MAIN ROADS

MARCH 196[illegible]

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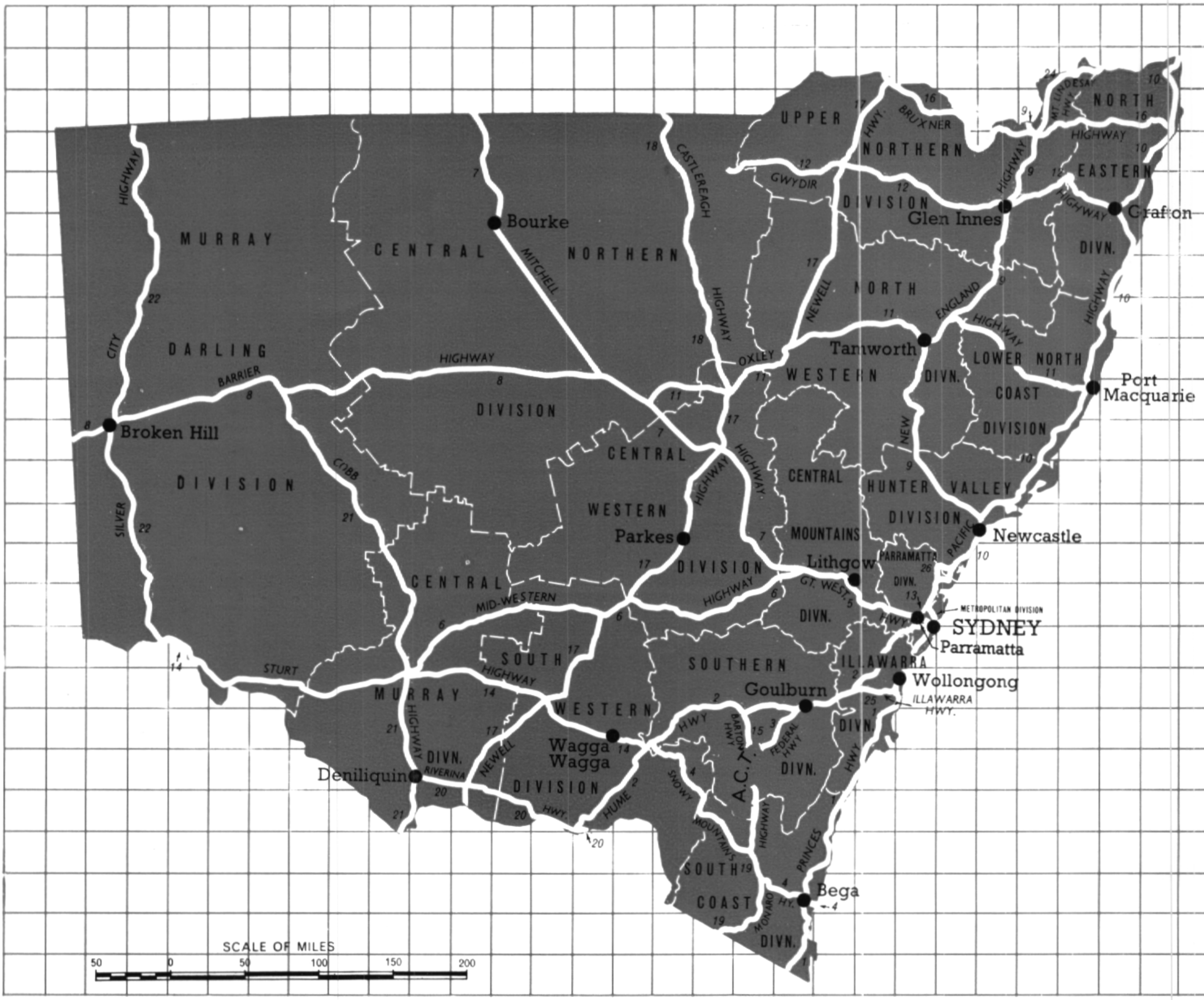

HIGHWAY SYSTEM OF NEW SOUTH WALES

Mileage of Main Tourist and Developmental Roads, as at 30th June, 1968

Expressways	21
State Highways	6,542
Trunk Roads	4,228
Ordinary Main Roads	11,593
Secondary Roads (County of Cumberland only) ..	159
Tourist Roads	218
Developmental Roads	2,746
	25,507
Unclassified roads, in Western part of State, coming within the provisions of the Main Roads Act	1,529
TOTAL	27,036

Area of New South Wales, 309,433 square miles
Length of public roads within New South Wales, 131,300 miles

Population of New South Wales at 31st March, 1968—4,370,307

Number of vehicles registered in New South Wales at 30th June, 1968—1,741,961

STATE HIGHWAYS
DIVISIONAL BOUNDARIES
DIVISIONAL OFFICES

MAIN ROADS

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MARCH, 1969

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Front Cover: This modern bridge carries the Prince's Highway over the North South Arterial Road at Ghosts Creek, Wollongong. The attractive mountain in the background is Mount Keira

Back cover: View over North Wollongong showing the two new bridges which allow local traffic to cross the North South Arterial Road at Porter Street

The Changing Face of Sydney

The name Kings Cross conjures up many images because the Cross itself is a composite of a wide variety of features. The image of bustling activity is probably the one we most frequently recall for crowded footpaths and crowded streets have become almost symbolic of Kings Cross. However, for many vehicle drivers, the image of traffic-choked roads is not one they recall with pleasure. Sitting across one of the main arteries to the Eastern Suburbs, Kings Cross has become a point of daily frustration to many motorists.

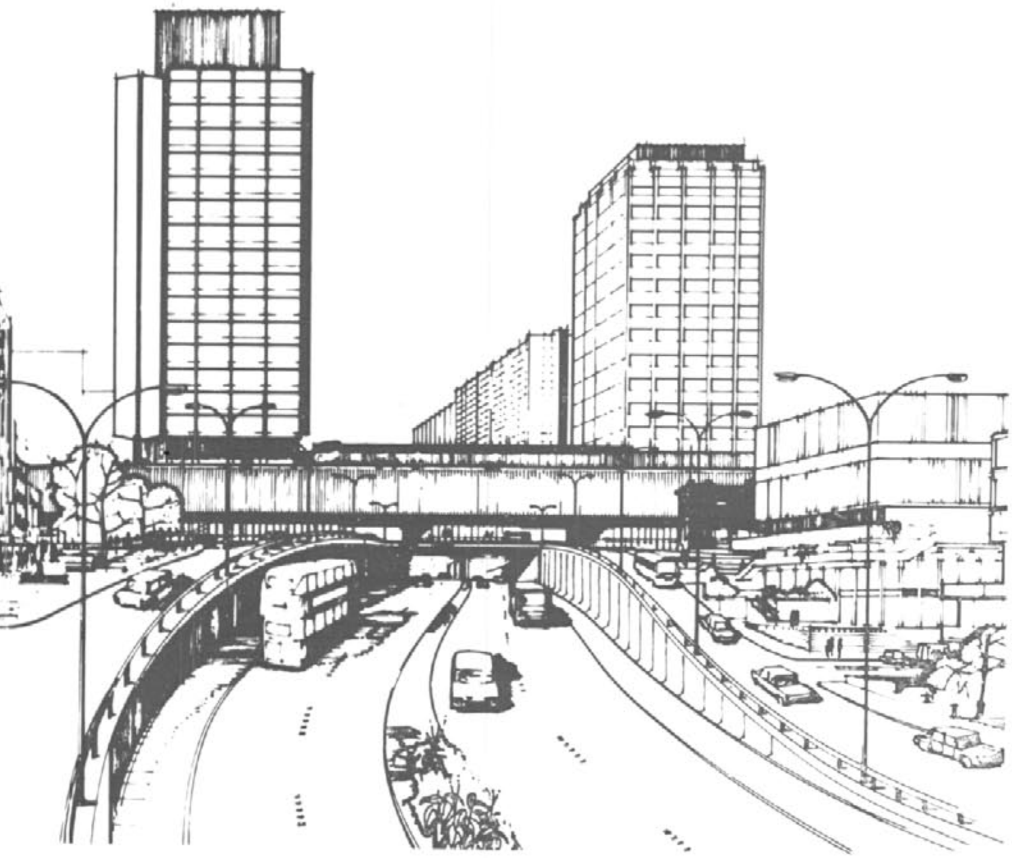
In February, 1969, the Minister for Highways, the Hon. P. H. Morton, M.L.A., announced details of a project to provide high standard road facilities for through traffic and improved conditions for local traffic in the Kings Cross area. Briefly, the scheme consists of a roadway linking William Street and Bayswater Road via a "tunnel" under Victoria Street. Further details and artists' impressions of the project are provided on the following pages.

Mr Morton described the scheme as an enlightened and original approach to a difficult problem. He said it would not only satisfy the requirements of vehicular traffic moving into or through the area, but also would be complementary to the Eastern Suburbs Railway.

Although many schemes have been examined by the Department of Main Roads, the present plan is the first to envisage the possibility of associated re-development in Kings Cross and its environs.

When the project is completed in about five years the face of some of Kings Cross will be changed but, by providing improved road facilities for motorists wishing to pass through the area, it will allow the Cross to pursue, under more pleasant conditions, those traditional activities which make it a fascinating part of the life of Sydney.

New Road Proposal fo



On 17th February, 1969, the Minister for Highways, the Hon. P. H. Morton, M.L.A., announced details for the construction of a road underpass and associated works proposed by the Department of Main Roads to relieve traffic conditions at Kings Cross.

Primarily, the scheme will consist of a new four-lane roadway for through traffic leaving William Street near Dowling Street and joining Bayswater Road east of Neild Avenue. It will pass under Victoria Street and emerge some 800 feet to the east under a new road to be built connecting Kings Cross Road and Craigend Street. It will be integrated with the Eastern Suburbs Railway layout in the Bayswater Road junction.

The proposal will involve approximately 700 feet of open cutting and 800 feet of cut-and-cover "tunnel". Construction of this "tunnel" will require resumption of about 2 acres of a mainly residential area between Kings Cross Road and Craigend Street. The scheme provides that this area will then become available for redevelopment. It is ideally situated for any project consistent with the planning of the City of Sydney.

The scheme will be implemented in stages and planned to permit safe movement for all traffic at all times with minimum interference to its flow. Plans are at present being prepared and the Department of Main Roads has commenced acquiring the necessary properties. It is expected that actual construction will commence in 1970 and will be completed in 1973.

Left: Driver's view of William Street, looking east, as it is today and as it may look following re-development above the roadworks (above left)

Kings Cross

Below: The proposed road underpass at Kings Cross. Artist's impression looking west from above Rushcutters Bay. The Eastern Suburbs Railway is shown in the upper right hand corner and lower centre

Bottom: Artist's impression looking east from above Woolloomooloo

The entire project, after allowing for the disposal of surplus lands, will cost approximately $10 million.

Acquisition of the land required for the project involves 118 different properties and about 600 tenants. Procedures for acquisition are the same as those adopted by the Department for the Warringah Expressway.

The resumption was gazetted on 28th February, 1969 and all affected owners have been advised by letter of the effect on their properties. A form was included with this letter to enable them to lodge a claim for compensation. Claims will be assessed by the Valuer-General for both owners and tenants who have a compensable interest. Following examination of these claims, notice of valuations will be forwarded to the owners and tenants. The prices paid will be the market value of the properties at the date of resumption.

The Department has commenced negotiations for occupation of the properties in the priority they are needed for work. Some properties will not necessarily be required for two to three years.

A special feature of the proposal is that, by arrangement with the Housing Commission, elderly persons will receive consideration for alternative accommodation.

The new roadworks at Kings Cross in no way reduce the need for the Eastern Distributor and the Eastern Expressway. Indeed, to obtain maximum benefit from the Kings Cross proposal, grade separation for traffic crossing William Street to and from the Cahill Expressway is imperative. The Department is currently examining the timing for construction of a section of the Eastern Distributor to provide this separation and allow traffic now using Palmer and Crown Streets to pass under William Street.

CLEARWAYS are they effective?

Clearways may be defined as those roads on which vehicles, except omnibuses, are not permitted to stop during prescribed periods of the day in order to provide full use of the road pavement and allow for the orderly flow of traffic where volumes are high.

Clearways provide essentially for the free flow of traffic without undue restrictions caused by parked or stopped vehicles. They are intended to make full and efficient use of all traffic lanes in peak periods. This does not necessarily imply that travel times will be faster although some benefit in this direction may follow.

Parramatta Road (State Highway No. 5) between Woodville Road, Granville and Harris Street, Broadway was the first road to be declared a clearway in the Sydney Metropolitan Area. It became effective from 19th June, 1967. It provided for a restriction on the inbound carriageway to the city in the morning peak and on the outbound carriageway from the city in the evening peak. On 10th June, 1968, this restriction was applied to both sides of Parramatta Road for both peak periods.

The Department of Motor Transport is the authority responsible for the declaration and signposting of clearways. However, as clearways apply to main roads in most instances, the Department of Main Roads is concerned with their effect on the flow of traffic.

The roads which have been declared clearways are shown in table 1.

In order to measure the benefits to traffic under clearway conditions, "before and after" studies were conducted on

TABLE 1 Roads Declared Clearways

Road	Section	Date
State Highway No. 5 Parramatta Road	Woodville Road, Granville to Harris Street, Ultimo	19th June, 1967
State Highway No. 10 Pacific Highway	Bobbin Head Road, Pymble to Sydney Harbour Bridge	29th April, 1968
Main Road No. 164 Spit Road Military Road	The Spit Bridge to Pacific Highway, Crows Nest	29th April, 1968
Falcon Street. Willoughby Road Mowbray Road	Penshurst Street, Willoughby to Pacific Highway, Crows Nest	29th April, 1968
State Highway No. 1 Prince's Highway	Tom Ugly's Bridge to Broadway	19th August, 1968
Main Road No. 199 Rocky Point Road	Captain Cook Bridge to Prince's Highway, Kogarah	19th August, 1968
Main Road No. 330 Cleveland Street	City Road, Chippendale to Anzac Parade, Moore Park	26th August, 1968
Main Road No. 172 Oxford Street Liverpool Street	Bondi Road, Bondi Junction to Elizabeth Street, City	2nd September, 1968
Main Road No. 173 New South Head Road William Street	William Street, Double Bay to College Street, City	9th September, 1968
Main Road No. 165 Victoria Road	(a) Marsden Road, West Ryde to Pyrmont Bridge	30th September, 1968
	(b) Church Street, Parramatta to Marsden Road, West Ryde	7th October, 1968
Main Road No. 523 Pyrmont Bridge Road	Parramatta Road, Camperdown to Gipps Street, Pyrmont	14th October, 1968
State Highway No. 2 Hume Highway	Yagoona to Parramatta Road, Ashfield	11th November, 1968
Main Road No. 167 Milperra Road Canterbury Road Stanmore Road	Milperra Bridge to Enmore Road, Enmore	25th November, 1968
Main Road No. 183 Canal Road Ricketty Street Gardeners Road	Prince's Highway, St Peters to Kingsford	10th March, 1969

TABLE 2

Average Travel Times

Road	Section between	Morning Peak—Inbound Before (min)	(sec.)	After (min)	(sec.)	% Change	Evening Peak—Outbound Before (min)	(sec.)	After (min)	(sec.)	% Change
Parramatta Road											
Rawson Place	Crystal Street	12	03	11	47	— 2·2	15	32	17	20	11·6
Crystal Street	Concord Road	13	55	13	46	— 1·1	15	45	13	40	— 13·2
Concord Road	Woodville Road	14	49	16	21	10·3	15	14	14	15	— 6·4
Average through route		39	47	42	50	7·7	43	40	45	0	3·1
Victoria Road											
Sussex Street	Lyons Road	19	26	24	38	26·5	16	10	12	19	— 23·9
Lyons Road	Devlin Street	9	34	11	2	15·4	10	51	10	54	0·3
Devlin Street	Silverwater Road	9	3	8	55	— 1·7	9	51	8	21	— 15·2
Silverwater Road	Church Street	7	0	7	1	0·2	9	17	7	36	— 18·1
Average through route		45	4	51	35	14·4	46	10	39	10	— 15·0
Prince's Highway											
Broadway	Australia Street	5	44	4	29	— 21·7	5	37	5	55	5·3
Australia Street	Lusty Street	13	20	16	52	26·5	12	20	13	46	11·6
Lusty Street	Park Road	9	55	10	10	2·5	10	8	10	1	1·2
Park Road	Port Hacking Road	6	16	8	59	43·3	6	1	6	32	8·8
Average through route		35	17	40	30	14·8	34	6	36	15	6·3
Oxford Street											
College Street	Oatley Road	5	52	5	45	— 2·0	5	48	6	22	9·8
Oatley Road	York Road	3	35	3	08	— 12·6	3	12	2	45	— 14·1
York Road	Bondi Road	3	02	2	50	— 6·6	2	59	3	12	7·3
Average through route		12	29	11	26	— 8·4	11	59	12	19	2·8
Military Road–Spit Road											
Merlin Street	Cremorne Junction	5	43	5	36	2·0	4	03	3	24	— 16·1
Cremorne Junction	Ourimbah Road	3	19	3	51	16·1	3	17	3	54	18·9
Ourimbah Road	Parriwi Road	5	25	5	27	0·6	4	34			....
Average through route		14	27	14	51	2·8	11	54			....

some selected routes. These studies were made on:

- State Highway No. 1—Prince's Highway.
- State Highway No. 5—Parramatta Road.
- Main Road No. 164—Spit Road and Military Road.
- Main Road No. 165—Victoria Road.
- Main Road No. 172—Oxford Street.

Separate studies were made of travelling times, lane usage and traffic volumes, for both morning and evening peak periods.

TRAVEL TIMES

The travel time survey was conducted over the total length of the clearway using what is called the "*floating car*" method whereby the survey vehicles travelled generally in the centre lane of the carriageway and attempted as far as possible to match their speeds with those of the main stream of traffic. In nearly all cases it would have been possible for the survey vehicles to reduce their travel times by changing lanes and using every available opportunity to travel faster.

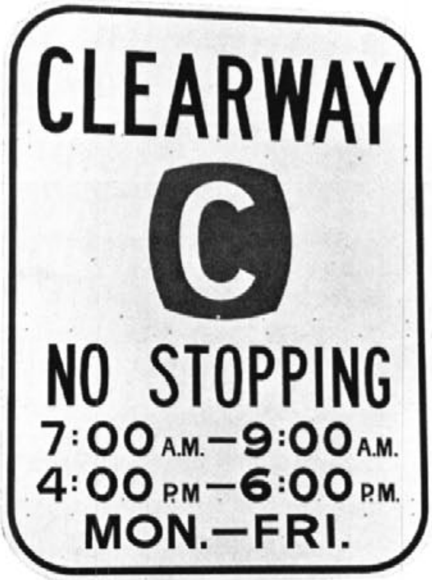
The travel times quoted in table 2 are in all cases the average times for each section of road, taken from a number of runs on different days of the week.

Generally increased travelling times resulted over the full lengths of the roads for both morning and evening peak periods but it was also found that in both periods there were savings in time for many sections of the clearways. The increased travelling times were confined to those sections where there is a heavier concentration of traffic due to the increased volume of traffic.

The slight increases in travelling times are not significant having due regard to the increased traffic capacity described later.

LANE USAGE

Studies of lane usage were made in peak periods at six locations along Parramatta Road and three locations along Victoria Road. The percentages by which the volume of traffic using each lane changed after the introduction of clearway conditions are shown in table 3.



Although lane usage studies have been limited in their extent, the results clearly indicate an increased usage of the kerbside lane in both morning and evening peak periods. The increases are more significant in the evening than in the morning. A general decreased usage of both the centre and median lanes also occurred, but these decreases, except in a few isolated cases, were not statistically significant.

TRAFFIC VOLUMES

Traffic volumes were measured by direction of travel at several locations along the length of Parramatta and Victoria Roads. The results indicate increased volumes at most sites. These are shown in table 4.

It would appear from these surveys that the most significant benefit resulting from the introduction of clearway conditions has been an increased capacity for traffic volumes.

CONCLUSIONS

During the past year clearways have become more and more a part of peak hour travel to and from the city and have brought about a marked improvement in peak hour traffic conditions on major urban routes.

From the studies carried out by the Department to assess their operational benefits, it appears that the introduction of clearway conditions has resulted in:

☐ Generally increased traffic volumes without significant reduction in travel time.

☐ Smoother traffic flow.

☐ Almost complete observance by road users of the "No Stopping" restrictions.

TABLE 3 — Lane Usage

Road	Location	Percentage difference in volume in lane usage		
		Median Lane	Centre Lane	Kerb Lane
	MORNING PEAK			
		%	%	%
Parramatta Road	Annandale, east of Young Street	— 3	— 6	+ 9
	Leichhardt, east of Palace Street	— 19	+ 17	+ 2
	Haberfield, east of Frederick Street	— 7	— 2	+ 9
	Burwood, east of Lucas Street	— 3	— 3	+ 6
	Flemington, west of Telopea Avenue	— 5	— 4	+ 9
	Clyde, east of Duck River Bridge	— 4	— 4	+ 8
Victoria Road	Rydalmere, east of Patricia Street	+ 3	— 6	+ 3
	West Ryde, east of Gaza Road	— 3	— 8	+ 11
	Ryde, east of Margaret Street	— 3	— 2	+ 5
	EVENING PEAK			
Parramatta Road	Annandale, east of Young Street	— 3	— 15	+ 18
	Leichhardt, east of Palace Street	— 4	— 8	+ 12
	Haberfield, east of Frederick Street	— 8	— 3	+ 11
	Burwood, east of Lucas Street	— 5	— 7	+ 12
	Flemington, east of Telopea Street	— 14	+ 2	+ 12
	Clyde, east of Duck River Bridge		— 11	+ 11
Victoria Road	Rydalmere, east of Patricia Street	— 3	— 4	+ 7
	West Ryde, east of Gaza Road	+ 1	— 11	+ 10
	Ryde, east of Margaret Street	— 3	— 3	+ 6

TABLE 4 — Traffic Volumes

Road	Location	Peak Hour Volume (Vehicles per hour)		
		Before	After	% Change
	MORNING PEAK—EASTBOUND			
Parramatta Road	Clyde Level Crossing	2,228	2,480	+ 11·3
	Burwood, east of Lucas Street	1,938	2,073	+ 7·0
	Leichhardt, east of Palace Street	1,638	1,848	+ 12·8
	EVENING PEAK—WESTBOUND			
Parramatta Road	Clyde Level Crossing	2,325	2,230	— 4·1
	Burwood, east of Lucas Street	1,975	2,195	+ 11·1
	Ashfield Park	1,693	1,818	+ 7·4
	Leichhardt, east of Palace Street	1,540	1,928	+ 25·2
	MORNING PEAK—EASTBOUND			
Victoria Road	Rydalmere, east of Patricia Street	1,499	1,744	+ 16·4
	West Ryde, east of Gaza Road	2,074	2,434	+ 17·4
	Ryde, east of Margaret Street	1,904	1,967	+ 3·3
	EVENING PEAK—WESTBOUND			
Victoria Road	Rydalmere, east of Patricia Street	1,322	1,250	— 5·5
	West Ryde, east of Gaza Road	1,695	1,684	— 0·6
	Ryde, east of Margaret Street	1,798	1,863	+ 3·6

Road Needs Survey 1969-79

Outline of Survey and Summary of Results in New South Wales

PREVIOUS ROAD NEEDS SURVEYS

In 1957 the National Association of Australian State Road Authorities (N.A.A.S.R.A.) adopted a basis for the first Australia-wide assessment of road needs. The survey, of needs existing at 1st July, 1960 or arising during the period 1st July, 1960 to 30th June, 1970, covered all public roads in rural areas and all classified and arterial roads, both existing and proposed, in urban areas. Other urban roads, carrying local traffic only, were excluded. The needs, in terms of road work and money, were assessed on the basis of providing a road system which would be adequate to meet the reasonable needs of traffic to the end of the ten year survey period.

For the 1960–1970 Road Needs Survey in New South Wales, in order to complete the survey in reasonable time during the year 1959–60, it was necessary to restrict detailed surveys to the more important roads. All state highways and most main roads were surveyed in detail and other roads (both classified and unclassified) were dealt with by a sampling method. A total of twenty-one Local Government Council areas were selected as sample areas representative of regions throughout New South Wales and information obtained by detailed survey of each sample area was extended to apply to other areas in the regional group. Engineers from the Department's Divisional Offices carried out the field survey for state highways and, jointly with councils' engineers, for trunk roads and ordinary main roads in the sample areas. The rural unclassified roads in the sample areas were surveyed by councils' engineers.

The results of the 1960–1970 survey were published in a NAASRA brochure "Australia's Road Needs—Ten Year Plan" issued in June, 1961 and an account of the New South Wales survey and its results was published in *Main Roads* issues of June and September, 1961.

In 1961, NAASRA agreed that it would be desirable to obtain more up-to-date information on Australia's road needs before the then current Commonwealth Aid Roads Act expired on 30th June, 1964. It was decided that a further Road Needs Survey should be made for the 10-year period 1964–1974. The basis adopted for assessment of needs was the same as that employed in the 1960–1970 survey, i.e. to provide a road system which would be adequate to meet the needs of traffic at the end of the survey period, but on this occasion the survey covered all public roads including unclassified roads in built-up areas.

The field work for the 1964–1974 Road Needs Survey was completed during 1962–63. Departmental officers were responsible for the detailed survey of all state highways throughout New South Wales and of all main and secondary roads within the County of Cumberland, and for the assessment of needs for expressways and new main roads. Trunk roads and ordinary main roads in country areas and all other roads were surveyed by councils' officers:

(*a*) On a sampling basis. A detailed survey and assessment of needs was made in eighteen of the Local Government areas selected as sample areas for the 1960–1970 survey.

(*b*) By submission of summarized survey information on a questionnaire form issued to all councils throughout the State.

Completed questionnaires were submitted by 44 (48 per cent) of the 92 municipal and city councils and 92 (68 per cent) of the 133 shire councils. The needs of areas for which questionnaires had not been submitted were estimated on a proportionate basis from the needs of sample areas or others which had submitted survey information and appeared to be generally similar.

Information obtained from the 1964–1974 Survey was published by NAASRA in 1963, in the brochure "Australia's Road Needs 1964–1974". Reference to the results of the survey in New South Wales has been made in the Department's annual reports, particularly that for the year ended 30th June, 1964, and in issues of *Main Roads*.

INITIATION AND PLANNING OF 1969–1979 SURVEY

The 1964 meeting of NAASRA agreed to carry out a further survey of road needs and prepare estimates of funds available for roads for the ten year period commencing 1st July, 1969. Two important considerations influenced the choice of the survey period 1969–1979:

(i) The then current Commonwealth Aid Roads Act was due to expire at 30th June, 1969.

(ii) Commonwealth legislation passed in 1964 provided for the establishment of a Commonwealth Bureau of Roads charged with a primary responsibility for advising the Commonwealth Government on matters relating to roads.

Obviously, it would be to the advantage of the separate State Road Authorities and the Commonwealth Bureau to obtain information on road needs at 1st July, 1969 (or backlog) and those arising during the 10 years 1969–1979—with perhaps some greater emphasis on the backlog and needs arising in the first 5 years, 1st July, 1969 to 30th June, 1974, expected to be the period covered by the next Commonwealth Aid Roads Act.

The Association agreed to co-operate with the Bureau and, early in 1966, appointed a steering committee (now consisting of the permanent heads of the State Road Authorities of Victoria, New South Wales, and Queensland) and a working committee (advance planning committee representatives of the same three States) for direct liaison with the Bureau in relation to the planning of the Road Needs Survey 1969–1979.

In accordance with practice which has been accepted generally, the stages taken into consideration in planning the survey were:

(*a*) Survey of the condition and extent of the existing network of roads, i.e. production of an inventory of roads and bridges.

(*b*) Estimation of future growth of traffic.

(*c*) Comparison of the requirements for predicted traffic with the capacity and condition of existing roads in the network.

(*d*) Determination of the improvements and new roads necessary to satisfy requirements.

(*e*) Estimation of the cost of required construction (improvements and new roads) and maintenance during the survey period.

(*f*) Estimation of funds available for roads during the survey period—for comparison with the estimated cost of the needs.

Initially, matters discussed by representatives of NAASRA and the Bureau related to definition of the problems and basic assumptions to be made in connection with the needs survey, with particular reference to "Instructions for the Assessment of Road Needs 1969–79" (prepared by NAASRA in 1965) and advice from the Chairman of the Bureau outlining information that would be required by the Bureau in preparing its advice to the Commonwealth Government in relation to the next Commonwealth Aid Roads Act.

At an early stage in the discussions it was agreed that the survey should be designed to produce an assessment of needs for three time periods:

☐ Backlog needs, i.e. needs existing at 30th June, 1969.

☐ Needs arising in first five years—1st July, 1969 to 30th June, 1974.

☐ Needs arising in second five years—1st July, 1974 to 30th June, 1979.

and for four area classes:

☐ Capital city urban.

☐ Major provincial urban (cities greater than 40,000 population).

☐ Provincial urban (cities and towns between 40,000 and 1,000 population).

☐ Rural.

It was also agreed that the survey should cover all public roads customarily used by vehicular traffic at the start of the survey period. Due regard would also be given to additional public roads which might be required or built during the survey period.

Consideration was then given to the drafting of a general specification for conduct of the survey on roads in *Rural and Provincial Urban Areas*. This specification, as finally agreed upon in June, 1967, included basic data relating to:

☐ Definitions of structures to be classed as bridges, construction works, maintenance works, etc.

☐ Projections of population, motor vehicles per 1000 persons, and numbers of motor vehicles, each year from 1966 to 1992; and a derived traffic growth index from 1966 to 1994.

☐ Classification of roads into defined functional classes (independent of State classifications).

☐ Tolerable standards, separately for rural and urban roads.

☐ Standards for improvement (or design standards), separately for rural and urban roads.

NAASRA had previously agreed on the basic requirements for road inventories. The survey specification now included standard forms to be used for the presentation of information relating to:

☐ Road Inventory Summary ☐ Bridge Inventory Summary ☐ Road Needs ☐ Bridge Needs.

All of the forms were designed with a view to convenience in processing the data by electronic data processing (E.D.P.) methods.

The procedures adopted for carrying out the survey of roads in rural and provincial urban areas were:

☐ *Initial Inventory* made in 1967 or 1968 of each section of road and each bridge.

☐ *Road Inventory Summaries* and *Bridge Inventory Summaries*, of conditions at 30th June, 1969, prepared for each road, taking into account improvement work likely to be carried out between the date of the initial inventory and 30th June, 1969.

☐ *Road Needs* and *Bridge Needs* were assessed following consideration of the functional (or operational) and structural adequacy throughout the survey period. Each section of road and each bridge, or bridge site, as determined from the inventory was considered separately. Failure to meet the tolerable standards indicated a "need" from functional considerations and, in other cases, structural inadequacy indicated a need for improvement. Where a need was established at the beginning of or within the survey period, the nature and extent of the needed improvement were based on requirements to meet the prescribed design standards 15 years later for roadworks and 30 years later for bridges. All costs were estimated at 1967–68 values.

The Commonwealth Bureau of Roads engaged consultants to undertake a study from which a basis for the survey in *Capital Cities* could be developed. Following completion of this study the Bureau issued, in May, 1967, "Guidelines for Data Collection—Australian Roads Survey—Capital Cities 1969–1974–1979". Later, in September, 1967, "Guidelines for Data Collection in Major Provincial Cities" was issued but was not used in New South Wales. The cities of Newcastle and Wollongong were surveyed using substantially the same procedures as for capital cities. "Guidelines for estimating costs—Capital Cities" was issued in December, 1967.

The capital city survey was necessarily a great deal more complex and detailed than that required for rural and provincial urban areas, and it is not possible, in this article, to give other than a very brief outline of procedures.

That part of the survey which led to identification and measurement of deficiencies in the road system consisted of a series of studies of the strength of the roads, their traffic sufficiency, and their safety.

Once the area to be surveyed had been defined, a peak hour aerial photographic survey was carried out. At the same time a start was made on a preliminary inventory of roads and streets likely to carry significant volumes of through traffic (i.e. streets carrying more than 1500 vehicles per day). Sample areas were selected as representative of the total survey area and inventories were prepared for all roads within the sample areas.

The aerial survey and subsequent traffic density analysis from the photographs, together with the results of the preliminary inventory, were used to assist a classification committee to classify the road system, and to identify areas warranting special studies (e.g. central business district).

Operational studies (travel time studies, load factor studies, and intersection capacity studies) were carried out on lengths of road and intersections with significant traffic densities and within the network of roads classified as arterial or sub-arterial.

An inventory was prepared of traffic casualty accidents on the network of arterial and sub-arterial roads, and on other roads and streets within the sample areas.

Structural deficiencies in roads and bridges were assessed following preparation of the preliminary inventory, when all possibly structurally deficient bridges were identified, and in the course of the sample areas study, when the structural condition of pavements and minor structures was assessed.

Solutions to the structural deficiencies and cost estimates were prepared during the course of field studies abovementioned.

Improvements to the network to overcome operational deficiencies were selected sufficient to remove the deficiency for at least 5 years. If any such improvement would result in unacceptable traffic conditions before the end of the survey period, a second improvement was then selected sufficient to remove the deficiency for another 5 years. There were two overriding provisos applied. The first was that the total solution, when examined in the context of a 15-year plan, would have the least capital cost of acceptable alternatives. The second was that inexpensive traffic management improvements should be incorporated in all solutions, if practicable, to enable major expenditures to be deferred.

The estimated cost of *Maintenance Needs* was derived from an examination of past trends in expenditures on road and bridge maintenance and expressed as a bulk sum.

In making an assessment of *Funds Available for Roadworks* during the survey period it was necessary, firstly, to estimate gross revenues likely to be received from all sources during the period 1969–70 to 1978–79 and made available for expenditure on roads. It was then necessary to deduct amounts of estimated expenditure on loan charges, asset improvements (including buildings, plant, motor vehicles, etc.), administration, survey and design, supervision, planning, and similar administrative and supervisory overheads other than field on-costs.

The financial estimates, of revenues and expenditures, were in all cases based on current trends, e.g. in the growth of the motor vehicle population and in the provision of loan funds for roads, and it was assumed that the rates of State motor vehicle taxation would remain unchanged throughout the survey period. In particular, it was assumed that the provision of Commonwealth funds for roads would continue to increase in total at the present rate of $10 million each year and that the distribution of such funds to the States would be in accordance with the current formula.

The estimated gross revenues less estimated deductions, as above, gave an estimate of nett revenues, or funds available for roadworks, which could be related directly to the estimated cost of construction and maintenance needs over the survey period.

CONDUCT OF THE SURVEY IN NEW SOUTH WALES

The survey in *rural and provincial urban areas* was carried out in respect of state highways, trunk roads, ordinary main roads, secondary roads and tourist roads by Departmental officers and in respect of all other roads by councils' officers.

Some delay in the early stages of the councils' part of the survey was occasioned because of objections raised by a number of shire councils, through the Shires Association of New South Wales, to the tolerable and design standards adopted for rural roads. It was agreed, following discussions with the Chairman of the Commonwealth Bureau, that the shire councils should make a supplementary assessment of the needs of their roads—such additional assessment of needs to be based on somewhat higher standards adopted by the Shires Association.

At the time of submission of survey results to NAASRA and the Bureau in August, 1968 the Department's part of the survey had been completed and 136 councils (of the 180 involved in rural and provincial areas) had supplied complete or partial needs data. The councils' survey data covered approximately 80 per cent of the total mileage of council roads in the State and was expanded statistically to provide complete coverage. To 1st January, 1969 a further 24 councils had submitted survey data which was being processed for inclusion in adjusted N.S.W. results.

The surveys for *capital city* and *major provincial cities* in New South Wales covered survey areas for:

☐ *Sydney*—the whole of the County of Cumberland proper, comprising 37 Local Government areas and parts of the Cities of Penrith and Greater Wollongong, Municipality of Camden, and Shire of Wollondilly.

☐ *Newcastle*—Cities of Newcastle, Maitland, and Greater Cessnock, and Shires of Lake Macquarie and Port Stephens.

☐ *Wollongong*—Municipality of Shellharbour and part of the City of Greater Wollongong not included in the Sydney survey area.

All of the councils, with the exception of two in the Sydney survey area, co-operated fully and assisted the Department and the Commonwealth Bureau by preparation and submission of relevant survey data, particularly inventory data.

Consultants were engaged by a number of councils to carry out the survey, and by the Department for a number of intersection capacity studies and load factor studies in the Sydney and Newcastle survey areas.

The cost of the needs survey in New South Wales is estimated at approximately $750,000; approximately $350,000 met by Local Government authorities and $400,000 by State Government authorities —almost wholly by the Department of Main Roads.

SUMMARY OF RESULTS OF SURVEY IN NEW SOUTH WALES
(All amounts in $ 000's)

Construction Needs	At 30-6-69	1-7-69 to 30-6-74	1-7-74 to 30-6-79	Total
Capital City—Sydney	716,530	212,799	233,510	1,162,839
Major Provincial Cities—				
Newcastle	54,111	30,099	31,235	115,445
Wollongong	10,845	25,726	26,530	63,101
*Provincial Urban	193,655	20,515	12,369	226,539
*Rural	1,056,725	219,440	124,341	1,400,506
Total Construction Needs	2,031,866	508,579	427,985	2,968,430
Maintenance Needs—				
Total	....	242,252	260,971	503,223
Total Needs	**2,031,866**	**750,831**	**688,956**	**3,471,653**

* Needs amounts subject to adjustment following inclusion of further survey data submitted by councils.

FUNDS ESTIMATED TO BE AVAILABLE FOR ROADWORKS
(All amounts in $ 000's)

	1-7-69 to 30-6-74	1-7-74 to 30-6-79	Total
Total Gross Revenue	1,023,498	1,238,274	2,261,772
Deductions	185,030	236,350	421,380
Total Nett Revenue	838,468	1,001,924	1,840,392

Some further adjustment and a detailed analysis of the survey results remains to be carried out and will be reported upon in a later issue of *Main Roads*. In particular, the above estimates of needs are based on 1967–68 values and will require adjustment to provide for progressive increase in costs, of the order of 2 per cent each year after 1967–68.

A general observation may be made at this stage that funds available for roadworks in New South Wales during the 10-year period 1969–1979 will fall short of needs by an amount of *at least* $1,630 million. If maintenance needs are regarded as having first call on available funds, the remaining funds will be sufficient only to provide for less than half of the construction needs.

Finally, it appears that unless additional funds are provided the backlog of needed improvements to the New South Wales road system will be substantially the same, in money terms, in 1979 as in 1969.

Clearing the Right-of-Way

By J. S. Endean, F.I.S. (Aust.)
Principal Land Surveyor and Property Officer, Department of Main Roads

Before road construction may commence, the right-of-way must be cleared of buildings and other improvements by adjustment, relocation or demolition.

Over the period 1961–1968 the Department has carried out the works set out in the following table:

DEMOLITIONS

Road	*Number*	*Cost (to the Department)*
Warringah Expressway (1961–1963).	490	$60,000 credit
All other roads (1964–1968).	289	....
RELOCATIONS	74	$244,000
ADJUSTMENTS		
(Excluding alteration of levels)	45	$200,000

The purpose of this article is to outline procedures in use by the Department to clear improvements from the right-of-way.

DEMOLITION

Where it is not possible to remove buildings to an alternative site or when such a procedure would not be an economical proposition, arrangements are made for demolition and/or removal following completion of the transfer to the Department. The property is meanwhile placed under the protection of a security service.

An estimate of the value of the improvements for demolition purposes is prepared. This estimate, besides being statistical as to materials available, must take into consideration—

(*a*) access to the site for removal of materials,
(*b*) need for hoardings in demolition, particularly on the street alignment,
(*c*) whether lime or cement mortar is used in the brickwork,
(*d*) whether the walls are cement rendered,
(*e*) nearest dumping area for materials and cost of dumping per load,
(*f*) type and quality of bricks, sandstone, wrought iron, timbers, window frames, doors, flooring, etc.,
(*g*) quality and condition of prime cost items,
(*h*) type of roofing,
(*i*) whether it is necessary to remove footings below natural surface, and
(*j*) cost of preventing nuisance and damage to adjoining properties.

It will be appreciated that if cement is used in (*c*) and (*d*) the materials will need to be dumped whilst many of the items in (*f*) such as sandstock bricks and wrought iron are in great demand at the present time.

The National Trust of Australia (N.S.W.) is advised of the proposed demolition of buildings containing materials and/or fittings suitable for restoration of historical buildings. Arrangements are then made for the removal by the Trust of selected accessible items prior to the demolition leaving the Trust to make any further arrangements with the successful contractor.

Tenders

Tenders for the demolition or removal are invited in the press.

Security Deposit

Upon signing a contract for the demolition or removal the contractor is required to pay in cash a deposit of $100 which is held as security for the due performance by the contractor of his obligations under the contract.

Insurances

The contractor is required to effect insurance with an approved insurance office under the Workers' Compensation Act covering all workmen and also possible damage to third parties.

Local and Statutory Authority Requirements Including Scaffolding and Lifts Act

The contractor must comply with the requirements of local and statutory authorities with regard to the demolition and/or removal of buildings and improvements.

Payment of Wages

The contractor is required to supply a statutory declaration that all workmen employed on the contract have been paid before the security deposit is refunded.

Hours of Work

No demolition or removal is allowed on Sunday or before 6 a.m. or after 6 p.m. on any other day in built-up areas.

Vandalism

Despite the protection of a security service a considerable amount of damage and theft in metropolitan areas generally occurs before the building can be demolished.

Average Costs

The average amount paid to the Department for the demolition of a brick cottage of 12 squares is $200 whereas the demolition of a weatherboard cottage of 12 squares does not usually result in a payment either to or by the Department.

RELOCATION

Timber framed buildings can often be relocated upon the residue of the property or upon an alternative site provided by the owner or the Department. Alternative sites are provided by the Department only if residual lands are available from other purchases or resumptions.

Before a decision is reached regarding relocation the improvements are inspected and, if it is considered practical to relocate them, an estimate of the cost is prepared. Where the total cost of the land required for road plus cost of relocation exceeds the value of the property the Department may negotiate with the owner for purchase of the whole property. Following completion of the transfer, tenders are invited for the demolition and/or removal of the improvements. The residue of the land, after excision of that part required for road purposes, is disposed of by auction sale or, if not required by the local council, by exchange with an adjoining owner whose property may also be affected.

The Department recently successfully relocated by contract on the same land a pair of semi-detached timber framed cottages divided by a 9-inch brick dividing wall. A brick wall was erected to foundation level on the new site directly behind the building. Steel rollers were placed at close intervals through the brick wall of the existing building which was then severed from its foundations and the wall and cottages rolled back on to the new foundations.

However, generally, it is found uneconomical to relocate brick buildings or timber framed buildings containing extensive external brick walling.

Relocation of weatherboard cottage at Helensburgh with bulldozer assisting prime mover and the same cottage at Helensburgh in the relocated position

Disturbance

The Department endeavours to reduce as far as possible the disturbance to owners or tenants of properties where the improvements are being relocated or adjusted.

In the case of relocations of timber framed improvements it is often possible for the owner or tenant to remain in occupation although a period of 24 hours may elapse before the usual services are restored to the relocated position.

If it is not practicable for the owner or tenant to remain in occupation, compensation is paid sufficient to cover the costs of board and lodgings at a hotel or guest house for the period of relocation. In country areas where improvements are being relocated on low ground subject to flooding it is often necessary to place a considerable amount of filling or to carry out extensive pier and protective work to maintain a residence above flood level.

The route between the present and alternative sites needs careful inspection as to its feasibility, with particular regard to clearances at bridges, level crossings, and under power and telephone lines which may need to be raised.

Average Costs

The average cost to the Department for the relocation of a cottage of 12 squares is $3,500.

ADJUSTMENT OF IMPROVEMENTS

When adjustment of improvements is necessary, estimates of costs are prepared during negotiations with the owner for the purchase of the land required and a decision with the owner is reached as to whether the Department will arrange for the adjustments or it will remain the responsibility of the owner and the cost allowed in the compensation to be paid.

The owner often desires to carry out additional work beyond what is considered to be equitable adjustment. The Department does not object to the additional work being carried out as part of the contract, provided it is at the owner's expense. Alternatively the owner may make his own arrangements with the contractor as a separate undertaking.

Preparation of estimates and final design drawings are facilitated by accurate measurements and photographs of the property with close-up photographs of any particular detail. The location of the various services to the property is determined at the site or obtained from the appropriate authorities.

Following the exchange of contracts containing provisions for alterations to the improvements by the Department, detailed drawings are prepared and submitted to the owner for signature. The detail on the drawings must be as complete as possible to avoid continual reference to the specification. A specification is prepared following signature by the owner.

Tenders are invited by advertising in the local press and the successful contractor signs a contract and is required to take out insurances for public liability, third party and workers' compensation. A security deposit of 1 per cent of the contract sum is lodged by the contractor and held until the completion of the maintenance period of 3 months.

The cost of building adjustments rise steeply where the following work becomes necessary:

(*a*) Underpinning of walls.

(*b*) Support of upper floors.

(*c*) Relocation of internal stairways.

(*d*) Redesign of the roof.

(*e*) Weather protection of doors and windows.

Shops

It will be appreciated that in an average road widening of 18 feet to 34 feet a major alteration becomes necessary in the case of shops, as in many instances, a residence is in use upstairs. The stairway is generally behind the shopping area which must be extended and consequently the stairway must be completely rebuilt. Where this is not possible internally because of limited space, consideration must be given to constructing the stairway outside the main building with the consequent expense of weatherproofing.

Extension of the shopping area generally results in removal and re-erection of internal walls which support the roof. This in turn may result in the need for a major redesign of the roof involving the construction of steel beams and columns for support which must be made fireproof by encasing in concrete or boxed in timber lined with a plaster board.

Cottages

It is often necessary to remove verandahs and porches from the front of cottages thus exposing entrance doors and front room windows to the weather. Hoods are provided of a design bearing in mind the aesthetic appearance of the cottage where large expanses of wall may be exposed. Where the windows are close to the new road alignment owners often require that wrought iron guards be placed across the windows and on occasions it has been necessary to relocate the main entrance from the front to the side of the building because of the difference in levels at the new alignment.

If the Department's proposals necessitate the excision of one or two rooms from the front of a cottage and the owner wishes to remain on the property consideration is given to adjusting the remaining rooms and adding an area at the rear equivalent to that lost.

Gardens and landscaping are restored by the Department or compensation allowed so that the owner may make individual arrangements.

At times the septic system absorption trenches located within the land required for road widening must be relocated. If the property slopes to the road it is necessary to instal a holding tank and a pump so that effluent may be pumped to an absorption trench system in the rear yard or to arrange for a tanker collection.

Considerable difficulty arises in the maintenance of access to garages where large cuts or fills occur at the new alignment. It is a common occurrence for garages to be relocated in the rear yard where cutting is involved or to be rebuilt or replaced on columns at the new alignment when heavy filling or walling occurs. In both cases costs are high.

Services Stations

The loss of a large part of the driveway area constitutes a major effect on a service station. To replace this area it may be necessary to alter the building on the site and to reposition the underground storage tanks.

The main building on a modern type service station does not lend itself to adjustment across the frontage with the result that consideration must be given to complete redesign possibly involving demolition and rebuilding. The cost of an average building would be in the vicinity of $50,000.

Rural Properties

Where buildings on rural properties need demolition, relocation or adjustment the procedure adopted is as outlined above.

However, on rural properties the economic operation of the property may be affected and adjustments must be made to paddocks, irrigation schemes, dams and yards and ramps associated with shearing sheds and stock loading operations. Increased capacity pumps may be required to cope with additional pumping distance to maintain an equivalent irrigated area to that in use prior to road proposal.

Recreation Areas

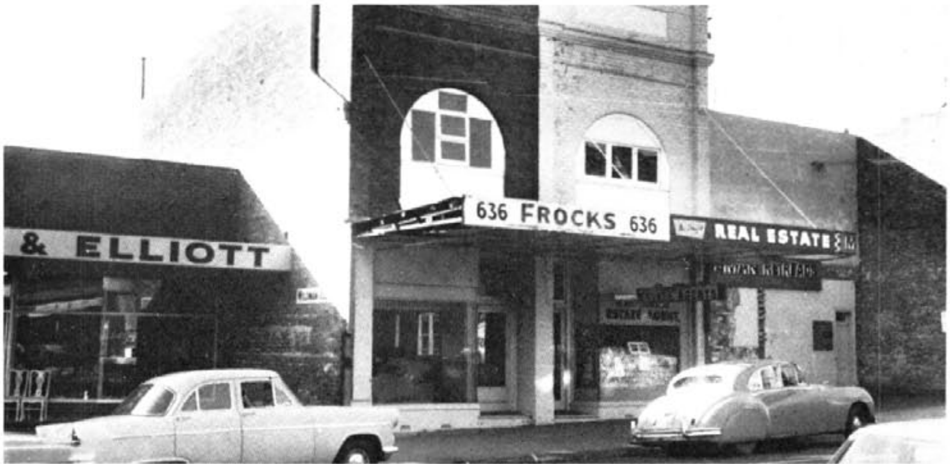
The loss of even a small area for road purposes from a recreation area may result in the remaining area being of insufficient size. This position arose in two recent instances where golf courses were affected but the clubs concerned were able to obtain sufficient additional areas of adjoining properties for their purpose. A third club was able to adjust the course within the remaining area.

The improvements in addition to buildings which may need to be adjusted or relocated on a golf course are greens, tees and fairways and the automatic watering system. The latter system if fully automatic and designed to water the whole area of play may need to be completely replaced and could cost in the vicinity of $100,000.

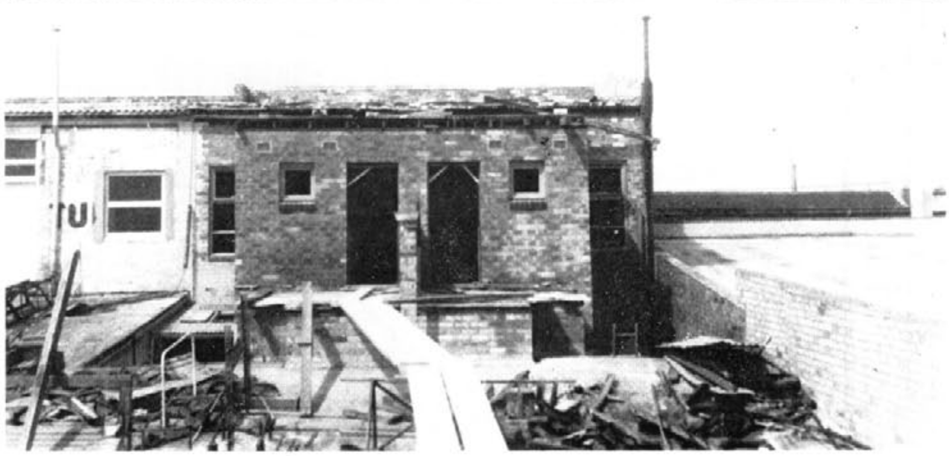
Disturbance

As far as possible, disturbance is reduced to a minimum as in the case of relocation but where shops are being adjusted not only personal but business disturbance is involved and closing down for a lengthy period may mean a major loss of customers.

It may be necessary however to close-down a business where a shop is being adjusted and for the period involved



Two-storey brick shops and residences before adjustment and after adjustment has been completed



Rear of two storey-brick shops and residences before adjustment and showing additions to compensate for loss of area due to widening compensation is paid covering the loss of profits for both the business and any rented premises being vacated for the period.

A business can often be carried on in the existing shopping space whilst a replacement area is constructed behind the new alignment. Very little loss of trading occurs whilst the stock and fittings are transferred to the new area and part of the old shop is demolished.

Where a building is being reconstructed on the road alignment the Department of Labour and Industry requires that a hoarding be erected. The display windows are thus unavailable to draw customer attention and can have an adverse effect on the business derived from casual customers. In the case of food shops this effect may not be so noticeable.

The prevention of dust reaching the shop from the working area is essential particularly in regard to food retailers.

Protection from the weather and from unlawful entry must be maintained at all times and in certain cases a tunnel for the protection of customers entering from the street may be necessary.

Construction of access road to Kingsford-Smith Airport through the Australian and Lakes Golf Courses. A new green is being constructed in the foreground while in the background complete reshaping is being carried out

Adjustment to Improvements Due to Change of Levels

The Department is required to adjust improvements such as fencing, access and garages because of regrading of the road involving alterations of levels on the road alignment.

The proposal to alter levels is advertised in the press and owners may claim compensation for any loss or damage occasioned by the change of levels.

Where changes of levels are not advertised owners have a common law right to damages resulting from the changes.

Negotiations are entered into with the owners as to the nature of the adjustments and following agreement plans are prepared for the owner's signature.

In all cases where the Department restores access and adjusts improvements the work performed mitigates against compensation claims which may arise.

The cost of this type of adjustment may vary from $100 to $5,000 depending upon the degree of change in levels and is generally carried out by the Department's own forces. Here again the Department does not object to minor additional work being carried out at the owner's cost.

Average Costs

The following figures show the average costs to the Department for building adjustments to shops.

- Shops 2-storey—$250–$280 per lineal foot of frontage including new awning.
- Shops 1-storey—$150–$180 per lineal foot including new awning.
- Shops 1-storey—$450 per foot where alterations cover reinstatement of equivalent accommodation.

CONCLUSION

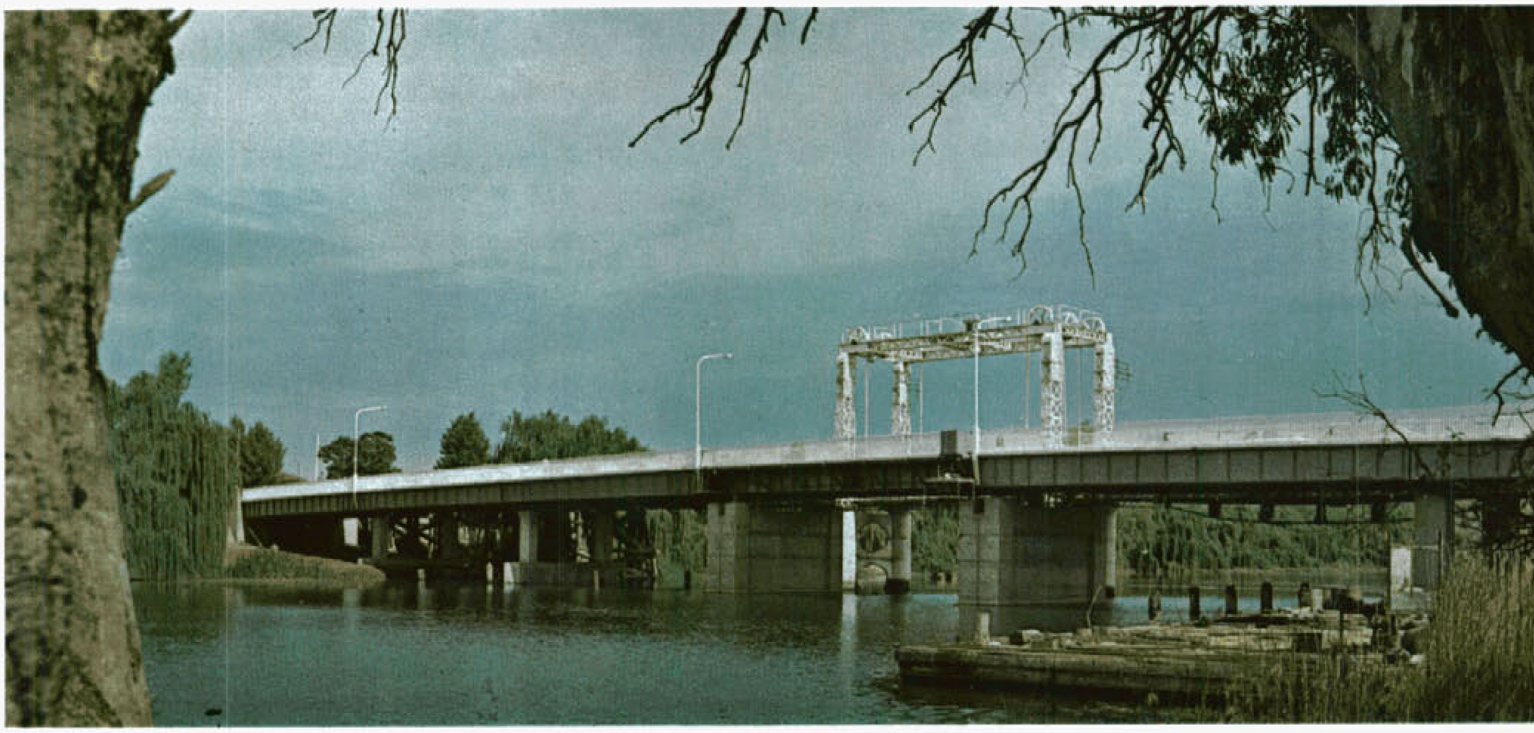
It will be appreciated that in spending public monies the Commissioner for Main Roads must ensure that funds are properly used and that the Department's obligation is limited to reinstatement of the property so that the owner's equity therein is not reduced beyond the amount of compensation which may be payable.

2 new bridges

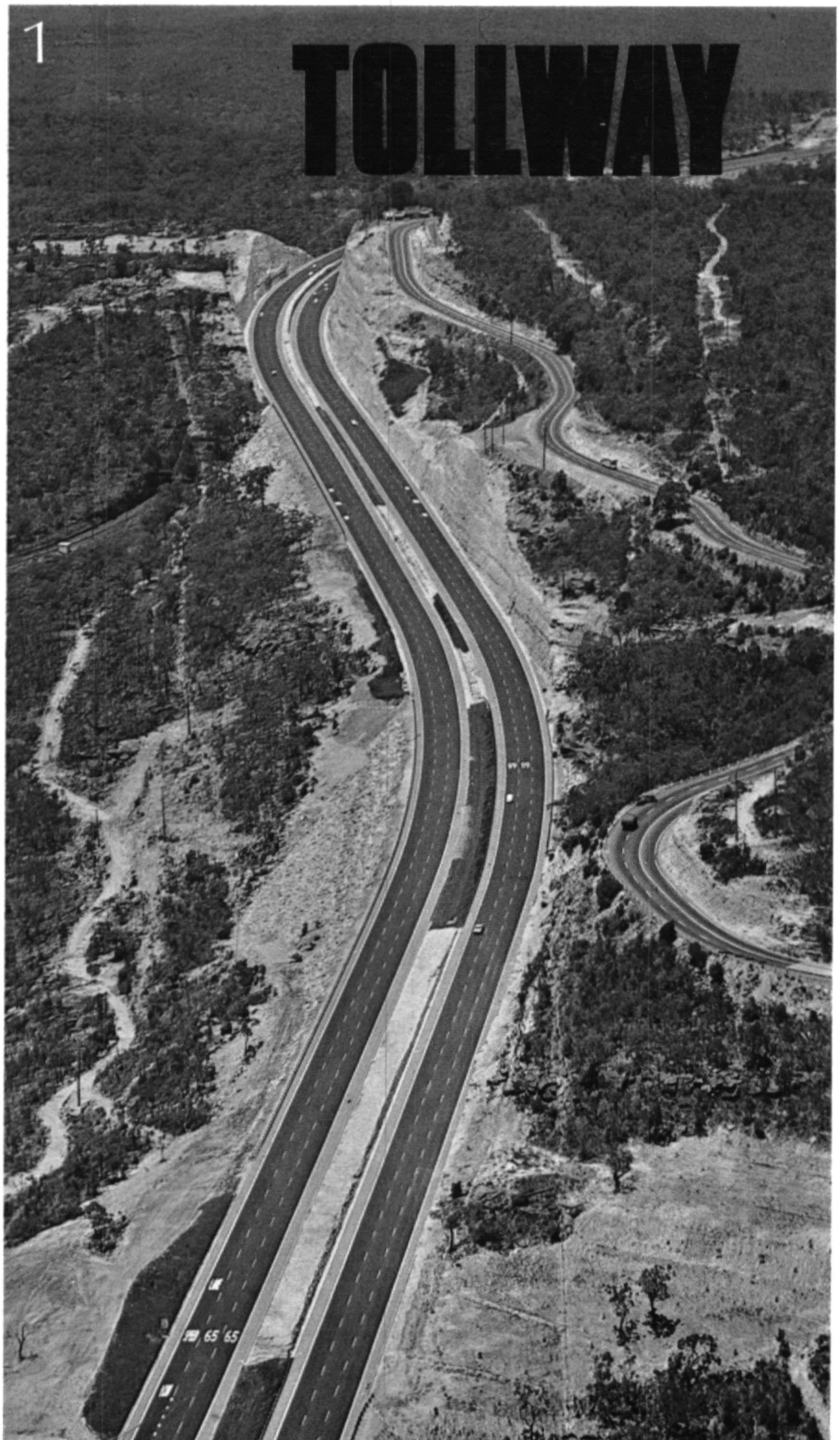
The new concrete bridge over Tuggerah Lake at The Entrance (right), built at a cost of approximately **$903,000**, *was opened to traffic on* **20th** *December,* **1968.** *This* **18**-*span structure,* **1,532** *feet long, has a carriageway width of* **28** *feet and a footway,* **8** *feet wide, on each side. This bridge replaced a narrow timber structure built in* **1933.**

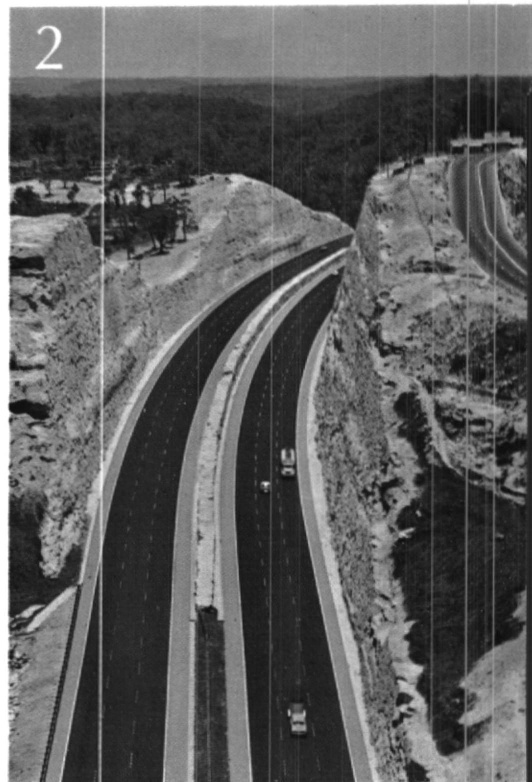
&

A new steel and concrete bridge over the Darling River at Wentworth (below) was opened to traffic on **23rd** *January,* **1969.** *This bridge, which is located on the Silver City Highway, consists of six steel girder spans and one steel girder vertical lift span. It has a length of* **532** *feet, a carriageway width of* **24** *feet and has been provided with a footway on each side. It was built at a cost of approximately* **$621,000**, *and replaced a narrow timber beam bridge.*



BEROWRA-HAWKESBURY RIVER TOLLWAY





1 This view of the tollway and the Pacific Highway (on the right) shows how road engineering has advanced to meet modern traffic requirements

2 View showing a deep cutting at "Hilltop". The Pacific Highway may be seen on the right

3 View of the footbridge constructed over the tollway near Cowan to provide bush-walkers with access to Ku-ring-gai Chase National Park

4 View looking south showing bridges carrying the main northern railway line and the south-bound carriageway of the Pacific Highway over the tollway

5 Extensive cutting and filling are a feature of the tollway as illustrated in this photograph

6 Looking south over the toll barriers and Department of Motor Transport Lorry Checking Station at Berowra

7 Retention of part of the cutting in the median to eliminate head-on collisions and headlight glare is a special feature of the tollway design


5


6


7

PACIFIC HIGHWAY WIDENING

Two views of the new deviation which was recently constructed in conjunction with the widening of the Pacific Highway to four lanes from Mount Kuring-Gai to Berowra.

PACIFIC HIGHWAY WIDENING

The widening of the Pacific Highway to four lanes from Mount Kuring-Gai to the Berowra Truck Checking Station was completed to coincide with the opening of the Berowra-Hawkesbury River Tollway on 12th December, 1968.

Over most of the reconstructed length the widened highway closely follows the line of the old road. There is, however, an important deviation which eliminates two narrow bridges with sharp approach curves over the Main Northern Railway Line between the villages of Mount Kuring-Gai and Berowra. The highway is now located on the western side of the railway line for the full length between Hornsby and Cowan. The reconstructed section, 3·2 miles in length, is on a vastly superior alignment.

During this work, construction was carried out under both rural and urban conditions. The section from just north of Mount Kuring-Gai to the northern end of the deviation passes through some very rugged country with deep fills and high cuttings which are comparable with sections of the Sydney-Newcastle Expressway. In contrast with this, the section through the village of Berowra features kerbing and guttering with associated underground drainage works, dual carriageways with a separating median strip and turning bays in the median strip at the important intersections. The length of the highway which traverses the rural areas is provided with two travelling lanes 11 feet wide in each direction and wide shoulders sealed with an aggregate of contrasting colour to the finished pavement. Protective steel guard-rail has been erected at the outside edge of the road on the top of embankments and, like the expressway, the embankments have been rock-faced to prevent scour. The whole project cost $1·7 million or approximately $530,000 per mile.

A group of aboriginal rock carvings of particular anthropological significance was located very close to the old route of the highway approximately half a mile north of the Mount Kuring-Gai Railway Station. Care was taken to locate the widened road away from the carvings and the area was fenced during progress of the work.

Two private properties had to be wholly acquired, seven private properties and land under the control of the Lands Department, the Department of Railways, Hornsby Shire Council and the Sydney County Council were affected partially in providing the right-of-way. Acquisition of property proceeded as the work progressed.

Work began in February, 1968 using the Department's own forces and, in the early stages, was confined to sections where the Department had already acquired the land and where there were no restrictions imposed by the existence of public utilities which had to be shifted to make way for the roadworks. The construction methods adopted on the work were based on proven techniques developed on work carried out by the Department on the expressway. The sandstone rock in the cuttings was loosened by heavy tractor-mounted rippers or by drilling and blasting, whichever method was appropriate, depending on the hardness of the rock.

The broken-down rock was loaded and hauled to the fills in motorized scrapers on the deviation length and in rock-buggies and trucks on lengths adjacent to the old highway. A total of 320,000 cubic yards of earth and rock were shifted on the project.

The faces of rock batters were trimmed by presplitting with explosives and in some cases it was necessary to blast quite close to houses and large buried water-mains. Damage to property was successfully prevented by carefully calculating the charge weights and using delay detonators to control ground vibrations and by using firmly secured blasting mats to prevent fly rock.

Other necessary work on the project included the compaction of fills, the placement of rock faced batters, the construction of underground and surface drainage, the provision of an asphaltic concrete pavement over a crushed stone or concrete base, median islands, guard-rail, linemarking, furnishings and landscaping. Up to 120 men were employed, in addition to the operators of the machines which were on hire. Most of the plant used on the project was hired and up to 23 bulldozers and 55 other major items were employed. Extensive use was made of an extruding machine for the construction of concrete kerb and gutter and concrete mountable median strip.

A temporary laboratory was set up at Berowra to maintain a check on the compaction of the material placed in fills and to check the quality of other materials used on the works.

The Department obtained the advice of the Soil Conservation Service before commencing the final clean-up and landscaping. Special seed mixtures and appropriate fertilizers were used to promote the growth of grass and accelerate the natural appearance of the roadside.

The heavy traffic volume using the highway, over 12,000 vehicles per day, added to the difficulties of the work. Most of the heavy construction work immediately adjacent to the highway was carried out to coincide with interruptions already caused to traffic by the Expressway work. In this way interruptions were kept to a minimum and allowed the target date for finishing the work to be achieved.

Other special measures were also employed to facilitate the work. Small transisterized radio transceivers were used extensively for the control of traffic. Men were employed to give motorists a warning of holdups in advance of the flagmen who actually controlled the traffic. This measure was taken particularly at situations where there was a blind curve immediately before the holdup site. A special set of manually controlled traffic signals, manned by an employee, was installed by arrangement with the

PACIFIC HIGHWAY WIDENING

Department of Motor Transport at a site where trucks were continually crossing the highway. Radio contact with the expressway organization was also maintained so that necessary interruptions to the highway traffic could be co-ordinated between the two organizations and the consequent delays to motorists kept to a minimum.

The work was planned using the critical path method based on precedence networks. This was the first project on which the Department's own IBM 1130 computer was used to analyse a critical path network. A feature in the use of the computer was the relative ease it could produce amended programmes when provided with up-to-date data as it came to hand.

The completion of the project by the due date was made possible by the co-operation received from the public utility authorities which had services requiring adjustment along the route. The authorities concerned were the Post-master-General's Department, the Metropolitan Water, Sewerage and Drainage Board, the Sydney County Council, the Department of Railways and the Hornsby Shire Council.

The use of the programme calculated from a critical path analysis made the Department's task of co-ordinating the work of these authorities to fit in with its own activities much easier. The authority concerned could be advised accurately when its work could commence, when it was desirable that the work be completed and when it was essential that the work be completed to prevent delaying the whole project. The authorities were thus able to plan their work to fit in with the Department's programme instead of rendering the whole project dependent on their capacity to complete their adjustments within a reasonable time.

It was necessary to make special arrangements with the Sydney County Council and the Department of Railways when blasting near their services. Overhead high voltage powerlines followed most of the route and, as these supplied power for the operation of railway signals on a section of the Main Northern Railway Line, great care was taken to prevent unscheduled interruptions to the supply. Cut-outs with alternative power supply from mobile generating sets were arranged when it was considered that blasting would endanger the powerlines and, on the deviation length, special air break switches were installed on each end of the lines so that they could be isolated during the frequent blasts. Power was available from an alternative network on the other side of the isolated section and this arrangement considerably reduced the cost of the cut-outs as it removed the necessity to supply power from the expensive mobile generating sets when cut-outs were arranged on the deviation length.

As the route closely follows the Main Northern Railway Line it was also necessary to co-ordinate all blasting with the railway timetable to avoid possible interference with train services. The Department of Railways provided flagmen along the railway line as an additional safety measure.

The Department widened three fills through the village of Berowra by 6 feet to accommodate the public utilities as a special measure. The Department also met the full cost of the removal and re-erection in new materials of the Berowra War Memorial which lay in the path of this work.

PROSPECT DEVIATION OPENED

A deviation of the Great Western Highway, commencing at Prospect and extending 2 miles to rejoin the Highway near Walter's Road, Blacktown, was opened to traffic on 19th December, 1968.

The Department carried out the entire work with the exception of the overbridge at Church Street, Prospect, which was constructed for the Department by contract.

The cost of the work, including the overbridge and the channelised intersection at Blacktown Road, Prospect, was approximately $1,122,000.

Both views are looking east.

NEW TOLLWAY SECTION OPENED

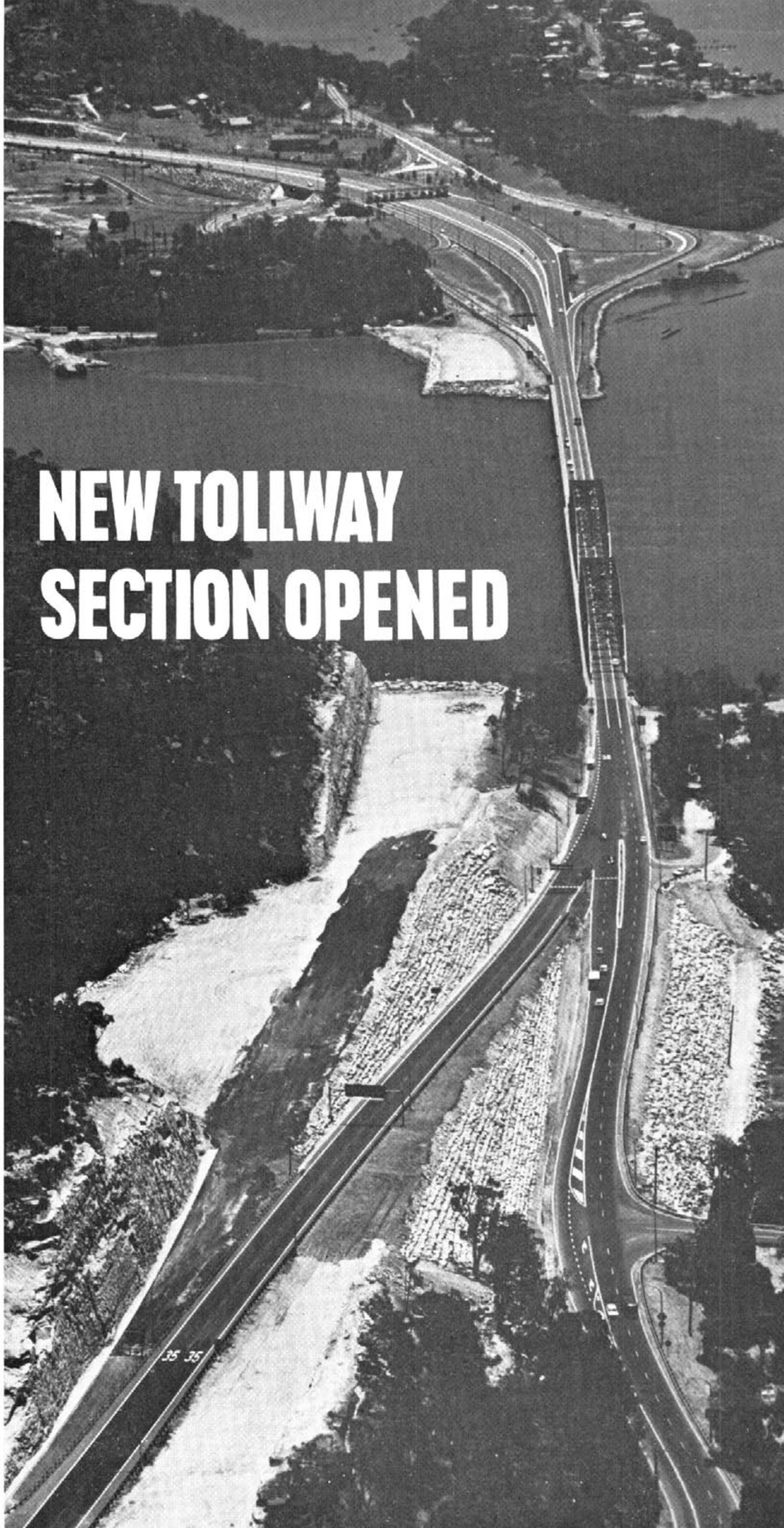
Another section of the Sydney-Newcastle Expressway was brought into service when the Berowra-Hawkesbury River Tollway was opened to traffic on 12th December, 1968.

Thus, three major lengths of this Expressway, all constructed through rugged country, have been completed and now provide vastly improved travelling conditions along this very busy route.

The next step in the construction of this important artery, connecting Sydney and Newcastle, will be the provision of a new bridge over the Hawkesbury River to serve expressway traffic. Until this facility is available, the existing three-lane bridge will be common to the expressway and the Pacific Highway.

Prior to the completion of the second section of the expressway north of the Hawkesbury River (Mount White to Calga), which was opened on 28th October, 1966, it was decided that any extension of the work should be designed to reduce traffic congestion south of the river, where serious problems occurred during holiday periods and at weekends. Although progressive improvements of the Pacific Highway had been undertaken on this length over a period of years it was still inadequate and failed to cope with the increasing traffic volumes. It was obvious that a road of expressway standard should be provided. Following the preparation of plans, construction was commenced in June, 1966.

The design was prepared by the Department's own staff working from



Aerial view showing the present traffic arrangements at the southern approaches to the Hawkesbury River Bridge and the site of the proposed new bridge for expressway traffic survey information obtained by photogrammetry. The Department's helicopter was used extensively in connection with the location and design of this section. It was evident from the start that massive earthworks would be involved mainly in sandstone rock.

The Department's overall proposals for construction of the expressway provide for the adoption of a route which extends south from the Hawkesbury River, ultimately joining the Lane Cove Valley Expressway near Wahroonga. From approximately 2 miles south of the river the route of the expressway is located on the eastern side of the Main Northern Railway Line. It was at first proposed to terminate this section at Cowan but, to provide relief as quickly as possible to the travelling public, it was decided to extend the construction to a point about 1 mile north of Berowra where it would link with the Pacific Highway by way of an interchange. This interchange is adjacent to the Department of Motor Transport Lorry Checking Station. In conjunction with this work it was also planned to widen the Pacific Highway between Mount Kuring-Gai and the proposed interchange to provide four lanes of traffic, thus eliminating the bottleneck where the two roads merge. A separate article relating to this latter work is included in this issue of the Journal.

It was desired to maintain grades within the limits of 6 per cent ascending and 6½ per cent descending and therefore the design provided for deeper cuts and higher fills than any experienced elsewhere on the expressway. The total earthworks involved the removal and placing of approximately 5·3 million cubic yards. Cuts were up to 150 feet deep and one fill was approximately 215 feet high at the centreline. This fill required about 1·7 million cubic yards of material. The largest cut required the removal of about 1·1 million cubic yards of sandstone.

Construction of this section was undertaken by the Department's Sydney-Newcastle Expressway Construction Division which has its divisional office at Mount Kuring-Gai and a works office at Mooney Mooney. Field control was exercised by a works engineer assisted by up to five engineers and six foremen. The bulk of the major plant used on the work was hired on a comprehensive basis but the control of plant operation and job planning were entirely in the hands of Departmental personnel.

The earthworks were mainly in sandstone rock of varying degrees of hardness. Shale seams were encountered in the

sandstone, but the shale and the thin layer of topsoil constituted only a small percentage of the material removed. The terrain through which the expressway was carved was equally as rugged as that on the northern side of the Hawkesbury River. Over the first 1·3 miles south of the river, cutting into steep sideling slopes immediately above the Pacific Highway added to the task.

Although there are many facets to expressway construction the largest single item, especially in this particular case, is the earthworks operation. This consisted essentially of establishing the construction limits by survey, presplitting the cut batters, loosening the rock between the presplit lines, loading, hauling and placing and compacting the loosened material in the fills. The presplitting technique was adopted throughout the work to establish the correct line and slope of batters by drilling and blasting before the earthworks were commenced. With this technique the limits of the work were clearly defined while batters were easily cleaned down during the course of the work. An advantage is its pleasing finished appearance.

Up to 60 per cent of the sandstone encountered was ripped to a condition suitable for large motorised scrapers to load and haul. This was done by suitably powered tractor-dozers each fitted with a single type ripper. The balance of the rock was either helper blasted and ripped or, where the rock was very hard, blasted by explosives and then loaded out using scrapers or loaders and large dump trucks. The outputs necessary to complete construction by the planned date required a large excavation plant force and at the periods of peak output no less than 27 tractor-dozers of 385 hp, 20 motorised scrapers, including 16 of nominal 24/30 cubic yards capacity and up to 22 dump trucks were in operation. Peak outputs of up to 25,000 cubic yards solid per day were achieved. After being hauled to the areas to be filled the material was deposited and spread in layers, approximately 12 inches deep then compacted and trimmed. The compaction equipment consisted of drawn sheepsfoot, grid and vibrating rollers. Larger type vibrating rollers, with a static weight of approximately 10 tons, became available for hire during the period of construction and were used to advantage. In view of the dimensions of the fills it was essential that adequate compaction was achieved in every layer of deposited material. The degree of compaction required by the construction specification was 95 per cent of Standard Proctor. A laboratory with specialist staff at Mooney Mooney Works Office carried out the testing.

The bulk of the blasting was undertaken with ANFO (ammonium nitrate—fuel oil) which was mixed at a central site factory. The explosive was transported in bags to the blasting site, placed in plastic tubing and then lowered into the drilled holes. A full range of delay detonators was used to ensure efficient blasting and adequate breakdown of the rock. A.N. Gelignite "60" was used for presplitting purposes and "Anzite" was also used as a priming charge and for blasting in very wet conditions.

Because of the nature of the material being excavated it was inevitable that some oversized rock would be encountered during excavation. Much of this oversized material was used to face fill slopes and in consequence, only a minimum of secondary blasting was necessary. The rock facing on the fills protects the face from scour, which is particularly desirable in sandstone material, and at the same time presents a pleasing finished appearance. The rocks were carefully moved into position by rock rakes under the direction of a ganger to ensure that correct lines and slopes were maintained.

Particular attention was given to the construction of the pavement to provide adequate strength and good riding qualities. To achieve this, the pavement was constructed in five layers comprising 12 inches of selected sandstone, two 4-inch layers of crushed stone basecourse of nominal $\frac{3}{4}$-inch grading, a $2\frac{1}{4}$-inch layer of $\frac{3}{4}$-inch nominal gauge asphaltic concrete and finally a $\frac{3}{4}$-inch layer of $\frac{3}{8}$-inch nominal gauge asphaltic concrete, making a total depth of 23 inches. The selected sandstone and crushed stone basecourse layers were carefully compacted to achieve 100 per cent Standard Proctor and trimmed to obtain correct line, shape and level before succeeding layers were placed. This procedure was essential prior to laying the asphaltic concrete surface course. To this end the Department investigated the use of automatic road trimmers to achieve good shape in the basecourse and some experiments were carried out with this type of equipment. These experiments indicated that there is considerable merit in this method.

The asphaltic concrete surface courses were laid by the Department using the most up-to-date techniques and machines available in Australia and very satisfactory results were achieved. The $\frac{3}{8}$-inch nominal gauge final course was laid

using either three or two paving teams in echelon thus obtaining sound longitudinal joints with a minimum of transverse joints. Maximum daily output on a three 12-feet lane carriageway, using three pavers, was approximately 1,550 tons, representing a length of approximately 1½ miles of full width pavement. Excellent riding qualities have been achieved which have been evidenced by low profilograph index readings.

To provide a high standard of alignment on the expressway it was necessary to relocate the Pacific Highway at four points and there are two crossings of the Main Northern Railway Line. Each of the highway relocations involved heavy earthworks and one required the construction of a bridge over the expressway. The first crossing of the railway line was constructed in a cutting over the Beronia No. 2 tunnel at Hilltop. This cutting is approximately 140 feet at its deepest point and the bottom is approximately 70 feet above the roof of the tunnel. Extreme care was necessary during excavation and blasting had to be carefully controlled to avoid damage to the tunnel. Blast vibrations were constantly checked by an employee of the Department of Railways using a vibragraph. The work was carried out without delays to rail traffic or damage to the tunnel. The second railway crossing is adjacent to the Berowra Interchange where the expressway ramps pass under a newly constructed railway embankment to link with the four-lane Pacific Highway. Consideration was given to burrowing under the existing embankment or alternatively, constructing a short deviation of the embankment incorporating a new bridge to serve as an underpass for the expressway. The latter proposal was considered more suitable and was adopted. The railway deviation is approximately 3,300 feet long and was made available for railway traffic on 29th September, 1968, thus enabling the old embankment to be removed.

Four bridges have been provided throughout this section of expressway. These are at the following locations:

☐ The bridge which takes a section of relocated highway over the expressway at approximately 29 miles north of Sydney. The bridge has an overall length of just over 271 feet and is 34 feet wide between kerbs, providing for three lanes of traffic. It is of continuous deck construction with hinged struts and ties. The structure was cast in place and both the deck and ties were post tensioned using the BBR system. The bridge has a pleasing appearance and is the first of its type built in New South Wales.

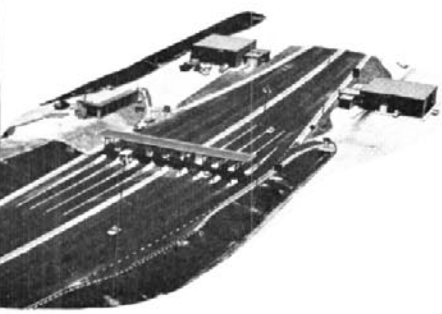
☐ A footbridge spanning the expressway has been provided near Cowan Railway Station at approximately 26 miles north of Sydney to provide access for bushwalkers into the Jerusalem Bay area of Ku-ring-gai Chase National Park. It comprises two spans each 80 feet long and it is 12 feet wide between kerbs. This width has been provided so that bushfire tenders may use the bridge when necessary. The structure was cast in place and post tensioned also using the BBR system. An interesting feature of the construction of the bridge was the pumping of the class 6K concrete into place in the superstructure in one pour. The total quantity of concrete in this pour was approximately 150 cubic yards.

☐ As mentioned previously a bridge was required to carry the relocated Main Northern Railway Line embankment over the expressway where it links with the Berowra Interchange. This bridge is of two spans each comprising six girders 82 feet 5½ inches long. The girders were precast as one unit adjacent to the bridge, post tensioned at the casting site then transported to the bridge work and lifted into place. The girders weigh approximately 63 tons each and they are the first prestressed concrete girders to be used in a railway bridge in New South Wales. The BBR system of tensioning was again used in this instance.

☐ The fourth bridge is within the Berowra Interchange and carries the southbound highway lanes over the expressway. This bridge is of two spans each comprising four girders of 100 feet length weighing approximately 60 tons each. The girders were constructed by contract in segments which were assembled and stressed on site. The completed girders were then lifted into place and the deck completed. The bridge is 23 feet wide between kerbs.

All bridge construction, other than the casting of the girders for the latter bridge was carried out by the Department by direct control.

Another major bridge is required across the Hawkesbury River to link the two



completed lengths of expressway. Planning is well advanced with the design and it is aimed to have this structure completed by 1972.

Until such time as the expressway bridge is available the existing Hawkesbury River Bridge will carry all traffic. Three lanes are available on this bridge and tidal flow arrangements are co-ordinated to cope with traffic requirements. On this new length of expressway all northbound traffic travels the full length and rejoins the highway immediately south of the Hawkesbury River Bridge via an off-loading ramp. Southbound traffic, after crossing the bridge, traverses the Pacific Highway for approximately one mile and then joins the expressway via an on-loading ramp. A system of traffic signals and road markers is used to control traffic south of the bridge and direct it into appropriate lanes.

In constructing the Berowra Interchange, connecting the expressway with the widened Pacific Highway, it was necessary to re-site and reconstruct the Department of Motor Transport Lorry Checking Station. New buildings were built to cater for haulage vehicles using both the highway and expressway. There is a pedestrian tunnel provided under the expressway to provide safe passage for employees between the buildings.

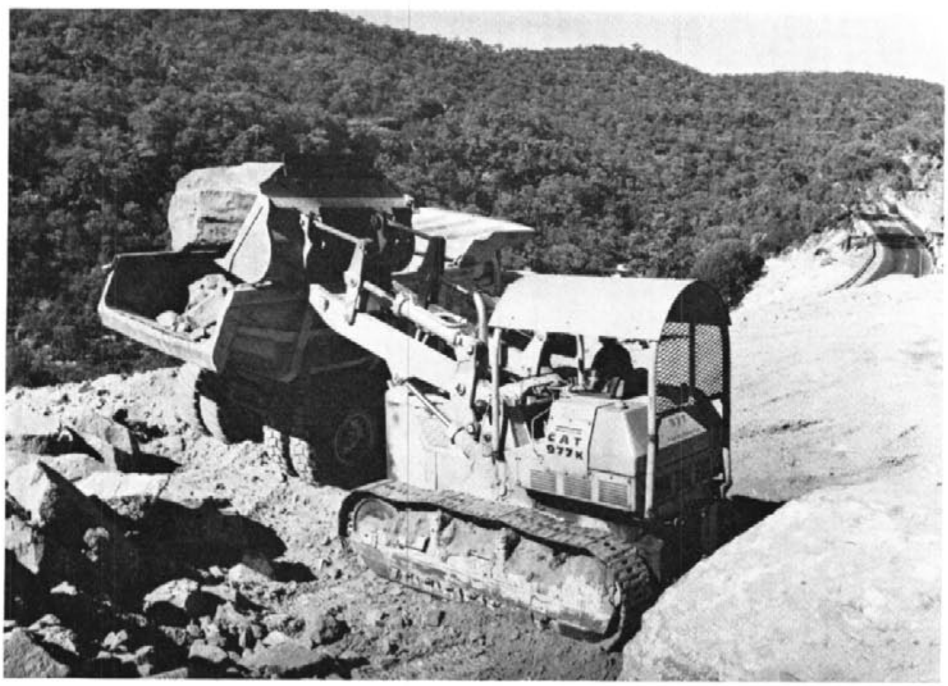
Facilities for collecting tolls have been constructed within the Berowra Interchange. The toll barriers are of similar construction to those at Mooney Mooney. However, two booths have been fitted with automatic toll collection devices. Because the existing bridge over the Hawkesbury River is common to the expressway and the Pacific Highway it is necessary to have toll barriers at both Mooney Mooney and Berowra until the new bridge is constructed.

Street lighting has been provided at locations where drivers have to make important decisions regarding the route to be taken, namely, throughout the Berowra Interchange, on the on-loading ramp for southbound traffic approximately 1 mile south of the Hawkesbury River and the temporary off-loading ramp for northbound traffic approaching the Hawkesbury River Bridge. Lighting is not provided elsewhere because road identification is adequately catered for by reflectorized edge lines, lane lines, etc. Special lighting is provided within the central portion of the Berowra Interchange by nine masts, 100 feet high, each surmounted by four 1000-watt lamps. This is the first time the Department has used this type of lighting which is very effective.

The high standard of design and construction in an expressway provides the highest form of safety in a road. Every endeavour has been made to improve this aspect by providing additional roadside furnishings and safety devices. Rock medians have been left through all cuttings to act as a barrier between opposing traffic flows and to eliminate headlight glare. Guardrail at the outer edges of fills and within medians, where necessary, acts as an effective barrier to vehicles which might get out of control. Low growing shrubs have been planted on flat open medians where, because of the road alignment, headlight glare could be a problem. The shrubs form an effective screen and also enhance the appearance of the road. A safety ramp has been constructed on the last steep grade approaching the Hawkesbury River for use in emergency by northbound traffic. It has been designed to stop any vehicle which is permitted to use the expressway and which may get out of control on the descent to the Hawkesbury River Bridge.

Particular care has been given to the design and location of road signs. Advance direction and information signs are positioned to assist motorists and to ensure that there is no confusion in selecting and proceeding onto the expressway or the highway as desired. To convey the message correctly to drivers, a separate colour scheme for signs has been adopted for each road, namely, white lettering on a green background is used for the expressway and white lettering on a black background adopted for the highway. Other signs along the expressway relate to speed limits, advisory speeds and distances from important towns. Special consideration has been given to the size and type of the signs and the lettering to ensure that they adequately convey the intended message. In this regard some signs have been erected on structures which span the carriageway. The more important signs have been illuminated to ensure complete legibility at night.

In conjunction with the signposting, lane lining and edge lining of the pavement have been given special attention to assist in the orderly and safe movement of traffic. The white reflectorized edge lines are painted while raised pavement markers have been used to delineate the lane lines. These consist of 4-inch diameter ceramic buttons and 4-inch square reflective markers. Groups of four ceramic buttons and one reflective marker are attached to



the pavement at regular spaces. This type of lane lining, previously used on the Warringah Expressway, provides better delineation especially at night and during wet weather. It also eliminates the need for repainting the conventional lines and a warning rumble noise is evidenced when traversed by vehicles. The carriageway shoulders have been flush sealed, using $\frac{3}{4}$-inch crushed river gravel, which because of its lighter colour clearly defines the limits of the darker asphaltic concrete pavement. The coarse texture of the shoulder surface also acts as a rumble strip warning the driver that the vehicle is travelling off the main pavement.

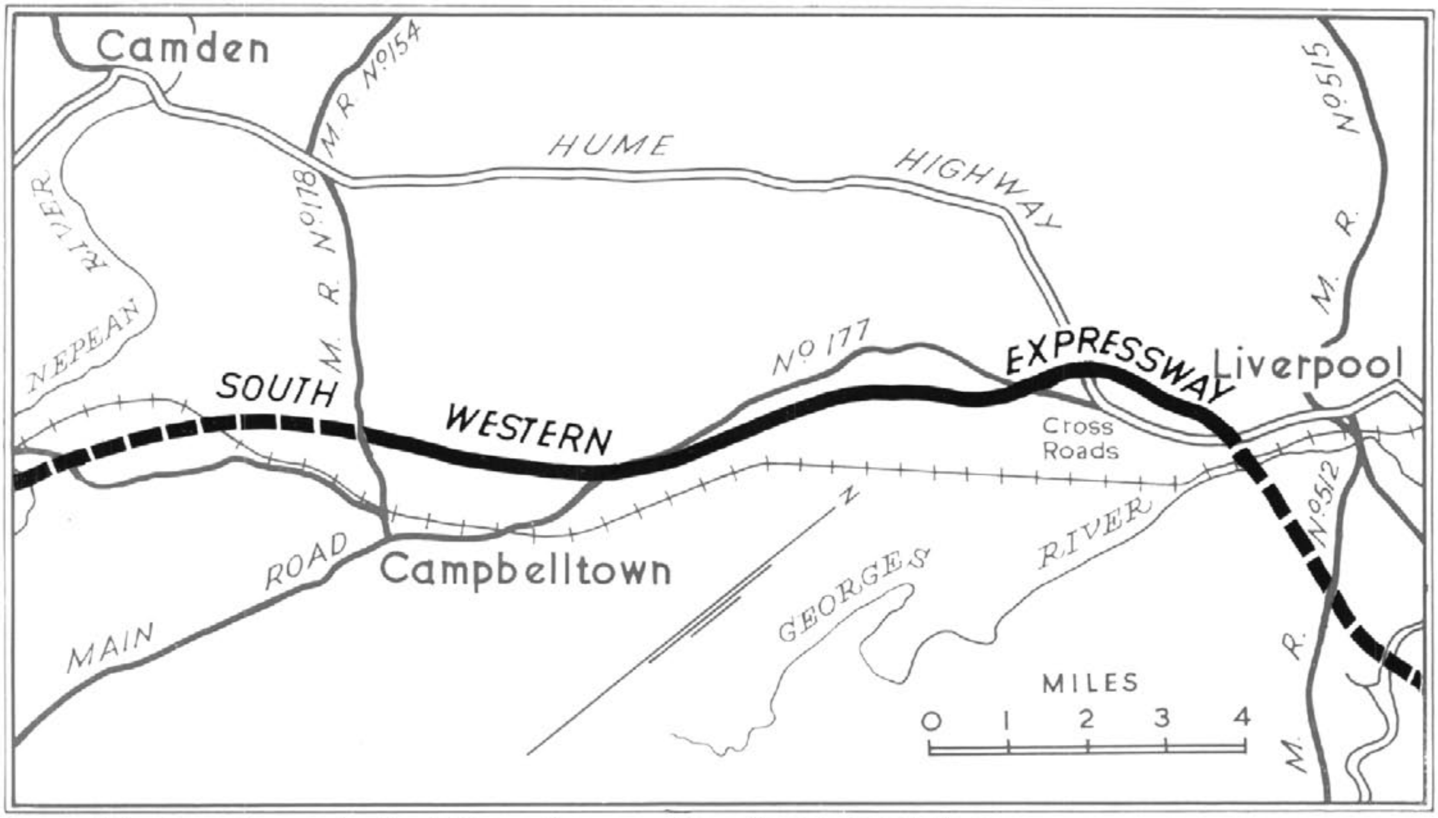
The line of the kerb and outer edges of the carriageways are also delineated by small square reflective markers placed either on the kerb or on the guardrail posts.

The Department has made every endeavour to avoid unsightly scars to the landscape during construction. Regeneration of natural growth and landscaping have been special features of the work. Open medians have been turfed with grass and indigenous trees and shrubs have been planted at suitable locations to present a pleasing aspect to the motorist. The introduction of exotic plants has been avoided. In order to maintain the natural appearance of the area the Department has arranged for the planting of flora which is characteristic of the Hawkesbury sandstone country and which is so evident in the neighbouring Ku-ring-gai Chase National Park and the Muogamarra Sanctuary. Waratahs, the floral emblem of New South Wales, have been planted along the side of the expressway north of the Hawkesbury River and at the appropriate time plantings will also be made along the section south of the river.

To assist the motorist who may experience mechanical or other trouble with his vehicle or be involved in an accident, emergency telephones, connected to the toll offices at Mooney Mooney and Berowra, have been provided along the expressway. The Tollway Manager has radio contact with a patrol vehicle which can be called to the assistance of the motorist.

Although the expressway acts as an effective fire break on the western boundary of Ku-ring-gai Chase National Park and the eastern boundary of Muogamarra Sanctuary, provision has been made for fire fighting vehicles to cross the expressway to gain access to fire trails in Ku-ring-gai Chase National Park should that be necessary.

SOUTH-WESTERN EXPRESSWAY



Proposed First Stage Construction, South Western Expressway, Cross Roads to Campbelltown

Cross Roads to Campbelltown

By K. J. Hatten, B.E., M.Eng.Sc., Grad.I.E. Aust., Department of Main Roads

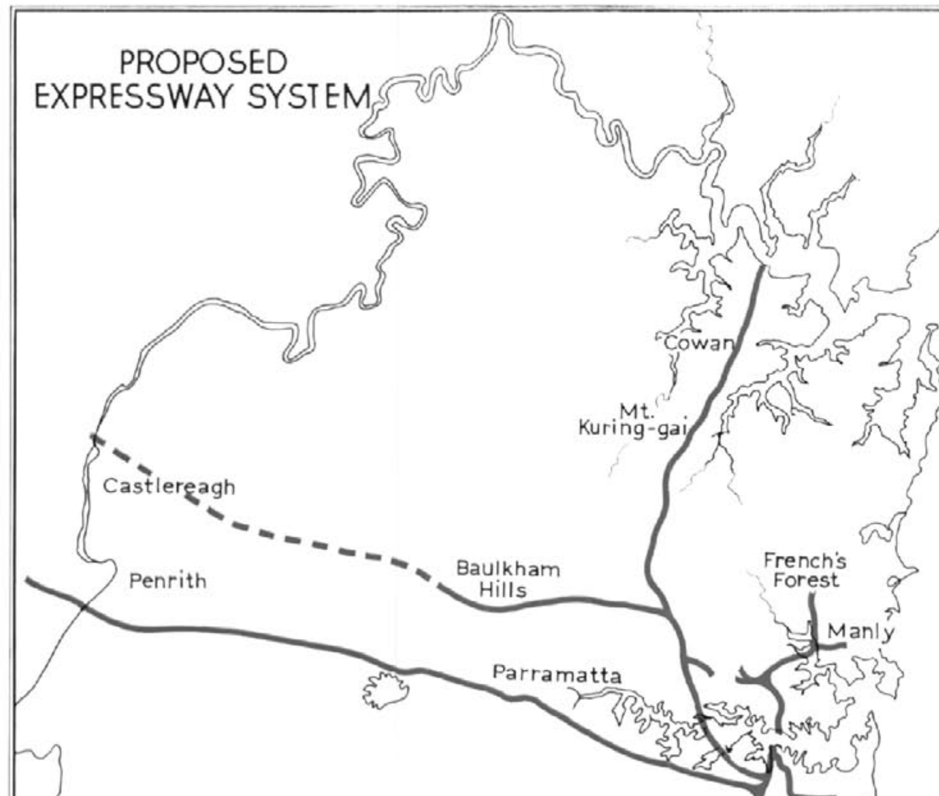
The South Western Expressway is one of the major roads planned to meet the future demand for road space by Sydney's growing population.

The State Planning Authority expects the population of Sydney to grow from its present figure of about 2·7 million to about 5 million by the year A.D. 2000. In the same period it is likely that motor vehicle ownership and usage will markedly increase. In 1960 there were 3·9 persons per vehicle in New South Wales and in 1968 there were 2·9 persons per vehicle. With the growing number of two-car families the index could approach the American figure which is currently about two persons per vehicle. The combination of these two trends, population and vehicle ownership, could result in there being up to three times as many cars as now exist in Sydney by the year 2000. The need for major roads can be readily appreciated.

Preliminary plans for the South Western Expressway had been developed from Sydney to Cross Roads by 1951 when the County of Cumberland Scheme was gazetted. In the mid-1950's further investigations were begun on a proposed extension of the expressway southerly towards Mittagong. The concurrent growth of populations and vehicle ownership made it obvious that an improved road link would be necessary between Sydney and Canberra and also between Sydney and Melbourne. It then appeared that traffic growth would justify the construction of an expressway type facility over the section of the inter-capital link between Sydney and the vicinity of Mittagong, while an improved highway would reasonably meet traffic needs south of Mittagong.

The initial investigation was for an expressway located generally parallel to the route of the Hume Highway between Cross Roads and Mittagong. This plan would have facilitated the gradual relief of the highway as a major route by suitable stage construction, and would, if implemented, reduce the need for major works on the highway itself. However, detailed studies of traffic growth led to the conclusion that an improved highway would be needed apart from the expressway.

The prospect of two major routes sharing the same general location presented engineering difficulties. There is only a relatively narrow corridor



suitable for the construction of major roads through the Razorback Range south of Camden. The country is also subject to landslides. At present, curves with advisory speeds below 30 miles per hour exist on the Hume Highway crossing of the Razorback Range. A design standard of say 60 miles per hour on the highway would necessitate deep cuttings and high fills which would require extensive protective walling and foundation support because of the unstable nature of the country. The cost of building two such roads would be high.

In 1960 the Department widened its field of investigations to include alternative locations for the South Western Expressway, south of Cross Roads, to serve new areas away from the existing Hume Highway. It was also envisaged that the expressway could also form part of a road link between the western areas of Sydney and the Wollongong–Port Kembla complex if suitable connections to the existing road system were provided. The existing Main Roads System, of which the Hume Highway is part, would be improved to adequately serve local needs, particularly inter-town traffic, since most existing settlements are located alongside either the railway or main roads in the area south of Cross Roads. The expressway could therefore be located to best serve the needs of through traffic and of any proposed major development south of Cross Roads.

The proposed expansion of Campbelltown has been one of the most significant influences on the location of the expressway. Campbelltown is in the southwest sector of the Sydney region and has been the subject of studies for a number of years. In 1960 the then Cumberland County Council published its report "Campbelltown—A New City in the County of Cumberland". The council envisaged Campbelltown as being a suitable location of a satellite city with a population of about 40,000. In 1968, the State Planning Authority, which replaced the Cumberland County Council in

1964, published its "Outline Plan for Sydney". The Authority looks upon Campbelltown as part of a comprehensive urban development to the south-west of Metropolitan Sydney.

The sector is strategically located near the Hume Highway and is directly served by the Main Southern Railway. It is reasonably close to the Wollongong-Port Kembla complex and its topography is suitable for urban development. More importantly, land suitable for industrial development is available close to the transport system.

As has been mentioned, Sydney's population is expected to reach 5 million by A.D. 2000. The rate of growth necessary to achieve this population is up to 100,000 per annum. While some of these people might be attracted to centres outside the Sydney region, the majority will have to be accommodated within it.

One of the areas capable of absorbing major population growth is the south-west sector. The publication, "Sydney Region: Outline Plan, 1970–2000 A.D.", envisages the creation of new cities instead of continuous suburbs and it is the State Planning Authority's aim to encourage employment within these centres. Three new cities are proposed in the south-west sector—Campbelltown, Camden and Appin. They are expected to have a total population of 500,000 by A.D. 2000, and while each will have a town centre it is proposed that the major development will be at Campbelltown.

At present the sector's population is about 31,000 but by A.D. 2000 the population of Campbelltown alone should approach 315,000. Camden and Appin should then have populations of 95,000 and 60,000 respectively. The early development will be concentrated at Campbelltown which is served by the railway.

In providing for this development the land use and transportation systems must be balanced. The development of appropriate transport links at an early stage of development may encourage residential and industrial development and, consequently, local employment. This will help transport authorities provide for the journey to and from work which generates the peak demand on the transport system. Already the State Government has electrified the railway to Campbelltown. This action is helping to make the district more attractive as both an employment and residential area.

Ultimately, Campbelltown will have a university and other advanced education facilities which will be adjacent to the new city centre. This is to be located south of the existing town centre near the railway. Campbelltown will become a major regional centre and will provide a substantial amount of office employment.

The sector as a whole will provide 4,500 acres suitable for industrial development. This area is sufficient to provide up to 90,000 industrial jobs when it is fully developed and will attract some workers from existing residential suburbs as well as the new centres. Near Narellan 2,600 acres have been zoned industrial while in the Bow Bowing Creek area adjacent to the railway at Campbelltown another 1,900 acres have been similarly zoned.

The building of the expressway from the Hume Highway near Cross Roads to Campbelltown is expected to encourage industrial development near Campbelltown by facilitating the movement of some employees to the area from existing neighbouring centres. The total process of development should then be accelerated by an expansion of residential development as additional jobs become available. The growth of employment outside the metropolitan area will provide more balance in the loading on the present transport system.

The location of the expressway between Cross Roads and Campbelltown has been determined with these factors in mind. The normal design constraints of topography, such as flood areas which have to be avoided, and short waterway crossings which are desirable, have been added to by the requirements of city planning. The road had to avoid the industrial lands referred to earlier. The topography of the area restricts the location of heavy industry to Bow Bowing Creek and Narellan, because only in these areas is there a large amount of flat, flood-free land. The Bow Bowing Creek area will require some flood mitigation works, but because of its proximity to the railway, the costs are justifiable.

The road location design had also to comply with the State Planning Authority's objective of maintaining a high quality urban environment. In this regard the Authority wished to retain the natural landscape where it enhanced the urban scene. The high ridge that runs through Campbelltown is an example of such a feature and had to be avoided.

Another factor considered in the location stage was the relationship of the expressway link to the existing Main Roads System and to other proposed extensions of it. For example, the State Planning Authority has provided for a ring road around the centre of Campbelltown along part of the Smiths Creek Valley. The planning of Campbelltown envisages this road as being access controlled and it was desirable that provision should be made to connect this road with the South Western Expressway in the future

The connections from Campbelltown to Wollongong and Port Kembla can be expected to carry increased traffic as Campbelltown develops. The volume of industrial traffic is likely to be high and a considerable amount of through traffic is likely to use the South Western Expressway and Main Road No. 177, between Campbelltown and Bulli Pass.

At present traffic on Main Road No. 177 is about 4,000 vehicles per day but by 1985 it is expected that 10,000 per day will use the road, about 5,000 of which will be Wollongong-Campbelltown traffic. The construction of the expressway will relieve Main Road No. 177 and the Hume Highway of a significant amount of north-south traffic until both these roads are improved and the expressway system extended. To ensure that this will be possible the expressway will provide links to other traffic distributing roads in the sector. To this end it is proposed that interchanges will be provided at Main Roads Nos 177 and 178. Grade separated crossings will be provided at the more important local roads such as Raby Road and Bringelly Road.

The section of the South Western Expressway between the Hume Highway near Cross Roads and Campbelltown is approximately 9 miles long. The location satisfies the requirements of the State Planning Authority and meets the demands of economic engineering design. The minimum curve radius on the section is 6,000 feet while a general curve radius of 9,000 feet is typical. The expressway will provide two travel lanes in each direction as well as breakdown lanes. A median strip of 70 feet width will separate the carriageways.

The expressway will provide safe operating conditions for up to 50,000 vehicles per day, which is about three times the present traffic using both the Hume Highway and Main Road No. 177 south of Cross Roads.

The construction of this section of the expressway is expected to cost in the order of $8 million and is programmed for completion by July, 1972. Detailed engineering designs are being prepared to enable construction to commence in 1969.

SYDNEY HARBOUR BRIDGE ACCOUNT

Receipts and Payments for the period 1st July, 1968 to 31st December, 1968

Receipts	$
Road Tolls	2,155,454
Contributions—Railway Passengers	147,629
Omnibus Passengers	13,547
Rent from Properties	65,960
Miscellaneous	..
Loan Borrowings for the Warringah Expressway Approach	300,000
Total Receipts	**$2,682,590**

Payments	
Cost of Collecting Road Tolls	400,707
Maintenance and Minor Improvement	290,795
Alteration to Archways, etc.	1,094
Provision of Traffic Facilities	51,376
Administrative Expenses	14,416
Loan Charges, Payment of Interest Exchange, Management and Flotation Expenses—State Loans	591,140
Interest and Provision for Repayment—Loan Borrowings under section 7 of Sydney Harbour Bridge Administration Act	582,450
Miscellaneous	6,828
Transfers to Expressway Fund	400,000
Total Payments	**$2,338,806**

MAIN ROADS FUND

Receipts and Payments for the period from 1st July, 1968 to 31st December, 1968

	County of Cumberland Main Roads Fund	Country Main Roads Fund
Receipts	$	$
Motor Vehicle Taxation (State)	3,662,649	14,650,596
Charges on Heavy Commercial Goods Vehicles under Road Maintenance (Contribution) Act, 1958 (State)	1,488,440	5,953,760
Commonwealth Aid Roads Act, 1964	2,809,555	10,960,218
Road Transport and Traffic Fund	..	..
From Councils under section 11 of Main Roads Act and/or for Cost of Work	3,679,189	151,988
Other	406,235	393,073
Total Receipts	**$12,046,068**	**$32,109,635**

Payments		
Maintenance and Minor Improvements of Roads and Bridges	2,956,024	8,735,812
Construction and Reconstruction of Roads and Bridges	3,874,073	15,934,222
Land Acquisitions	1,599,335	302,947
Administrative Expenses	1,008,524	1,697,390
Loan Charges, Payment of Interest, Exchange, Management and Flotation Expenses—State Loans	82,500	434,765
Interest and Provision for Repayment of Loan Borrowings under section 42A of the Main Roads Act	321,490	48,095
Miscellaneous*	1,662,195	1,794,413
Total Payments	**$11,504,141**	**$28,947,644**

* Includes transfer to Special Purposes Account, in respect of finance for Operating Accounts, Suspense Accounts and Reserve Accounts.

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $10,000) for Road and Bridge Works were accepted by the Department for the three months ended 31st December, 1968

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
State Highway No. 5	Great Western Highway. City of Blue Mountains. Supply of up to 3,700 tons of ¾ inch and 2,300 tons of ⅜ inch asphaltic concrete to Springwood Deviation.	Bituminous Pavements Pty Ltd	63,460.00
State Highway No. 10	Pacific Highway. Shire of Port Stephens. Supply and delivery of basecourse material between 5.50 miles and 7.75 miles north of Raymond Terrace.	Greentree and McGhan	26,000.00
State Highway No. 10	Pacific Highway. Shire of Port Stephens. Supply and delivery of shoulder gravel between 5.50 miles and 7.75 miles north of Raymond Terrace.	Greentree and McGhan	10,100.00
State Highway No. 13	Woodville Road. Municipality of Bankstown. Construction of overbridge to replace level crossing at Villawood.	Arthur Boyd Constructions Pty Ltd	165,296.15
State Highway No. 17	Newell Highway. Shire of Forbes. Construction of a 9 span prestressed concrete bridge 469 feet long over Lake Forbes at Forbes.	Moy Bros Pty Ltd	247,702.85
State Highway No. 17	Newell Highway. Shire of Boolooroo. Supply and delivery of precast culvert units to reinforced concrete box culvert sites at Tackinbri, Mungle and Mungle Back Creeks between 46.70 miles and 51.90 miles north of Moree.	Monier (N.S.W.) Pty Ltd	18,202.72
State Highways Nos. 7 and 17.	Shires of Gilgandra, Talbragar and Timbrebongie. Bitumen surfacing and resurfacing at various locations.	Shorncliffe Pty Ltd	35,927.30
Trunk Road No. 63	Shire of Yallaroi. Construction of a 5 span steel and reinforced concrete bridge 295 feet long over Warialda Creek at Warialda.	Central Constructions Pty Ltd	135,000.00
Main Road No. 593	Municipality of Randwick. Manufacture, delivery and erection of pretensioned concrete bridge girders for bridge at Epsom Road.	Transbridge Pty Ltd	94,347.00
Western Expressway	City of Penrith. Construction of a 5 span prestressed concrete bridge 1045 feet long over the Nepean River at Regentville.	M. R. Hornibrook (N.S.W.) Pty Ltd	1,454,400.00
	Shire of Wakool. Caretaking and operation for three years, of the ferry over the Murray River at Speewa.	B. J. Coster	14,043.24
	City of Greater Newcastle. Haulage of 200,000 cubic yards of fill material to Stockton approach to bridge over the north arm of the Hunter River at Newcastle.	G. Hawkins and Sons	58,000.00
	City of Greater Newcastle. Delivery of 10,000 tons of rock to the Stockton approach to the bridge over the north arm of the Hunter River at Newcastle.	Blue Metal and Gravel (Newcastle) Pty Ltd	27,900.00

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $10,000) for Road and Bridge Works were accepted by the respective Councils for the three months ended 31st December, 1968.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Abercrombie	Various	Bitumen surfacing and resurfacing on various roads	Emoleum (Aust.) Ltd	11,984.87
Ashford	Various	Bitumen surfacing and resurfacing at various locations	Emoleum (Aust.) Ltd	79,513.83
Berrigan	D.R. 1172	Construction of two, 3 span steel and reinforced concrete bridges each 90 feet long at 4·53 m. and 4·56 m. from Tocumwal.	Danckert Construction Pty Ltd	19,751.83
Boolooroo	Various	Supply and delivery of 2,562 cubic yards of aggregate to various stockpile sites.	Ron Johnstone Pty Ltd	13,320.72
Boolooroo	Various	Bitumen surfacing and resurfacing works at various locations.	Shorncliffe Pty Ltd	33,620.08
Cessnock	M.R. 181	Supply and delivery of up to 14,000 tons of crushed rock between Wollombi and Bucketty.	Kulnura Quarries Pty Ltd	29,700.00
Coolah	D.R. 1304	Construction to compacted subgrade level 10·00 m. to 15·30 m. east of Trunk Road No. 55.	Cec. Swords Pty Ltd	99,826.42
Coolah	D.R. 1304	Bitumen surfacing 0·00 m. to 10·00 m. east of Trunk Road No. 55.	Shorncliffe Pty Ltd	22,041.92
Crookwell	Various	Supply and delivery of 2,742 cubic yards of aggregate to various locations.	R. M. Concrete (Canberra) Pty Ltd	16,233.60
Crookwell	Various	Supply and spray bitumen on 165,309 square yards of pavement.	Allen Bros Pty Ltd	28,994.62
Darling	T.R. 68	Supply and delivery of precast concrete box culvert crown sections between 0·00 m. and 3·00 m. east of Bourke.	Monier Pipe (N.S.W.) Pty Ltd	12,439.20
Goobang	M.R. 350	Bitumen surfacing between 0·90 m. and 5·10 m. north of Trundle.	Allen Bros Pty Ltd	11,727.33
Goobang	M.R. 350	Supply and delivery of reinforced concrete box culvert crown sections at various locations.	Humes Ltd	11,188.80
Jemalong	Various	Loading and hauling of gravel and aggregate during 1969.	Stubbs Transport Co.	14,000.00 (approx.).
Jemalong	Various	Bitumen surfacing and resurfacing at various locations	Allen Bros (Asphalting Contractors) Pty Ltd	31,632.45
Lachlan	M.R. 231	Supply and delivery of aggregate to stockpiles	Western Blue Metal Pty Ltd	16,105.30
Lachlan	T.R. 57, M.R. 231.	Bitumen surfacing at various locations	Allen Bros (Asphalting Contractors) Pty Ltd	27,555.49
Lyndhurst	Various	Supply and delivery of aggregate to various locations	Western Blue Metal Pty Ltd	16,175.21
Lyndhurst	Various	Bitumen surfacing at various locations	Emoleum (Aust.) Ltd	42,568.52
McIntyre	M.R.'s 134, 135 & 137.	Bitumen surfacing and resurfacing at various locations	Emoleum (Aust.) Ltd	15,923.68
Port Stephens	M.R. 301	Construction of a 2 span prestressed concrete bridge 60 feet long to replace Taylors Bridge, 0·20 m. from Woodville.	Central Constructions Pty Ltd	21,000.00
Timbrebongie	T.R. 89	Bitumen surfacing between 10·10 m. and 14·10 m. south of Narromine.	Shorncliffe Pty Ltd	11,653.84
Wakool	M.R. 319	Construction of a 6 span steel and reinforced concrete bridge 316 feet long over the Edward River at Patterson Street, Moulamein.	Moy Bros Pty Ltd	97,535.16
Waugoola	T.R. 56	Construction of a 3 span steel and reinforced concrete bridge 135 feet long over Kangarooby Creek near Gooloogong.	A. Cipolla & Co	43,887.00
Waugoola	Various	Bitumen surfacing and resurfacing at various locations	Boral Road Services Pty Ltd	66,521.84
Windouran	S.H. 21	Construction of a 3 span steel and reinforced concrete bridge 170 feet long over Billabong Creek at Wanganella.	Danckert Constructions Pty Ltd	70,829.10
Wyong	M.R.'s 335, 509	Supply and laying of up to 1,890 tons of asphaltic concrete at various locations.	Bituminous Pavements Pty Ltd	22,585.00