiction. During the past year the Board again made provision for a limited programme of works including construction and reconstruction of roads and bridges as well as assisting towards maintenance of unclassified roads generally.

Commonwealth Aid Roads moneys were allocated for these purposes. Applications totalling £14.534.583 were received from councils for major works on unclassified roads and a total sum of £6,023,148 was allocated subject to contributions from councils varying in accordance with the circumstances in each particular case. For maintenance of unclassified roads £1.500.000 was applied for and £652.280 allocated again subject to councils' contributions. In allocating maintenance grants for unclassified roads the Board does not accept responsibility for the entire costs of maintenance of the road but makes a contribution to assist councils with such maintenance with the stipulation usually that the councils contribute at least £1 towards each £2 provided by the Board.

The total expenditure from Board's funds on unclassified roads during 1960–61 amounted to £3,634,216 for construction and reconstruction works and £592.962 for maintenance. Particulars of some major works typical of the main improvements on unclassified roads undertaken during the year are set out hereunder :—

Bairnsdale Division.

Avon Shire.—Clydebank Road—Reconstruction and sealing of 1 mile, 12 feet wide. Holland's Landing Road—Construction of 2·5 miles including a deviation to complete an all-weather road. Llowalong Road—Reconstruction and sealing of 1 mile. Montgomery Road—Reconstruction and sealing of 1 mile. Wonnangatta Road—A length of 4 miles of construction of new access road to Happy Valley was completed.

Bairnsdale Shire.—4·6 miles of bituminous surfacing extension 12 feet wide was carried out on unclassified roads including 2 miles on Fernbank–Glenaladale Road. 1 mile on Fernbank–Stockdale Road and 1 mile on Mount Lookout Road.

Omeo Shire.—Deans Road—Construction of additional 2 spans of low-level bridge at Tambo Crossing. Hollands and O'Briens Road—construction of additional 2 spans of low-level bridge at Swifts Creek.

Orbost Shire.—Karbethong Road—Construction of 1·6 mile of new roadway to connect Mallacoota Foreshore Road and Mallacoota Tourist Road. Marlo-Cape Conran Road—1 mile of sealing 12 feet wide. West Cann Road—installation of 120-in. diameter culvert at Jim Walkers Creek.

Sale City.—Raymond Street—Reconstruction and sealing for 0·2 mile.

Tambo Shire.—Buchan South Road—Reconstruction and sealing 1 mile. 12 feet wide. Gillingal Road—Construction of a 3 cell 54-in. diameter culvert at Frying Pan Creek. Kalimna West–Nungurner Road—Realigning and sealing 12 feet wide for ·9 mile. MacRae's Road—Construction of a new low-level timber bridge over Murrindal River. Mossiface–Tambo Upper Road—Reconstruction and sealing ·9 mile, 12 feet wide. Snowy River Road—Construction of a new road 14 feet wide between Suggan Buggan and New South Wales border for approximately 12 miles.

Wangaratta Shire.—Ovens Highway Detour Road—A commencement was made to replace two old timber bridges over Reedy Creek with two reinforced concrete bridges, 196 feet total length by 22 feet between kerbs.

Yackandandah Shire.—Back Creek Road—3 miles of reconstruction and widening. Lockhart's Gap Road—Reconstruction and widening of 1 mile.

Bendigo Division

Kerang Shire.—Kerang–Koondrook Road—4 miles of reconstruction and sealing 20 feet wide.

Mildura Shire.—Red Cliffs-Morkalla Road—4 miles of forming and limestone rubbling between Bambill and Yarrara railway stations. Red Cliffs–Colignan Road—3·8 miles of forming and rubbling between Stewart and Iraak.

Rochester Shire.—Gunbower Island Road—1·75 mile of strengthening and sealing-cement stabilized granitic sand was used in the construction of the pavement on this project. Lockington-Kotta Road—Reforming and surfacing in preparation for sealing of 3·1 miles.

Cohuna Shire.—Cohuna–Koondrook Road—3 miles of reconstruction and sealing 20 feet wide. Cohuna–McMillans Road—·75 mile of sealing 18 feet wide.

Gordon Shire.—Bendigo–Pyramid Road—·93 mile of reconstruction and sealing 12 feet wide. Boort–Kerang Road—5·2 miles of resheeting and sealing 12 feet wide. Pyramid–Leitchville Road—·73 mile of sealing 18 feet wide.

Huntly Shire.—Elmore–Raywood Road—3·52 miles of resheeting and sealing 12 feet wide.

Korong Shire.—Wedderburn–Boort Road—10·9 miles of reconstruction, resheeting and sealing on various sections 12 feet wide. Borung–Hurstwood Road—4 miles of sealing 12 feet wide.

Marong Shire.—Bridgewater–Maldon Road—2 miles of reconstruction and sealing 12 feet wide. Ravenswood–Marong Road—2 miles of widening and sealing 20 feet wide.

Dandenong Division.

Eltham and Doncaster and Templestowe Shires.—Eltham–Templestowe Road—This road will form an important link between Eltham and the eastern suburbs. Construction of the road from both Eltham and Templestowe, together with a new bridge over the Yarra River is in progress. The new route will serve a large community as the nearest bridges over the Yarra are at Heidelberg and Warrandyte.

Cranbourne Shire.—1 mile of reconstruction of Greens Lane between South Gippsland Highway and Dandenong–Frankston Road.

Doncaster and Templestowe Shire.—0·3 mile of realignment widening and replacement of culvert on Hall Road, South Warrandyte.

Korumburra Shire.—Outtrim–Moyarra Road—1·27 mile of reconstruction, widening and realignment between mileages 0·0 and 1·27 from Korumburra–Wonthaggi Road.

Nunawading City.—0·41 miles of reconstruction of Middleborough Road between Springfield Road and Katrina Street, Blackburn West.

Phillip Island Shire.—Reconstruction to sealing standard of 1·75 mile of Back Beach Road from the end of bitumen to Ventnor Road.

Ringwood City.—0·42 mile of reconstruction of Mullum Road from Hobart Street to Byron Street, North Ringwood.

Geelong Division.

Bannockburn Shire.—Meredith–Shelford Road—2·25 miles reconstructed and sealed 12 feet wide.

Bellarine Shire.—Boundary Road—0·75 mile reconstructed preparatory to sealing, being a major link between Geelong–Portarlington Main Road and the Bellarine Highway. Swan Bay and Banks Roads—A 2-span bridge on each of these roads has been constructed.

Colac Shire.—Larpent Road—Reconstruction and sealing of 2 miles of this road south from Princes Highway completed.

Corio Shire.—Thompson Road—Channelization completed. The Midland Highway intersection was completed with the result that traffic flow between the industries at Norlane to West Geelong has been greatly improved.

Leigh Shire.—Winchelsea–Doroq Road—Construction of 4-span bridge, 100 feet over-all length, is nearing completion and will result in the completion of an all-weather school bus route.

Melton Shire.—Exford Road—1·1 mile reconstructed and sealed to complete the total length of this road in the Shire and provide good access to the Exford weir and pleasure resort.

Werribee Shire.—Ballan Road—2 miles of forming and gravelling. Farm Road—Reconstruction of 1·5 mile adjacent to the Farm Road overpass—commenced late in the year and well towards completion at 30th June, 1961.

Winchelsea Shire.—Kinsella's Road—Construction of a 3-span concrete and rolled steel joist bridge 100 feet long by 18 feet between kerbs over Mathews Creek, to replace an old timber bridge built in 1905. Cape Otway Road—A further 2 miles reconstructed and sealed.

Horsham Division.

There is a length of 293 miles of unclassified roads sealed in the Division at present. Extension to the sealed length was 88 miles, mostly 12 feet wide. The seal is being extended at the rate of about 80 miles per year. The work carried out during the financial year 1960–61 included the following:—

Arapiles Shire.—Jallumba–Clear Lake Road—2 miles of construction and sealing.

Dimboola Shire.—Warracknabeal–Jeparit Road—2 miles of construction and sealing.

Kara Kara Shire.—Natte Yallock–Moyreisk Road—2 miles of construction together with a new reinforced concrete bridge at Coady's.

Kowree Shire.—Sealing was extended by a length of 16 miles on various unclassified roads.

Stawell Shire.—Two small steel and concrete bridges were constructed on Glenorchy Lake–Lonsdale Road and Allanvale–Dunneworthy Road.

In addition to the foregoing work, a total length of 20 miles was resealed in the Division.

Metropolitan Division.

Camberwell City.—Union Road—Widening pavement from Whitehorse Road to Belmore Road to a width of 42 feet. Balwyn Road—Widening pavement from Whitehorse Road to Belmore Road.

Footscray City.—Sunshine Road—Reconstruction of pavement west of Graingers Road. Moore Street—Reconstruction of pavement.

Northcote City.—Separation Street—Continuation of pavement reconstruction to Victoria Road.

Prahran City.—Alexandra Avenue—Reconstruction of pavement from Toorak Road to Como Park, providing one-way crossfall around curves.

Traralgon Division.

Alberton Shire.—Pound Road—2·00 miles of construction realignment and extension of sealing 12 feet wide.

Morwell Shire.—Mountain Hut Road—2·80 miles of realignment and reconstruction in preparation for sealing on through route between Morwell and Mirboo North.

Rosedale Shire.—Longford–Letts Beach Road—2·00 miles of resheeting and 6·5 miles of sealing to complete sealing throughout. Rosedale–Longford Road—2·00 miles of construction and extension of sealing. Sale–Heyfield Road—5·40 miles of extension of sealing to complete sealing throughout.

South Gippsland Shire.—Fish Creek–Yanakie Road—1·52 miles of realignment of sharp curves south of Fish Creek (Plate 28).

Woorayl Shire.—Meeniyan–Buffalo Road—1·08 mile of forming and surfacing near Buffalo.

11. TOURISTS' ROADS.

During the year the total length of tourists' roads was increased to 426 miles by the declaration of the Mt. Dandenong Tourists' Road. Application for funds totalled £857,920 and £659,500 was allocated. With the exception of a length of the Ocean Road in the Shire of Otway which is supervised by the Otway Shire Council, all maintenance and improvement works on tourists' roads are under the direct supervision of the Board. The Board bears the full cost of all works on proclaimed tourists' roads.

A portion of the Mt. Buffalo Road between Egg Rock and the Horn, a length of 2 miles, was reconstructed and widened. The Alpine Road in the Shire of Bright was improved by widening of two sections totalling about 2 miles, while a 2-mile section near the summit in the Shire of Omeo was widened and surfaced. Widening of the Mt. Buller Road was continued and a start has been made on the widening and reconstruction of the Acheron Way between Warburton and Cement Creek.

Three new bridges were completed on the Ocean Road at Sheoak River, Separation Creek and Flatbottom Creek (Plates 29 and 30) and at the end of the year a new bridge over the Barham River at Apollo Bay was in course of construction. General widening to accommodate longer passenger buses was completed to the stage that vehicles 33 feet in length were permitted between Lorne and Apollo Bay before Christmas 1960. The 5-ton axle load restriction was also removed between Torquay and Apollo Bay. The road was realigned at Separation Creek and at Flatbottom Creek. Widening and reconstruction between the Bown Coal Mine access and the Anglesea township was commenced late in the year. A length of approximately three-quarters of a mile on the western approach to Port Campbell was reconstructed.

On the Grampians Road a section subject to flooding at Illawarra was reconstructed and raised, a length of $3\frac{1}{2}$ miles of the road widened near the Pomonal turnoff and reconstruction and sealing extended by 4 miles south from the Silverband Road. At the Mirranatwa Gap a $4\frac{1}{2}$ miles section in mountainous terrain was reconstructed and sealed. All tourists' roads were maintained in a satisfactory condition for traffic throughout the year and access to the snow fields at Mt. Buller, Mt. Buffalo and Mt. Hotham maintained by snow removal during the winter season (Plate 31).

12. FOREST ROADS.

Applications totalling £404,012 were received for the 463 miles of forest roads proclaimed under the Country Roads Act and £347,376 was allocated.

Much of this work is under Councils' supervision but no contribution is required from the Councils.

Major works on forest roads undertaken during the year included :—

Benalla Shire.—Tatong–Tolmie Road—2 miles of reconstruction, realignment and sealing, south of Tatong (Plate 32).

TOURISTS' ROADS.

Plate 29.—Shire of Winchelsea. Ocean Road. Realignment including new bridge at Separation Creek.

Plate 30.—Shire of Otway. Ocean Road. Realignment including new culvert at Flatbottom Creek.

Plate 31.—Shire of Omeo. Alpine Road. Snow clearing.

FOREST ROADS.

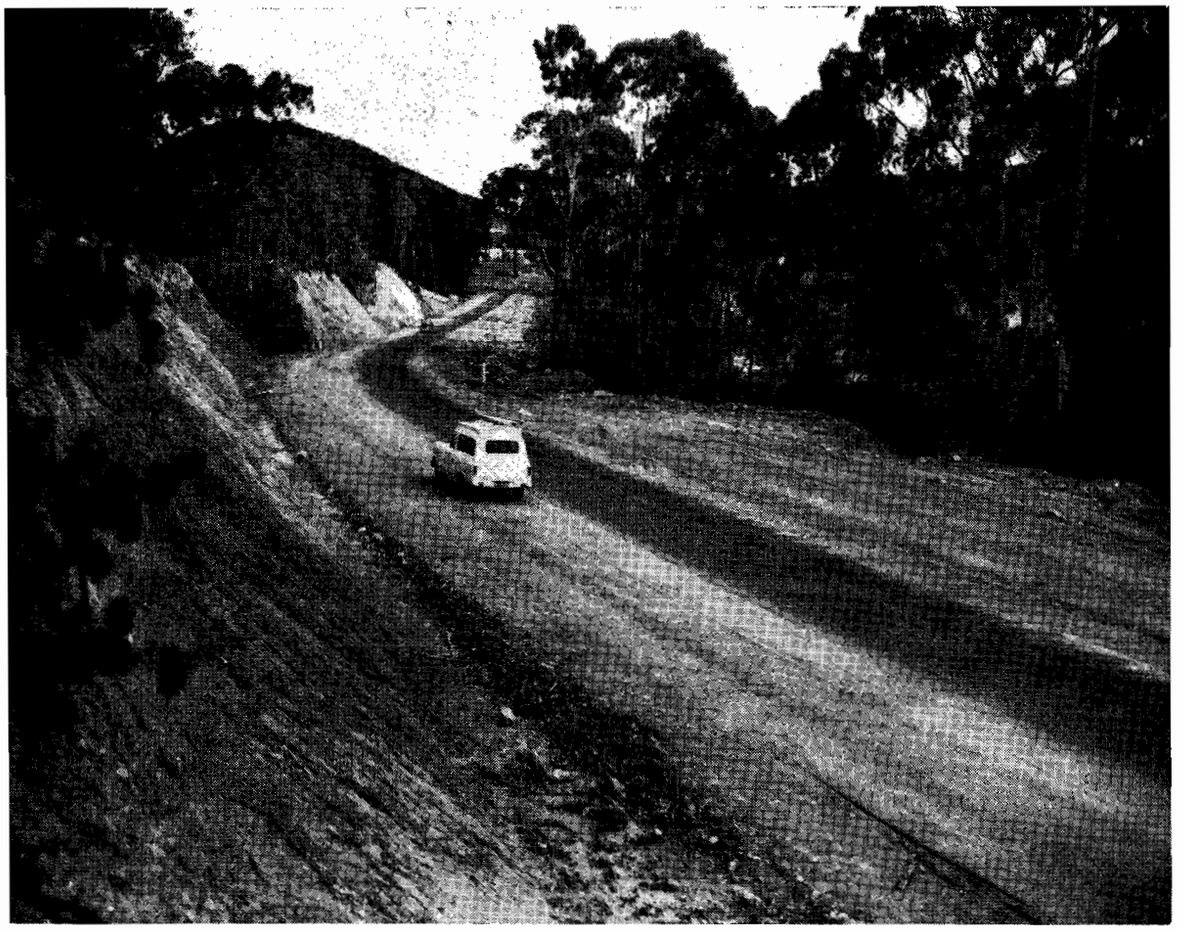


Plate 32.—Shire of Benalla. Tatong Tolmie Road. Widened and reconstructed section south of Tatong.

Plate 33.—Shire of Narracan. Walhalla Road. Deviation of road around Moondarra Reservoir. Old road on lower left.

Narracan Shire.—Walhalla Road—Commencement of construction of 8·75 miles of deviation of this road required for the construction of Moondarra Reservoir by the Latrobe Valley Water and Sewerage Board (Plate 33). The project includes the construction of a 3-span reinforced concrete bridge over the Tyers River.

Otway Shire.—Forrest–Apollo Bay Road—A further length of 1·5 mile of widening, realigning, strengthening and sealing 18 feet wide concluded.

Tambo Shire.—Bruthen–Buchan Road—2·75 miles of reconstruction of a section near Bruthen, at Kilmorie Hill.

Winchelsea Shire.—Deans Marsh–Lorne Road—Widening, minor realigning, strengthening and sealing, which was in progress in financial year 1959–60, but deferred because of the wet winter, was completed over a length of 1·4 mile this financial year, the restored seal being 16 feet wide.

13. BRIDGES.

The volume of new bridge construction work undertaken in the twelve months again increased during 1960–61. 211 new bridge projects were commenced, the estimated total value being £1,724,000 compared with £1,630,000 in 1959–60. 136 of these new bridges (estimated to cost £864,000) were under municipal supervision and 75 (estimated to cost £860,000) were under the Board's supervision. The Board's Bridge Division, as in previous years, collaborated in the design of some of the more complex bridges constructed under municipal supervision. The transfer of head office to Kew enabled sections of the bridge designing staff who had been temporarily accommodated at the separate premises at Drummond Street, Carlton, to rejoin the main divisional staff which now occupies one floor of the new building, with consequent benefits.

Some of the major bridges completed under the Board's supervision in various parts of Victoria during 1960–61 included the following :—

(*a*) 482 ft. x 22 ft. over the Glenelg River at Harrow in the Shires of Kowree and Wannon. The bridge was officially opened by the Chairman, Mr. D. V. Darwin on 11th August, 1960 (Plates 34 and 35).

(*b*) 240 ft. x 30 ft. over the Mitchell River on the Bullumwaal–Tabberabbera Road at Wy Yung in the Shire of Bairnsdale. The Chairman, Mr. D. V. Darwin performed the opening ceremony on 20th October, 1960.

(*c*) 164 ft. x 23 ft. over the Goulburn River on the Mansfield–Woods Point Road in the Shire of Mansfield, replacing an old timber bridge known as Burns Bridge (Plate 36).

(*d*) 201 ft. x 26 ft. over Bullabul Creek at 123·1 mile on the Calder Highway.

(*e*) Three reinforced concrete bridges totalling 505 ft. x 28 ft. over the Morwell River on the new route of the Princes Highway East together with two rail overpass bridges totalling 169 ft. x 28 ft.

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

(*a*) A reinforced concrete bridge 176 ft. x 22 ft. over Serpentine Creek on the Charlton–Durham Ox Road in the Shire of Gordon. The Board's Chief Engineer, Mr. J. Mathieson, opened the bridge on 17th March, 1961.

(*b*) 220 ft. x 22 ft. over the Buffalo River on the Buffalo River Road in the Shires of Oxley and Myrtleford. The bridge consisted of reinforced concrete substructure with 1/50 ft. 2/45 ft. and 1/80-ft. steel girder span and reinforced concrete deck.

(*c*) 240 ft.x 26 ft. over the Wimmera River at Quantong on the new Wimmera Highway in the Shire of Wimmera consisting of 4/60 ft. spans with concrete piers, steel girders and rail in concrete slab deck.

(*d*) 239 ft. x 12 ft. over the Mitta Mitta River on the Mitta North Road in the Shire of Towong, six spans with concrete piles, piers and abutments, steel girders and timber deck.

BRIDGES.

Plate 34.—Shires of Kowree and Wannon. Coleraine-Harrow-Edenhope Road. Old bridge over Glenelg River at Harrow.

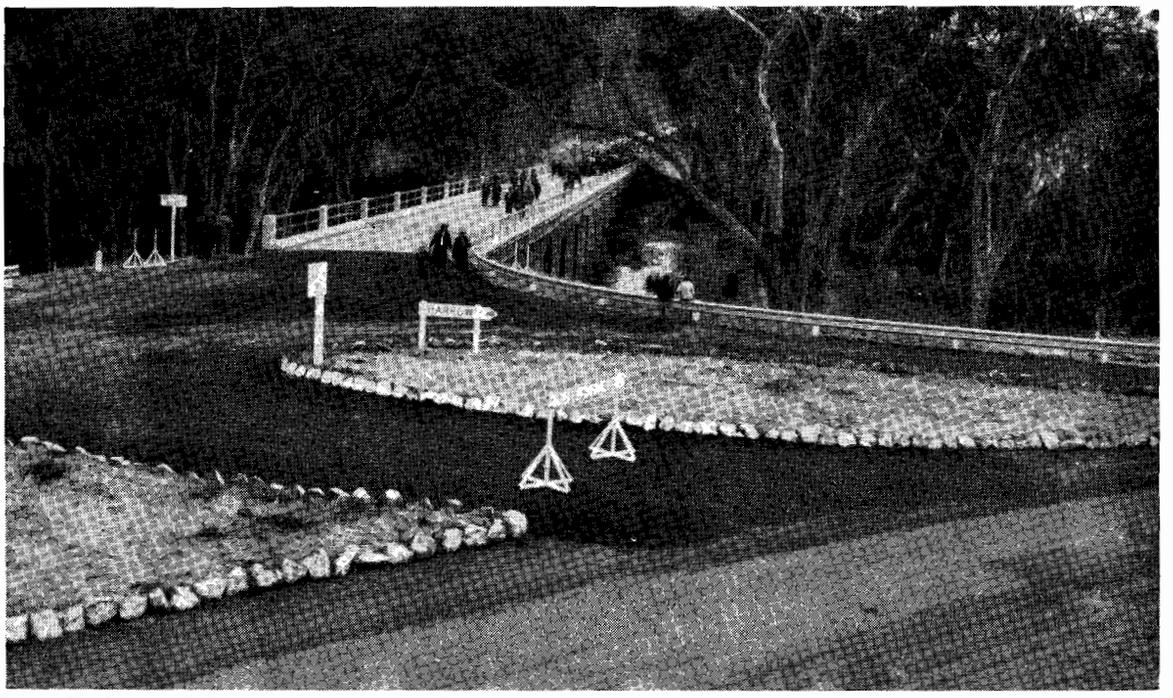


Plate 35.—Shires of Kowree and Wannon. Coleraine-Harrow-Edenhope Road. Official opening of new bridge over Glenelg River.

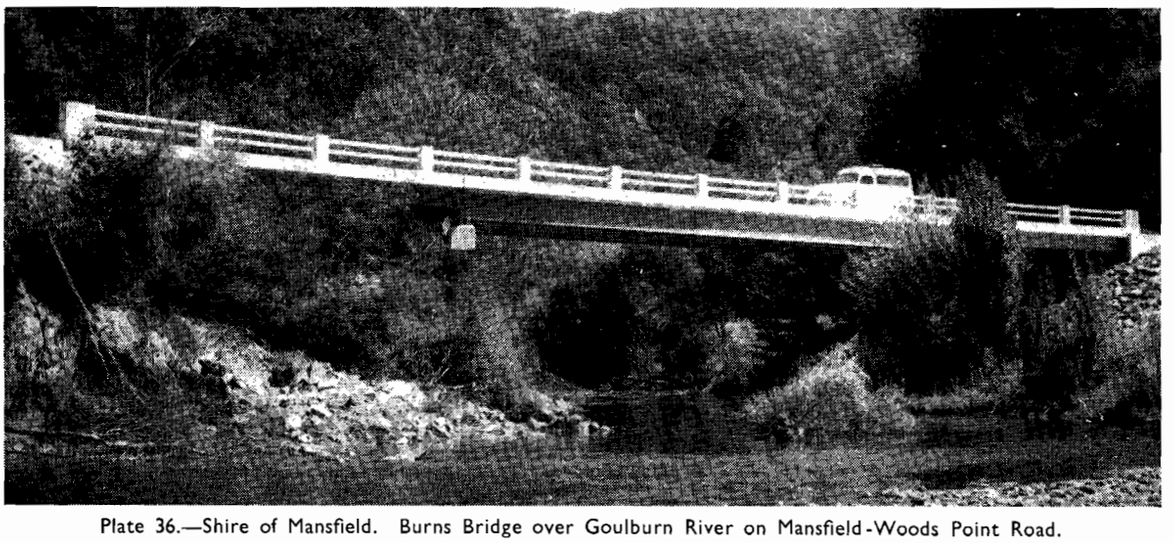


Plate 36.—Shire of Mansfield. Burns Bridge over Goulburn River on Mansfield-Woods Point Road.

Plate 37.—Opening Ceremony—Kings Bridge. 12th April, 1961.

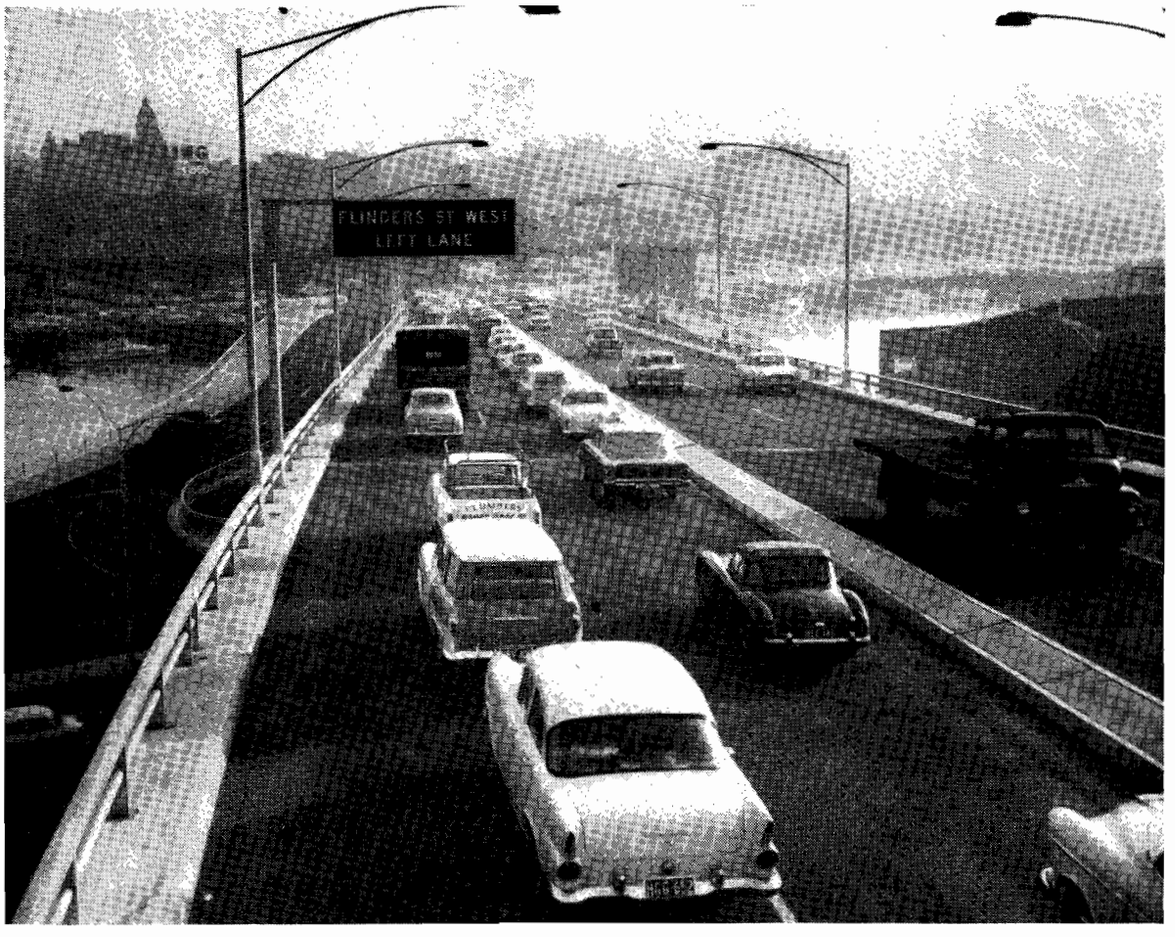


Plate 38.—Early morning peak traffic over Kings Bridge.

Kings Bridge.—Traffic commenced using the east and west lanes of the low-level bridge over the Yarra in November, 1960, and on 12th April, 1961, the main bridge was officially opened by the Premier, The Honorable H. E. Bolte, M.L.A. The Commissioner of Public Works, The Honorable Sir Thomas K. Maltby, E.D., M.L.A., unveiled the commemorative plaque (Plates 37 and 38).

As anticipated the bridge is now providing appreciable relief as a traffic outlet and has reduced the flow of traffic over Spencer Street Bridge and Queens Bridge. Further details of the Kings Bridge project are contained in the report of the Chief Engineer.

Other Metropolitan Bridges.—Construction of the new bridge, 278 ft. x 28 ft. plus a 6-ft. wide footway over the Yarra River at Banksia Street, Heidelberg, was completed and the bridge is now open to traffic. Work was also commenced on the construction of a new high-level bridge 642 ft. x 28 ft. over the Carrum Outfall Drain in the City of Springvale.

Other bridges on which work has been started include :—

(*a*) Dual rail over-pass two lane structures at Albion on the Western Highway, 28 ft. x 226 ft. for the northern lanes and 28 ft. x 260 ft. for the southern lanes, with provision for widening each structure to three lanes.

(*b*) Dual rail over-pass two lane structures at Craigieburn on the Hume Highway of 27 ft. x 240 ft. each with provision for widening to three traffic lanes.

(*c*) Reconstruction and widening of the bridge 127 feet long over the Merri Creek on St. Georges Road in the Cities of Fitzroy and Northcote to 50 feet plus two footways 8 feet wide.

Maltby By-pass Road.—Ten bridges and culverts were constructed on the Maltby By-pass Road totalling 2,013 lineal feet and costing approximately £350,000.

Bridge Inspections.—During 1960–61 inspections have been made and reports prepared on the condition of more than 300 bridges. A detailed report has also been prepared on the damage resulting from overloading to the San Remo Bridge, including methods which might be adopted to strengthen the bridge to a higher load standard.

Materials.—Contracts were let during the year for the supply of pre-stressed concrete slabs and beams to a value of £140,000 and reinforced concrete pipes and box culverts valued at £234,000. Supplies from country centres showed a further increase, approximately one-half of the Board's pipe requirements and two-thirds of box culvert requirements being provided by contractors in rural areas. Purchases of corrugated steel pipes and guard rail during the year totalled £45,000.

Due to continuing shortages of steel from Australian sources, orders were placed in the United Kingdom for the supply of approximately 2,000 tons of steel beams and plate. Approximately 1,900 tons of reinforcing round steel was obtained from local suppliers. Sufficient supplies of cement were made available during the year and approximately 9,000 tons were used on Board's projects.

Tendering.—Urgent demands for the construction of bridges and overpasses in the metropolitan area and on the Maltby By-pass Road, with insufficient time to prepare and advertise completed drawings and specifications, necessitated a considerable increase in direct labour works. In addition some difficulty has occurred in obtaining tenders for bridge works in several areas. Tendering for the supply of various bridge components has continued to be keen.

14. BITUMINOUS SURFACING.

Extent of Work.—In 1960–61, 2,783 miles of bituminous surfacing was completed on all classes of roads, an increase of 5·85 per cent. on the length of work done in 1959–60. This work included the provision of 1,146 additional miles of sealed roads, 378 miles of restoration of the seal coat on reconstructed sections, 1,053 miles of maintenance retreatment, and 107 miles of seal coat widening. It also included a length of 99 miles of sealing work undertaken to assist municipalities and State authorities.

The sealed network in Victoria was thus extended by 72 miles being added to the length of sealed pavements on State highways, by-pass roads, tourists' roads and forest roads, 454 miles on main roads and 620 miles on unclassified roads. Retreatment and restoration of the seal coat on reconstructed sections of the declared system amounted to 1,261 miles or 12·1 per cent. of the sealed system, retreatment amounting to 909 miles or

8·7 per cent. The total length of sealed surface on the Board's declared system, which was increased during the year to 14,512 miles, is now 11,003 miles or 75·8 per cent. The Chief Engineer's report shows full details of the various types of treatment on different road categories.

The work was again predominantly of the sprayed type, undertaken by the Board's mobile sealing units, with some assistance from municipalities, but there was a notable increase in the use of hot-mixed machine-spread asphalt on the more heavily trafficked roads nearer the metropolitan area and the provincial cities of Geelong and Ballarat. This work was undertaken by contractors and amounted to a length of 77 miles of various widths, an increase of 48 per cent. on the length of similar work completed in 1959–60.

Bituminous Plant and Personnel.—In 1960–61 the same complement of plant and personnel were engaged as during the previous year. 23 of the Board's mobile spraying units and approximately 650 men being again employed on spraying work.

Up to seven asphalt plants were operated by contractors manufacturing and laying hot-mixed asphalt during the year and the design and supervision of this type of work has made increased demands on the Board's staff and supervisory personnel.

Supply of Material.—27,708 tons of bitumen was bought for the sprayed work from two oil refineries in Victoria, 98·8 per cent. of this material being distributed in bulk throughout the State by rail (75 per cent.) and by road (25 per cent.). In addition to the bitumen a considerable quantity of priming materials comprising tars and cut-back bitumen is used each year in the spraying work. A quantity of approximately 7,500 tons of these materials was supplied this year from metropolitan and country gas works and from oil refineries.

Three hundred and sixteen thousand one hundred and sixty-eight cubic yards of covering aggregate were used in the sprayed work during the year this being supplied mainly by contractors, augmented to some extent by the Board's own crushing plant. Table 5 in the Chief Engineer's report indicates the trend in costs of aggregate over the past few years.

SOLDIER SETTLEMENT.

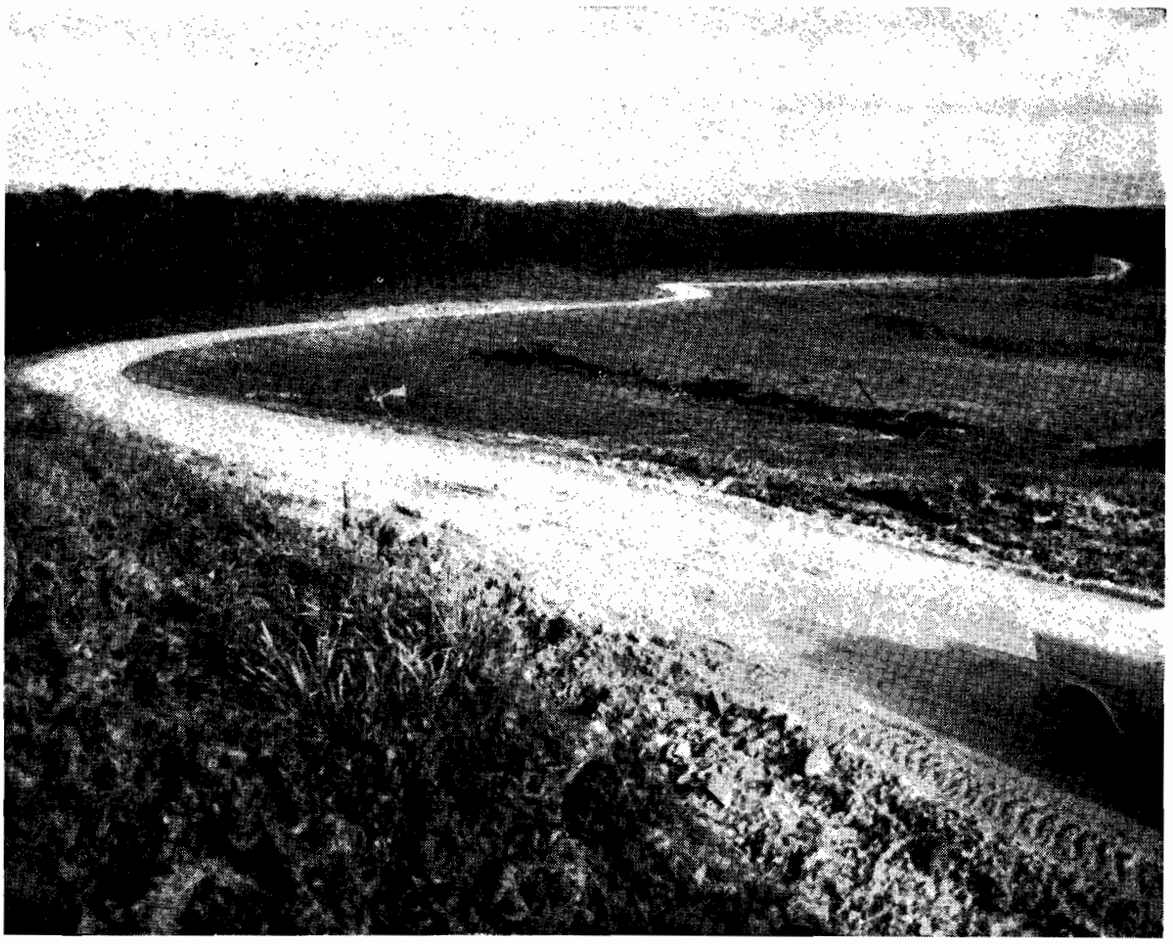


Plate 39.—Shire of Otway. Heytesbury Soldier Settlement. Approximately 2 miles north of Ocean Road.

15. SOLDIER SETTLEMENT ESTATE ROADS.

Provision of sub-divisional roads in estates purchased by the Soldier Settlement Commission or allotted from Crown Lands continued during 1960–61 in conjunction with the Commission and municipalities.

A further 22 miles of new road formation in the Heytesbury Soldier Settlement area was constructed under the Board's direct supervision (Plate 39) and 4 miles under the supervision of the Shire of Heytesbury. Gravel has been laid on 33 miles of road most of which were formed in 1959–60, and in preparation for the 1961–62 road making season a further 12 miles of roads have been cleared and surveys are proceeding. Three bridges have also been constructed.

Work was also undertaken for the Soldier Settlement Commission on Warrowie Estate in the Shire of Colac and on the East Goulburn irrigation settlement area in the Shire of Tungamah.

During the year the total expenditure on road and bridge works to serve Soldier Settlement Estates was £273,333 of which £90.842 was paid by the Commission, £156,405 by the Board and £26,086 by councils. The total expenditure on all road and bridge works associated with Soldier Settlement Estates since the inception of the scheme is £1,987,416 of which £1,051,756 was contributed by the Commission £707,589 by the Board and £228,071 by councils.

16. WORKS FOR OTHER AUTHORITIES.

The following summary shows works undertaken during the year at the cost of other authorities :—

WORKS EXECUTED ON BEHALF OF COMMONWEALTH AND STATE GOVERNMENT AUTHORITIES FOR YEAR ENDED 30TH JUNE, 1961.

Departments.	Description of Works.	Expenditure.	
		£ s. d.	£ s. d.
Victorian Departments.			
State Rivers and Water Supply Commission	Construction of various bridges over Commission Channels ; roadworks in connexion with Eppalock Weir, &c.	26,651 0 9	
Soldier Settlement Commission	Roadworks—Soldier Settlement Estates throughout the State	91,607 10 11	
State Electricity Commission	Roadworks—Morwell Shire ; Hernes Oak Deviation on Princes Highway East	183,449 2 7	
Housing Commission ..	Roadworks in Morwell Housing Estate	30,426 13 8	
Department of Lands and Survey	Roadworks in Shires of Kaniva, Kowree, Orbost and Glenelg	29,665 8 4	
Department of Public Works	Roadworks—Horsham Technical School, Albert Park Lake Reserve Roads. Pile Driving—Dookie Agricultural College ; Construction of various fruit fly inspection points	2,976 5 3	
Melbourne and Metropolitan Board of Works	Roadworks—Healesville Shire	1,706 3 8	
Latrobe Valley Water and Sewerage Board	Roadworks—Gould Deviation on Walhalla Road, Shire of Narracan	88,689 0 9	
Forests Commission ..	Construction of bridges, Shire of Maffra	3,438 4 0	
Latrobe Valley Development Advisory Committee	Contribution towards cost of widening Morwell-Maryvale Road—Shire of Morwell (Land Compensation, removal of buildings &c.)	9,000 0 0	
			467,609 9 11
Commonwealth Departments.			
Department of Works ..	Roadworks—Devonshire Parade, adjacent to Melbourne Airport ; various access roads to Commonwealth establishments	16,190 7 7	
			16,190 7 7
Special Projects.			
Kings Bridge	Construction of bridge over the Yarra River with southern viaduct approach and overpass in Flinders Street, including land acquistion—Cities of Melbourne and South Melbourne	1,029,721 19 2	
Napier Street Bridge ..	Construction of bridge over the Maribyrnong River and rail overpass—Cities of Melbourne and Footscray	23,486 10 4	
Coal Canal Bridge ..	Construction of temporary bridge over the Railway Coal Canal at West Melbourne—City of Melbourne	7,009 15 7	
Railway Level Crossings ..	Elimination of various railway level crossings	195,190 13 4	
Municipalities Forest Road Improvements	Improvement of various roads adjacent to State forests to facilitate the extraction of forest produce	9,166 13 7	
			1,264,575 12 0
	Total	.. ..	1,748,375 9 6

17. ELIMINATION OF LEVEL CROSSINGS 1960–61.

Total expenditure on level crossings projects this financial year totalled £1,300,000 which generally was apportioned as follows:—

	%
Country Roads Board	45
Victorian Railways	25
Level Crossings Fund	30

For projects connected with construction of standard gauge tracks on the north-eastern railway between Melbourne and Albury this apportionment varied in accordance with the relationship of the type of work to each Department's needs. In addition, these works were subsidized by the Uniform Gauge Trust Fund. Total estimated cost of level crossings projects for standard gauge works is £1,950,000 of which the Board's share will be approximately £861,100. Works of this nature were in progress at 30th June, 1961 at Newport, Sunshine, Albion, Tallarook, Seymour, Euroa and Wangaratta. In addition, the construction of the Hume By-pass Road was proceeded with, to enable the closing of six level crossings. The construction of works in connexion with the standard gauge has meant considerable effort by the Board to achieve completion by the end of 1961.

The project at Elsternwick was completed at a cost of approximately £430,000, whilst works at Newport (estimated total cost £460,000) Dandenong (£120,000) and Craigieburn (£380,000) are nearing completion. Preliminary expenditure including land acquisition was also incurred in connexion with projects at Warrigal Road, Oakleigh, Pascoe Vale Road, Strathmore, and Princes Highway West, Brooklyn.

18. FLOOD DAMAGE.

Restoration of damaged roads and bridges in the Wimmera region has proceeded with the balance of funds provided under the Commonwealth–State Flood Relief Agreement of 15th February, 1957, and the availability of funds from this source is now terminated.

No major damage to roads and bridges was reported during the year under review and any isolated damages due to sudden storms were generally repaired from existing maintenance funds available.

However, the changing levels of the waters in Lake Corangamite continued to cause inundation of the lower areas in parts of the Shires of Colac and Heytesbury during the year. Certain of the roads in these areas became either impassable or suffered damage from traffic.

19. ROADMAKING MATERIALS AND RESEARCH.

The scope, extent and complexity of the work of the Materials Research Division has continued to increase. The development of more refined techniques in the study of pavement behaviour, roadmaking materials and foundation problems has been facilitated by the recruiting of scientific staff with basic training in chemistry, physics and geology.

The portable seismograph has continued to be widely used in the rapid investigation of sites of deep cutting, bridge foundations, embankments over alluvial flats, and in locating sandstone deposits in the Wimmera. The information obtained at relatively low cost has permitted design work to proceed with confidence, and has allowed more costly detailed investigations to be reduced to a minimum.

The construction of roads on French Island has been hampered by a shortage of roadmaking materials. A study of the geology of the area resulted in the location of deposits of ferruginous gravelly sand and decomposed basalt which, when combined, may be suitable as base course material. A deposit of basalt on the south side of the island will be suitable for the production of surface course fine crushed rock.

Deposits of roadmaking materials have also been investigated in many other areas of the State. In many areas existing sources of materials have been worked out and the problem of locating new sources of material, or of determining the best method of extending existing workings, is a pressing one. Investigations of this nature were carried out in the Shires of Newstead, Yea and South Gippsland. In the Shire of Warrnambool and Borough of Koroit, many sources of scoria were investigated as alternatives to Tower Hill deposits, but with only limited success.

Laboratory and field investigations of hot mixed bituminous concrete have continued. In recent work, the use of natural sands and angular stone dust. and mixtures of these materials has been studied.

The Board's crushing and screening plant which had been set up at Bald Hills, 7 miles north of Ballarat, was transferred during the year to Newtown, 3 miles south of Scarsdale. The plant was used to produce quartz aggregate for B.S.T. work on the neighbouring roads.

New quarries operated by contractors at Glenrowan, Euroa and Barnawartha supplying ballast for the north eastern rail gauge standardization project have provided large quantities of fine crushed rock and sealing aggregrate for Board and municipal road work.

Extensive surveys were carried out with the seismic refractograph in the Shires of Donald and Birchip.

Large scoria pits have been opened up on Mt. Rouse by a private contractor and this material was used successfully with the addition of a small amount of loam or stone dust.

The establishment of the Country Roads Board Fellowship in Highway Engineering in the University of Melbourne was referred to in previous Reports. The first Fellow Mr. D. T. Currie B.C.E. commenced work in May, 1956, on an investigation of the strength of multi-layer systems of granular materials under static loads. The Multi-layer system simulates in a simplified way the construction of a flexible pavement. The published work was studied and appraised, and the problems of instrumentation and construction of laboratory models were investigated theoretically and experimentally. The results of this work were reported in a thesis for which Mr. Currie was awarded the degree of Doctor of Philosophy by the University.

The Fellowship is currently held by Mr. J. Morris B.C.E., who was appointed in March, 1960, for a two-year period. The design and construction of pressure cells and the techniques of model construction have been improved, and work is proceeding using layered systems comprising a sand bed with overlays of bituminous concrete or portland cement concrete of various thicknesses. Good correlation has been obtained between theoretical predictions and experimental results.

This work was carried out in the C.S.I.R.O. soil mechanics laboratory adjoining the Board's depot at Syndal.

During the year construction of a structural testing laboratory was commenced by the University of Melbourne Civil Engineering Department at Syndal. The building is a steel framed structure with asbestos cement cladding. The main facility is a testing floor 80 feet long by 40 feet wide for load testing of full size structures and components. Construction of this laboratory was financed by donations from industry.

20. LEGISLATION AFFECTING THE BOARD.

The following legislation affecting the Board became operative during the financial year :—

Motor Car (*Amendment*) *Act* 1960 (No. 6628)

Section 4 of this Act provided authority for the Governor in Council to make regulations prescribing fees for tests of qualification for the issue of drivers' licences. In November, 1960, a regulation was made prescribing a fee of £1.

Such fees less cost of testing are paid into the Country Roads Board Fund and in 1960–61 the nett payment amounted to £10,631.

Tourist (*Amendment*) *Act* 1960 (No. 6682).

Section 9 of the *Tourist Act* 1958 (No. 6395) set down what was in effect intended as a formula for ascertaining the amount to be paid annually out of the Country Roads Board Fund into the Tourist Fund.

Prior to the enactment of the *Tourist* (*Amendment*) *Act* 1960 the amount to be paid was 2 per cent. of the nett total amount credited to the Country Roads Board Fund from motor registration fees, fines and drivers' licence fees less certain deductions. The

deductions included the amount which is required to be paid out of the Country Roads Board Fund " for the costs and expenses of the administration of the said Act." There were many varying points of view about which items should be classed as costs and expenses of administration and the Crown Solicitor suggested that a new formula be introduced.

The *Tourist (Amendment) Act* 1960 overcomes the difficulty by removing altogether the provision for deductions in assessing the amount to be paid into the Tourist Fund.

The financial effect was to increase the payment from the Country Roads Board Fund in 1960–61 to £187,872. Under the old formula the amount would probably have been approximately £165,200.

Road Traffic (Amendment) Act 1960 (No. 6718).

Section 39 (3) of the *Country Roads Act* 1958 gave the Board authority with the approval of the Governor in Council, after consultation with the Chief Commissioner of Police and the municipal council concerned, to apply out of the Country Roads Board Fund certain sums of money towards the construction, purchase and installation on any road of traffic control lights.

As it is necessary under the provisions of the Road Traffic Regulations 1960 to obtain the approval of the Traffic Commission before any traffic control signal is installed it was found that considerable administrative and clerical work was necessary to obtain the approval of both the Chief Commissioner of Police and the Traffic Commission to proposed installations. In order to expedite the handling of such proposals the words " Chief Commissioner of Police " were deleted from Section 39 (3) of the Country Roads Act and the words " Traffic Commission " substituted therefor.

Motor Car (Amendment) Act 1961 (No. 6762).

This Act provides *inter alia* that every special permit issued under the Motor Car Act to allow motor vehicles or trailers of excess dimensions to travel in any two or more greater metropolitan municipalities on any one journey shall be issued by the Country Roads Board.

Such an arrangement will provide uniform control over the routes used by commercial vehicles in the metropolitan area and will benefit heavy hauliers and to a lesser extent the travelling public.

Another section of the above Act which concerns the Board but which was not proclaimed prior to the 30th June, 1961 provides for a fee of £10 to be paid on the issue of every motor driving instructor's licence. When the section is proclaimed half the amount of such fees received less cost of collection will be paid into the Country Roads Board Fund.

21. CONTROL OF HEAVY TRAFFIC.

The number of offences under the Motor Car Act reported in 1960–61 was 6,419, a decrease of 10 per cent. as compared with the total for the previous year. Of these offences 5,817 were successfully prosecuted resulting in total fines and costs of £90,060 which is 13·8 per cent. less than in 1959–60.

The decrease in the number of offences is believed to be due to several causes :—

(*a*) The number of interstate vehicle trips has decreased by approximately 20 per cent. probably as a direct result of the credit restrictions imposed during the year by the Commonwealth Government.

(*b*) Vandals damaged a weighbridge on the Hume Highway near Melbourne, putting it out of action for a period.

(*c*) As a result of the amendment to the Motor Car Act providing for mandatory minimum penalties for over-loading rising from £10 for one ton overload to £20 for 1 ton 1 cwt. overload, operators are now more careful to prevent overloading by a figure greater than one ton. There has been a consequent drop in fines, but with corresponding increased protection of roads.

Cases of refusing to weigh decreased from 59 to 37 and the number of trucks impounded dropped from 60 to 32.

There was also a decrease in the number of cases dealt with under the Country Roads Act. Offences totalled 197 compared with 216 in 1959–60. However, fines totalled £1.049 an increase of 26 per cent. compared with last year which is the result of an increase in the number of prosecutions for exceeding load limitations of certain bridges (61 in 1960–61 against 15 in 1959–60).

The sections of the Board's roads limited to 5 ton gross axle loads under the provisions of the Motor Car Act on the 1st July, 1960, totalled 550 miles. During the year this limitation was removed from the Ocean Road between Torquay and Bellbrae and from Anglesea to Apollo Bay. The mileages of such restrictions at present in force are :—

	miles
State highways	142
Main Roads	192
Tourists' and Forest Roads	195
	529

Certain other sections of roads, the construction and locality of which make them subject to excessive damage during the winter, were also restricted to load limitations under the provisions of the Country Roads Act for specific periods during the year.

Ten thousand five hundred and sixty-nine permits relating to various exceptions made in favour of vehicles and loads in excess of statutory limitations were issued during 1960–61 in cases which were considered to warrant special concession. This was an increase of 29 per cent. over the number of permits issued in 1959–60.

It must again be recorded that the position regarding unpaid fines is still most unsatisfactory notwithstanding excellent work on the part of the police officers seconded for duty with the Board for the purpose of collecting such unpaid fines. The two officers concerned collected a total of £33,151 of which £11,000 resulted from a visit of five weeks to Sydney by these officers. Despite their efforts, however, £37,000 was still unpaid at 30th June, 1959, with an estimated further £20,000 unpaid for the year 1959–60.

The co-operation of Chief Commissioner of Police and the keenness and efficiency of the members of the Mobile Traffic Section of the Victoria Police who have been seconded for duty with the Board are greatly appreciated.

22. NEW ACCOMMODATION FOR HEAD OFFICE STAFF.

The Board's new head-office building at 60 Denmark Street, Kew, on the site of the former Kew railway station, became available for occupation on 5th December, 1960. Prior to this date arrangements were made to move from the occupied offices in the Exhibition Building, Carlton, commencing on the afternoon of Friday, 2nd December, 1960. The operation continued throughout the weekend and the move was completed successfully early in the evening of Sunday, 4th December, 1960. Business was resumed in the new offices at the usual hour on Monday, 5th December, 1960. As noted elsewhere the transfer to these new premises is a most significant event in the Board's history.

The new building was officially opened on Wednesday, 15th February, 1961, by the Honorable Sir Thomas K. Maltby, E.D., M.L.A., Minister of Public Works (Plates 40 and 41).

The new offices have been so designed on the site as to allow for further building development as dictated by the Board's needs. Plans are at present being prepared for the building of a laboratory at Kew to permit the Board's Materials Research Division to be more efficiently accommodated than in their present cramped and unsatisfactory quarters, which are, moreover, in an area of Carlton shortly to be resumed by the Housing Commission.

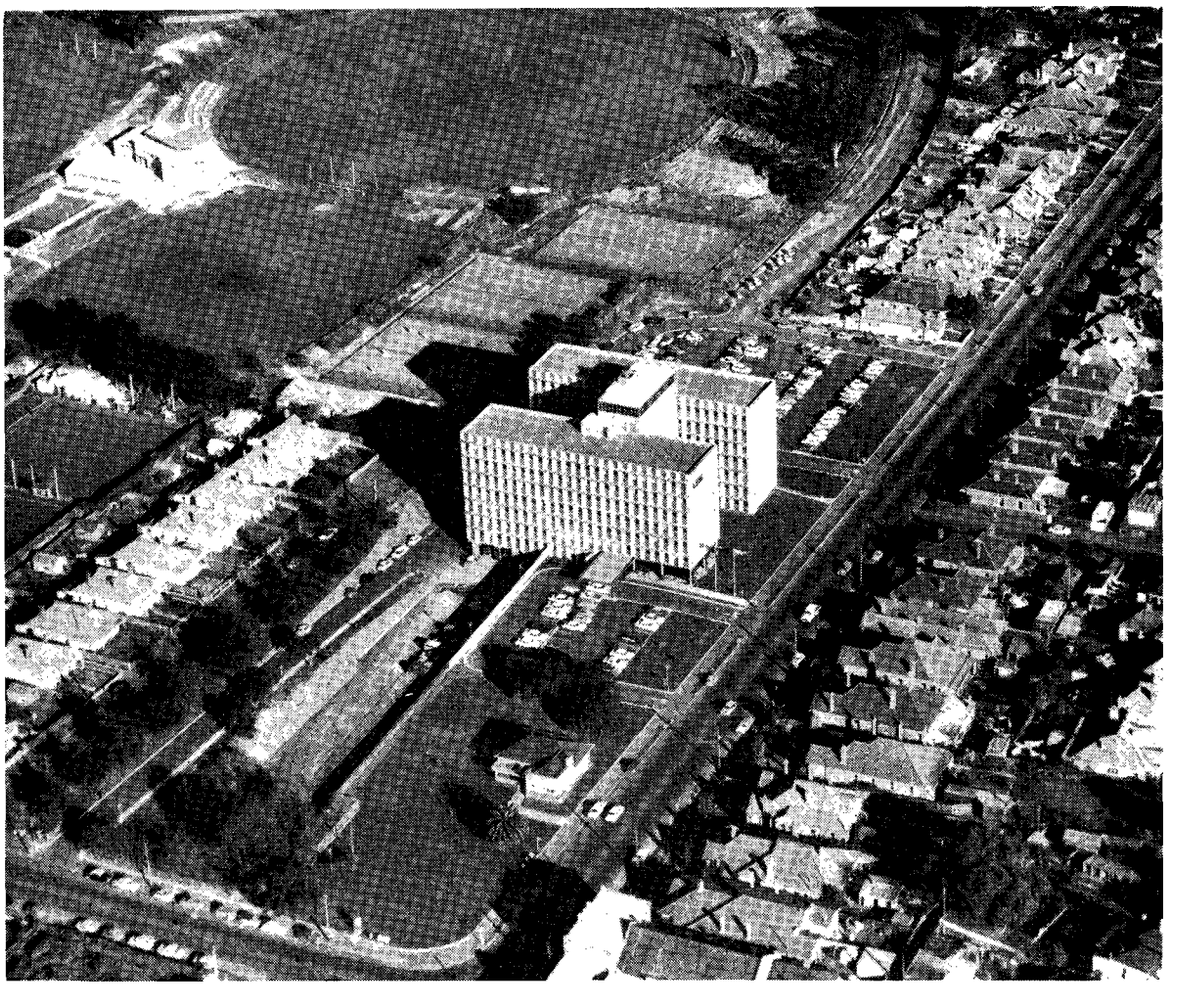


Plate 40.—Aerial view of new head-office building, Denmark Street, Kew.

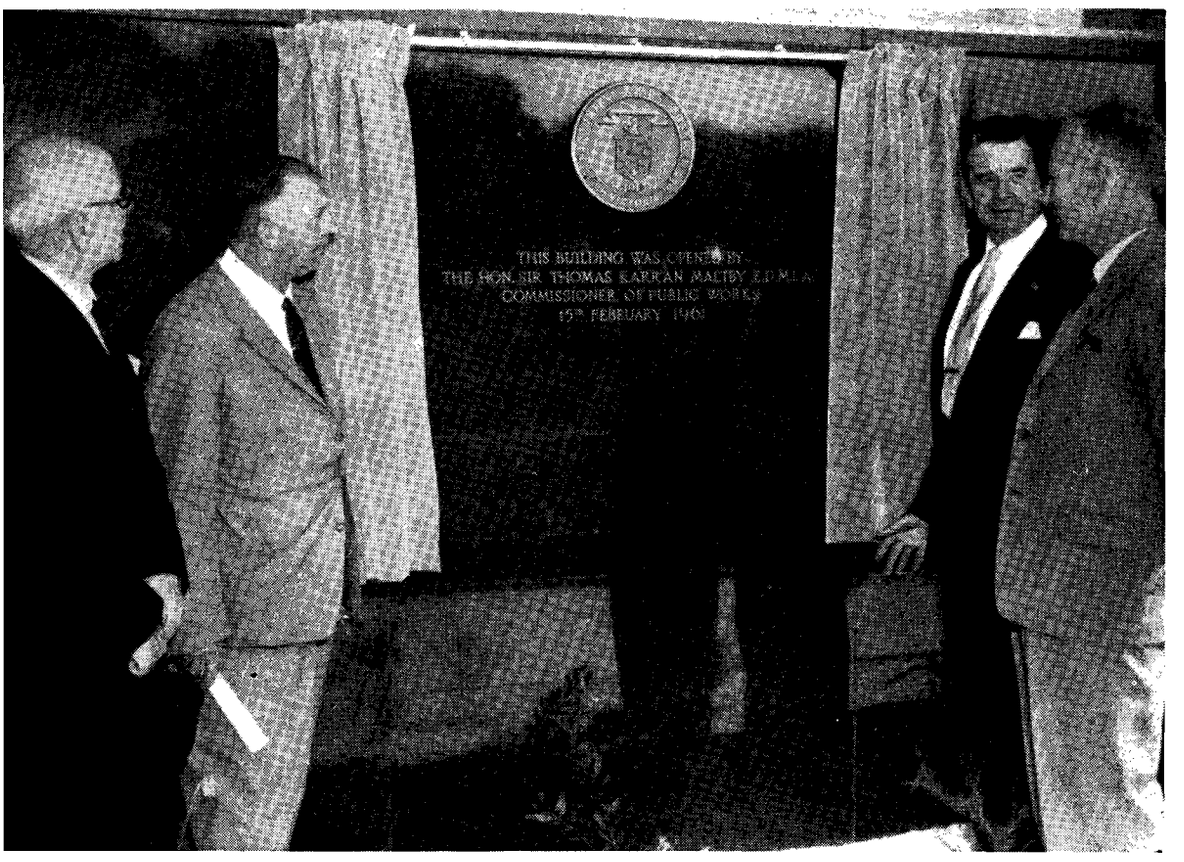


Plate 41.—Official Opening of Country Roads Board's Head Office, Denmark Street, Kew. Left to Right : His Worship the Mayor of Kew, Councillor W. H. S. Dickinson, M.B.E., J.P. ; The Hon. H. E. Bolte, M.L.A., Premier of Victoria ; The Hon. Sir Thomas Maltby, E.D., M.L.A., Commissioner of Public Works ; Mr. D. V. Darwin, Chairman, Country Roads Board.

9984/61.—4

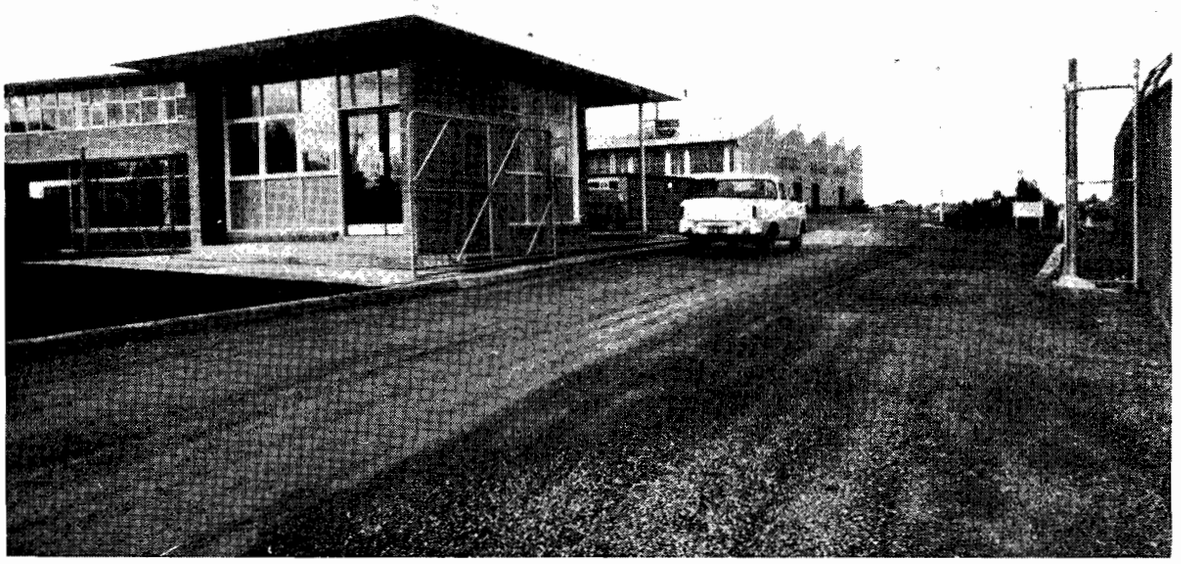


Plate 42.—Country Roads Board new workshop and office at Syndal.

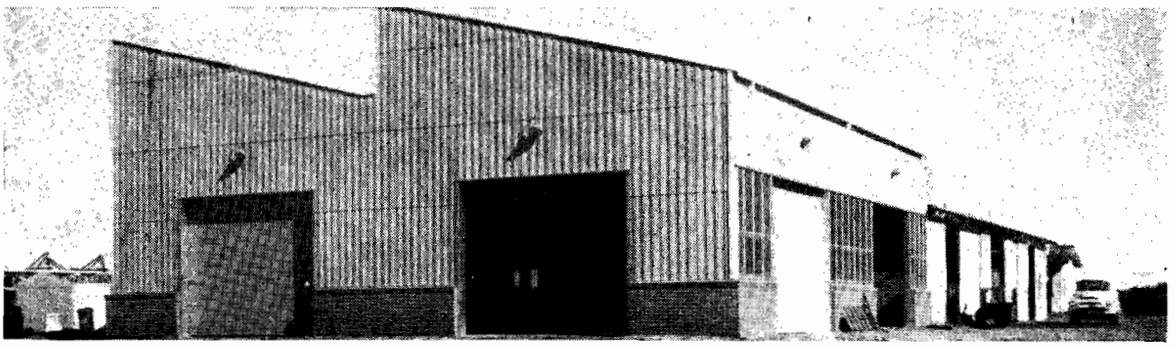


Plate 43.—Extension to divisional depot at Bairnsdale.

23. NEW ACCOMMODATION FOR MECHANICAL DIVISION AND CENTRAL STORES.

Syndal Depot.—During 1960 and the early months of 1961 the Board's entire Mechanical Division and the Central Stores were moved from South Melbourne to the new Syndal Depot (Plate 42). The new depot accommodates all offices required for the central administration of the Board's mechanical engineering, stores and purchasing activities. In addition the Syndal establishment includes a combined workshop and stores building a concrete pre-casting and steel storage area, and plant storage and testing facilities. A modern canteen and amenities block and recreation areas are also provided.

Approximately 3¾ acres of the Board's land is sublet to the Commonwealth Scientific and Industrial Research Organization and to the University of Melbourne. These organizations carry on soil and structural research activities at Syndal which are of great interest to the Board.

The move from dispersed, makeshift premises in South Melbourne to a consolidated well planned, modern workshop at Syndal has resulted in greater total output, better quality work and generally improved efficiency and morale.

24. TOURIST DEVELOPMENT.

During 1960–61 the Treasurer made £100,000 available for expenditure on road works requested by the Tourist Development Authority.

Allocations to the amount of £100,000 were mutually agreed upon by the Tourist Development Authority and the Country Roads Board. Where the road works were of some benefit to ratepayers relevant grants were made subject to a financial contribution from the councils concerned. The Board then arranged for the necessary works to be carried out either under the supervision of its own staff or by the councils concerned.

The sum of £100,000 has been fully allocated in providing for access to various waterfalls, picnic places, seaside resorts and other places of scenic attraction including the Gippsland Lakes (Kalimna and Nungurner Jetties), One Tree Hill at Ararat, Mt. Tarrengower near Maldon, Jerusalem Creek and Fraser National Park (Eildon), Flat Rock in the Grampians, Telegraph Saddle on Wilson's Promontory, Torquay Foreshore and connexions at Barwon Heads.

The amount of £100,000 is in addition to the amount which the Board is required to pay each year into the Tourist Fund under the terms of the *Tourist Act* 1958, representing 2 per cent. of the amount credited to the Country Roads Board Fund from motor registration fees, fines and drivers' licence fees. (The amount so credited in 1960–61 to the Tourist Fund from the Country Roads Board Fund was £187,872). Income from this latter source is utilized by the Tourist Development Authority in the construction and maintenance of works or amenities in relation to tourist travel or tourist resorts.

In developing the whole road network throughout Victoria the Board is also developing the State's attraction to overseas and interstate visitors. Tourism benefits from road improvements and systematic maintenance on State Highways, main roads, proclaimed tourists' roads and forest roads and from the new category of by-pass roads, for all of which the Board has statutory responsibilities and in many cases there is also an element of tourist service in works of specified standards undertaken on unclassified roads. It is difficult to separate one type of use such as recreational and tourist travel from those which together warrant the undertaking of an item of road work.

25. DECENTRALIZATION.

The existing workshop at the Board's divisional depot, Bairnsdale, was extended by the erection of a steel framed saw tooth structure to provide an additional 3,600 square feet floor area for workshop purposes (Plate 43).

The divisional depot, Horsham, was extended by the purchase of an additional 4 acreas of land, making the total area of the depot 12 acres. The new area which will be used for storage of box culverts and bituminous materials has been fenced and drainage and surfacing completed.

Plans were prepared for additions to the Board's Geelong divisional office increasing the gross floor space by 3,000 square feet and at the close of the year a tender was accepted for the alterations. A tender has also been accepted for erection of new divisional offices at Benalla where for many years the Board has been renting very antiquated and inadequate premises. At Warrnambool office additions are in progress for improved laboratory and drafting accommodation.

26. WORK STUDY.

Since the successful completion of several methods study assignments, requests for method surveys from various sections in the Board have increased. This awareness of the benefits of methods study and intensification of the methods improvement programme has resulted in a most satisfactory year's work for the methods section.

During the year an engineer was seconded from the Chief Engineer's Branch to the section and formally trained in methods engineering techniques. The methods section will now undertake surveys of engineering activities, initially under the guidance of W. D. Scott and Co. Pty. Ltd., whose services are being retained for a limited number of investigations.

The major project undertaken during the year consisted of review of the Board's mechanized accounting procedures and examination and consideration of statistical and accounting systems suitable for an integrated data processing system of electronic accounting machines and punched card equipment. It is anticipated that, in the ensuing year the detailed investigation necessary to plan and develop procedures, systems and programmes in order to convert existing accounting practices to integrated data processing methods will be made.

In conjunction with engineers from the Chief Engineer's Branch, an investigation was made of accounting and statistical procedures suitable for computer application.

Other aspects of the Board's activities investigated during the year included workshop and depot costing, printing and stationary procedures, forms design, accounting and clerical procedures and office machines.

27. PHOTOGRAPHY.

Throughout the year many still photographs were taken of Board's and council's activities on road and bridge works by the Board's photographers. Engineers supervising works also took many photographs to illustrate reports and record progress of works.

Owing to the large extent of some projects the only satisfactory method of indicating the scope and relative position of the new work is by means of aerial photography. One of the Board's photographers who has long experience of aerial photography made the required exposures from hired aircraft.

For public information and technical training moving picture records were taken of works in progress and of traffic operations. These sequences will be incorporated in colour sound films as the various projects are completed.

The Board's mobile projection unit screened programmes made up of films hired from commercial distributors and of films produced by the Board. A total of 121 screenings were given in 36 camps at locations remote from townships, to an estimated audience of 3,050 persons.

In addition six screenings of Board films were given to various clubs and these films were viewed by 350 persons. Films were loaned on seventeen occasions and reports indicate that the viewing audience totalled 1,300 persons.

On several occasions film supplied by television studios was exposed by the Board's cine photographer and then telecast in news sessions to illustrate news items concerning opening of new bridges or progress of large works.

Numerous 35 mm. transparencies were prepared for lecture purposes.

DISPLAYS.

Plate 44.—Country Roads Board exhibit at Motor Show, March, 1961.

Plate 45.—Maltby By-pass Road inspection by Sir Thomas Maltby and parliamentary party at Werribee.

28. DISPLAYS AND EXHIBITIONS.

At the 1960 Show of the Royal Agricultural Society of Victoria the Board displayed a model of realignment works between Hernes Oak and Morwell on the Princes Highway East. A leaflet was distributed to interested inquirers and the model was supported by large size photographs and by true colour transparencies of works in progress.

This model was also exhibited at the Traralgon Show, at the Motor Show, (Plate 44) and at the Leongatha Apex Club. A model of Kings Bridge was displayed at the Vacuum Oil Company's building in connection with the ceremony of the opening of the bridge. The model of the Maltby By-pass Road was exhibited during the year in the State Electricity Commission's showrooms at Colac, Geelong and Werribee and during Education Week at Colac Technical School.

This model was also displayed at the Returned Soldiers Hall in Werribee during an inspection by Members of Parliament of works in progress on the Maltby By-pass Road (Plate 45).

A model of a typical section of highway together with photographs of Board's works was displayed at the Bendigo Town Hall during Commonwealth Apprentices Week (Plate 46).

DISPLAYS.

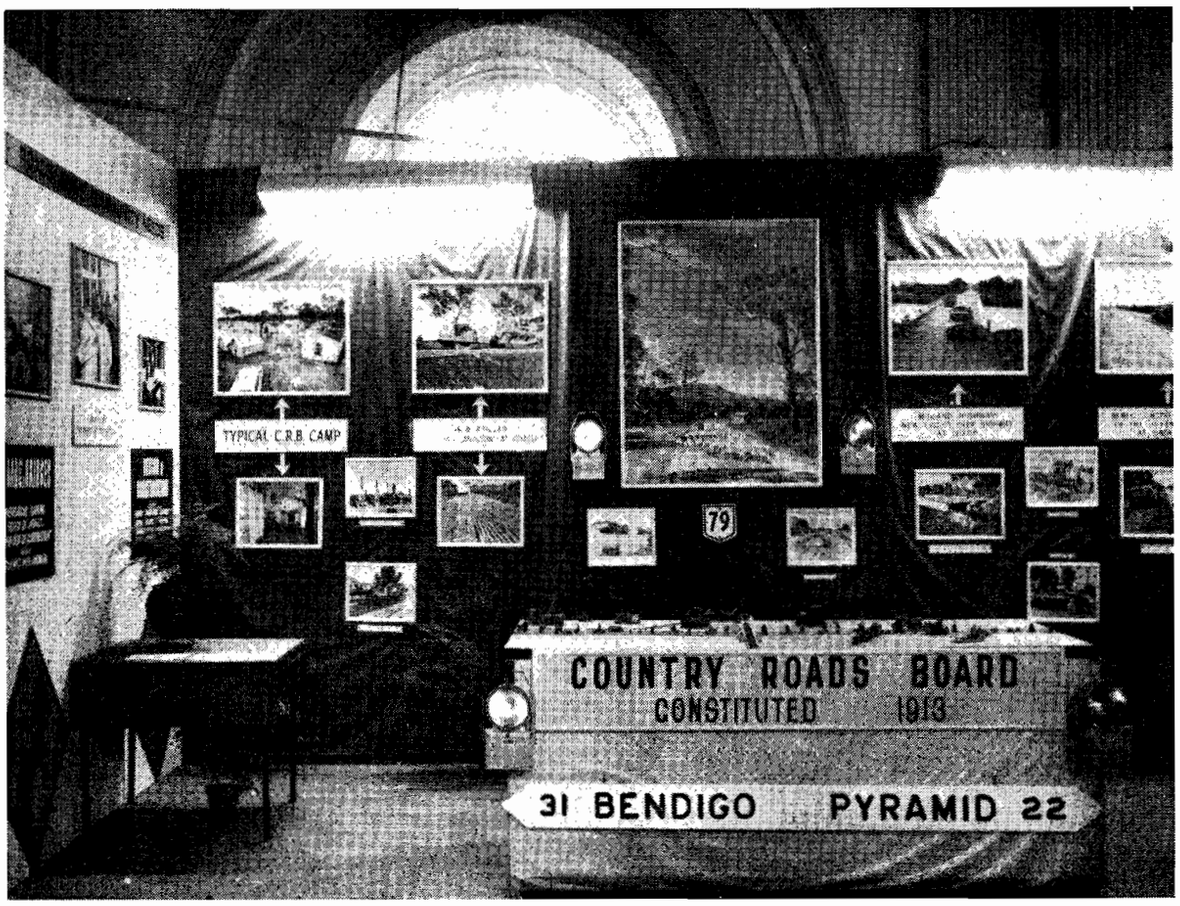


Plate 46.—Country Roads Board display Bendigo Town Hall during Commonwealth Apprentices Week.

29. NATIONAL ASSOCIATION OF AUSTRALIAN STATE ROAD AUTHORITIES.

The 23rd meeting of the National Association of State Road Authorities was held at the offices of the Department of Public Works, Hobart, Tasmania, from the 7th to the 11th of November, 1960. Representatives of each State Road Authority throughout the Commonwealth and the Director-General of the Commonwealth Department of Works attended, whilst officers of the Commonwealth Department of Shipping and Transport were present when items of special interest to that authority were being discussed.

There were 68 items on the agenda, including methods of combating the theft of plant and materials from the roadside; preparation of a guide to traffic engineering; the adoption of a uniform policy on pavement markings; further route numbering in the National and State systems, regulation of weights of and loads on vehicles; Australian road needs survey over a ten-year period and the relation of the results of the survey to the report of the Commonwealth Committee for Transport Economic Research; and the preparation of standard specifications for various tests and materials.

Arrangements were made for the various sub-committees to meet during the year, i.e.. Principal Technical Committee, Materials Research Committee. Bridge Design Committee, Traffic Engineering Committee, Plant and Equipment Committee. It was also decided to establish the Bituminous Pavements Committee and to hold the first meeting in Melbourne in June, 1961.

30. AUSTRALIAN ROAD RESEARCH BOARD.

The second meeting of the Australian Road Research Board was held at the offices of the Department of Public Works, Hobart. Tasmania between the 9th and the 11th November, 1960. The Australian Road Research Board comprises the Commissioner for Main Roads, New South Wales, the Chairman, Country Roads Board, Victoria, the Commissioner of Main Roads, Queensland. the Commissioner of Highways, South Australia, the Commissioner of Main Roads, West Australia, the Director of Public Works, Tasmania and the Director-General, Commonwealth Department of Works.

Mr. R. C. Sharp, Director of Public Works, Tasmania was appointed chairman for the period up to the next ordinary meeting in October—November, 1961. Mr. D. V. Darwin being reappointed as deputy chairman.

Items on the agenda included appointments to the Advisory Council, research projects to be undertaken, and matters concerning finance and administration of the Board.

The third meeting of the Australian Road Research Board was held at its offices in Kew, Victoria on 1st May. 1961 (Plate 47). Matters discussed included the appointment of scientific and engineering staff. the formation of specialized committees; the use of electronic computors. and co-operation with N.A.A.S.R.A. Technical Committees and local government authorities. Preliminary arrangements were made for the holding of the first Australian Road Research conference in Canberra in September. 1962.

The Advisory Council to the Australian Road Research Board held its first meeting at the offices in Kew, Victoria on 6th and 7th February, 1961.

The creation of the new Board is already proving of value to the State road authorities by reason of the Director's systematic contacts with officers of the Commonwealth Scientific and Industrial Research Organization, the Universities in each capital city and the research and constructional staffs of the road authorities themselves. Contacts have also been established in the field of local government engineering which is closely linked with that of the State authorities. Mr. A. J. Scala, formerly Principal Scientific Officer in the Materials Research Division of the Country Roads Board is one of the new appointees to the staff of the Australian Road Research Board. Although this is a loss to the Division the interstate studies which Mr. Scala and his new colleagues are making will assuredly bring fresh answers to problems of pavement and foundation design applicable in Victoria, and this is but a beginning of the services which the new research authority will render to Australian road engineering.

31. MUNICIPAL ASSOCIATION CONFERENCES.

This year conferences were attended as follows:—

1. Municipal Association of Victoria ..	At Melbourne on 12th and 13th October, 1960. Attended by Chairman and Members.
2. Gippsland District	At Frankston on 14th April, 1961. Attended by Mr. D. V. Darwin, Chairman.
3. Northern	At Castlemaine on 27th April, 1961. Attended by Mr. D. V. Darwin, Chairman.

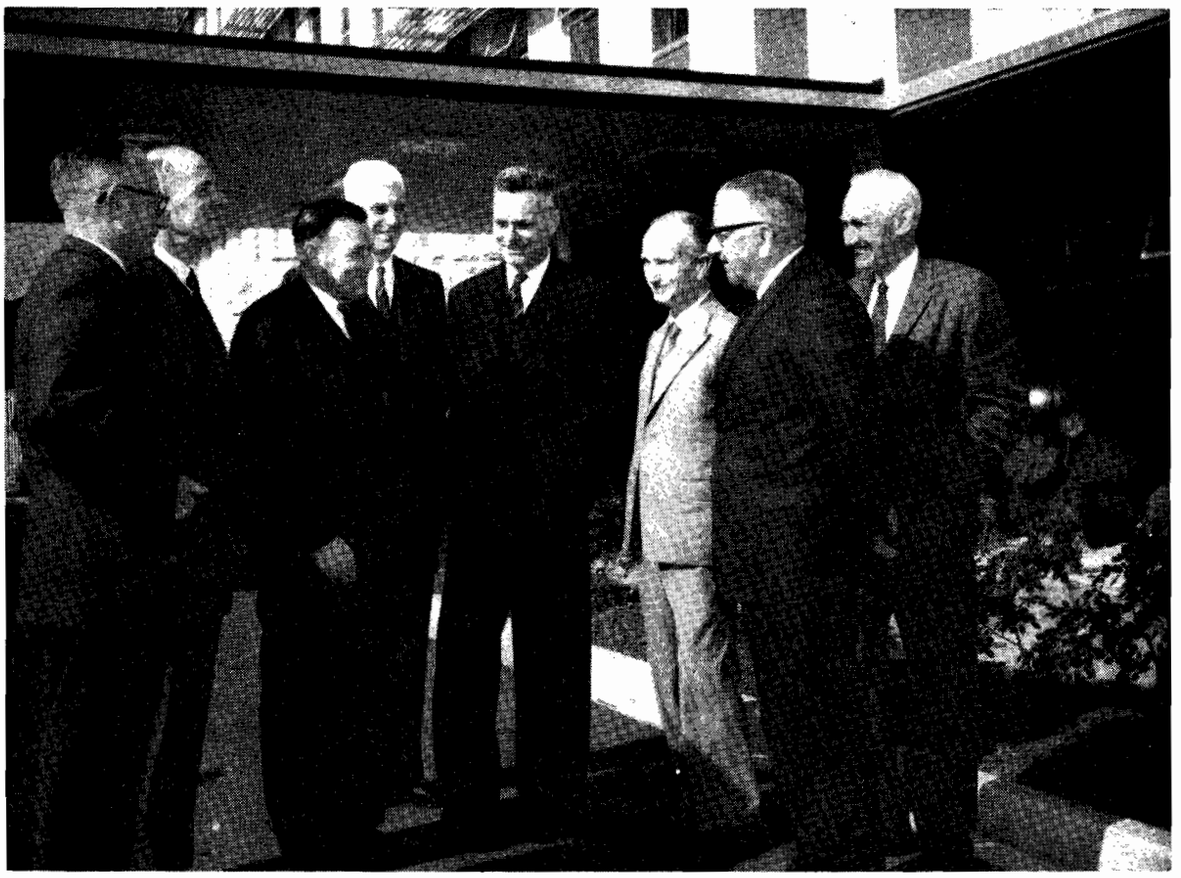


Plate 47.—Third Meeting of Australian Road Research Board, May 1961, held at Country Roads Board, Head Office, Denmark Street, Kew.

Left to right :

Mr. F. D. Jackman, B.E., A.M.I.E. Aust., Commissioner of Highways, S.A.
Mr. H. M. Sherrard, C.B.E., M.C.E., M.I.C.E., M.I.E. Aust., M. Inst.T., Commissioner for Main Roads, N.S.W.
Mr. R. C. Sharp, B.E., A.M.I.C.E., A.M.I.E. Aust., Director of Public Works, Tas.
Mr. D. F. Glynn, B.C.E., A.M.I.E. Aust., M.A.S.C.E., Director of A.R.R.B.
Mr. C. N. Barton, O.B.E., E.D., B.E., M.I.E. Aust., A.F.A.I.M., Commissioner of Main Roads, Queensland.
Mr. D. V. Darwin, M.M., M.C.E., M.I.C.E., M.I.E. Aust., C.E., F.A.P.I., Chairman, Country Roads Board, Victoria.
Mr. J. D. Leach, B.E., M.I.E., Aust. M.Inst.T., Commissioner of Main Roads, W.A.
Dr. L. F. Loder, C.B.E., M.C.E., D.Eng., M.I.C.E., M.I.E. Aust., Director-General, Commonwealth Department of Works.

Plate 48.—Mr. I. J. O'Donnell, Deputy Chief Engineer, making presentation on behalf of Board and staff to Mr. R. Swartz, Inspector of Works, on his retirement.

4. North-Eastern	At Cobram on 28th April, 1961. Attended by Mr. C. G. Roberts, Deputy Chairman.
5. Western	At Hamilton on 12th May, 1961. Attended by Mr. J. W. C. Pascoe, Divisional Engineer.
6. North-Western	At Horsham on 26th May, 1961. Attended by Mr. W. H. Neville, Member.

The Board appreciates the opportunity to attend these conferences because of the close co-operation which exists between it and local government and the mutual benefit derived from the discussion of matters of common interest.

32. CONFERENCE OF MUNICIPAL ENGINEERS.

The seventeenth conference of municipal engineers, convened by the Board was held at the Board's head office, 60 Denmark Street, Kew, on 31st May, and 1st June, 1961. This was the first occasion on which the conference has been held at the Board's office and the facilities provided enabled it to be conducted more smoothly and under more favourable conditions than has been possible in the past.

Approximately 250 attended, including engineers from most of the 208 municipalities throughout the State, senior engineers of the Country Roads Board and representatives of various Commonwealth and State Government departments which were interested in various items on the agenda.

In introducing the Honorable Sir Thomas Maltby, E.D., M.L.A., Minister of Public Works, Mr. D. V. Darwin, chairman, expressed the Board's appreciation of his assistance and of his administration of the Board's work during his term of office. The chairman stated that the Board had received the utmost encouragement from Sir Thomas, particularly in carrying out major projects, and the erection of the new head-office building was largely due to his interest and ability to get things done.

Sir Thomas welcomed the delegates and officially opened the conference. He traced briefly the history of road construction in Victoria and it had been gratifying to note that in recent years the Board, in conjunction with municipal engineers, had been able to apply its knowledge and experience to original work rather than the elaboration of the old, and insufficiency of funds was the only factor which prevented more of this type of work being done. The Minister considered that municipal engineers held positions of tremendous responsibility, not only in the work involved but in the guidance and advice given to their councils. He asked that serious consideration be given to any proposals which would involve obtaining more financial assistance from the Country Roads Board to the detriment of its proper function of constructing State highways and main roads; it was wrong to expect the Board to assist municipal councils so that rates could be reduced, or that unclassified roads could be brought to a higher standard than State highways and main roads.

Sir Thomas was pleased to note that the Institution of Engineers, Australia had taken an interest in the proposal to establish a trust fund to send municipal engineers abroad for study each year.

The Minister noted that replies by Country Roads Board engineers to items to be discussed at the conference were sent out with the agenda and considered that this practice added greatly to the value of the conference.

Items on the agenda included the suggested treatment of 99-ft. streets in residential areas; soil cement footpaths; the causes of delayed stripping of aggregate in bituminous seals; effectiveness of vibrating and other types of rollers on earthworks, and the standards of super-elevation required on curves on rural roads.

33. BOARD'S INSPECTIONS.

During the year the members of the Board, accompanied by the divisional engineer concerned, inspected roads and bridges in 33 municipalities in all parts of the State.

Those visited were the Shires of Glenelg, Wannon, Ballarat, Swan Hill, Ripon, Rochester, Yea, Dunmunkle, Kara Kara, Bairnsdale, Talbot, Creswick, Korong, Myrtleford, Bright, Doncaster and Templestowe, Avon, Numurkah, Nathalia, Tambo, Hastings, Frankston, Dimboola, Cobram and Tungamah ; the Boroughs of Swan Hill, Sebastopol, Clunes, and Inglewood ; the Town of St. Arnaud ; and the Cities of Ballaarat, Heidelberg and Moorabbin.

The Board extends its thanks to these municipalities for their co-operation in making detailed arrangements. These inspections benefit both the Board and the municipality visited as they provide an opportunity for discussion of road and bridge problems and works proposed in the coming years.

34. STAFF AND EMPLOYMENT.

Completion of the Board's new offices at Kew in December, 1960, enabled the appointment to be made of a number of engineers and draftsmen and other urgently needed staff who could not be accommodated in the cramped quarters previously occupied in the Exhibition Building, Carlton. Improved working conditions in the new offices have increased staff efficiency and have already proved to be a considerable aid in attracting additional staff needed to deal with the increased works programme.

Forty-three male officers and 35 female officers resigned during the year. Two hundred and eight new appointments were made (148 males and 60 females) reversing the trend of 1959–60 when a greater number of officers resigned than were recruited. The following officers retired during 1960–61 :—

Mr. P. R. Swartz, Inspector of Works, Chief Engineer's Branch, on 26th June, 1961, after 34 years' service with the Board (Plate 48).

Mr. I. R. Romey, Instrument Maker, Materials Research Division, on 17th February, 1961, after twelve years' service with the Board.

Mr. L. White, Draftsman, Plans and Survey Section, after 46 years' service with the Board.

It is greatly regretted that three highly-valued officers passed away during the year. These officers were :—

Mr. L. L. E. Vartus who was employed as an Assistant Experimental Officer in the Materials Research Division.

Mr. T. Jordan who served as a Traffic Inspector in the Traralgon Division.

Mr. R. T. Thornton of the Board's Geelong Division.

A tribute to the efficiency of the Board's organization was paid when the Board's Mechanical Engineer, Mr. G. M. Langham, B.Mech.E., Dip.Elec.E., A.M.I.E. Aust., A.I.A.A.E., was selected to represent Australia at the International Congress and Exposition of the Society of Automotive Engineers of the United States of America at Detroit, U.S.A., from the 9th to the 13th January, 1960, in his capacity as President of the Institution of Automotive and Aeronautical Engineers of Australia. Mr. Langham was abroad for four months from December, 1960, and besides attending the congress, investigated field plant maintenance facilities, workshops, road plant development, and snow clearing plant of selected State highway organizations. Visits were also made to certain suppliers of automotive and earth moving equipment in U.S.A. and Canada. Following the period in America, a brief visit was made to the United Kingdom where inspections and investigations were carried out on similar lines.

Cadetships.

The following table shows the number of Board's cadets at Universities in the current academic year :—

Year.	Course.	Number of Cadets.
First Year	Civil Engineering	4
First Year	Commerce ..	2
First Year	Economics ..	1
Second Year	Civil Engineering	4
Second Year	Commerce ..	1
Third Year	Civil Engineering	10
Third Year	Surveying ..	1
Fourth Year	Civil Engineering	3

Four civil engineering cadets commenced on probation with the Board in February, 1961. On the successful completion of their probation they will commence at the University in March, 1962. Two pupil surveyors were articled to the Board's licensed surveyors during the year 1960–61.

The Board was pleased to provide a cadetship in economics at the Monash University during its inaugural year.

Training.

Training of staff and employees continued in accordance with the Board's policy. All new staff and employees are trained directly on the job by their immediate supervisors. In addition to the cadetships already mentioned suitable personnel have also been subsidized by the Board at the University and technical schools. Many officers are also taking courses in their own time and at their own expense. Lectures provided by the Australian Institute of Management on various subjects have been attended by engineers and accountants and other officers of the Board.

Certain officers from overseas organizations were given opportunities to observe road practices in Victoria and to otherwise add to their experience. The Board's methods section was visited in June, 1961, by Mrs. A. R. Munoz, a Colombo Plan fellow and senior management analyst of the Philippines Government's Bureau of the Budget and various aspects and techniques of work simplification employed in the Board's organization were discussed. Mrs. Munoz attended Session 10 of the Australian Administrative Staff College (February-May, 1961) which was also attended by the Board's secretary, Mr. R. E. V. Donaldson. Mr. R. G. Cooper, the Board's accountant, is at present attending Session 11 of the Australian Administrative Staff College. Mr. J. R. Roy, M.Sc. (M.I.T.), B.C.E., Dip.C.E., returned to the Board's service on 11th July, 1961 after three years abroad in North America. He studied at the Massachusetts Institute of Technology during part of his stay abroad and had a degree of Master of Science (Civil Engineering) conferred on 30th June, 1961.

Employment.

The number of employees for the year averaged 3,326. The peak of employment for the year (which also represented the highest figure of employment in the history of the Board) was reached in April, 1961, when 3,606 employees were engaged on works in the following categories :—

Workshops and Depots	657
Patrol Maintenance	582
Bridge Construction	362
Bituminous Surface Treatment	664
Construction	1,341

These figures do not include employees of contractors and municipalities engaged on works financed by the Board.

The total number employed on works being carried out for other authorities reached its peak for the year during September, 1960, when 70 men were working on projects for—

Latrobe Valley Water and Sewerage Board	23
State Electricity Commission	47

A further 45 employees became eligible for and were granted general staff conditions. The number now receiving these benefits is 581.

A comparison of employment figures over the past three years is :—

—	Average Number Employed.	Peak of Employment.
1958–59	2,760	2,995 (Nov. '58)
1959–60	3,072	3,323 (Mar. '60)
1960–61	3,326	3,606 (Apr. '61)

Due to the prevailing economic conditions a greater number of men have sought employment with the Board than in previous years but these numbers commenced to drop notably in the latter weeks of the financial year.

Staff Charities Fund.

A large number of the Board's staff again gave substantial support to this fund by contributions deducted from each fortnightly pay. The total sum contributed during the year, including special donations, was £401, an increase over the contributions for the previous year.

A total amount of £394 was contributed to 23 charities throughout the State including various metropolitan and country hospitals, the junior legacy group, the Institute for the Blind, the various appeals by or on behalf of the Returned Sailors, Soldiers and Airmen's Imperial League of Australia. Donations on a " bulk basis " were, as usual, made to several special button day appeals by purchasing buttons or badges for each contributor to the fund. The balance of £180 on hand at 30th June, 1961, will be used to meet commitments which will arise later in the calendar year.

35. MOTOR REGISTRATION.

Registrations effected during the year under the Motor Car Act totalled 901,646 an increase of 5·3 per cent. on the registrations effected during the previous year, as compared with an increase in 1959–60 of 7·3 per cent. over the total for 1958–59.

Vehicles.	Financial Year 1959–60.		Financial Year 1960–61.		Increase.	Decrease.
Private—						
New	73,225		68,543			
Second-hand—						
Re-registered	20,072		21,281			
Renewals	553,090		599,840			
		646,387		689,664	43,277	
Commercial and Hire—						
New	12,435		11,446			
Second-hand—						
Re-registered	4,455		4,894			
Renewals	91,430		93,823			
		108,320		110,163	1,843	
Primary Producers—Trucks—						
New	4,043		4,079			
Second-hand— ..						
Re-registered	3,952		4,449			
Renewals	57,586		59,549			
		65,581*		68,077†	2,496	
Licences under Motor Omnibus Act ..		766		792	26	
Trailers		13,120		13,676	556	
Motor Cycles		21,968		19,274	..	2,694
		856,142		901,646	48,198	2,694

NOTE.—*Includes 28,819 No Fee Tractors.
†Includes 30,287 No Fee Tractors.

36. ACKNOWLEDGMENTS.

The sincere thanks of the Board are tendered to the Minister of Public Works, the Honorable Sir Thomas K. Maltby E.D., M.L.A., for his help and interest in its work. It is regretted that Sir Thomas's decision to retire from Parliament after 32 years' service will terminate his association with the Board as Minister of Public Works for the past six years. The Board would like to record its appreciation of Sir Thomas's support and guidance as Minister of Public Works and extends to him its best wishes for his retirement.

It is also desired to offer the Board's thanks and appreciation for the co-operation and assistance of officers of Government Departments, other State instrumentalities and municipal councils, as well as the road authorities in other States.

We have the honour to be,

Sir,

Your obedient servants,

D. V. DARWIN, M.M., M.C.E., M.I.C.E., M.I.E. Aust., C.E., F.A.P.I., Chairman.

C. G. ROBERTS, M.C., B.Sc. (Eng.), A.M.I.C.E., M.I.E. Aust., C.E., F.A.P.I., Deputy Chairman.

W. H. NEVILLE, A.A.S.A., Member., J.P.

R. E. V. DONALDSON,
A.A.S.A., A.C.A.A., J.P.,
Secretary.

COUNTRY ROADS BOARD.

STATEMENT OF RECEIPTS AND PAYMENTS FOR YEAR ENDED 30TH JUNE, 1961.

(Adjusted to nearest pound.)

		Country Roads Board Fund.		*Commonwealth Aid Roads Act* 1959.		Loan Funds.	Commonwealth–State Flood Restoration.	Total.
		Act 6229.	Act 6222 Road Maintenance Account.	Sec. 7 (1)	Sec. 7 (2)			
RECEIPTS.	£	£	£	£	£	£	£	£
Balances at 1st July, 1960		643,647	30	..	..	..	..	643,677
Motor Car Registration Fees	9,170,494							
Additional Registration Fees	592,302							
Drivers' Licence Fees	256,673							
Drivers' Licence Testing Fees	38,969							
Fines	213,077							
	10,271,515							
Less Cost of Collection	693,800							
		9,577,715	..	..	..	..	..	9,577,715
Municipalities' Repayments—								
Permanent Works—Main Roads	32,374							
Maintenance—Main Roads	756,289							
		788,663	..	..	..	..	..	788,663
Moneys provided by *Commonwealth Aid Roads Act* 1959		..	..	5,310,406	3,673,370	..	..	8,983,776
Proceeds from Commercial Goods Vehicles Act 6222		..	2,254,421	..	..	..	..	2,254,421
Receipts from State Loan Funds—Act 6229		..	..	..	..	283,000	..	283,000
Moneys provided under Commonwealth–State Agreement for Flood Restoration		..	..	..	..	..	966	966
Fees and Fines under Country Roads Act		559	..	..	..	..	..	559
General Receipts		49,664	..	..	..	..	..	49,664
		11,060,248	2,254,451	5,310,406	3,673,370	283,000	966	22,582,441
PAYMENTS.								
Main Roads—								
Construction and Reconstruction		3,290,728	..	1,402,312	..	58,683	..	4,751,723
Maintenance		1,167,542	..	..	..	..	..	1,167,542
State Highways—								
Construction and Reconstruction		1,245,393	..	3,189,837	..	191,317	..	4,626,547
Maintenance		..	2,254,451	..	..	..	..	2,254,451
By-pass Roads—Construction		1,096,742	..	..	..	..	..	1,096,742
Tourists' Roads—								
Construction and Reconstruction		382,791	..	..	..	33,000	..	415,791
Maintenance		184,341	..	..	..	..	..	184,341
Forest Roads—								
Construction and Reconstruction		23,941	..	..	161,952	..	..	185,893
Maintenance		89,472	..	..	..	..	..	89,472
Unclassified Roads—								
Construction and Reconstruction		..	..	715,760	2,918,456	..	966	3,635,182
Maintenance		..	..	..	592,962	..	..	592,962
Murray River Bridges and Punts		88,612	..	..	..	..	..	88,612
Traffic Line Marking		39,676	..	..	..	..	..	39,676
Plant Purchases		708,141	..	..	..	..	..	708,141
Traffic Lights		4,742	..	..	..	..	..	4,742
Contribution—Australian Road Research Board		..	..	2,497	..	..	..	2,497
Interest and Sinking Fund Payments		888,244	..	..	..	..	..	888,244
Payment to Tourist Fund		187,872	..	..	..	..	..	187,872
Kew Office		528,123	..	..	..	..	..	528,123
General and Administrative Expenditure		1,130,988	..	..	..	..	..	1,130,988
		11,057,348	2,254,451	5,310,406	3,673,370	283,000	966	22,579,541
Balances at 30th June, 1961		2,900		..	..	..	..	2,900

NOTE.—Relief to Municipalities granted under Act 6229 Section 32, amounted in 1960–61 to £59,403 7s. 6d.

R. G. COOPER,
Accountant.
20th October, 1961.

AUDITOR-GENERAL'S CERTIFICATE.

The accounts of the Country Roads Board for the year ended 30th June, 1961, have been audited. In my opinion the above statement of Receipts and Payments fairly presents in summary form the transactions during that period.

R. W. GILLARD,
Auditor-General.
5th December, 1961.

COUNTRY ROADS BOARD.

Loan Liability as at 30th June, 1961.

—	£ s. d.	Main Roads, &c. £ s. d.	Developmental Roads. £ s. d.	Total. £ s. d.
Permanent Works—				
Main Roads	7,054,649 0 4			
State Highways	5,798,469 17 4			
Tourists' Roads	121,292 10 3			
Forest Roads	1,083 18 11			
		12,975,495 6 10	..	12,975,495 6 10
Developmental Roads		..	6,425,757 10 11	6,425,757 10 11
Discounts and Expenses		261,206 19 8	266,765 0 3	527,971 19 11
Total Amount Borrowed		13,236,702 6 6	6,692,522 11 2	19,929,224 17 8
Less Redemption of Loans—				
Redemption Funds		85,219 1 1	646,386 7 4	731,605 8 5
Main Roads Sinking Fund		285,688 7 7	..	285,688 7 7
Developmental Roads Sinking Fund		..	55,083 0 2	55,083 0 2
State Loans Repayment Fund		1,172,295 17 2	..	1,172,295 17 2
National Debt Sinking Fund		1,552,460 17 4	1,908,190 14 0	3,460,651 11 4
		3,095,664 3 2	2,609,660 1 6	5,705,324 4 8
Loan Liability at 30th June, 1961		10,141,038 3 4	4,082,862 9 8	14,223,900 13 0

CHIEF ENGINEER'S REPORT

Country Roads Board,
Melbourne,
1st November, 1961.

THE CHAIRMAN,

SIR,

I have the honour to report on matters of technical interest included in the work carried out during the financial year 1960–61.

MECHANICAL DIVISION.

History.—In the first year of the Board's operation 1913–14, the plant consisted of five steam rollers, four self-spreading hopper wagons for road metal and two scarifiers, which were housed, repaired, and maintained at South Melbourne. Gradually more plant was obtained to keep step with gradually increasing activities, and at the end of 1938–39, the fleet comprised some 460 items of plant. During the years of the Second World War, the Board was chiefly engaged in defence projects, and its plant increased as follows :—

	1938	1946
Crawler tractors	4	86
Power graders	30	57
Bucket loaders	2	45
Compressors	13	49

The maintenance of the plant was the responsibility of the Plant Engineer, who, with his staff and some workshop facilities, was now established at South Melbourne in two neighbouring areas totalling 5¼ acres. Later in the early 1950's, two more blocks in Port Melbourne were leased to provide further facilities for holding plant.

The workshop facilities located in two separate areas which were unsuitable for further development, were considered inadequate as early as 1942, and the situation was further aggravated by the fact that the only earth moving machinery the Board could acquire for its very large post-1945 operations, was plant disposed of after war use by the Allied Forces and the Allied Works Council. Most of these machines required much immediate repair and the shortage of spare parts and skilled personnel proved a serious handicap. Gradually the spare parts and labour position improved, but with the continued increase of the plant fleet, the workshop facilities became totally inadequate even though eight small country workshops were established throughout the State in the 1945–57 period.

Investigations into the establishment of an adequate new centre for the mechanical engineering activities of the Board were commenced in 1942, and eventually resulted in the purchase of 38 acres of land at Syndal on which the new workshop, stores, and office buildings were erected.

Features of the Syndal Depot.—The main aim in the planning and design of the new establishment and its personnel structure was to obtain a modern and flexible organisation to cope satisfactorily with both present conditions and possible future changes in the methods and system of operation of the Board.

As initial requirements, the Board decided on the following main features :—

(*a*) All workshop controls and facilities to be under one roof with 50 per cent. increase of total workshop floor area compared with that available in South Melbourne. The workshop to be set out to satisfy the particular requirements of the Board and its layout, facilities, and organisation to be in accordance with the best and most modern practices.

(*b*) The Central Stores to be transferred from South Melbourne to the new depot with a building providing maximum accessibility with minimum handling of stores.

(*c*) Provision of plant testing facilities within the depot area.

(*d*) Provision of adequate plant storage facilities.

(*e*) Plantations of trees, shrubs, and lawns to screen the industrial features of the depot from the adjoining residential areas, and to provide recreational facilities for the personnel.

(*f*) In the absence of local catering facilities to provide an attractive canteen.

(*g*) The provision of adequate heating for all buildings.

(*h*) A concrete precasting yard.

(*i*) A transport office combined with a service station.

(*j*) A medical centre staffed by a fully qualified nursing sister.

The transfer to Syndal.—The construction of the Syndal depot began in 1954, with a considerable amount of earth works largely carried out by plant requiring field testing. The first stage of the combined workshop and stores building was completed in mid-1958, and it was possible for a small advance party to commence maintenance work of bituminous treatment plant in it. Eventually more and more personnel moved to Syndal as the second stage of the workshop approached completion. The office block having been completed, the entire contents and personnel of the South Melbourne workshops and offices were moved in December, 1959. At the same time a small advance party of stores personnel with some essential engineering stores were also moved into temporary locations at Syndal.

The eighteen months since the move was mainly a period of consolidation. Difficulties were experienced during the boom period late in 1960 and early in 1961, when it was not possible to replace qualified engineers and tradesmen, and there were consequent losses in output. The completion of the third building stage brought the workshop and stores building to the designed total floor area of 103,000 square feet of which the stores occupy 33,000 square feet. This extension, and the move into it by the workshop and stores, was completed early in 1961 with practically no loss of workshop output and little interruption to stores activities. The new arrangement has proved most satisfactory, and not only speeded up considerably the supply of parts and materials to the workshop, but generally simplified stores procedure.

The depot is now complete with all the initial requirements already outlined in full use.

Improvements due to move to Syndal.—It is somewhat early to show in definite numerical terms the savings and improvements in output due solely to the transfer to Syndal of these maintenance and stores facilities. However, it can already be stated that—

(*a*) Staff and employee morale has been greatly improved by the well designed and modern workshop, stores, and office facilities, and the attractive surroundings both within and outside the depot area. The improved morale shows mostly in the better attendance figures,

better work quality, and a greater will to work on all sides. It also shows in the ready acceptance of the much closer supervision and personnel controls compared with those possible in South Melbourne.

(*b*) The quality of the work has also greatly improved as a result of the introduction of the planning of workshop operations and loadings and the well designed workshop facilities. Furthermore, the introduction of exhaustive tests and inspection of new plant when purchased and subsequently in the field and after overhauls has materially reduced the likelihood of early plant failures.

(*c*) Due to the concentration of workshop and stores facilities, there is a considerable reduction in all types of time wastage by personnel who previously operated in four separate areas. As an example, one of the incidental advantages of the new layout was a reduction in the number of hand gas welding sets from fourteen at South Melbourne to six at Syndal without loss of output.

The Role of the Syndal Depot.—The depot is the centre of the plant maintenance, repair, and operating activities of the Board. The Central Stores serve as the main control base of all purchasing and stores activities. The small country workshops are chiefly bases for the personnel in charge of the maintenance and minor repairs of plant operating within the divisional boundaries. When not fully engaged in field work the personnel of the divisional workshops is employed in the repair of less complex plant items, mainly bituminous treatment machines, and for this purpose some simple general purpose machine tools and other facilities are provided in these shops. The divisional depots, apart from the workshops, also contain small stores and plant storage areas. The special workshop machinery testing and other facilities provided at Syndal have not been duplicated in the divisions, and virtually all the major repairs of the more complex items of plant are carried out at Syndal. This system works most satisfactorily, as the greatly improved quality of modern plant, combined with better field service and field maintenance, has resulted in major plant breakdowns becoming less frequent. As a result, it is seldom necessary to transport plant for urgent repairs from outlying districts to Syndal, and plant replacements are generally made available when any item approaches the major overhaul or replacement stage. Syndal is, however, also the divisional workshop for the Metropolitan and Dandenong divisions, and a section of its personnel is responsible for the field maintenance of plant within these divisions.

The present indications are that the initial aims of the Board in establishing the new depot are being realised, and that "Syndal" will provide satisfactory facilities for many years to come.

New Facilities and Plant.—The initial field testing of four new aggregate loaders was recently started and their design, together with that of the latest rotary road broom, was finalized. The valve control system of the 800-gallon bitumen sprayers was modified. A very large number of road sign drawings was produced and drawing office assistance was generally provided to all sections of the division. Considerable progress has been achieved toward the completion of an illustrated list of standard engineering parts for design, planning, workshop, and stores use, and the compilation of parts books of all plant designed by the Board's staff has commenced.

The following additions were made to the workshop facilities :—

(*a*) Test bench for vacuum and air pressure brake and other systems and components. This machine was designed and its erection supervised by two graduates in mechanical engineering of the Madras University, India, both of whom spent over twelve months with this division, gaining experience and rendering at the same time valuable services to the Board.

(*b*) A second dynamometer was obtained and is so erected that it is possible to operate either both meters separately or, by coupling their shafts, to use them in series for the testing of the few powerful diesel engines used by the Board.

(*c*) A high precision, 20-in. swing, Martin lathe capable of turning a length of 59 in., was obtained for the machine shop.

The following items not previously used were added to the Board's plant :—

(*a*) South Pacific-Bros eleven wheeled, pneumatic tyred, self-propelled rollers fitted with torque converters.

(*b*) Huber-Warco heavy tandem drive power graders fitted with torque converter and power shift transmissions.

(*c*) Case Terramatic model 800 crawler tractor fitted with angle dozer.

(*d*) South Pacific combined nine wheeled pneumatic tyred and steel drum rollers coupled to Chamberlain Countryman towing tractors.

(*e*) Pow-R-Pak road widening conveyor.

(*f*) Cranes and Shovels pneumatic tyred front-end loader with torque converter and foot operated instant forward-reverse transmission.

(*g*) Liquified propane gas heater 135-gallon capacity patrol bitumen heater.

(*h*) Caterpillar D7 crawler tractor-dozer fitted with a rear mounted hydraulic ripper.

Overseas Visit.—During the year the Board, jointly with the Australian Institution of Automotive Aeronautical Engineers, decided to send the Mechanical Engineer, Mr. G. M. Langham, to the United States of America and the United Kingdom. Mr. Langham spent four months abroad and attended an international conference sponsored by the Society of Automotive Engineers in Detroit in January, 1961. While abroad, Mr. Langham investigated earthmoving machinery developments including economies in maintenance practice methods of snow removal, and plant testing. Particular attention was also given to the very important problem of removing dust from the intake air to diesel engines or plant which frequently works in dusty conditions.

ASPHALT DIVISION.

Extent of Work.—Table 1 sets out the mileage of work carried out on declared roads, unclassified roads, and for other authorities during the past two years, the total length for 1960–61 amounting to 2,783 miles, or 5·85 per cent. more than that carried out in 1959–60.

Table 2 shows the lengths of different types and weights of work for both initial treatments and retreatments on the declared system.

Table 3 sets out in summarized form the lengths of different categories of work carried out on all roads to which the Board contributed funds.

Types of Work.—As before, the work was predominantly of the sprayed type, but in the past five years there has been a marked increase in the use of hot mixed bituminous concrete to meet the demands of heavier traffic, the extent of this type of work increasing from eleven miles undertaken in the year 1956–57 to 77 miles carried out during 1960–61.

Cost of Work.—The average costs of the various weights of sprayed work carried out this year, subdivided into the four major categories—material, stores, plant hire, and labour—are set out in Table 4. An analysis of the average costs of work over the past five years shows no significant trend. Costs have varied from year to year mainly according to the variations in the weight of treatment and for initial treatment ranges between 34·5 and 37·7 pence per square yard. This year the average cost of all initial treatment work was approximately 36·9 pence per square yard, compared with the average cost for the past five years of 36·3 pence per square yard.

Materials.

(*a*) *Aggregate.*—Table 5 indicates the cost of aggregate used in sprayed work over the past five years and shows that the weighted average cost of aggregate has maintained a slight downward trend.

The quantity of aggregate used in this work has grown from 191,766 cub. yds. in the year 1956–57 to 316,168 cub. yds. in 1960–61, an increase of 65 per cent.

(*b*) *Bitumen.*—Two refineries in Victoria continue to supply the Board's bitumen requirements in bulk throughout the State. A quantity of 27,708 tons was used in the sprayed work and approximately 4,500 tons by contractors in the hot mixed work, making the total used in the bituminous surfacing programme about 32,200 tons.

(*c*) *Priming Materials.*—Supplies of crude horizontal retort tar, produced in country gas works, are diminishing because of the increase in the use of liquid petroleum gas, and it has been necessary to find substitute materials to make up this deficiency in crude horizontal tar for priming limestone and other absorbent materials used in some areas in the north.

Reference was made in the Firty-seventh Annual Report to experimental work which was being carried out with lightly distilled crude vertical retort tar on limestone pavements, and this practice has been continued with apparent success during 1960–61. In the north of Victoria use has been made of quantities of petroleum tar, brought in bulk from Sydney to provide a primer of medium grade, in cases where it was usual to use mixtures of crude horizontal and vertical retort tars. The petroleum tar appears to be suitable as a primer provided that due care is exercised in using the grade and quantity appropriate to the nature of the pavement surface.

(*d*) *Additives.*—Continued use has been made of cationic surface active agents, incorporated in the binder, to assist adhesion when aggregate is wet and bad weather conditions prevail. So far it has been necessary to import adhesion agents suitable for this purpose from overseas, but there has been some recent work done by local commercial interests, and it is hoped that a suitable locally produced material may soon be available.

Rubber.—Sprayed work in which a small quantity of rubber was incorporated in the bitumen has again been undertaken this year in some cases where pavement was badly cracked or where because of special conditions of traffic it was believed that the apparent assistance to early adhesion provided by rubberised bitumen could be advantageous.

TABLE 1.—LENGTH OF BITUMINOUS SURFACING WORK CARRIED OUT IN 1959–60 AND 1960–61.

Type of Road and Plant Used.	Miles.			
	1959-60.		1960-61.	
(*a*) Work on C.R.B. declared roads—				
(i) Board's plant ..	1,617		1,780	
(ii) Municipal plant ..	76		48	
(iii) Contractor's plant ..	48		59	
		1,741		1,887
(*b*) Work on undeclared roads to which the Board contributes—				
(i) Board's plant ..	745		723	
(ii) Municipal plant ..	52		58	
(iii) Contractor's plant ..	4		16	
		801		797
(*c*) Work done for other Authorities by Board's plant—				
(i) Municipalities ..	78		84	
(ii) State instrumentalities..	9		15	
		87		99
		2,629		2,783

Hitherto, when using rubber in bitumen it has been the practice to add finely divided rubber powder to the hot bitumen, the mixture requiring a considerable amount of agitation and mixing before the powder could be thoroughly incorporated. It has also always been necessary to add power kerosene in order to counteract the increase in viscosity caused by the addition of rubber in addition to that which might normally be required in the binder.

A development, designed to reduce the time consuming operation of mixing rubber powder was initiated and eventuated in the production of a solution of masticated sheet rubber and power kerosene. Some work has been done with this material which automatically provides in the solution the kerosene necessary to correct the binder viscosity, and although the best technique for adding the required quantity of solution to the binder and ensuring its proper incorporation is still a matter requiring further experimentation, the development shows great promise.

Light Temporary Surfacing.—Reference was made in the Forty-seventh Annual Report to practices adopted, particularly in the winter months, when it is better to use a light temporary treatment, rather than the normal weight of treatment, under unfavourable conditions of pavement and weather so that the risk of failure is rather high. It is usual to maintain the temporary treatment throughout the winter and apply a normal treatment some months later.

A good example of this type of work was undertaken this year when it was necessary to apply a bituminous treatment to a length of 6½ miles of the Maltby By-pass in June, 1961. The pavement consisted of granitic sand which was almost saturated, air temperatures were low, nights were damp and foggy so that the pavement had no opportunity of drying out and conditions were against normal prime and seal procedure being successful.

It was therefore decided to apply a light temporary treatment which would enable traffic to use the by-pass during the winter months. Basically the treatment consisted of an extremely light application of a very light grade of primer, followed by a cutback bitumen seal coat covered with ⅜-in. one-sized aggregate. Rubber was added to the binder because its effect in assisting early adhesion had been observed previously, and it was thought advisable to employ every available assistance when carrying out this work under the prevailing cold and wet conditions. The resultant work is good and after some months is carrying traffic of approximately 2,500 v.p.d.

TABLE 2.—MILEAGE OF EACH TYPE OF WORK CARRIED OUT ON DECLARED ROADS DURING 1960–61.

Type of Road and Control of Work.		Length in Miles.																			
		Nature of the Work.																			
		Initial Treatments.														Retreatments.					
Road.	Control.	I.T.P. and Seal.	I.T.P. and S. ⅜-in. and Over.		I.T.P. and S. ½-in.		I.T.P. and S. ⅜-in.		I.T.P. and S. ¼-in. and Sand.		I.T. Seal Only.		I.T.P. and Two Application Seal.		I.T.	P.M.S.	Reseals.				P.M.S.
																	Nominal Size of Aggregate.				
		Widening.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	⅜-in. and Over.	½-in.	⅜-in.	¼-in.	
State Highways and By-pass Roads	Direct ..	30·42	14·77	100·42	1·33	33·00	12·74	4·23	20·29	33·54	4·34	18·59	..	1·09	..	2·52	22·65	75·83	146·75	158·15	47·07
	Municipal ..	..	..	..	..	..	..	17·93	..	..	..	..	..	..	..	..	..	..	..	..	..
Main, Forest, and Tourists' Roads	Direct ..	1·41	10·38	3·47	13·92	10·21	3·67	0·25	2·48	0·17	0·66	2·79	..	..	..	..	3·84	4·44	26·65	3·90	..
	Municipal ..	68·50	92·15	35·17	105·42	13·32	33·28	6·49	30·98	5·94	179·60	60·33	..	..	..	2·36	37·82	115·43	114·75	142·17	9·43
		100·33	117·30	139·06	120·67	56·53	49·69	28·90	53·75	39·65	184·60	81·71	..	1·09	..	4·88	64·31	195·70	288·15	304·22	..
Totals		100·33	256·36		177·20		78·59		93·40		266·31		1·09		4·88		852·38				56·50
		978·16															908·88				
		1,887·04																			

Abbreviations.—E. Extension to the bituminous surfaced system. R. Initial treatment on reconstructed length of previously sealed pavement. P.M.S. Treatment with plantmix.

NOTE.—The table does not include 797 miles of work on undeclared roads to which the Board contributed funds.

TABLE 3.—SUMMARY OF THE MILEAGES OF DIFFERENT CATEGORIES OF WORK CARRIED OUT ON ALL ROADS TO WHICH THE BOARD CONTRIBUTED FUNDS DURING 1960–61.

—	State Highways.	By-pass Roads.	Tourists' and Forest Roads.	Main Roads.	Unclassified Roads.	Totals.
Initial Treatments—						
Extensions to the sealed system	42·20	11·27	18·77	453·77	620·12	1,146·13
Reconstruction of lengths of previously sealed pavements :—						
(*a*) Sprayed work	208·80	..	6·47	131·67	23·10	370·04
(*b*) Plant mixed work	2·52	..	..	2·36	2·96	7·84
Widening of existing sealed pavements	30·42	..	..	69·91	6·55	106·88
Retreatments—						
(*a*) Sprayed reseals	403·38	..	29·65	419·35	131·12	983·50
(*b*) Plant mixed work	47·07	..	..	9·43	13·14	69·64
Totals	734·39	11·27	54·89	1,086·49	796·99	2,684·03

including about 30 per cent. of commercial vehicles, quite satisfactorily. Details of the process were as follows :—

Primer.—Crude vertical retort tar cut back with equal parts by volume of a light tar oil, and applied at the rate of 0·075 to 0·10 gallon per square yard.

Little, if any, of this primer was expected to be absorbed into the damp or wet pavement. It was applied, rather to assist adhesion of the binder to the pavement. Where there was some excess of primer in slight depressions or on particularly tight sections of the pavement, rotary road brooms were used to distribute and/or sweep off the excess.

Binder.—80/100 penetration bitumen to which was added 2 per cent. by weight of rubber in the form of the rubber–power kerosene solution referred to earlier in this report. The rubberised bitumen was cut back by the addition of from 7½ to 12 parts of power kerosene per 100 parts of bitumen according to the prevailing air temperature. The rate of application of the binder, excluding the power kerosene cutter, was 0·13 gallon per square yard.

Aggregate.—One sized crushed basalt, ⅜ in., applied at the rate of approximately 1 cubic yard to 100 square yards.

General.—Much of the light primer was still damp when the binder was applied a few days after priming, and some slight fluxing of the binder would occur. It is believed that any ill effects, such as flushing, which might be expected to occur in warm weather because of this, may be counteracted by the presence in the bitumen of rubber which tends to reduce the susceptibility of the binder to changes of temperature.

In order to take advantage of any favourable break in the prevailing bad weather, even a short one, arrangements were made to augment the normal sealing plant by additional bitumen sprayers, supply tankers, aggregate spreaders, loaders, rollers, &c., and this enabled the priming of 6½ miles 24 feet 8 inches wide, to be carried out in 3½ hours. With the additional aggregate spreading and compacting equipment it was possible to cover the sprayed binder with a minimum of delay, and this, no doubt, contributed to the success of the operation.

Rates of Application and Cutting Back of Binder in Sprayed Work.—It is necessary to keep under constant review design procedures and techniques for sprayed work to meet the wide extremes of conditions encountered, particularly traffic densities and speeds. Work of this type may be carried out on roads carrying any traffic from a few vehicles per day up to ten or fifteen thousand.

In the design of this work it is assumed, basically, that the voids in the mat of cover stone in the seal coat, after traffic compaction, including the volume taken up by the binder, will be reduced to 20 per cent. with all the stones lying with their least dimension vertical. The rate of application of binder is determined by deciding to fill a certain percentage of these voids with binder, this percentage being assessed after taking into consideration traffic, and the nature of the aggregate being used. This should be sufficient to hold the aggregate firmly together, and yet not rise high enough to creep over the tops of the stones early in the life of the seal coat. The problem which arises is the difficulty of modifying this basic design to provide for the cases where, under very heavy traffic the reduction of the voids may reach a minimum in the first few hours of the life of the seal coat, or on the other hand, where the traffic is very light, the voids may never be reduced to the theoretical 20 per cent. nor the stones be packed till their average least dimension is vertical.

On heavily trafficked roads the problem is still further complicated if power kerosene cutter is added to the binder, in order to retard the increase in viscosity after spraying, so as to ensure proper wetting and adhesion of the aggregate. Any power kerosene added is in addition to the binder and the rate of application is increased accordingly. A long time elapses before the binder gives up this added cutter, and when the mat of stone is compacted rapidly, early "fatting up" may occur if the rate of application is excessive.

Reference was made in the Forty-fifth Annual Report to the apparent need to provide for a slight general increase in rates of application on all work, because of certain stripping troubles which had been encountered. Experience subsequent to this appeared to indicate that an increase was not required on heavily trafficked roads and unduly accelerated the "fatting up" of the seal coat. On the lightly trafficked roads, however, it was obvious that still further increases to the rates of application could be tolerated and were desirable in order to counteract the hungry appearance of these seal coats, the possiblities of stones plucking out and to avoid the need for early resealing.

Rates of application have therefore been again modified during the 1960–61 season, providing for a slight reduction on roads carrying over 2,000 vehicles per day, and a material increase on roads carrying less than 100 vehicles per day. It is possible that still further increases would be beneficial on the very lightly trafficked roads. For the year 1960–61 the designed percentages of voids to be filled under various conditions are as set out in Table 6. Further, in order to minimise as much as possible the complications caused by the addition of power kerosene, the quantities of cutter added to meet varying conditions of temperature when the work was carried out were materially reduced. Under average and warm weather

TABLE 4.—AVERAGE COST OF SPRAYED BITUMINOUS SURFACING CARRIED OUT BY COUNTRY ROADS BOARD PLANT ON ROADS TO WHICH THE BOARD CONTRIBUTED FUNDS DURING 1960-61.
(Cost in Pence per Square Yard).

Item.	Nature of the Work.																			
	I.T.P. and S. ⅝-in. and Over.		I.T.P. and S. ½-in.		I.T.P. and S. ⅜-in.		I.T.P. and S. ¼-in. and Sand.		I.T.P. and Two Application Seal.		I.T. Seal Only.		Reseal ¾-in. and Over.		Reseal ½-in.		Reseal ⅜-in.		Reseal ¼-in. and Sand.	
Square Yards Costed ..	3,565,554		3,003,995		802,397		62,329		19,818		4,664,629		705,075		2,180,608		3,196,811		3,182,612	
	d.	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%
Material	22·1	56·2	21·2	59·2	20·6	67·8	14·4	61·0	25·2	64·6	15·5	61·7	16·3	59·5	15·3	61·9	12·0	62·8	10·1	68·7
Stores	1·5	3·8	1·1	3·1	0·9	3·0	1·1	4·7	1·2	3·1	0·8	3·2	0·8	2·9	0·7	2·8	0·6	3·1	0·4	2·7
Plant Hire	7·2	18·4	6·3	17·6	4·3	14·1	3·9	16·5	6·2	15·9	4·0	16·0	4·7	17·2	4·0	16·2	3·0	15·7	2·0	13·6
Labour	8·5	21·6	7·2	20·1	4·6	15·1	4·2	17·8	6·4	16·4	4·8	19·1	5·6	20·4	4·7	19·1	3·5	18·4	2·2	15·0
Totals ..	39·3	100·0	35·8	100·0	30·4	100·0	23·6	100·0	39·0	100·0	25·1	100·0	27·4	100·0	24·7	100·0	19·1	100·0	14·7	100·0

TABLE 5.—AVERAGE PRICE OF AGGREGATE FOR BITUMINOUS SURFACING AT PER CUBIC YARD IN STACKS BY THE ROADSIDE FOR THE YEARS 1956–57, 1957–58, 1958–59, 1959–60, 1960–61.

Material.	Price per Cubic Yard.									
	1956–57.		1957–58.		1958–59.		1959–60.		1960–61.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Screenings	51	5	49	4	47	9	48	6	47	2
Gravel	39	11	46	1	46	1	42	2	43	0
Sand	29	3	26	3	32	6	27	4	21	1
Scoria	26	2	18	9	8	6	27	1	21	3
Average price all aggregates	48	8	47	11	47	0	46	5	45	8

conditions this appears to have been satisfactory, although it has been necessary in certain cases to spray shorter lengths than before in order to ensure that the viscosity of the sprayed binder remained sufficiently low to properly wet the covering aggregate. When work has been done under cold conditions, however, there is some evidence that the reduction of power kerosene has been too severe, and the procedure may require some further modification to meet such abnormal conditions.

TABLE 6.—PERCENTAGE OF VOIDS IN THE TRAFFIC COMPACTED WORK TO BE FILLED WITH RESIDUAL BINDER.

—	Surface Condition—Primed. Smooth, or Black.				
	Traffic—Vehicles per Day.				
	Under 100.	100 to 500.	500 to 1,000.	1,000 to 2,000.	Over 2,000.
Recognized good types of aggregate	85	75	70	65	60
Quartz aggregates ..	90	80	80	75	75
Other aggregates	90	80	75	70	65
Absorptive limestone aggregates	Two application procedure				

NOTE.—For initial treatment (prime and Seal) where the traffic exceeds 1,000 v.p.d. add 5 per cent. to the percentage of voids to be filled.

DIVISION OF ROAD DESIGN.

During the past year, the work of this division has been greatly increased over that of previous years. In addition to the large volume of detailed engineering surveys and plans which are required for current projects to be constructed at an early date, there has been a large volume of planning and preliminary design work for future by-pass roads and other major routes.

Some of the work unavoidably is in areas already subdivided, but there is also urgent need to acquire land (often with controlled access) before rapid development renders the cost of acquisition too expensive. Planning work has therefore been expanded to the absolute limit of the available staff. Location and general design are developed with a reasonable degree of certainty but details are left to be worked out subsequently.

It is certain that this procedure will be vindicated by very substantial savings in the future as property values will undoubtedly rise considerably with the State's development. There is further advantage in early planning on by-pass roads in areas where the adjacent property is still broad acres in that provision of alternative access is greatly simplified and reduced in cost as compared with areas subdivided with small allotments.

Digital Terrain Modelling.—This is a special development of photogrammetry using air photos with stereo coverage, and is particularly suitable for road location and design.

Instead of using the normal topographical plan with plotted contours, the method produces systematic information relating to selected alternative routes, giving spot levels in lieu of contours, and thus enabling longitudinal and cross sections to be plotted or tabulated directly from the plotting machine results. The data, thus obtained, can be punched directly on to cards or tape, and used with an appropriate programme in an electronic computer to provide depths of cut and fill, earthwork quantities, &c.

The co-ordinates of any desired trial alignment can be machine plotted with facility, and since spot levels can be measured with greater accuracy than a contour line can be plotted, the method has many advantages in road design.

The method was further investigated by the Board's Engineer for Road Design, Mr. G. J. Dempster, when on a short visit to the U.S.A. in 1960, after some preliminary studies with officers of the Victorian Lands Department.

The latter department has recently installed a Wild A.7 Stereo-plotter together with auxiliary I.B.M. equipment, and is now able to undertake Digital Terrain Modelling for the Board and other Departments.

An important highway investigation project is at present being processed using this method, and the resulting punch cards will be put through an electronic computer (using a tested programme) to determine earthwork quantities. This will enable a very reliable comparison to be made of the economics of several alternative locations.

Electronic Computation.—In addition to the above special application, a start has been made with electronic computation of earthwork quantities with the object of later adopting the method as standard practice. To date, 11 miles of earthwork quantities have been computed and a few trial survey traverses closed. This processing of data has been done at the I.B.M. computing centre, as being the most economical method until sufficient experience is accumulated and the volume of work justifies further development.

It is probable that the stages of development in this field will be along the lines of the early appointment of a programmer to develop methods of computation for salient design requirements, the introduction of key punches and verifiers to prepare the input-data, and possibly later the hire of a computer. New types of transistorised digital computers occupying small floor space have recently become available in Victoria, and programmes for their use will shortly be prepared.

By-pass Roads.—The number of designs prepared for by-pass roads has increased during the year, and layout plans of a standard sufficient for the reservation of the necessary land have been completed for the system around Dandenong. Other routes of this type to provide for fast, safe and economical movement of large volumes of traffic are being designed to the Mornington Peninsula, to Geelong, to the Tullamarine Jet Airport, to by-pass Greensborough, to connect Ringwood and Dandenong, to the Latrobe Valley, and to supplement portions of the Hume Highway. Access to the new routes will be by interchanges designed not to interfere with the free-flowing characteristics of the freeways which will retain their traffic carrying capacity even if the adjacent land continues to develop.

The extensive use of topographic plans produced by photogrammetry from aerial surveys has expedited the location and design work for these projects.

Liaison with Melbourne and Metropolitan Board of Works Planners.—The Chief Engineer and the Traffic and Location Engineer continue to meet regularly with the Chief Planner and the Engineer for Metropolitan Highways of the Melbourne and Metropolitan Board of Works. These meetings are of value in co-ordinating, as far as possible, the activities of both authorities within the metropolitan area.

Intersections.—The growth of traffic at signallized urban intersections has led to the neeessity for a type of treatment which, by flaring the intersection, provides a greater number of traffic lanes on the approaches to the signals. The application of this treatment will reduce the length of traffic queue and thus the delays at these intersections. In addition, many channelized layouts for both rural and urban intersections have been designed to reduce conflicting traffic movements and improve safety.

Road Signs.—The publication of the revised Road Signs Code, 1960 by the Standards Association of Australia, has resulted in changes in the shape, size, colour, legend and usage of some signs. This will result in greater uniformity of signs throughout Australia. The Board's engineers actively co-operated in the preparation of the code which represents a significant advance in signs practice. The experimental tunnel in the head office building permits convenient visual testing of new materials and designs for road signs.

In addition to the signs specified in the Code for general use, there is need for special signs to meet uncommon or unusual situations, and the National Association of Australian State Road Authorities, through its Traffic Engineering Committee, has established a procedure whereby the design of any such sign is made available, should similar circumstances be found in other States.

A recent innovation which is already appreciated by the travelling public is the provision of advisory speed signs placed underneath the normal diamond-shaped warning signs on a section of the Western Highway. The signs indicate the speed (to the nearest 5 m.p.h.) at which a vehicle can comfortably and safely negotiate the curve while travelling within its correct traffic lane.

Traffic Volumes.—Regular traffic counts on declared roads are used to make predictions of future traffic. A traffic index, based on a weighted average of counts at a large number of points throughout the highway system, has been established. This index is revised from time to time and indicates that there is a continued increase in the rate of traffic growth.

For example, traffic volumes in 1960 were about 2·6 per cent., and in 1961, 4·3 per cent. greater than predicted. In other words, the actual growth of traffic over the last two years has averaged over 8 per cent. per annum, whereas growth predicted in 1959 was approximately 6 per cent. per annum.

The rate of traffic growth within the metropolitan area is probably greater than the rates indicated by the Rural Highway Traffic Index, several arterial routes showing increases consistently greater than 10 per cent. per annum.

Traffic Generation from Residential Areas.—It is often necessary to predict the traffic volumes which will be generated by new housing areas, and two small studies undertaken, indicated that the amount of vehicular traffic generated from housing areas in Victoria is comparable with that in the United States of America.

The Dennington area, west of Warrnambool, was examined by the direct observation of traffic at the streets joining the Princes Highway West, as there are no other connexions to the area which is circumscribed by a railway and a river. The Doveton area near Dandenong was also examined. It is circumscribed by two streams and has only three road connexions. The registration plate numbers of vehicles entering and leaving the area were noted during the study period, and the relatively small volume of through traffic could thus be excluded from the observed volumes.

The data are compared in Table 7 with United States conditions as found by W. L. Mertz in a study in the metropolitan area of Washington D.C., and as recorded by him in " A study of Traffic Characteristics in Suburban Residential Areas ", Public Roads, Vol. 29, No. 9, August, 1957.

Dennington shows a traffic generation slightly higher than the United States studies, and Doveton shows a lower generation. The Doveton result could be partly due to the size of the area which is large enough to contain a significant number of internal trips for such purposes as local shopping, local deliveries, home-to-school, social, and recreational.

In all studies, a trip is regarded as a one-way vehicular movement either into or out of the area studies. The results are for weekdays only.

Traffic Line Marking.—The total mileage of roads maintained in a striped condition during the year 1960–61 was 3,840 miles, an increase of 407 miles over the previous year's figures.

This total comprised State highways 2,822 miles, other declared roads 856 miles, and other roads 162 miles, representing 6,557 miles of " standard 3-inch stripe ", i.e., a line consisting of 10-ft. dashes and 30-ft. gaps. The total expenditure on this type of work during the financial year was £40,675, and the average cost per mile of standard stripe, £6 4s. The total quantity of lacquer used was 22,592 gallons, with an average rate of application per mile of standard stripe of 3·44 gallons or 95·78 square feet per gallon.

Title Surveys.—During the year, 610 title surveys affecting approximately 5,000 properties were carried out by the Board's staff in conjunction with many private surveyors. Seven thousand Title Searches were required for these surveys and for planning investigation. To cope with the additional amount of work, one senior and four junior draftsmen have been added to the staff.

Photogrammetry.—Approximately 500 miles of the more recently declared highways were flown to enable strip mosaics to be compiled at a scale of 300 feet to an inch, 250 miles of which have been completed. Strip mosiacs were also assembled for all the recently declared main roads in the metropolitan area at a scale of 300 feet to an inch, and final record survey plans were produced for the Borung and the Ouyen Highways—a length of 130 miles.

Odometer surveys were carried out to accurately fix new mile posts, position of bridges, and municipal boundaries on 1,300 miles of road.

Printing.—A Statfile camera was purchased so that most of the bridge, engineering, and other plans could be recorded on half-plate negatives. After a period, the originals will probably be destroyed so as to save valuable space. Prints from the plan printer can be obtained from a half-scale transparency.

A copy print machine was also purchased to enable copies from technical bulletins, old plans, &c., to be produced. The machine can also produce offset plates, and from these, up to 10,000 runs can be made at low cost.

TABLE 7.

Locality.	Description.	Number of Vehicular Trips per Dwelling Unit.
Parkglen Apartments, Arlington, Virginia, U.S.A., 195 apartments occupied	Multi-story apartments in a developed suburb 6 miles from Washington, D.C. Public transportation available. Shops adjacent	5·07 trips per 16-hour day (6 a.m. to 10 p.m.)
Georgetown Village, Maryland, U.S.A., 150 homes occupied	Single unit homes at the periphery of the suburban area, 12 miles from Washington, D.C. Limited public transportation. No adjacent shops	4·99 trips per 16-hour day (6 a.m. to 10 p.m.)
Dennington, Victoria, 49 Urban homes and 10 small farmhouses	Portion of the Township of Dennington (population 1,000) which is 3 miles from Warrnambool (population 12,000). Shops within ¼ mile. Limited bus service to Warrnambool	2·46 trips per 6-hour afternoon (1 p.m. to 7 p.m.) = 4·30 trips per 12-hour day (7 a.m. to 7 p.m.) = 5·53 trips per 16-hour day (6 a.m. to 10 p.m.)
Doveton, Victoria, 1,311 houses	Single-unit houses at the periphery of the surburban area, 1 mile from Dandenong (population 25,000) and 20 miles from Melbourne (metropolitan population 1,900,000). Limited bus service to Dandenong	1·07 trips per 6-hour morning (7 a.m. to 1 p.m.) = 2·49 trips per 12 hour day (7 a.m. to 7 p.m.) = 3·21 trips per 16-hour day (6 a.m. to 10 p.m.)

MATERIALS RESEARCH DIVISION.

Plasticity of Fine Crushed Rock.—Some further work has been done on a section of the Western Highway at Rockbank paved with fine crushed rock (newer basalt) which had been thought to increase in plasticity with time. While the material is plastic, and contains an excess of fine particles, there is no evidence to suggest that there has been any increase in the plasticity index or in the proportion of fine material, during the last five years.

Eighty-three slides prepared from stone from sites in the road showed an average secondary mineral content of 11·5 per cent., with only two slides in excess of 20 per cent. According to experience in Oregon, United States of America, this proportion of secondary minerals should have little effect on the durability of the stone. Furthermore, there appeared to be no significant difference on secondary mineral content between stone sampled from the road and fresh basalt from newer basalt quarries.

This investigation is being extended to the decomposed basalt material known locally as "salamander". This material contains a high percentage of secondary minerals and is believed to be likely to deteriorate in a pavement.

Evaluation of Pavement Behaviour.—Studies of pavement behaviour and the development of design criteria for flexible pavements have been a major activity of the Materials Research Division for many years. The need to strengthen the Murray Valley Highway, section 3, between mileages 34·0 and 38·5 afforded an opportunity to evaluate the behaviour of a pavement which had been investigated in detail during 1946 after extensive pavement failures.

The 1946 investigation involved sampling and *in situ* tests at quarter-mile intervals. C.B.R. values were calculated from simple soil tests and correlated with *in situ* C.B.R. values determined by Proctor Needle, and with in-situ moisture content determinations. These indications indicated that the sub-grade materials were grey-brown clays and grey silty clays, with design C.B.R. values of 5 to 8 per cent. The 1946 traffic count was 37 vehicles per day, giving a design traffic volume of less than 60 vehicles per day. With this data, and average C.B.R. value of 6, total pavement thicknesses of 9 inches (where no irrigation existed) and 11 inches (in irrigation areas) were recommended. To conserve funds, construction was finally carried out to provide a total pavement thickness of 9 inches and with this reduced pavement depth, failures were to be expected, even had traffic conditions remained unchanged.

In 1961, investigation involved more thorough sampling with field C.B.R. values determined from cone penetrometer tests, and laboratory C.B.R. values determined from simple soil tests. *In situ* moisture content of the subgrade had increased by 1 to 3 per cent. with a slight reduction in C.B.R. value to 5. Increase of traffic led to a design traffic volume of 550 vehicles per day, and the recommended total pavement thickness was 15 inches to 17 inches. With an existing pavement thickness of 9 inches a resheet of 8 inches was required.

Before sampling or carrying out *in situ* tests, the deflection of the pavement under an axle load of 18,000 lb. was measured with the Benkelmann Beam apparatus. Two beams were used to obtain simultaneous measurement of deflection in the inner and outer wheel tracks, measured deflections ranging from 0·040 in. to 0·10 in. Deflections in excess of 0·040 in. are considered to be indicative of pavement weakness, while 0·030 in. might be considered reasonable for new construction. With some simplifying assumptions the thickness of pavement required to reduce deflections to acceptable values may be computed.

In Fig. 1 the results of these calculations are plotted together with the detailed results of both 1946 and 1961 laboratory field investigations. All results are given in terms of pavement thickness computed, where applicable, in accordance with the methods set out in Technical Bulletin 21. The following conclusions may be drawn :—

(1) Recent laboratory and field C.B.R. tests and Benkelmann Beam tests show reasonable correlation.

(2) The slight increase in subgrade moisture content between 1946 and 1961 has reduced the bearing value of the subgrade resulting in an increase of pavement thickness for equivalent traffic of 2 inches.

(3) The increased pavement thickness required as a result of recent investigations is due mainly to the increase in traffic volume.

Sand Equivalent Test.—Further work has been done on the sand equivalent test which was referred to in the Forty-fifth Annual Report, and following a suggestion from overseas, a hand-operated mechanism has been constructed (Plate 1). This apparatus utilizes the vibration of a cantilever beam to control the shaking motion of the cylinder containing the sample, and enables different operators to obtain consistent results.

Portable Seismograph.—This instrument has been used successfully in locating sandstone pits in the north-western part of the State, and has also proved valuable in the

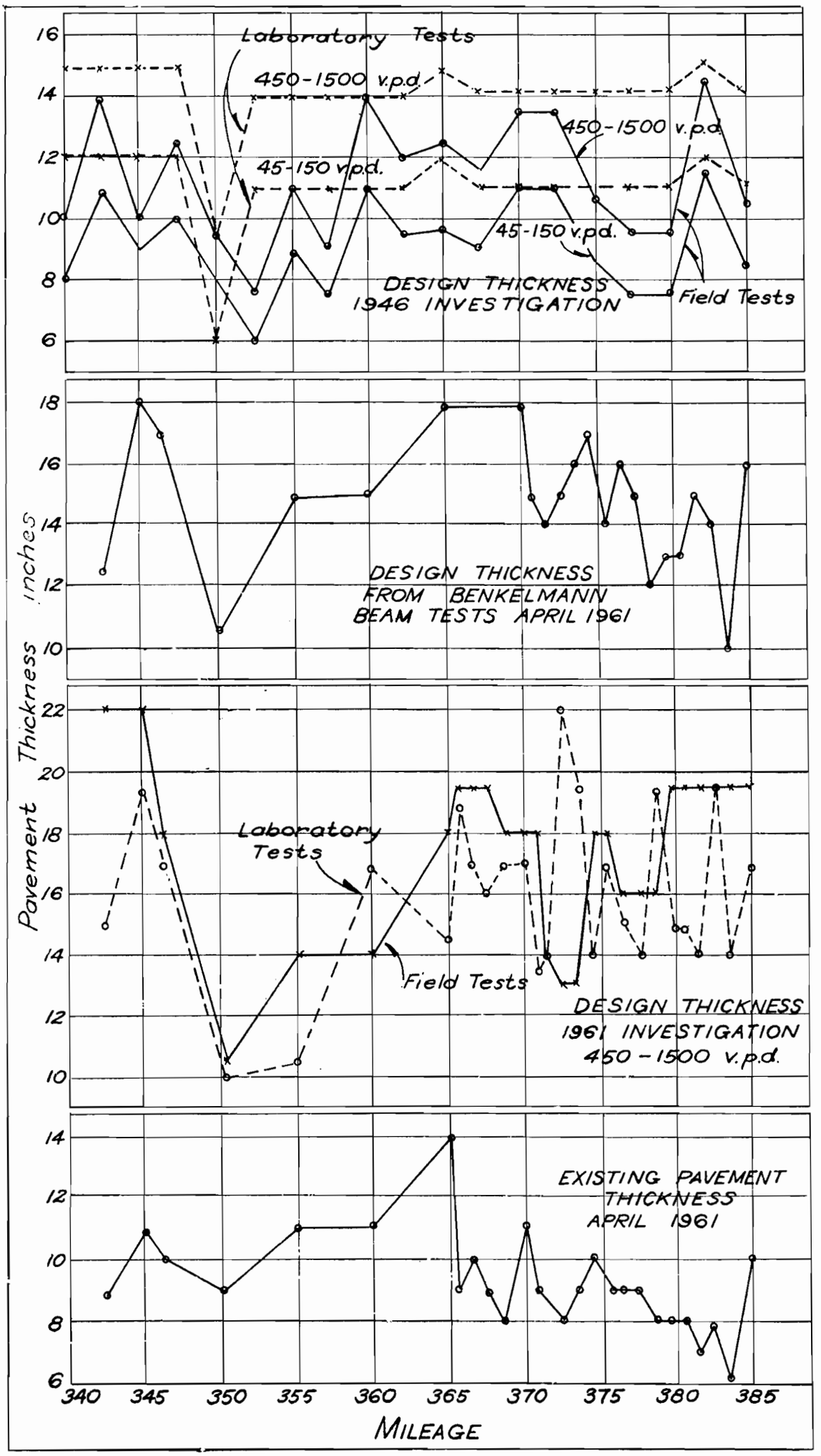


FIG.1. PAVEMENT INVESTIGATIONS MURRAY VALLEY HIGHWAY SECTION 3

exploration of bridge sites and the sites of proposed deep cuttings. Since this unit was obtained it has been in almost constant use, and over 1,000 traverses have been made. Some difficulties, due to extraneous noises, have been experienced near the metropolitan area, but it is anticipated that these will be overcome when a more advanced instrument, which is now on order, has been obtained.

Skid Resistance of Pavements.—A portable pendulum type skid resistance apparatus has been obtained from England, and will be used to check pavement surface conditions.

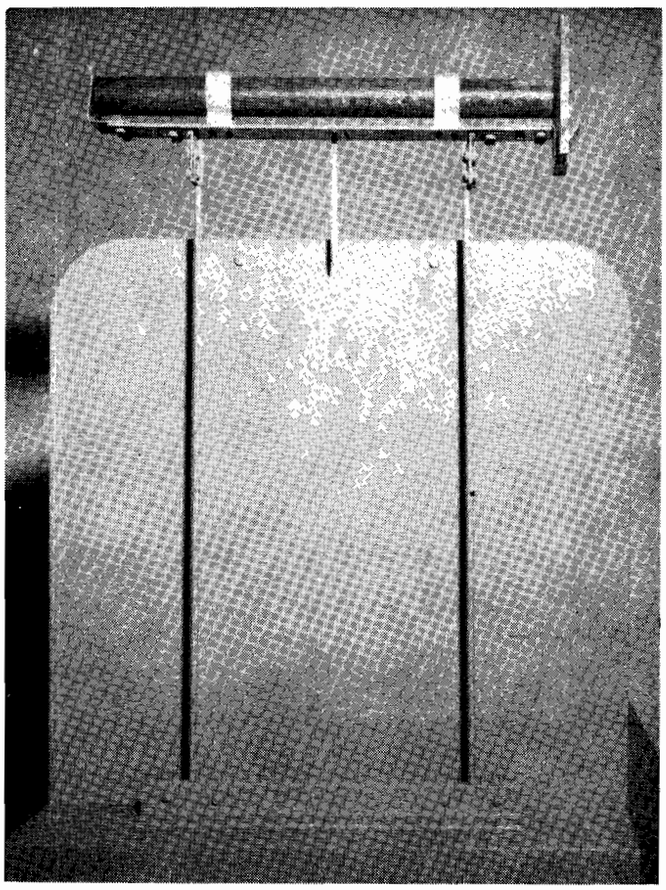


Plate 1.—Sand equivalent apparatus.

Paving Materials.—

(*a*) *Limestone.*—On the Calder Highway, section 4, in the vicinity of Berriwillock, large quantities of paving materials were required. The only material available was limestone with the following properties:—

Liquid limit	.. 33
Plastic limit	.. 18
Plasticity index	.. 15
Linear shrinkage	.. 6

This material was used on a pavement of 10 inches total thickness, of which the top 5 inches was stabilized by the addition of one part by volume of fine sand to three parts by volume of limestone. The grading of the sand was as follows:—

B.S. sieve size :	14	25	36	52	100	200
Per cent. passing :	100	97	82	48	19	6

The limestone was placed in two layers and broken to approximately 3 inches maximum size with 10-ton rollers. The fine sand was spread over the limestone at the pre-determined rate and mixing performed by disc cultivating and blading with heavy grader. An excellent job resulted.

(*b*) *Granitic Sand.—Fine Sand.*—No suitable natural paving materials were available for resheeting the Murray Valley Highway, section 3, west of Cohuna. The possibility of stabilizing fine sand from Spence's Bridge or granitic sand from Mt. Hope with cement was therefore investigated.

The fine sand was non-plastic and was graded as follows:—

B.S. Sieve size :	52	100	200
Per cent. passing :	100	60	28

Laboratory tests indicated that a C.B.R. of 200 could be obtained with the addition of 4 per cent. by weight of cement. This was considered to be satisfactory for this highway, and since the sand deposit was close to the job, it was decided to adopt this process for a 5-in. thick surface course on the same sand.

The materials were mixed in a Barber Greene pugmill mixer and spread with a Barber Greene paver. Compaction was carried out with a Jackson vibrating compactor and a Pacific self-propelled multi wheel roller. During the curing period, water was applied to the surface by pressure sprayer fitted with Copley jets so as to produce a fine spray. Many difficulties were experienced in mixing, handling and compacting the mixed material, and although the finished pavement seemed of doubtful quality, it was sealed, and is in use, but the more expensive granitic sand was used for the remainder of the work. This material was stabilized with 4 per cent. by weight of cement with the marked improvement in the properties as shown in the following:—

Sieve Size	*Before Stabilizing*	*After Stabilizing (random tests)*
3/16"	98	100
No. 7 B.S.	90	92
36 B.S.	54	52
100 B.S.	40	33
200 B.S.	32	20
Liquid limit ..	Varies from 15 to 29	..
Plastic limit ..	Varies from 13 to 13·5	..
Plasticity index	Varies from 2 to 15·5	N.P.
Linear shrinkage	Varies from 1 to 2	..

The material was easily handled by the available plant and a reasonable pavement resulted.

The conclusions reached from this project are—

(1) When material to be stabilized is imported to the road, and is free flowing, the use of central mixing plant is satisfactory.

(2) The use of a paver for spreading the mixed material permitted better control of pavement thickness, and provided more satisfactory conditions for traffic than would have been obtained had graders been used. However, it is essential that the base course be compacted and trimmed accurately, and that the paver be used within its capacity.

(3) Fine sand such as that from the deposit at Spence's Bridge is not suitable for use as a surface course after stabilization with relatively small amounts of cement.

(4) On works of this nature, it is absolutely necessary that an experienced engineer be on the job full time to handle the problems which continually arise, and that an experimental officer be stationed at the mixer to control and check the moisture and cement contents.

Plant.—The "Hyster" grid-roller has been used continuously in Bendigo division on projects where it has been necessary to break down ripped sandstone or limestone.

The material is normally of 9-in. size when spread on the roadbed, and after spreading with a dozer into as thin a layer as possible is usually given five to six passes of the roller, with grading to reduce the thickness of the layer as the size is reduced. It is readily possible to reduce the maximum size to 3 inches.

The unit has been used with excellent results on such materials having a Los Angeles Abrasion Loss between 35 per cent. and 55 per cent. (See Plate 2).

Operations have generally been confined to half-width of pavement at a time to avoid interruption to traffic.

Grooved Rollers.—Heavy rollers were required for the compaction of embankments leading to railway overpass structures, and to supplement the heavy tamping rollers owned by the Board a grooved cylindrical steel roller was hired from the Melbourne and Metropolitan Board of Works. This type of roller has been used extensively by the Melbourne and Metropolitan Board of Works for compacting material in earth fill dams. It is 66-in. diameter and assembled in two sections in the same manner as a tamping roller; each section has six 3-in. deep grooves at 10-in. pitch, and a total working weight of 25·5 tons on a rolling width of 9-ft. 8-in.

The unit is more economical than a tamping roller for the compaction of earthworks in that less passes are necessary to obtain the required density. If rolling is commenced on material at the correct moisture content the grooved roll seals the surface against evaporation and does not leave a loose pockmarked surface that will collect rain water. These two factors are of considerable importance, as the importation of water to counteract the drying of the fill can add appreciably to the cost of compaction. The use of a grooved roller instead of a sheepsfoot or tamping roller will be frequently worth consideration (see Plate 3).

BRIDGE DIVISION.

Kings Bridge.

The Forty-seventh Annual Report (1959–60) referred to the completion of the Flinders Street Overpass, progress made on the river bridges and elevated carriageway, and described the design and fabrication of the welded high tensile girders. The low level bridges (east and west lanes) were opened to traffic in November, 1960. The elevated carriageway was completed on 30th March, 1961, and the official opening of the project took place on the 12th April, 1961. (The final certificate of completion is dated 3rd October, 1961.)

River Bridges and Elevated Carriageway.—Fabrication and erection of the steel girders were completed on 29th January, 1961. The girders in the elevated carriageway, except those over the City Road intersection, were off-loaded and lifted into position by means of a 20-ton mobile crane. The 160-ft. long girders over the City Road Kingsway intersection were off-loaded and erected by means of two 30-ton mobile cranes (see Plate 4).

Concreting of Deck.—Plant mixed concrete, delivered to the job, was placed in position by a skip attached to a mobile crane which either operated on the roadways beneath the bridge or on top of the bridge. Transverse screeding of the deck was used. Concrete was placed at a rate of between 20 and 25 cubic yards per hour. A wearing surface of hot rolled sheet asphalt 2-in. thick was subsequently placed on the deck of the river bridges and elevated carriageway.

Lighting.—A good standard of lighting was provided for the carriageway by means of 400 watt colour corrected mercury vapour lanterns mounted on welded mild steel lighting standards spaced 70 feet apart and 30 feet above the roadway and shielded to obviate glare owing to the approach grades and vertical curves. The lighting standards were positioned in line with the outer handrails for aesthetic reasons. This necessitated the use of a supporting cable spanning 130 feet at the northern approach of the river bridge (see Plate 5).

Overhead Direction Sign.—Overhead neon direction signs, consisting of white letters on a green background, mounted 16 feet above the roadway, were installed for the guidance of motorists.

Deck Joints.—The deck expansion joints in the roadway on the river bridge and elevated carriageway are of the finger type, the fingers being of cast steel providing for a movement of $\pm$ 1·9 in. Footway expansion joints consist of sliding plates of checquered mild steel.

The 1 inch wide fixed deck joints in the roadway and footway of the river bridge and elevated carriageway are filled with "Thickol" joint sealer approximately 1-inch deep, slightly recessed beneath the general level of the deck surface and placed between mild steel armour plates which are flush with the sheet asphalt. The joint filler under the Thickol is "Corex" which is supported by a neoprene hose. Four different types of "Thickol" have been used, and their performance, which has been satisfactory so far, will be observed at intervals.

Traffic using Bridge.—Considerable traffic commenced using the river bridges and elevated carriageway as soon as they were opened. As predicted, a considerable volume of traffic has been attracted from nearby Spencer Street and Queens Bridges, affording considerable relief to these arteries. A comparison of the traffic using Spencer Street, Queens and Princes Bridges, before and after the opening of Kings Bridge, is shown in Table 8.

Check Levelling for Settlement.—In the Forty-seventh Annual Report reference was made to the materials on which the cylinders of the piers were founded, and it was stated that some settlement might take place eventually. In order that such settlement may be measured, not only in order to check the estimates made at that time, but also to be prepared for any secondary stresses which might result because of such settlement, a number of permanent marks were established on the substructure.

The marks were in the form of—

(i) permanent survey mark plaques set in concrete tie beams;

(ii) permanent survey mark plaques set as above and enclosed in a cast iron box;

(iii) stainless steel hexagon bolt set on the inside of the concrete columns.

These marks were accurately levelled in October, 1959, and again in June, 1961, and referred to a bench mark on the pumping station on the north bank of the river immediately upstream of the bridge (see Table 9). This structure is founded on basalt, and it is thought that its level may remain stable. Likewise, piers 9 and 10 are also founded on basalt, and points on them should remain stable. Elsewhere levels may vary, but it should be possible to determine with considerable accuracy any relative movement of the various parts of any pier. Plate 6 shows generally the location of points on the structure, and Plate 7 shows a typical position of the stainless steel bolt in a pier column.

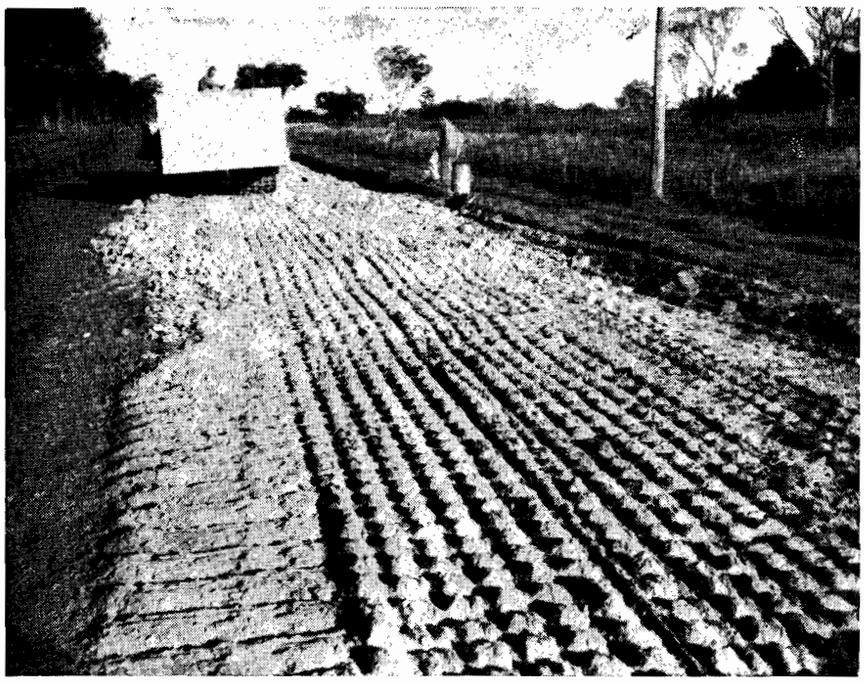


Plate 2.—Grid roller used in raising pavement above flood level, Midland Highway, Section 3.

Plate 3.—Grooved roller working at Craigieburn.

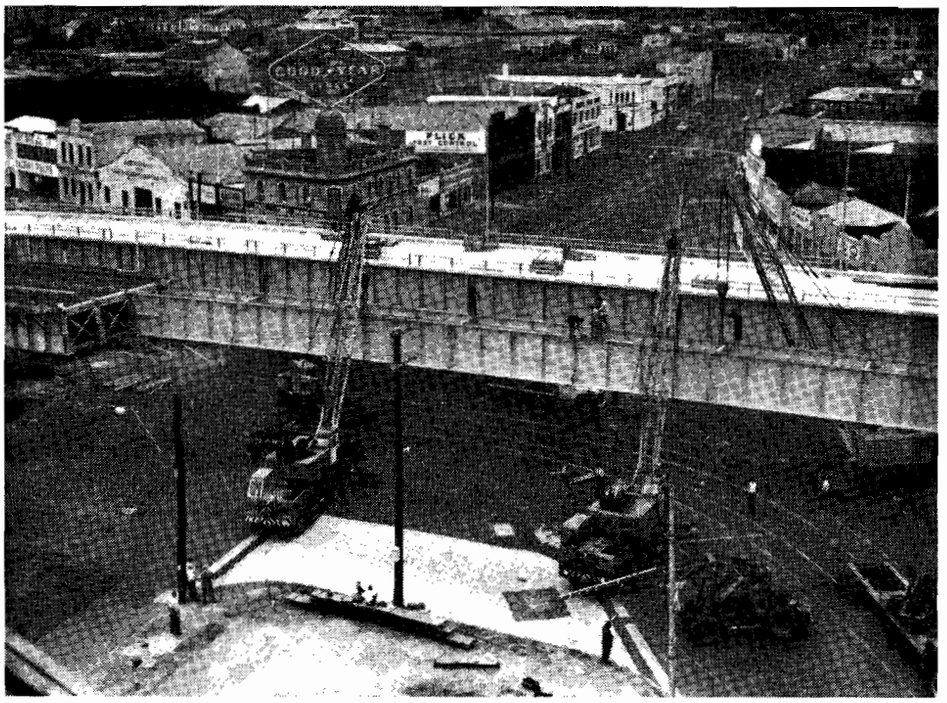


Plate 4.—Kings Bridge, Girder erection, City Road.

Plate 5.—Kings Bridge, Lighting and overhead signs.

TABLE 8.—CHANGES IN TRAFFIC ON BRIDGES OVER YARRA RIVER.

—	Spencer Street Bridge.			King Street at Flinders Street.			Queens Bridge.			Princes Bridge.		
	V.P.D. (12 hour).	V.P.H.—Peak.		V.P.D.	V.P.H.—Peak.		V.P.D.	V.P.H.—Peak.		V.P.D.	V.P.H.—Peak.	
		8–9.	5–6.		8–9.	5–6.		8–9.	5–6.		8–9.	5–6.
Before opening of low level bridge—												
N to S	26,850	2,090	3,240	8,500	1,030	970	17,000	1,615	2,910	15,300	1,250	1,520
S to N	23,200	2,900	1,760	6,000	490	690	15,600	3,050	1,160	15,000	1,420	1,160
Total	50,050	..	..	14,160	..	..	32,600	..	..	30,300	..	..
				Kings Bridge.								
After opening of low level bridge—												
N to S	18,300	1,570	2,570	11,700	1,276	2,057	14,180	1,290	2,110	14,750	1,160	1,640
S to N	22,900	2,670	1,880	7,050	1,424	1,093	16,200	2,710	1,210	14,900	1,460	1,110
Total	41,200	..	..	18,750	..	..	30,380	..	..	29,650	..	..
After opening of elevated carriageway—												
N to S	17,650	1,610	2,210	20,600	1,700	3,100	10,650	1,340	1,940	14,400	1,170	1,480
S to N	19,450	2,520	1,930	16,900	2,800	1,810	12,100	2,050	1,180	14,000	1,530	1,300
Total	37,100	..	..	37,500	..	..	22,750	..	..	28,400	..	..

Handing over to Melbourne and Metropolitan Board of Works.—Under the provisions of the *King-street Bridge Act* 1957, the Board certified in the *Government Gazette* of the 30th August, 1961, that the Flinders-street Overpass was complete, and in the *Government Gazette* of 18th October, 1961, that the whole of the work was complete. Under the provisions of the Act, the overpass and the remainder of the work became a metropolitan bridge or a metropolitan highway within the meaning of the *Melbourne and Metropolitan Board of Works Act* 1956 as at those dates.

Pre-stressed Concrete.

The use of pre-stressed concrete slabs and beams in works carried out with funds provided by the Board, has considerably increased during the year. Contracts to the value of £140,000 were let for the supply of these products compared with £80,000 for the previous year. Further precast pre-stressed concrete units have been added to the list given in the Forty-seventh Annual Report, and the list now includes 35-ft. and 45-ft. span beams, and a 35-ft. hollow slab designed for composite action with a cast *in situ* reinforced concrete deck slab. The cast *in situ* deck slab permits the use of the precast slabs in skew bridge (Plate 8), but at a reduction in the saving obtained by the use of pre-stressed concrete slabs.

Tests of Light Weight Aggregate Pre-stressed Concrete Slabs.

Comparative studies of the behaviour under load and the ultimate strength of two 30-ft. span standard pre-stressed concrete slabs were carried out at the University of Melbourne. The light-weight aggregate slab weighed 2·44 tons or 122 lb. per cubic foot compared with 3·36 tons or 167 lb. per cubic foot for a slab of normal aggregate.

Each slab was tested in bending with 2-point central loading, deflections being measured with each load increment, and in shear by a single-point loading applied 3 feet to 4 feet from one support. During the bending tests both slabs behaved similarly with near linear load-deflection curves in the working range, with first crack loads of 16 kips and 18 kips, and ultimate failure loads of 32 kips and 31 kips, for the light weight aggregate slab and normal concrete slab respectively. However, for loads up to cracking load the deflection of the light-weight aggregate slab was 1·8 times the deflection of the normal aggregate slab for the same applied load.

The shear tests indicated that the light weight aggregate slab had a lower shear strength than the normal slab, but that there was an adequate margin of safety between working load and the loads causing diagonal tension cracking or shear failure of the light-weight slab. Investigations are being continued into the possible use of light-weight aggregate for pre-stressed units.

Table 9.—Kings Bridge.
Levels of Permanent Marks.

Pier Number.	Mark Number.	R.L. at— 13th October, 1959.	R.L. at— 26th June, 1961.	Column 5.
				ft.
	UBM 5A	..	10·541	..
A	A A	3·205	..	..
A	A B	3·167	..	..
1	1 A	3·562	3·554	..
1	1 B	3·586	3·574	..
1	1 C	3·606	3·598	..
1	1 D	3·547	3·535	..
1	1 E	3·589	3·579	..
1	1 F	3·531	3·522	..
1	1 G	3·579	3·567	..
1	1 H	3·556	3·544	..
1	1 K	3·562	3·550	..
1	1 L	3·558	3·545	..
1	1 M	3·597	3·581	..
1	1 N	3·538	3·528	..
2	2 A	3·619	3·615	..
2	2 B	3·568	3·566	..
2	2 C	3·568	3·569	..
2	2 D	3·538	3·533	..
2	2 E	3·531	3·528	..
2	2 F	3·582	3·578	..
2	2 G	3·560	3·564	..
2	2 H	3·541	3·541	..
2	2 K	3·541	3·544	..
2	2 L	3·527	3·528	..
2	2 M	3·578	3·580	..
2	2 N	3·617	3·618	..
3	3 A	8·455	8·459	8·598
3	3 B	8·404	8·407	9·962
3	3 C	8·412	8·413	9·936
3	3 D	8·404	8·405	8·634
4	4 A	9·481	9·483	15·402
4	4 B	9·447	9·450	16·637
4	4 C	9·703	9·703	16·371
4	4 D	9·613	9·618	15·266
5	5 A	8·331	8·333	21·157
5	5 B	8·320	8·322	21·475
5	5 C	7·891	7·893	21·857
5	5 D	8·141	8·143	21·331
6	6 A	8·286	8·285	21·091
6	6 B	8·253	8·250	20·757
6	6 C	8·289	8·285	20·718
6	6 D	8·466	8·460	20·938
7	7 A	7·060	7·056	20·224
7	7 B	7·164	7·158	19·733
7	7 C	7·056	7·051	19·871
7	7 D	7·112	7·111	20·201
8	8 A	7·057	7·050	18·731
8	8 B	6·975	6·968	18·446
8	8 C	7·090	7·083	18·329
8	8 D	7·192	7·190	18·582
9	9 A	..	7·458	16·807
9	9 B	..	7·469	16·383
9	9 C	..	7·325	16·524
9	9 D	..	7·327	16·936
10	10 A	..	7·390	12·968
10	10 B	..	7·563	12·837
11	11 A	5·027	5·014	..
11	11 B	5·035	5·017	..
11	11 C	5·040	5·024	..
11	11 D	5·039	5·022	..
12	12 A	5·032	5·014	..
12	12 C	5·028	5·012	..
13	13 A	5·770	5·752	..

Reference Marks—

Bolt west wall screen house (U.B.M. 5A) .. .. 10·541

Phosphor bronze bolt pier 9 Flinders-street overpass 8·814

Column 5 gives height from top of bolt to under-side of cross-head.

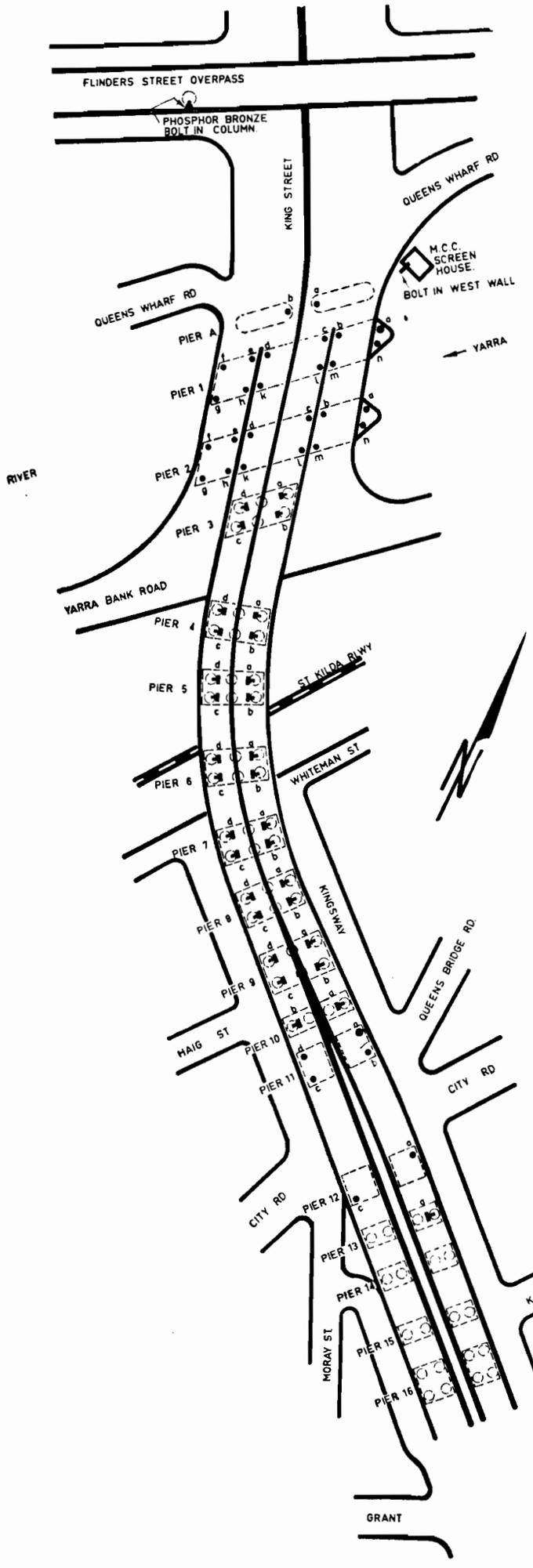


Plate 6.

KINGS BRIDGE

LOCATION OF PERMANENT MARKS

- INDICATES PSM PLAQUE SET ON CONCRETE TIE BEAM
- INDICATES STAINLESS STEEL HEXAGONAL BOLT SET ON INSIDE OF CONCRETE COLUMN

PIERS 9 & 10 ARE FOUNDED ON SOLID BASALT.
PLAQUES ON PIERS 11 & 12 ARE IN CAST IRON BOXES.

Plate 7.—Kings Bridge, showing typical position of stainless steel bolt in pier column.

Rubber Bearings for Bridge Girders.

The useful life of steel roller bearings under bridge girders is reduced by corrosion caused by accumulation of moisture and debris at the contact faces. These factors can be overcome by regular maintenance, but this maintenance is frequently neglected and the rollers cease to function as intended.

Recent developments of durable compounded and synthetic rubbers have led overseas bridge designers to use pads of these materials instead of steel rollers for girder bearings. The first application of neoprene rubber bearing pads by the Board is in the overpass now being constructed to grade separate the level crossing at Albion. Neoprene runner pads 10 in. x 10 in. x $1\frac{1}{4}$ in. with a thin steel plate in the centre, are being used as bearings at the piers for the girders in the structure. Two 1-in. square steel bars grouted into cored holes in the crosshead on each side of the girder bottom flange permit longitudinal movement, but restrain the girders against lateral movement.

Sole plates and base plates are not required with this type of bearing, which costs approximately £3 10s., compared with approximately £12 for a cast steel roller with sole plate and base plate. So far this type has been used in short spans only.

Finishing of Concrete Decks—Screeding.

Construction of the bridges on the Maltby By-pass by direct labour allowed further development of the concrete deck finishing methods used at Djerriwarrh Creek, and mentioned in the Forty-seventh Annual Report. The screeding system developed uses pipe templates parallel to the bridge centre line to support and guide a steel screed covering the width of the roadway. Detachable angles fitted to the screed were shaped to provide the required deck cross-section. By the provision of various angles of specified shapes, any bridge of constant cross-section and with roadway widths from 20 feet to 28 feet between kerbs can be finished with the screed by longitudinal screeding. The screed could be adjusted for finishing decks of variable cross-section.

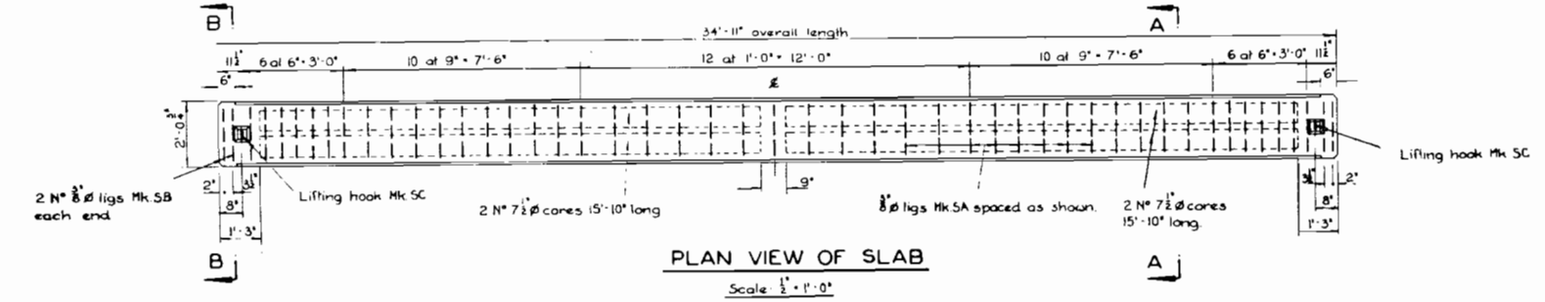
The screed templates or guides were made from 1-in. diameter water pipe carried on recoverable metal chairs fitted over threaded rods welded to the main girders and adjusted to the correct height by a nut on the rod. The screed consisted of two petrol-driven vibrators mounted on a light box section mild steel beam, to which the screed angles were attached by high tensile bolts. After screeding, local irregularities were corrected by the use of a float 4-ft. long, attached to a tubular aluminium handle 16-ft. long, and operated from outside the area being finished. Thus a wide area was covered rapidly, and a very regular surface obtained.

The deck was then checked for uniformity and small irregularities were corrected using a 10-ft. straightedge of aluminium alloy box section attached to a 16-ft. tubular aluminium handle. The straightedge was placed parallel to the bridge centre line and passed across the deck from kerb to kerb advancing along the length of the deck in 5-ft. steps. The surface was finally given a broomed finish and water cured using hessian covers and perforated hose.

After hardening, the deck was again checked for uniformity using the straightedge as above. Werribee River Bridge deck, 274 ft. long, showed no irregularity greater than 3/16-in. over 10 feet. The screeding of a 55-ft. long section of deck 28-ft. wide took approximately 2 hours 20 minutes. (See Plates 9, 10 and 11).

Boring Gang.

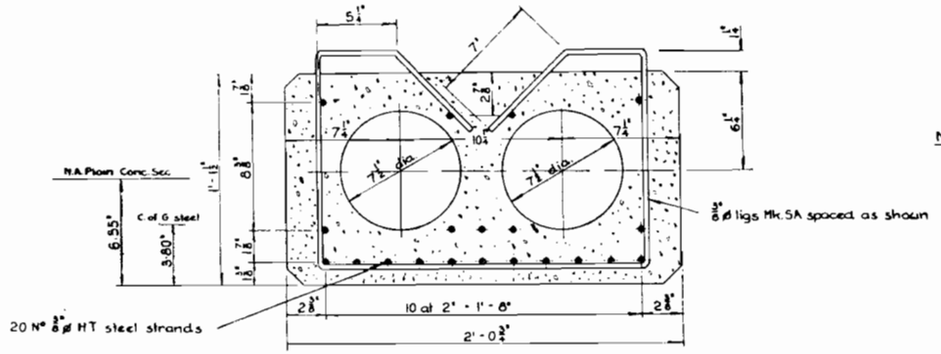
During the year, the foundation boring gang put down 105 test bore holes totalling 3,014 linear feet. The work was mainly sited in the north-eastern part of Victoria, and was slowed down by the large amount of shingle encountered. The gang has now been equipped with a Hawthorne bit to improve boring speeds in shingle.



PLAN VIEW OF SLAB

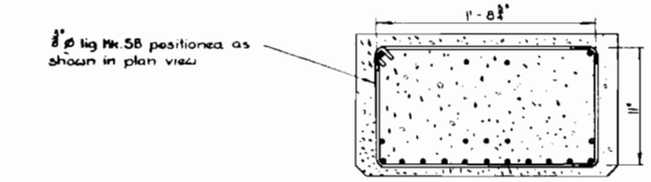
Scale: ½"=1'-0"

Note: At top of slabs chamfer to be omitted at both ends and for 6" from both ends



SECTION A-A

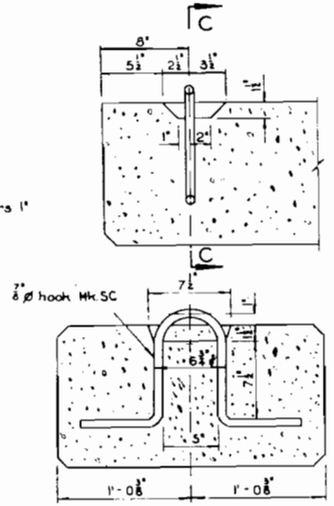
Scale: 3"=1'-0"



SECTION B-B

Scale 2"=1'-0"

Note: All chamfers 1"



SECTION C-C
DETAIL OF LIFTING HOOK

Scale: 2"=1'-0"

NOTES:

1. Crushing strength of 12"x6"ø concrete control cylinders.
   (a) at release 4000 p.s.i.
   (b) at age 28 days 5000 p.s.i.
2. H.T. steel strand ⅜"ø
   Ultimate load 21,000 lb per strand.
   Jacking load 14,700 lb per strand.
   Design load 11,750 lb per strand.
3. Top surface of slabs to be scabbled except portion 6" from the end of the slabs.
   See specification for other surface finishes.
4. Top side of slab shall be kept uppermost at all times during handling, lifting & storage.
5. Slabs shall be lifted only at the lifting hooks provided & a spreader bar shall be used during all handling. Slabs shall be supported during storage by using bearing strips extending over the full width of the slab & not more than 12" from each end.
6. Weight of prestressed slab 4.5 TON (approx) at 165 lb per cubic ft.
7. Nett Volume: 2.3 cubic yds.
8. Design Load. A.A.S.H.O. H20 S16 44
   0.38 W plus 30% impact, where W=16K
9. Tolerances Length. ± ⅜"
   Width, thickness & position of 7½ø holes ± ⅛"
   Position of ⅜ø strands ± 1/16"
   Between diagonal corners ± ¼"
10. In situ deck slab 4" thick composite deck slab reinforced with A.R.C. N° 4 mesh with main bars square to road centre line cast in situ after placing slabs.

Plate 8.

COUNTRY ROADS BOARD

35' SPAN PRESTRESSED SLAB

DRAWN: K.A.W.	CHECKED: E.H.	REF.N° 1/81
TRACED: L.L.	DATE: 2.11.61.	N° 40528

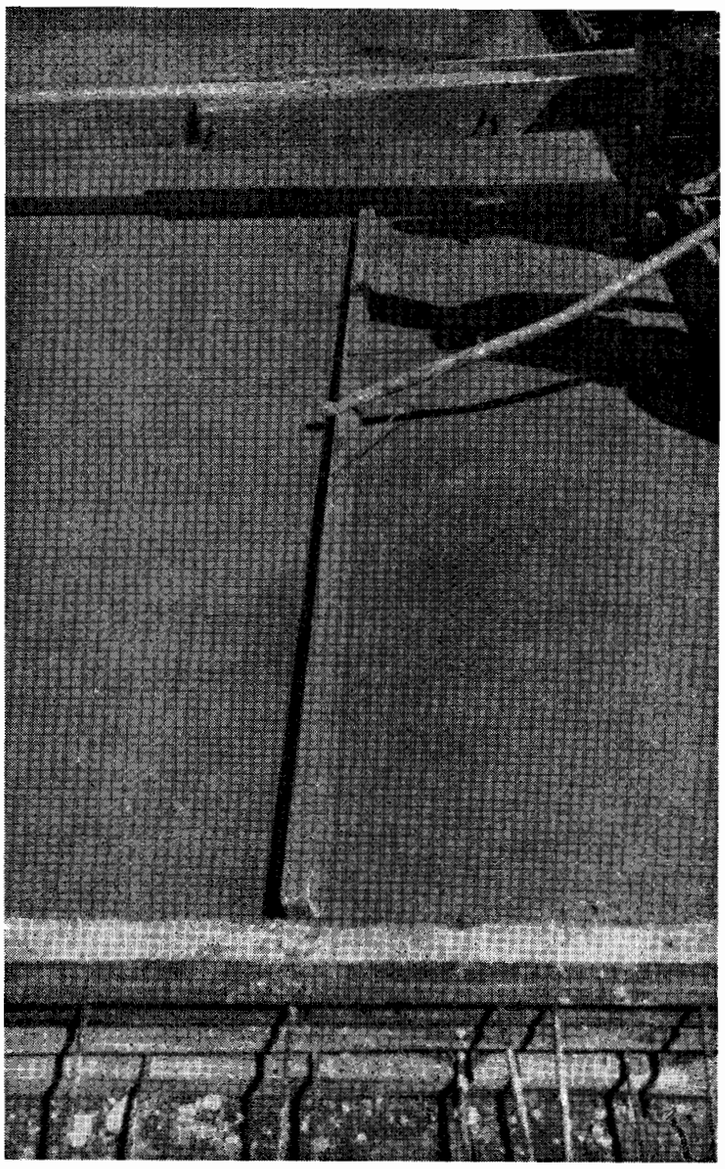


Plate 9.—Werribee By-pass. Bridge over Werribee River. Preliminary transverse screeding of deck using aluminium float.

Plate 10.—Using vibrating screed moved longitudinally.

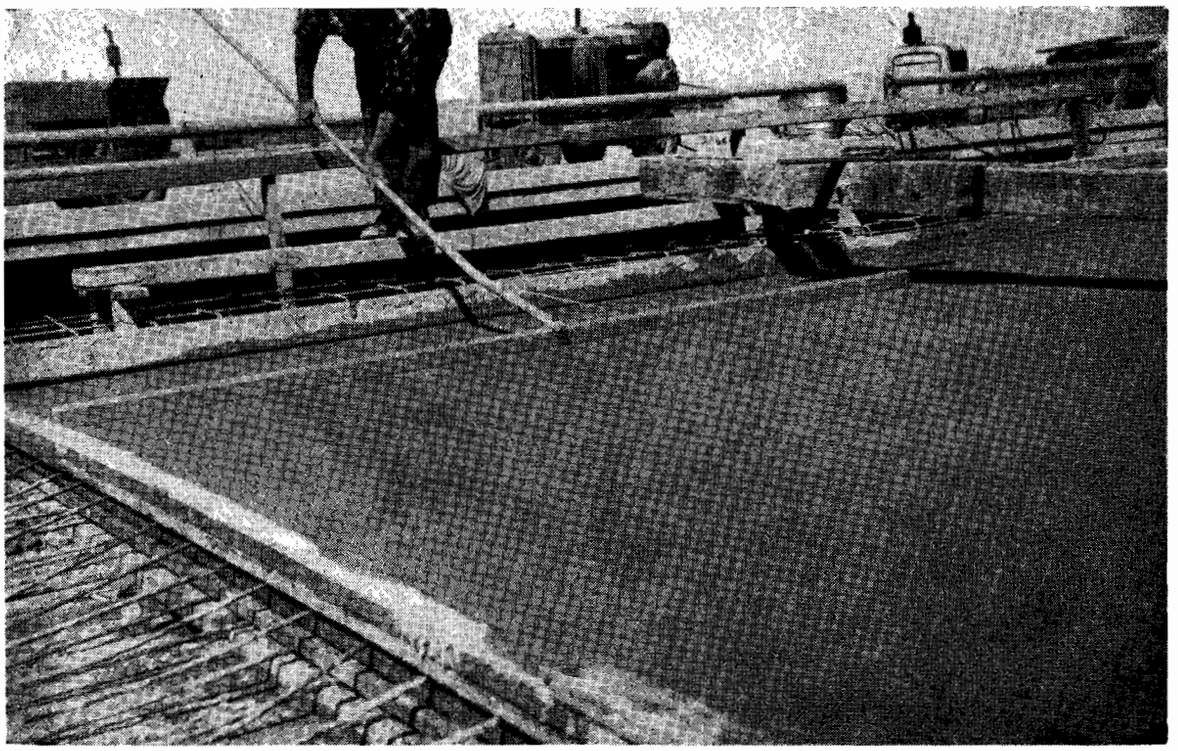


Plate 11.—Checking a connexion of finished deck surface using 10-ft. aluminium straight edge.

TREATMENT OF TIMBER DECKING.

The timber deck of an old bridge on Stud Road has been treated with a laminated surfacing of fibre glass and polyester resin with the following objectives:—

(*a*) Preservation of timber deck.
(*b*) Improvement of riding surface, and
(*c*) to make the deck act as a composite unit with reduction in timber stresses.

The bad condition of the deck before treatment is shown in Plate 12, and the result of the treatment in Plate 13.

The treated bridge has been in service for approximately four months and results to date are promising. Investigations are continuing, and arrangements are in hand for static load tests and fatigue testing to be carried out on models at the Aeronautical Research Laboratory.

Plate 12.—Timber deck before treatment.

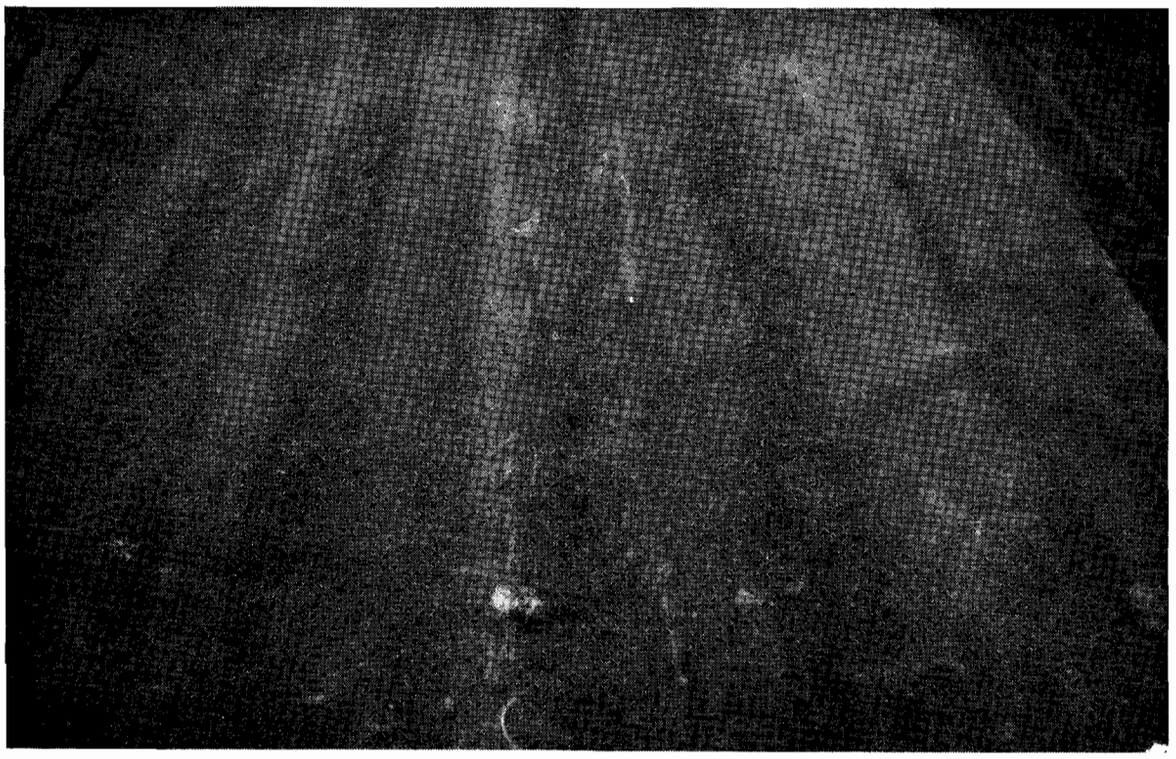


Plate 13.—Timber deck after treatment with Polyester resin and fibre-glass sheet.

PUBLICATIONS.

During the year the following papers were presented in connexion with the Board's engineering work :—

Paper.	Author.
Compaction equipment in road construction. Presented at the Highways and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia on 12th April, 1961	R. C. Handley, C.E., A.M.I.E. Aust.
Priority of improvements to a road system. Presented at the Highways and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia on 6th July, 1960	C. G. Roberts, M.C., B.Sc. (Eng.), A.M.I.C.E., M.I.E. Aust.
Small embedded earth pressure cells—their design and calibration. Presented at the 3rd Australian-New Zealand Conference on soil mechanics and foundation engineering 1960	Dr. D. H. Trollope (University of Melbourne), and D. T. Currie, Ph.D., A.M.I.E. Aust., E.W.S.
Recent development in bituminous surfacing plant. Presented at the Institution of Engineers, Australia Annual Engineering Conference, Melbourne, 1961	C. C. Perrin, C.E., A.M.I.E. Aust.
The development of electric welding with particular reference to Kings Bridge. Presented at the Institution of Engineers, Australia Annual Engineering Conference, Melbourne, 1961	C. A. Masterton, M.C.E., C.E., A.M.I.E. Aust.
Some aspects of the theory of traffic flow. Presented at the Highways and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia, on 14th June, 1961	R. T. Underwood, B.C.E., Dip. T.R.P., C.E., C.H.T. (Yale), M.A.P.I., A.M.I.E. Aust.

The following engineering notes and technical bulletins were issued during the year :—

No.	Title.	Date.
	Engineering Notes.	
66	Reduction of Plasticity Index of Gravels	7th September, 1960
67	Soil Testing : Foundations for Bridges and Embankments	22nd November, 1960
68	Notes on some Principles of Pavement Design	23rd November, 1960
	Technical Bulletins.	
20	Design of Concrete Mixes ..	20th July, 1960
21	Design of Flexible Pavements ..	28th November, 1960
22	Waterbound and Dry Macadam ..	20th July, 1960
24	Priority of Improvements to a Road System	2nd November, 1960

STAFF.

The move to Kew has relieved the congested conditions under which the staff have been working, but the volume and complexity of the work continue to increase and the efforts of all concerned in coping with the ever-increasing demands are much appreciated.

J. MATHIESON, M.C.E., M.I.E. (Aust.),
C.E., M.A.P.I., Chief Engineer.

A. C. Brooks, Government Printer, Melbourne.