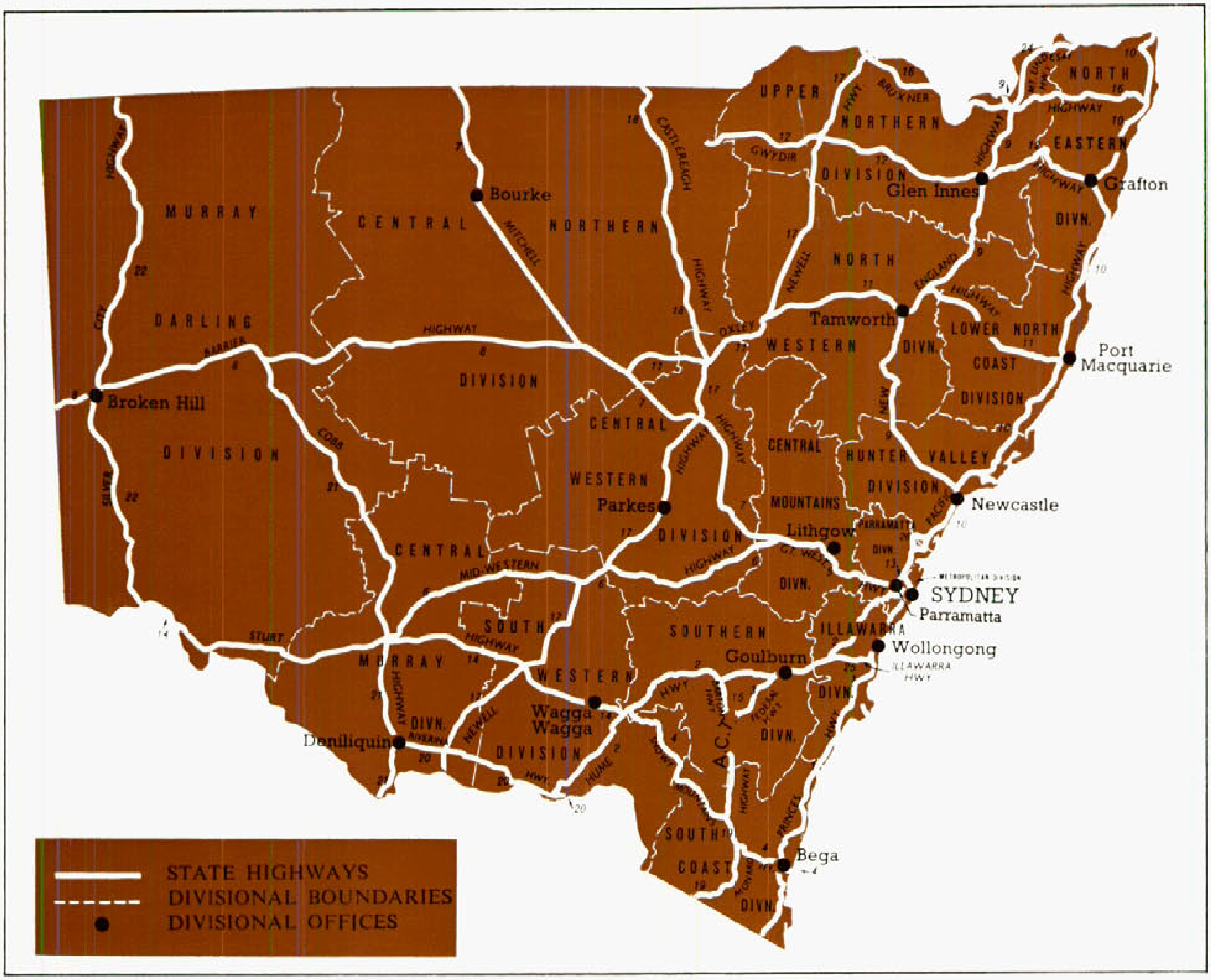
MAIN ROADS

DECEMBER 1975



New South Wales

Area—801 428 *km*²

Population as at 30*th June*, 1975—4 793 200 (*estimated*)

Length of Public Roads—208 804 *km*

Number of Motor Vehicles registered as at 30*th June*, 1975—2 171 900*

** "This figure has been obtained from the Australian Bureau of Statistics. It should be noted that, due to the exclusion of certain categories of vehicles (such as tractors and trailers), etc., this figure is considerably lower than the statistics published prior to December, 1974, which were obtained from the New South Wales Department of Motor Transport."*

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

Lengths of Main, Tourist, and Developmental Roads, as at 30th June, 1975.

Freeways	91
State Highways	10 492
Trunk Roads	7 081
Ordinary Main Roads	18 316
Secondary Roads	287
Tourist Roads	400
Developmental Roads	3 642
Unclassified Roads	2 477
TOTAL	42 786 km

MAIN ROADS

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64 TENDERS ACCEPTED BY COUNCILS

Front Cover:

Top: Looking east from the City towards the western entrance of the Kings Cross Road Tunnel and the Victoria Street overpass.

Below left: The pedestrian overbridge near Roslyn Street.

Right: Lighting inside the tunnel.

Below: View showing the approaches to the eastern portal of the road tunnel, with extensive tree-planting in the wide median. The Eastern Suburbs Railway Line emerges from its own tunnel in the background.

PROOF OF THE PUDDING

Another Christmas has come and gone. Although we are a long way from the northern hemisphere's colder climate, we still hold on tenaciously to the traditional trimmings associated with their festive period. Cards picture unseasonal snow and unfamiliar architecture—shop windows are framed with spray-on snowflakes—and, no matter how hot the weather, we indulge in the sort of excessive feasting which would be more appropriate on cooler days or winter nights. Old habits die hard and in spite of more summer salads by the beach, steaming hot puddings (with a sprig of Christmas bush stuck on top) are still a Christmas favourite.

The proverb says "*The proof of the pudding is in the eating*", but its popularity on the plate is obviously dependent on the variety of ingredients that initially go into the mixing bowl. The main thing is what is put in, and what proportions, and how well it is mixed, rather than how it is served up. The same can be said of this Journal "Main Roads" which could be irreverently regarded as the Department's "*pudding*".

It has always been a difficult task choosing the ingredients to make each issue as *appetising* as possible. Reader's tastes vary so much—some look for involved technical articles, some skim over technical terms seeking more readily understandable items, some like history, some are attracted by colour illustrations, some are primarily interested in roads, others in bridges, some look for economic aspects, some focus immediately on country news, others are more concerned with urban matters. Over a period, every endeavour is made to mix in something to satisfy all these different interests.

It is, of course, not always possible to include the wide variety of subjects which have gone into this particular issue but it gives a good example of the type of *recipe* we like to follow. The *ingredients* include an appropriate measure of road construction (Pacific Highway), bridge construction (Bega), tunnel construction (Kings Cross), flood damage repairs (Hume Highway), history (Hartley) and equipment (automatic trimmer spreader), together with a stir of the transport question ("Who Goes Where—How, When and Why?") and a dash of flowers (Orange Works Office).

Having chosen the ingredients and mixed them all together, we don't often have the opportunity to gauge our readers' reactions—so we would be pleased to receive comments from you, at any time, about the content or style of "Main Roads". We can always add a few different ingredients to give our "*pudding*" a wider appeal.●

KINGS CROSS ROAD TUNNEL

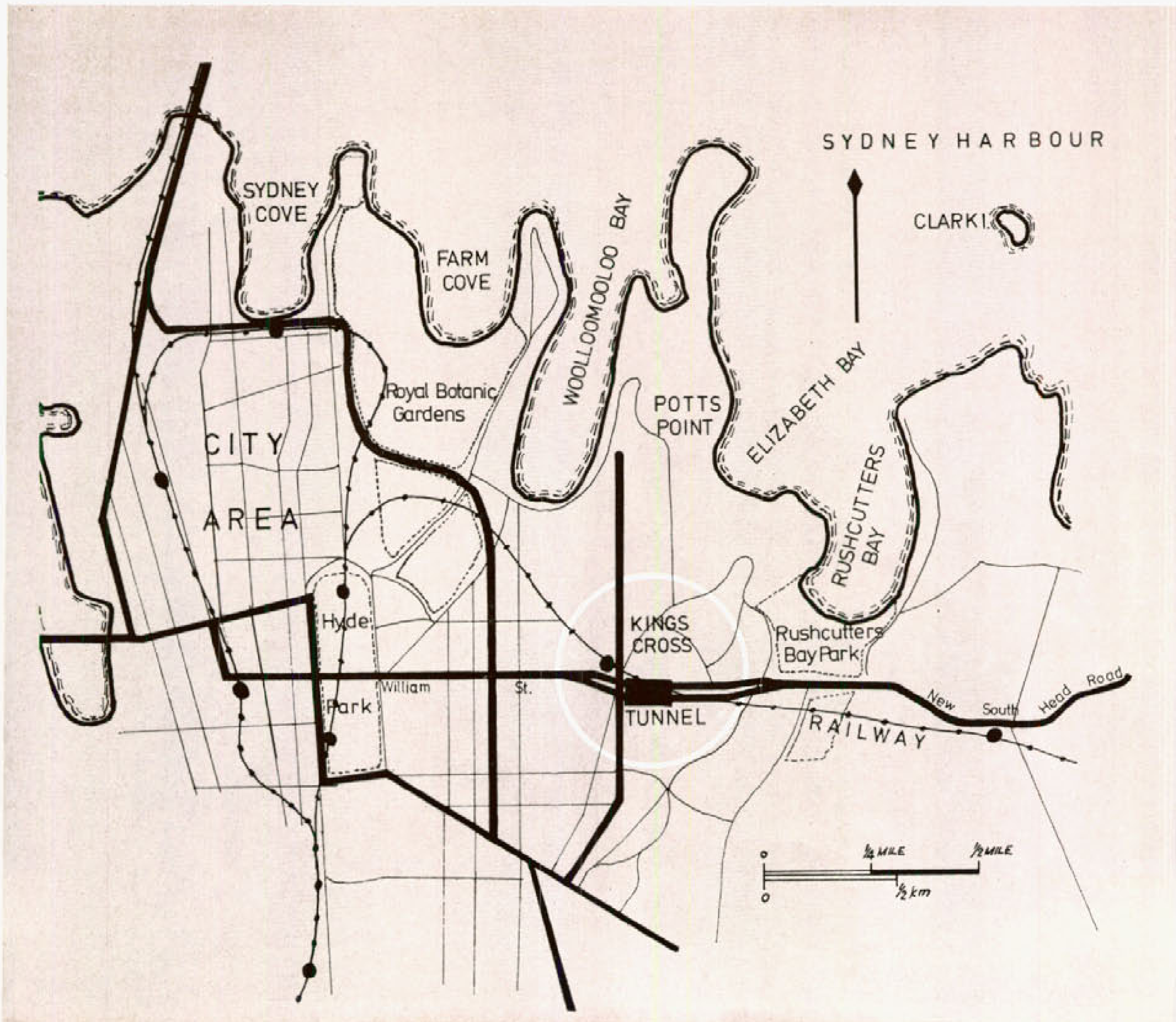
Kings Cross is a happening place. It has been variously described as Sydney's bohemian centre, its cosmopolitan centre, its night spot area, a tourist attraction, in fact it has something for everyone. It also had a major traffic problem.

However on Monday, 15th December, 1975 when the Premier of New South Wales, the Hon. T. L. Lewis, M.L.A. officially opened the Kings Cross Road Tunnel to traffic and led a motorcade through the work from east to west, through traffic was taken out of The Cross and the traffic problem was considerably eased.

Inside the tunnel, dual carriageways in separate tunnel cells each carry two lanes of traffic and a continuous break-down lane. The two tunnel cells are each 11·54 metres wide and 4·9 metres high between the roadway pavement and the ceiling line.

Bridges at each end of the tunnel form the portals and carry cross-traffic over the through traffic in the tunnel. The eastern portal bridge is at Craigend Place and was constructed under contract by R. M. & B. Coceancig at a cost of approximately $80,000. The western portal bridge is at Victoria Street and

(continued on page 36)



OPENS TO TRAFFIC

(Above): The view from above the eastern portal of the tunnel looking towards Edgecliff includes the pedestrian overbridge near Roslyn Street and some of the landscaping and tree planting on this approach to the tunnel.

(Below): At the opposite end of the tunnel the view west follows William Street into the commercial heart of the city.

As the trees in this carefully planned landscaped area mature they will provide a green oasis in an otherwise densely populated urban area.

was built by the Department because of the need for stage construction to maintain satisfactory traffic arrangements in the area.

The tunnel was constructed by contract but the Department's own forces were used to construct the approaches and make adjustments to the local surface streets made necessary by the construction of the tunnel complex.

Construction of the Tunnel by Contract

The contract for the construction of the road tunnel was awarded to Pearson Bridge (N.S.W.) Pty Ltd on 28th May, 1973 for the tendered price of $1,974,873. Work began on 19th June, 1973 with the bulk excavation for the sandstone cutting which contains the sides and bottom of the tunnel shell.

Construction details of the work performed under contract are:

Bulk Excavation of the Sandstone

Excavation was carried out by trenching with jackpicks and ripping with a dozer. No major problems were encountered during the excavation and by January, 1974 the bulk of the material had been excavated.

During excavation some vertical cracks parallel to the face occurred in the rock berm making it necessary to stabilise the rock face with rock bolts. The release of the restraint when the rock was excavated for the tunnel resulted in minor outward movement of the vertical rock face in a few isolated areas so that some trimming back of the rock was required.

Construction of Development Columns

At a future date, the air space above the tunnel will be used for property development. Columns and footings were constructed, as part of the project, to accommodate this proposal. Excavation for the columns was carried out concurrently with the bulk excavation. The footings for some of the columns were excavated by undercutting the rock face.

A number of footings required lowering below the design levels to eliminate soft seams and to obtain the necessary bearing to conform with Local Government building requirements.

Some development columns consist of two or three individual columns 12 mm apart and are based on a common footing. Rather than pour each column separately polystyrene sandwiched between two sheets of "Galvabond", was used to separate the columns and double and triple columns were constructed in one operation.

Above the roof of the tunnel, three rows of galvanised iron caps mark the top of the columns which will be utilized when the air space development takes place.

Sidewalls of the Tunnel

The sidewalls were designed to be cast-in-place concrete with corrugated iron against rock to take natural seepage away from the wall. However the construction method adopted involved horizontally pre-casting each sidewall panel on site and anchoring it on steel formwork designed to take the weight of the wall during erection. The form was hinged by steel pins at the ends nearer the sidewall position, to two vertical members which were adjustable in height. The vertical members were bolted in set positions to concrete pads.

When the steam cured wall section achieved a strength of 15 mPA it was lifted to near vertical by a crane. Final erection of the wall section was effected by using a retracting hydraulic ram.

The wall was then temporarily anchored to the rock berm and on the following day the form was released from the wall section, moved to the next position and the construction process repeated.

Inconsistency of the mortar bedding on which the wall sections were erected resulted in variations to the final height of the wall. Movement of the mounting pins or protrusions in the rock face also moved the wall out of alignment so creating difficulties in the alignment of the wall linings in some areas.

Sidewalls under Craigend Place Bridge and Victoria Street Bridge were constructed in reinforced masonry blocks because the available headroom under the bridges restricted the use of cranes to erect the precast panels.

Centrewall of the Tunnel

The centrewall is of cellular construction and the design provided for variable cell sizes. However, as steel forms were used, cell sizes were standardised. Where centre development columns occur, the centrewall is constructed around the columns but remains independent of them.

The centrewalls under Victoria Street Bridge and Craigend Place Bridge were constructed in reinforced masonry blocks because, once again, the available headroom under the bridges restricted the use of cranes to lift the formwork.

Tunnel Roof

The roof of the tunnel consists of precast concrete beams and girders with in-situ concrete infills between members.

The precast members were cast by E.P.M. Concrete Pty Ltd at Blacktown and transported to the site where they were placed in position by cranes.

Roadworks in the Tunnel

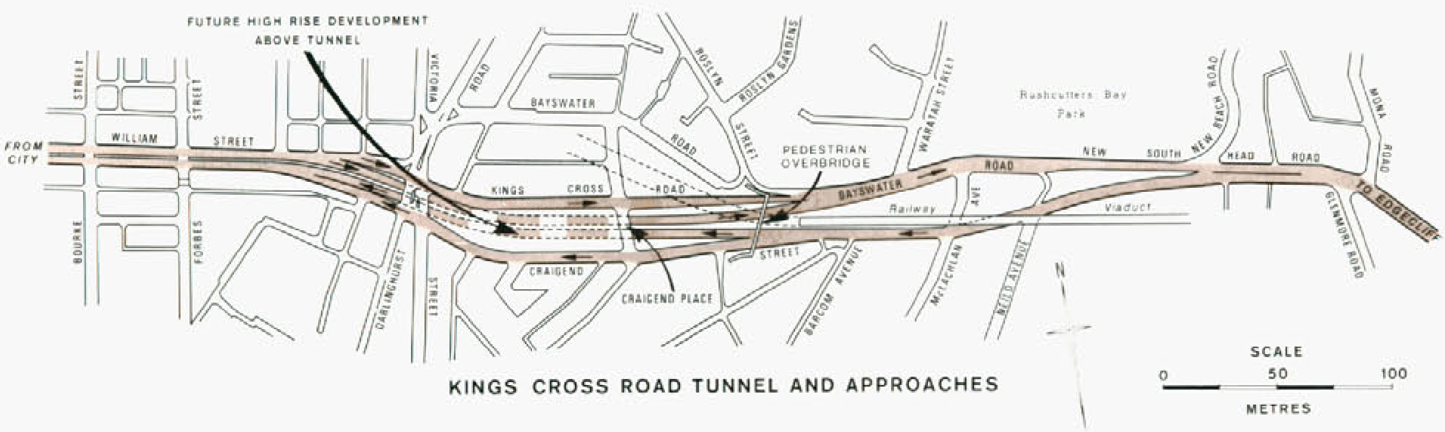
Difficulties were experienced in the compaction of the subgrade in some areas because of seepage through faults in the rock.

Tunnel wall lining

The tunnel walls are lined with an asbestos cement sheet wall cladding. There were minor difficulties in maintaining alignment of the asbestos cement sheeting where the sidewall sections were misaligned during erection, as referred to earlier.

Tunnel ceiling lining

Work on lining the ceiling began in June, 1974 and continued until the week before the tunnel was opened. Progress of ceiling wiring had to be co-ordinated



KINGS CROSS ROAD TUNNEL AND APPROACHES

with the progress of tunnel lantern installation which was virtually the last work to be completed.

Tunnel lighting

In the design of the work, consideration was given to the construction of a sun-screen over each tunnel entrance to lessen the effect on motorists of a sudden change from full sunlight to tunnel lighting. However, the high level of lighting provided in the tunnel made sunscreens unnecessary. Four rows of fluorescent and sodium lights illuminate each tunnel cell and in the event of a power failure there are 34 incandescent battery operated emergency guidance lights which switch on automatically. To counteract glare from the rising and setting sun, the levels of illumination are co-ordinated in the interior and at the thresholds of the tunnels.

CONSTRUCTION OF APPROACHES AND RECONSTRUCTION OF LOCAL SURFACE STREETS

The western tunnel approach from William Street was constructed entirely by the Department and was carried out in stages to ensure that traffic was adequately catered for, particularly in the "peak" periods. In respect of each stage, there was prior consultation with other bodies concerned with the movement and control of traffic on roads and agreement reached on the method of control.

The work included the construction of major concrete retaining walls on the approach roads, earthworks, the provision of a concrete base course and asphaltic concrete pavement.

A major portion of the earthworks in the eastern tunnel approach was included in the contract for the tunnel. However, the pavement base preparation and construction of the concrete base course and asphaltic concrete pavement were carried out by the Department.

Both the immediate western and eastern approaches to the tunnel are dual carriageways and each pavement is 7·6 metres wide with a 1·5 metre wide concrete shoulder. There is a variable width central median.

Major reconstruction of surface roads including William Street, Craigend Street, New South Head Road and Kings Cross Road was necessary. In each case multi-stage work was necessary to ensure that access was available to business development fronting these roads and that the new levels conformed to the existing local street system.

In William Street, old tram tracks embedded in concrete 0·6 metres thick were encountered. This created a minor construction delay because of the need to use a large drop hammer to break up the concrete before the tram tracks could be removed.

To enable pedestrians to cross the eastern approaches to the tunnel, a prestressed and reinforced concrete foot-bridge, 115·8 metres long, from Roslyn Street on the north side to Oswald Lane on the south, was also constructed by the Department's organisation.

Extensive landscaping of the approaches to the tunnel were put in hand as the work progressed. Lawns and garden areas have been developed on the medians and on the batter faces and to this date some 430 trees have been planted.

COST

The estimated cost of the entire project is $21·3 million which includes $13·1 million for the acquisition of land and $8·2 million for construction. A total of 118 properties were involved in the acquisition.●

Four out of seven: *Present at the opening ceremony for the Kings Cross Road Tunnel were four of the seven men who have held the position of Commissioner for Main Roads, New South Wales and whose terms of office reach back over twenty-two years. They are Mr H. M. Sherrard* (19*th August*, 1953 *to* 19*th April*, 1962, *second from left*), *Mr J. A. L. Shaw*, (20*th April*, 1962 *to* 25*th August*, 1967, *far left*), *Mr R. J. S. Thomas* (26*th August*, 1967 *to* 25*th August*, 1974, *second from right*). *The present Commissioner for Main Roads, Mr A. F. Schmidt* (*centre*) *who took up office on* 26*th August*, 1974 *is the seventh Commissioner for Main Roads. Mr B. J. Sexton, Assistant Commissioner for Main Roads is on the right.*

Hume Highway Repairs

Above: New asphaltic concrete surface 70 km south of Goulburn.

Exceptionally high rainfall throughout New South Wales in 1974 made that year one of the wettest in recent times. The damage caused by these weather conditions particularly affected the Hume Highway. The first repairs became necessary in April, 1974 but rain continued through the winter months and intensified in July and August. By then, much of the country through which the highway passes was water-logged. As the weakened sub-grades and pavement of the Hume Highway continued to carry the usual high volume of heavy trucks, sections of the road were once again extensively damaged. Floodwaters which crossed the highway at a number of locations during 1974 also contributed to the damage of embankments and pavement.

The rain eased in November, 1974 and was generally back to its normal level in January, 1975. However, the country through which the Hume Highway passes remained water-logged at many locations well into the early months of 1975.

PAVEMENT PROBLEMS

When much of the Hume Highway was originally paved many years ago, its construction was on an 8·5 metre wide formation with a 6·1 metre wide pavement. The material used in the pavement was obtained, in general, from nearby naturally occurring surface deposits of gravel. The pavement wearing surface in some places remained a single coat flush seal consisting of a bitumen layer only about 5 mm thick, topped with crushed stone. At other locations, subsequent reseals over the years had added to the thickness of the pavement. During the excessively wet weather described above the thin bitumen surface proved to be inadequate and, when continuously subjected to the passage of heavy vehicles, it deteriorated rapidly.

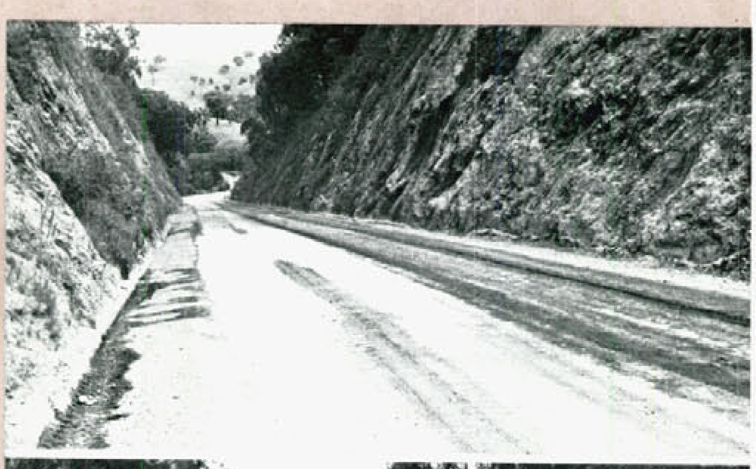
As water tables rose, general failure occurred in the sub-grades as well as in the pavement along many sections of the road, particularly where natural drainage was poor. This was characterised by depressions, potholes and the *craze*

Before and after

The following series of photographs show sections of the Hume Highway in their damaged condition, during late 1974, and compares them with recent photographs of the repaired highway at the same locations.

1

2



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4

Figures 1, 2: Comparative photographs taken about 2·4 km south of Gundagai show the high quality of repair work carried out on the highway, including the provision of better drainage facilities.

Figures 3, 4: These views were taken looking south through a cutting, approximately 20 km south of Gundagai.

cracking of large areas of the bituminous surface.

While heavy rain continued to fall, little permanent restoration work could proceed. However, the Department's workmen filled the potholes in the road and generally assisted traffic to move.

AN UNCOMPLAINING WORKFORCE

The following extract from a recent report by the Department's Works Engineer at Yass illustrates the difficulties which were encountered in carrying out work under conditions of almost continuous rainfall.

"*A general problem encountered in undertaking restoration work during rain was that before a patch could be filled, it was necessary first to bail or sweep water from the hole to a depth of up to* 75 *mm. A trafficable surface was maintained but only through the sustained, uncomplaining efforts of the workforce who frequently worked* 10 *hours a day for* 12 *days each fortnight.*

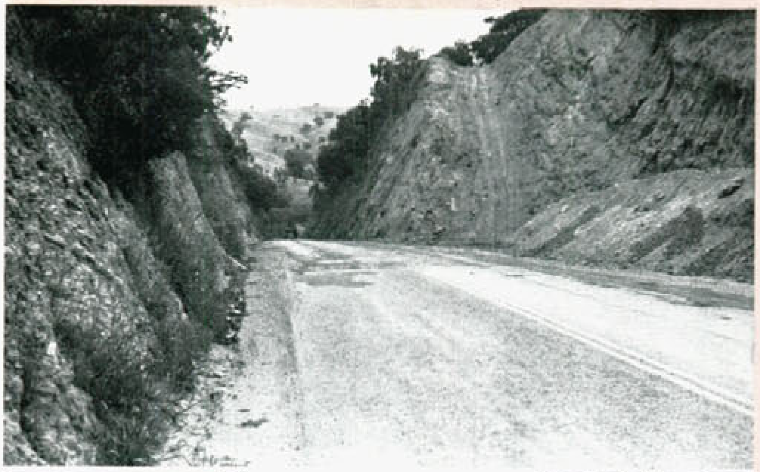
Just as the worst of the storm damage appeared to be in hand, closure of the highway would occur again and the additional damage caused would also need attention.

In the latter part of October, 1974, *the Hume Highway was closed both by flooding and a landslide at the same time. It was necessary to clear the landslide at night in pouring rain.*

The damage sustained after flooding was never immediately evident. The Highway was closed as soon as the water level rose to the edge of the road shoulder. However, many trucks and some cars ignored the barriers, flashing lights and signs, and continued to drive over the flood covered pavement. The trucks caused

Figures 5, 6: Another comparison at the cutting 20 km south of Gundagai where the road surface almost completely disintegrated during the very wet conditions. Widening at this location on the western edge of the road (right hand side in photographs) is underway to further improve travelling conditions.

Figures 7, 8: The patched pavement, 33 km south of Gundagai, has been resurfaced and widened.



5

6

Before and after

7

8

severe damage to the totally saturated pavement and the cars often became stranded. This involved tired men having to assist stranded motorists from a situation which the workmen had erected barriers to prevent. In one case this involved a foreman standing in waist deep water passing written instructions to a deaf and dumb motorist.

By late November, 1974 the situation was becoming more manageable and major drain deepening and pavement resealing programmes were commenced in conjunction with the patching programmes. Even though the occurrence of rain and subsequent flooding was decreasing, the entire countryside was totally saturated and the only means of lowering the water table in the highway formation was to substantially deepen the silted-up open drains.

The rise in the water table was so severe in the Gundagai area that a 10 000 gallon underground petrol storage tank started to float even though concreted into place."

GETTING INTO ACTION

Departmental engineers inspected the highway and prepared a programme of repair work late in 1974. The cost of the programme was expected to be $2,928,000. It was designed to lower the level of ground water under and in the vicinity of the highway formation, strengthen weakened areas of pavement, repair shoulders and restore the edges of the carriageway, and provide a waterproof surface throughout. Sections of the pavement were checked for deflection using the Benkelmen Beam and where this showed adequate strength, the surfaces were programmed for strengthening and sealing with asphaltic concrete, wherever available funds and the time schedule permitted.

9

10

11

Figure 9: Extensive edge failure occurred at 30·5 km south of Goulburn.

Figure 10: Patched section at the approach to Jugiong Creek shows further pavement failure from prolonged wet weather and constant heavy traffic.

Figure 11: Completed dual carriageway construction 3 to 9·3 km south of Holbrook, looking south. The construction of dual carriageways along the route of the Hume Highway in New South Wales is an important aspect of the Department's work on this highway.

During normal conditions, approximately 75 per cent of Departmental employees working on the Hume Highway are involved in construction of new lengths of highway and about 25 per cent on routine maintenance activities. Small gangs of about four men patrol lengths of the highway over distances of about 30 km, carrying out minor repairs to the pavement, its shoulders and the roadside furniture. These gangs have the equipment and the special knowledge to carry out a large variety of the tasks needing attention each day. Where problems are encountered which require more men and heavier equipment, the work is programmed for attention by other gangs which have such capacity.

In July and August, 1974, it became obvious that the existing mode of operations could not maintain the highway satisfactorily under the extreme conditions then prevailing. Action was then taken to cease all new construction activities along the route of the highway, except for some work on the South Western Freeway (F5), and the routine maintenance gangs were reinforced with men and equipment from the construction activities so that the task of restoring the highway could be intensified. The work had to proceed quickly during the summer months as the highway had to be in a satisfactory condition to withstand normal rainfall during the winter of 1975.

WHAT WAS DONE

Strengthening of long lengths of the highway pavement began in December, 1974. Where the pavement had been badly damaged, tests were carried out to determine the additional thickness of pavement needed to provide a satisfactory surface for traffic and adequate cover on the subgrade.

In many cases the quality of naturally occurring gravel available locally was not satisfactory for a bitumen surface or had characteristics which made it susceptible to damage by water. The gravel in these cases was stabilized using quicklime (CaO). The pavement was widened during strengthening to 6·7 metres and the formation width to 11 metres wherever possible. A length of 24 km of this class of work was completed on the Hume Highway from December, 1974 to the end of June, 1975.

On sections of highway where the bearing tests had indicated that the pavement was in a satisfactory condition and the route of the highway was unlikely to be changed for some years, arrangements were made to add an asphaltic concrete surface sealing and strengthening course. The amount of work which could be treated in this fashion was limited by the funds and time available to carry out the work.

The asphaltic concrete was supplied and laid on contract by Pioneer Aust. Pty Ltd and by the Department's own asphalt plant. Up to June, 1975, 60 km of asphaltic concrete surfacing had been completed and the work has continued during the latter half of 1975.

The clean up after the "*big wet*" in 1974 showed that a long length of the thin bitumen surface on the highway was no longer acting as a waterproofing layer and sections which had potholed were uneven. It was therefore considered to be essential that the whole length of the highway which was damaged by rain and flooding in 1974 should be repaired by patching and then resealed with bitumen during the summer of 1974–75. From December, 1974 to the end of June, 1975, 270 km of resealing was carried out on the Hume Highway. In carrying out this work, the Department used 2 750 000 litres of R90 bitumen and 27 000 tonnes of crushed stone.

A CONTINUING TASK

The work which was commenced during the first half of 1975 has been continued and the Department has in progress work on many sections of the road where a wider and stronger pavement with greatly improved drainage will be provided so that the problems and holdups to traffic which occurred in 1974 will be less likely to happen in the future.

Action is also being taken to progressively raise low-lying sections of the highway so that they will be above flood level. The construction of the new bridge over the Murrumbidgee River at Gundagai is now well advanced and tenders have already been invited for the construction of the bridge at Comatawa Creek (4 km south of Tarcutta). Plans are being finalised for new structures at Keajura, McIntyres and Kilgowlah Creeks (10 to 13 km south of Tarcutta) where frequent holdups occurred during flooding in 1974 and 1975.

Recently, the Commonwealth Minister for Transport announced that investigations undertaken by the Australian Bureau of Roads had confirmed the opinion held by this Department that economic, environmental and social considerations favour the location of the Goulburn–Albury section of the National Highway between Sydney and Melbourne in the vicinity of the existing Hume Highway. This means that the firm planning for major deviations of the highway around known trouble spots can now proceed.

Other major construction work which will relieve traffic conditions on the Hume Highway includes the extension of the South Western Freeway from the Campbelltown–Camden Road (Main Road No. 178) to Yanderra, Yerrinbool, and Aylmerton. It is anticipated that most through traffic will use this freeway when it is completed, in preference to the Hume Highway.

THE PRESENT AND THE FUTURE

Along the route of the highway itself, major construction is now in progress, or is to be commenced during 1975–76, at the following locations:

- From Apps Corner to Picton 75·3 to 81 km from Sydney—reconstruction, realignment and provision of a climbing lane.
- Between Uringalla Creek and Exeter Road 39 to 54 km north of Goulburn —reconstruction of the highway on improved alignment with dual carriageways.
- On the northern approach to Goulburn — construction of dual carriageways between 1·9 and 2·9 km north of Goulburn, including:

  Construction of a new four-lane bridge over Mulwaree Ponds, to replace the old Fitzroy Bridge.

  Construction of a new four-lane bridge over the Main Southern Railway Line at North Goulburn.

  Construction of a new four-lane bridge over the Crookwell Railway Line at North Goulburn.
- Over Fish River 42·2 km north of Yass —construction of a new bridge and approaches.
- Over the Yass River at Yass—construction of new flood-free bridge.
- Over Derringullen Creek 7 km south of Yass—construction of a new bridge.
- Between 6·4 and 12 km south of Yass construction of dual carriageways.
- At Connors Creek 35 km south of Yass —construction of new bridge and approaches.
- At Gundagai—construction of a new bridge over the Murrumbidgee River. This work includes the construction of a deviation around the town of Gundagai and an interchange structure for entrance and exit from Gundagai. (See more on page 57 of this issue.)
- Between Jugiong and the Tarcutta Range—strengthening, improvements to drainage and widening of the formation on selected sections of the highway.
- Between 4 km and 13 km south of Tarcutta—construction of bridges over Comatawa, Keajura, McIntyres and Kilgowlah Creeks.
- Between 12 and 20 km north of Holbrook—asphaltic concrete surfacing of both carriageways of the Highway.
- Over the Main South Railway Line at Ettamogah 12 km north of Albury—construction of a new bridge (now completed, see page 56 of this issue).
- Between 5·1 and 12·5 km north of Albury—reconstruction.●

Articles on the Hume Highway which have appeared recently in "Main Roads" include:

—*Report on Construction of Dua Carriageways. March*, 1974; *Vol.* 39, *No.* 2, *pp.* 88–91.

—*Camden Deviation. December*, 1974; *Vol.* 40, *No.* 2, *p.* 53.

—*Schedule of Restoration Work. December*, 1974; *Vol.* 40, *No.* 2, *pp.* 62–3.

Hartley, situated on the Great Western Highway (State Highway No. 5), 10.9 km east of Lithgow, is an old town by Australian standards, having first been settled in 1815.

In recognition of its historical value, it was gazetted as an Historic Site on 18th October, 1972. Historic Sites are areas that are the sites of buildings, objects, monuments or events of national significance. Some subsequent gazettal has occurred to enlarge the Hartley Historic Site which is under the control of the National Parks and Wildlife Service.

Apart from the important historical connotations of its early settlement, the town contains several fine old buildings of significance to historians and which demand preservation in the interest of our national heritage.

At nearby Hartley Vale and Little Hartley other old buildings dating from the early years of settlement west of the Blue Mountains further contribute to the value of the whole area as a focal point for historians and tourists.

The decision to construct a new bridge over the Lett River just west of Hartley brought an opportunity to deviate the Great Western Highway away from the town and leave its old buildings in relative peace, as they were a century ago. The new Lett River bridge and associated deviation does not encroach on the historical nature of the town and in fact improves its position in that regard because highway traffic no longer rumbles directly through it. Naturally, the new road and bridgeworks provide better travelling conditions for through traffic using the Great Western Highway in that locality.

The new bridge and deviation were opened to traffic on 16th December, 1975, to meet the needs of Christmas holiday travellers. A few aspects of the work still required completion at the time of opening. At present, Main Road No. 253, which leads to Jenolan Caves, has a temporary connection to the deviation and this will be used for a few months until the planned connection is completed a little further to the east.

The length of Great Western Highway which previously ran through Hartley is to be re-proclaimed as part of Main Road No. 253. The narrow timber beam bridge replaced by the new structure will remain in use as part of this road.

The deviation is 1·7 km long and its construction includes a four cell reinforced concrete box culvert 37 metres long over Boxes Creek, a tributary of the Lett River.

The flood-free reinforced concrete bridge over the Lett River was designed by the Department and is 61 metres long and 8·5 metres wide between kerbs. It was constructed for the Department by Simon-Carves Pty Ltd of North Sydney. The final cost of the bridge is approximately $165,000, while the cost of approach works when fully completed is expected to be about $786,000.

Hartley

NEW BRIDGE AND DEVIATION FOR HISTORIC AREA

SETTLEMENT AT HARTLEY

William Cox's road crossed the Blue Mountains in 1815 and it appears that later that year government stockmen and private individuals established camps in the Hartley area.

Individual settlement was not encouraged at first because the government wanted to retain the good grazing land for its own stock. The first permanent settler in the Hartley district was Irishman John Grant who was granted land and in 1819 built Moyne Farm a few kilometres from the present township.

More settlers were attracted after the town of Hartley was laid out and established between 1836 and 1838. The survey of the proposed village beside the Lett River Bridge was initially carried out by Assistant-Surveyor Butler and a village of 16 streets was then planned by Deputy Surveyor-General Samuel Perry. In the immediately following years, many new landholders moved into the vicinity of the town, although it was never fully developed in accordance with the original plan.

Communications had improved by then, with the completion in 1836 of Sir Thomas Mitchell's road over the Blue Mountains to Bathurst. This roadwork resulted in a better descent down Mount Victoria and the definite establishment of Hartley as a centre on the western route, which gave it an assurance of prosperity from the passing trade. The discoveries of gold further west contributed to the development of Hartley as a busy thriving centre during the 1850's and 1860's. Mining nearby for kerosene shale in the 1860's further boosted activity in the town. F. F. Bailliere's New South Wales Gazetteer of 1866 includes a detailed description of the shale mining and notes that the population of Hartley was then about 150. The number of dwellings was about 30. When the railway from Sydney was extended to Mount Victoria in 1868 and to Lithgow in 1877 it brought an end to Hartley's more active and prosperous period. With the loss of passing trade, Hartley went into a form of "retirement". The coming of motor transport never really resulted in any revival of development in the town, but the new bridge and deviation will now bring benefits to the historic old buildings by allowing them to remain in a more tranquil setting to remind us of a never-to-be-repeated era.

HISTORIC BUILDINGS IN HARTLEY

Hartley Court House

Completed in 1837 from a design by the Government Architect Mortimer Lewis, the Court House quickly became a major centre of activity. The cells were added to the building in 1840 at a cost of £33, and they were in constant use for the detention of cattle duffers, bushrangers and other wrongdoers. The Court House was used for auctions of confiscated goods as well as the more regular judicial activities. It was closed in 1887 and saw brief use as a private residence before the site was reserved for public recreation in 1914.

More information about the Court House can be found in "Early Australian Architects and Their Work" by Morton Herman.

The Anglican Church of St John the Evangelist

The corner stone of this church was laid on 21st April, 1858 and the first service in the newly-completed building was conducted by Rev. John Troughton on 27th February, 1859. Earlier Anglican services had been held in the Court House since mid-1850. On 15th September, 1864, the Church was consecrated by Bishop Barker of Bathurst.

Although the internal fittings of the Church are original, the exterior has seen some changes and the church doorway was originally on the other side of the building.

The Royal Hotel

Only slight alterations have been made to the exterior of this hotel, originally built in 1846. The first licensee was James Nairn who called it the "Hartley Hotel". For some time in the 1850's it was used as an Anglican Rectory and Hartley's first school classes were conducted at the rear of the building. It soon reverted to being a hotel, which it remained for the following 80 years until 1945 when it became a private residence.

The Old Inns

As well as the Royal Hotel, Hartley boasts two notable old inns. Probably the earlier of the two is the *Shamrock Inn* built in 1841 by Patrick Phillips who held the license until 1869. The passing years have brought little change to the original external structure of the Shamrock Inn.

The *Farmers' Inn* was built in the 1850's by John Finn, a member of a family which was prominent for early settling and building in the area. Following its initial use as a private residence, it was opened as an inn in 1861. The license lapsed in 1879 and was taken up by Robert McGarry for his Royal Hotel. Minor changes to the original exterior include the repositioning of a door and the enclosure of a verandah.

Hartley's inns must have witnessed many riotous evenings during their active years. Being on the main route between Sydney and Bathurst, and a staging post for vehicles carrying gold bullion and supplies, as well as a convenient place for overnight accommodation, the town was a magnet for all kinds of travellers.

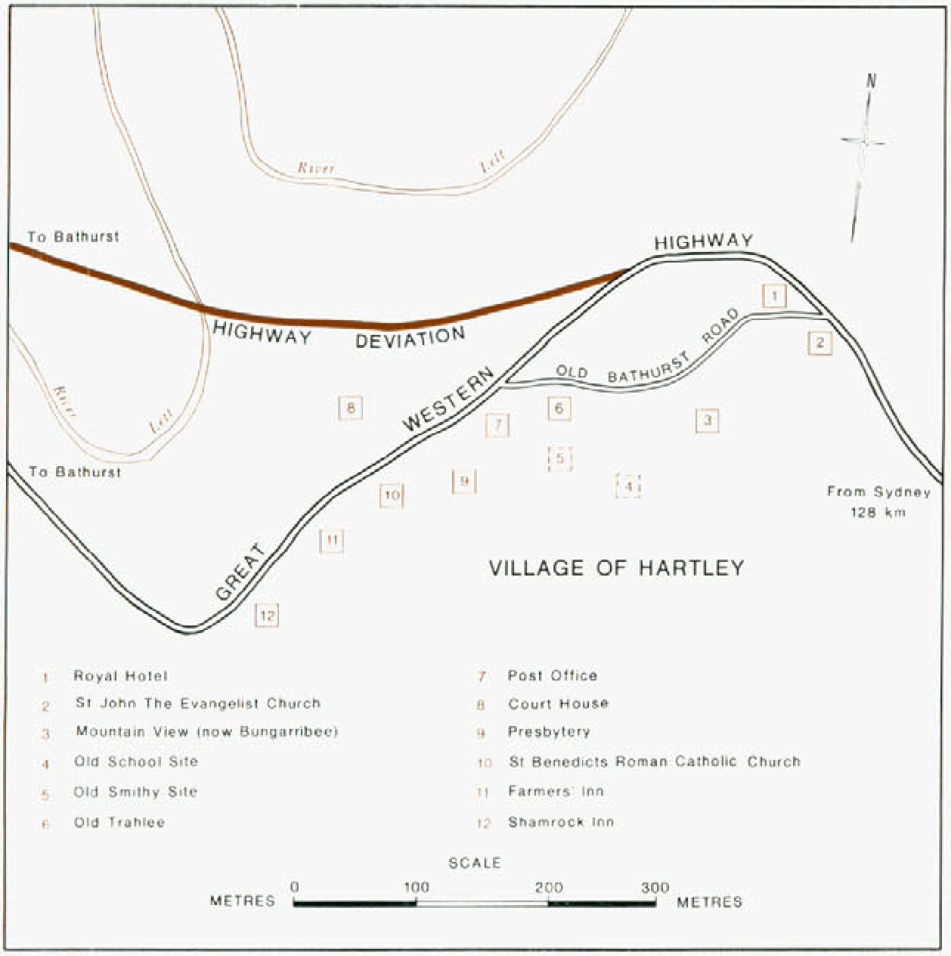
Other buildings of interest at Hartley (see locations on map) include:

St Benedict's Roman Catholic Church, dating from 1842 and constructed with sandstone

(Left): Two views of the completed bridge over the Lett River.

Two photographs from the Holtermann Collection taken in 1871 depict the Post Office at Hartley (top centre) and the Roman Catholic Presbytery (below centre). *(Reproduced by courtesy of the Mitchell Library, Sydney.)*

Some of Hartley's old buildings are in good order, such as the Anglican Church of St John the Evangelist (top right), while others such as the Shamrock Inn (below right) are showing their age and need attention.



walls approximately 600 mm thick. The pews and prayer stools are of red cedar and an outstanding feature is the altar, probably convict-carved, of white and grey sandstone which has been given the appearance of unpolished marble;

The Roman Catholic Presbytery, also dating from 1842 and which, apart from the removal of roofing shingles, has had few alterations;

The Post Office, probably the oldest remaining one in New South Wales, where business has been conducted since 1849; and "Old Trahlee" which was built in 1859 by the Morris family and has always been a private residence.

The School which served the district for many years and the Blacksmith's Shop no longer stand and only their former sites are recorded.

* * *

It is hoped that the new highway deviation will bring more popularity and more tourists to this lovely township by allowing sightseers to wander freely and inspect its many interesting sites without the danger or frustration of having to dodge impatient fast-moving through vehicles. There is much restoration to be done but Hartley can now look forward to enhancing its heritage of old buildings and developing its historical and tourist attractions, unhindered by traffic.●

* * *

Colour photographs of the Court House, the Royal Hotel and Farmers' Inn appear on the back cover of this issue. Much of the information used in the preparation of this article was based on material from the National Trust of Australia (N.S.W.), the booklet entitled "The Story of Hartley and its Historic Court-House" by W. C. Foster, W. L. Havard and B. T. Dowd, published in 1937 by Blaxland Shire Council, and an article entitled "Hartley—The Gateway to the West" by W. C. Foster, published in the Journal of the Royal Australian Historical Society, Vol. 18, Pt. 5, 1932, pp. 209–45.

GARDEN IN BLOOM

AT ORANGE WORKS OFFICE

It is not usual to think of roadworkers as being garden-lovers. The following news may come, in fact, as a surprise to some of our readers and may help to erase any misconceptions about the capabilities and enthusiasm of the men on the road for adding a touch of colour to our world.

Since 1970, flowers, mostly roses from the garden at the Department's Works Office at Orange have been entered at annual shows conducted by the Orange and District Horticultural Society. Awards received have included 19 firsts, 18 seconds and one very highly commended.

As well as entries for individual flowers and groups of flowers, the entire garden has been entered in "The Sydney Morning Herald" annual garden competition. In 1971 and 1972 the garden was highly commended in the western zone of that competition. The Cryptomeria trees along the southern fence form one of the best groups of trees of one species in Orange.

The garden was first laid out in 1965 by maintenance labourer, Mr Eric Whittaker, who planted the trees on the southern and western sides of the depot and was initially responsible for the roses. Since March, 1970, the upkeep of the garden has been in the hands of Mr Walter Tuddenham, a maintenance labourer employed at Orange, who gives a great deal of his own time in arranging entries and exhibits for the various flower shows and garden competitions. Over the years Mr Tuddenham (with the approval and co-operation of successive Works Engineers) has made several alterations to the garden and planted new trees and shrubs to enhance the beauty of the grounds.

The colour photographs on the page opposite were taken in late Spring when the garden is seen at its best.

The city of Orange is 267 km west of Sydney on the Mitchell Highway (State Highway No. 7) and it is the fifth-largest rural city in New South Wales. The city itself has a population of about 25 000 and the district 50 000. The city's population is expected to increase dramatically as the plans for the State's first Growth Centre (at Bathurst-Orange) are implemented.

Orange is renowned as one of Australia's most fertile fruitgrowing, mixed-farming and fat-lamb raising areas. It is widely known for its cherries, pears, plums, peaches, grapes, and of course, those sweet juicy apples (the Orange district produces two-thirds of the State's annual apple crop). But, as the Department of Tourism's leaflet states, "*Orange, always renowned for its beauty, is perhaps best epitomized in the lovely private gardens and public parks, especially Cook Park with its many trees from distant parts of the world . . .* ". Cook Park's attractions also include special-effect coloured lighting, from dusk until midnight and a Begonia Conservatory which features its famous blooms at their loveliest from February to May. Situated 8 km south of Orange on the Pinnacle Road, Campbell's Corner has more than 200 varieties of cold-climate trees and shrubs from 20 countries. The blaze of autumn tonings from March to May each year makes this roadside beauty-spot a joy to botanist, photographer and garden-lover, alike.

* * *

The Department's Works Office at Orange is one of two Departmental Works Offices in the Central Western Division (the other is at Dubbo). It was established late in 1964 on the commencement of a programme for major reconstruction of sections of the Mitchell Highway between Bathurst and Dubbo. In addition to works on an 110 km length of the Mitchell Highway, the Orange Works Office controls road and bridge works on the Mid Western Highway for a length of 71 km west of Bathurst.

The Works Office is currently responsible for the expenditure of approximately $1·8 million annually and employs approximately 90 people from the city and surrounding areas.

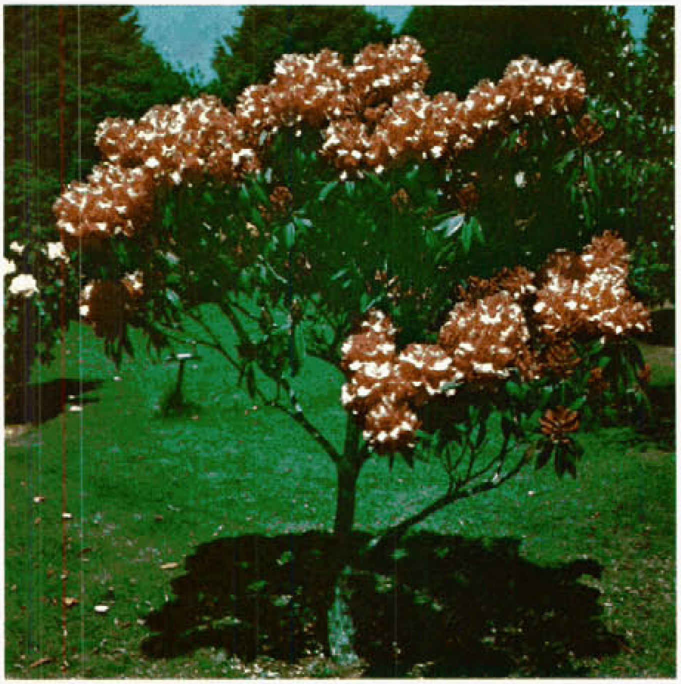
A feature of recent construction work undertaken from the Orange Works Office has been the newly completed deviation around the historic town of Carcoar on the Mid Western Highway, about 50 km west of Bathurst. The March 1975 issue of "Main Roads" (Vol. 40, No. 3, pp. 76–9) gives an account of this project under the title "Highway Deviation at Carcoar Historic Site".

Proposals for the location of a traffic relief route to the north and east of Orange were reported in an article entitled "A Programme for Traffic Relief —Orange" in the June 1973 issue of "Main Roads" (Vol. 38, No. 4, pp. 121–3).●

The garden has attractions beside roses — such as the deep pink rhododendron bush (below) and hundreds of ground covering plants, including gazania daisies (at right).

(Above): Under the intense blue skies of Spring on the Mid Western Plains, roses burst into profuse bloom.

(Below): From any angle, a glorious sight, as a dozen blooms vie for beauty honours on one rose bush.



(Right): Blooms like this yellow rose have contributed to the array of prizes won by the garden.

MOVI

The operator's cabin contains the control console with fingertip switches and levers by which the operator can monitor automatic operation of the machine and also exercise manual control where desired.

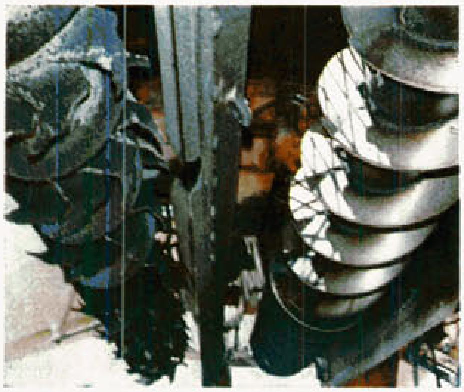
Since the Department purchased its first dual lane automatic trimmer spreader in 1970*, a further two trimmer spreaders (a dual lane and a single lane unit) have been acquired. These machines have been placed in service on Freeway and Main Road projects where their high capacity and precision can be fully utilised.

Part of the efficiency of these versatile machines results from their mobility. They can be quickly and conveniently disassembled, loaded onto semi-trailers and transported to a new location. Once there the machines can be reassembled ready for action in about two hours. They can first be serviced if necessary, and then connected through the automatic sensors to the stringlines for automated level and steering control.

* *See December, 1970 issue, Vol. 36 No. 2, pp. 34-5.*

With the flick of a switch the operator can raise the mainframe high enough for loading onto a semi-trailer.

The semi-trailer backs under the trimmer spreader which is then lowered onto timbers placed on the bed of the trailer.



This unusual view beneath the machine shows the four main working components. They consist of (from left to right) a cutter-auger, a mouldboard, an auger and an aft mouldboard, all of which can be raised or lowered and fixed within the mainframe to an accuracy of 3 mm.

A MOBILE MARVEL

A trimmer spreader laying two lanes of asphalt at the same time in a single operation. The machine can be converted for asphalt paving by the installation of gas heated vibratory screeds on the rear of the mainframe.

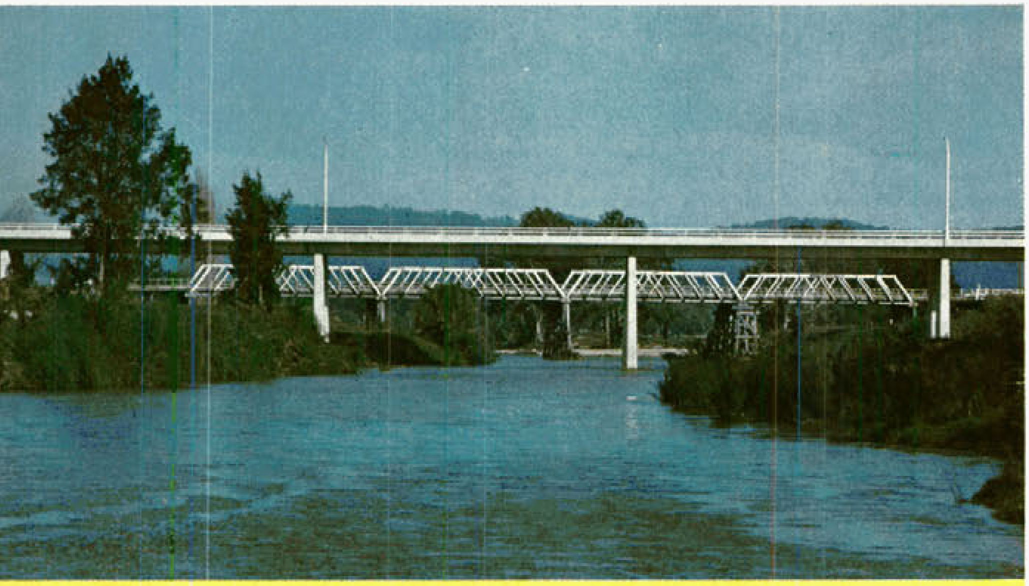
For travel on public roads, the pin-connected legs are removed and loaded onto a second semi-trailer using any lifting device capable of hoisting in excess of 4 tonnes. A 5 tonne full-slewing crane is generally preferred for this operation.

A crew of 4 men and a crane can have the machine disassembled and loaded for highway travel in two hours. Trimmer spreaders have been freely moved between the Western, South Western and Southern Freeway projects to gain maximum utilisation and efficiency.

For travel over short distances on Freeway construction works, the legs can be raised and the machine transported without disassembly.

An aerial view of a dual lane trimmer spreader undertaking pavement work on the Western Freeway between Prospect and Regentville, not long after acquisition.

Beautiful Bega has a new Bridge



(Above): The new Bega bridge highlights the elegance and simplicity of modern bridge design in contrast to the old fashioned timber truss construction.

(Above, right): The old bridge at Bega had a difficult life, having to cope with numerous floods during its 77 years of service. In February, 1971, for example, flood waters rose to the level of the cross girders which protrude over the edge of the deck. Several years ago it was also necessary to construct supports around some of the piers after they were damaged by repeated flooding. (Above, left): A good example of past bridge building techniques on timber truss bridges is this pier support at the end of one of the main trusses of the old Bega bridge.

(Left): The prosperous Bega Valley is a well-known beauty spot which every year attracts thousands of visitors who stay at Bega or pass through on their way to other pleasant holiday centres on the South Coast. The Bega Co-operative Society's factory is featured in this view.

Opening Ceremony

The new bridge over the Bega River at Bega was opened to traffic by the then Minister for Transport and Highways, the Hon. Wal Fife, M.L.A., on Monday, 29th September, 1975.

Situated on a new deviation of the Princes Highway, the bridge is located 183 metres upstream from the previous bridge, a 77-year old structure which is being demolished. Design of the new bridge was undertaken by the Department and construction was carried out by Peter Verheul Pty Ltd. The cost of the bridge was \$1·57 million.

Associated roadworks, giving a much improved alignment of the northern approach to Bega, have cost a further \$1·5 million. These roadworks were constructed by the Department's own forces, attached to the Bega Works Office.

Bega and District

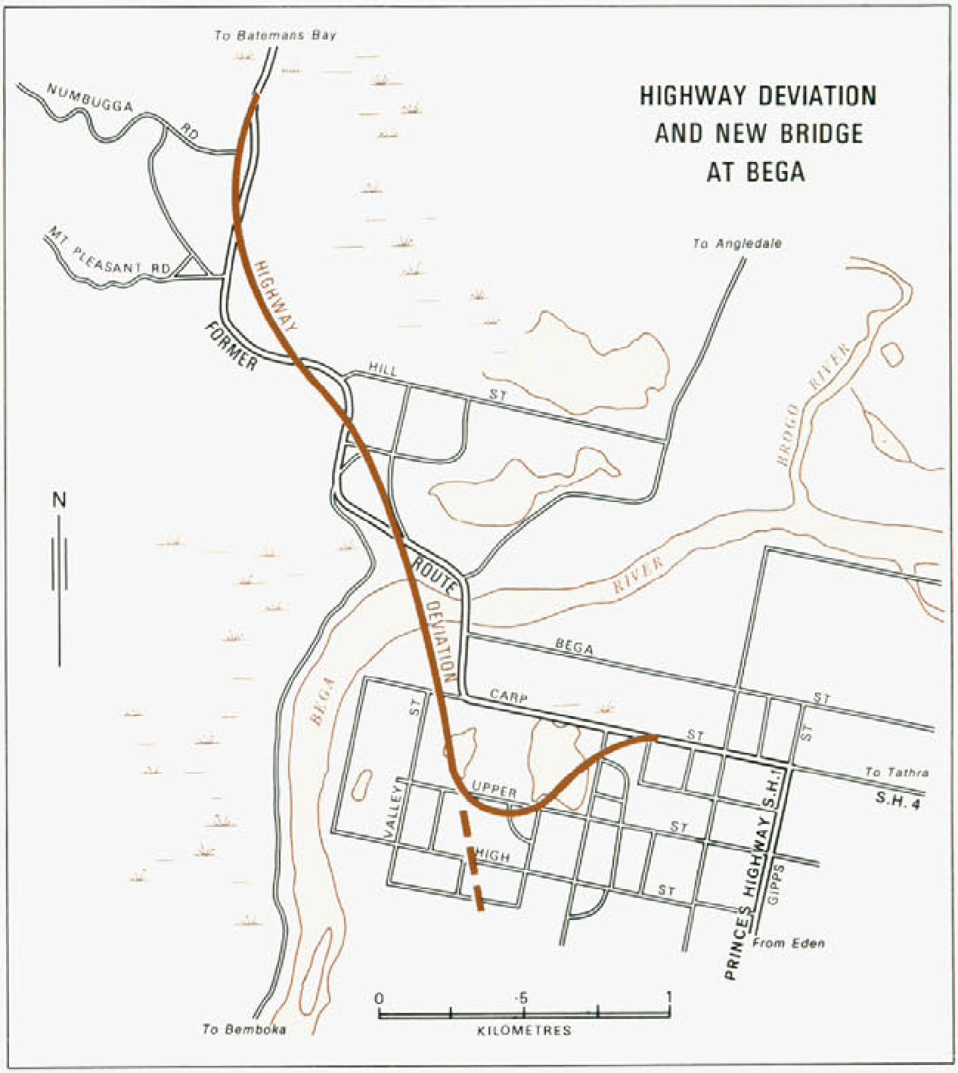
Bega is a *road town*. It depends on road transport completely as its nearest railway link is 111 km away at Cooma and its closest airport is 40 km away at Merimbula. (The South Coast Railway Line stops short at Bomaderry, near Nowra, 270 km north of Bega.)

The importance of Bega's road communications is heightened by the fact that it is a thriving commercial town, the centre of a prosperous dairying district and virtually the *heart* of the South Coast's tourist attractions.

Dairy produce is the Bega Valley's greatest income earner. While the number of dairies in the region has decreased since the 1930's, overall production has tripled and the present marketing district reaches from Moruya in the north to the Victorian border in the south. When butter began to lose its potential in the early 1960's, Bega found a vast new market for milk in Canberra and Queanbeyan.

The maximum daily supply to these cities is now up to 40 000 gallons. Cheese manufacture has gained impetus in recent years and the Bega Co-operative Society's factory is now the largest single manufacturer of cheese in New South Wales.

As Bega is dependent on road access, great inconvenience and disruption has been caused to business in the town whenever the old bridge over the Bega River and its approaches have been cut by floodwaters. The southern approach to the old bridge has been blocked by floods with increasing frequency in recent years, one reason for this being that the bed level of the Bega River has been slowly rising due to the depositing of alluvial sands. The new bridge and approaches now give flood-free access to Bega from the north.



Design of New Bridge

The new bridge is a 624-metre long reinforced and prestressed concrete structure having a clearance of 1·2 metres above the highest known flood level (February, 1971). The bridge extends across the river and continues for almost the full width of the flood plain. It is the sixth longest road bridge in New South Wales (after Sydney Harbour Bridge and the bridges at Camden, Stockton, Gundagai and Harwood). There are twenty-one 27·4 metre spans and two 23·1 metre end spans of twin prestressed concrete box girders supported on reinforced concrete twin tapered column piers and spill-through abutments. The carriageway is 8·5 metres wide between kerbs with a 1·5 metre wide footway on the downstream side.

Features of Construction

Among the construction features in this major work was the driving down to rock formations of 118 steel universal bearing piles, with a total length of 2 596 metres. The concrete encasement of the tops of these piles and the construction of thirty 0·690 metre diameter cast in place piles, with a total length of 165 metres, was also noteworthy.

Two reinforced concrete abutments and 22 piers were additional features of the construction as well as the supply and erection of 546 precast concrete segments.

The concreting of the joints between these segments was carried out when they were in place. The contract for the bridge also included the supply and stressing of the prestressing tendons in the twin box girders. Final construction activities included the construction of the cast-in-place concrete deck slabs and crash barriers, and the manufacture and positioning of handrails and lamp standards.

The contract for the construction of the bridge did not include the supply of the steel universal bearing piles. These were obtained by the Department from The Broken Hill Proprietary Co. Ltd before the major contract was let and were supplied to the contractor (Peter Verheul Pty Ltd) in an effort to obviate possible delays from the non-availability of the piles at short notice.

Foundations

The bridge design was based on foundation bores which indicated that the bridge site crossed a sunken valley in granite bedrock filled with alluvial sand and with sandy clay towards each end of the bridge. The design provided for all piers and abutments to be supported on steel piles driven to rock with concrete encasement at the top. While test piles were being driven, however, it became apparent that steel piles would not drive to an acceptable depth through the material, which had been described as "*orange-brown sandy clay with quartz pebbles*". Additional bores revealed that this material was a weathered granite rock.

As a result of these investigations, it became necessary to replace the steel piles at the north and south abutments and at two piers at the north end and at one pier at the south end. The replacements were cast-in-place reinforced concrete piles, 0·690 metres in diameter, which were socketted into the rock.

To construct the cast-in-place piles, a 6 mm thick permanent steel casing, reinforced to 22 mm thick at the toe, was driven as deeply as possible. Soft material was then excavated from inside the casing using truck-mounted auger.

The rock sockets were excavated by raising and dropping a 3 tonne star drill to break up the rock, or by jack-picking. The depth of the rock sockets was 0·9 metres but this was reduced where very hard fresh granite was encountered.

The excavated shaft then had a reinforcement cage lowered into it and concrete placed through a tremie tube. Where water occurred in a pile shaft, concrete with a slump of 180 mm was used, to ensure that the flow of concrete through the tremie tube went smoothly to displace the water and that the concrete was not dropped through water.

The remainder of the piles comprised driven steel 356 mm x 368 mm universal bearing piles. To drive these, a Delmag D22 diesel hammer was used, operating on a leader hung from an NCK Pennine crawler crane. The rated energy output of the hammer was 54 000 joules. The piles were driven to refusal on rock with a final penetration of not more than 25 mm per 24 blows. The maximum length of pile which could be pitched was 16·8 metres. For greater lengths, a splice was made with a full penetration butt weld over the whole cross section of the pile. The longest pile was approximately 32 metres.

All the piles and pile caps were placed below ground level and to prevent the possibility of corrosion near the tops of the steel piles (where fresh water charged with oxygen might be flowing under the sand), the design allowed for the top 4·6 metres of the steel piles to be encased in reinforced concrete. To carry out this operation, a 1·2 metre diameter, 6·1 metre long temporary steel casing surrounding the pile, was sunk by high pressure water jetting and driving. The toe of the casing was sunk to 1·5 metres below the required level for the bottom of the encasement.

The sand inside the casing was removed by pumping out the water-sand mixture. A temporary steel casing, 4·6 metres long, with an expendable base plate and a 4·9 metre long permanent light steel former, both 0·7 metres in diameter, were positioned inside the outer casing. The reinforcement cage was positioned, and the encasement concrete was placed in water by tremie. After the temporary casings were withdrawn, the space around the encasement was backfilled with sand.

The pile caps for eight out of the 22 piers are below the normal water table. Nature assisted their construction by producing an unusually dry spell of weather during the first year of construction, which resulted in a lowering of the water table. However, to enable these pile caps to be constructed in complete dryness, the water table in the sand around the pile caps was further lowered mechanically, by as much as 1·5 metres, using various combinations of pumps, well-points and sumps.

(Above): The bridge reaches out span by span over the main channel of the river.

(Left): Looking marooned in the swirling waters of the swollen river, piers await their turn to support the girders for the deck slab.

The same set of formwork with steel walings and studs, supporting plastic line plywood, was used for the concreting of the pile caps on all piers except Pier 12 (see below).

Piers

Each of the 22 piers features two tapered reinforced concrete columns. There are four different heights of piers but all pier columns, except those at Pier 12, have the same shape and dimensions at the top and the same taper. The tallest pier columns are 10 metres high and were concreted in two lifts. All other columns up to 7·6 metres high were poured in one lift.

Pier 12, a short pier near the centre of the bridge, is the anchor pier to which the superstructure is fixed longitudinally. Expansion bearings permit relative movement between the superstructure and the other piers. The columns at Pier 12 are thicker and more heavily reinforced than at the other piers.

Conventional timber walings and studs supporting plastic coated plywood were used for the formwork of the Pier 12 columns.

Superstructure

Twin prestressed concrete box girders with cast-in-place reinforced concrete sections form the superstructure and complete the deck slab, as well as forming the parapet walls for the barrier kerbs.

The box girders consist of precast concrete segments, generally 2·3 metres long, 1·2 metres deep on their centrelines with a bottom slab width of 2·4 metres and a top slab width of 4·6 metres. The top and bottom slabs are generally 180 mm and 150 mm thick, respectively, and the webs are generally 220 mm thick. At special locations, these thicknesses are greater, such as in pier segments and anchorage segments.

Individual segment weights vary from 7·1 to 14·7 tonnes, the normal segment weighing 10·2 tonnes. Ducts were cast into the webs to allow the prestressing cables to be pulled into the girders. Reinforcement steel was projected from the segments for bonding with cast-in-place slabs and parapets.

The contractor first considered casting the segments at the site but later decided to use his existing Sydney casting yard. The routine was for segments to be cast in the afternoon, steam cured overnight, and the next morning, (provided that the concrete had attained a compressive strength in excess of 31 MPa), the segments were lifted from the steel moulds ready for the one day casting cycle to recommence. The segments were then transported to Bega by road.

The design required the girders to be erected and stressed in span lengths, commencing at the anchor pier in the middle of the bridge and proceeding in either or both directions—provided that the resultant horizontal force on each column of Pier 12 (due to expansion and contraction of the constructed girders) did not exceed 490 kN.

Because the southern half of the bridge crosses the almost level flood plain, while the northern half crosses the river and the sloping bank, construction of the girders at the south end progressed more quickly and they were all completed while there were still several spans of girders remaining to be completed at the northern end.

Mobile cranes were used to lift the precast concrete segments from the ground onto the steel and timber falsework. The cranes stood on temporary embankments constructed over the main channel when they were lifting segments there. Gaps of 110 mm were left between the segments for in-place concrete joints which were correctly aligned and set to predetermined levels.

The falsework comprised two universal beams under each box girder, supported by universal columns, with bracing to prevent sideways movement. The falsework columns were founded on reinforced concrete pad footings except in the sandy beds of the river channels where there could have been a danger of scouring under the footings, if a flood occurred. In the river bed, temporary timber piles were driven to support the falsework.

The falsework could not be fixed to the piers as this would have caused powerful horizontal forces (due to temperature and prestress movements of the girders) to be applied to piers which had not been designed for such forces. The falsework supporting the span under construction was therefore fixed to the completed girder and moved with it, so preventing damage to the jointing concrete between the unstressed segments. Sufficient falsework was provided for the simultaneous construction of one span of the twin box girders at each end of the bridge.

Generally, the in-place concrete for this bridge was 21 MPa and 28 MPa ready-mixed concrete containing crushed gravel from the Brogo River, 20 km north.

However, when the 42 MPa concrete was tested for use in the joints between the segments, trial mixes containing Brogo River crushed gravel did not give the specified target compressive strength. After further trial mixes were tested, approval was given for the contractor to use 10 mm crushed aggregate supplied from Canberra. The 42 MPa joint concrete was weight-batched and mixed on site in a pan-type mixer.

The stressing cables were made up on site from coils of strand, and pulled into the ducts in the segment webs. The ducts were made continuous and mortar-tight across the gaps. The joints were formed up using re-usable steel forms with plywood linings for the exposed surfaces, and were then concreted. The expansion bearings to support the box girders were positioned and concreted at the same time as the joints between the segments.

When the concrete in the joints had attained a compressive strength of 35 MPa, the new span length of girders, which cantilevered 7·6 metres into the next span, was stressed. In summer, the joint concrete reached the required transfer strength after 4 to 5 days. However, in the cold winter weather, this time increased to about 7 days. As it was desired to stress as soon as possible, the time to reach the required transfer strength during winter was successfully reduced to between 4 and 5 days by the use of high early strength portland cement instead of normal portland cement. Moisture curing was maintained until the joint concrete had attained the specified transfer strength.

There are four cables in each girder, each consisting of fourteen 15·2 metre diameter super grade stress-releaved strands for internal spans and twelve 15·2 metre strands for the end spans. The jacking force in each cable was 2 713 kN and 2 246 kN for internal spans and end spans respectively. The cables for each new length of girder overlapped the cables of the completed girder by one segment length.

Thus two sets of cables were anchored at the opposite ends of the end segment of each stage. These anchorage segments have 610 mm thick webs and the projection of the inside edges of the adjoining segment webs accommodate the heavy cable anchorages.

To protect the cables against corrosion, the cable ducts were filled with grout within 24 hours of stressing. The removal of the falsework commenced on the day after grouting so that it could be erected for the next span.

Concrete deck pours of 13·7 metre lengths were made for the infill slab between the box girders for the footway and for the barrier kerbs. First of all, the 13·7 metre lengths in the middle of spans on each side of a pier were poured, and then the 13·7 metre length over the pier. To control cracking due to differential shrinkage between the new in-place concrete and the much older precast concrete in the segments, contraction joints at 6·85 metre intervals as well as additional reinforcement, were provided.

The only expansion joints in the superstructure are at each abutment. The carriageway expansion joints consist of steel finger plates between the moving ends of the girders and the fixed abutments. The expansion bearings have to provide for estimated temperature movements of ± 76 mm as well as long term shortening due to shrinkage and creep.

A three flight reinforced concrete stairway supported on reinforced concrete friction piles is provided to connect the bridge footway to Carp Street below. Because the bridge superstructure moves longitudinally, there is a small gap between the stairway and the superstructure.

The steel crash railings, handrailing, lamp standards and expansion joints were fabricated by the contractor at his Sydney works. The shop protective treatment, consisting of the application of a minimum dry film thickness of 75 microns of inorganic zinc silicate primer, was done by a sub-contractor, Mayne Irvine Pty Ltd.

The field protective treatment consisted of minimum dry film thicknesses of 75 microns of chlorinated rubber high build intermediate coat and 50 microns of chlorinated rubber finish coat. The colour of the finish coat on the lamp standards and crash railings is white and on the grille-type footway handrailing it is a "natural gold" colour.

Both the carriageway and the footway are paved with asphaltic concrete. Before the asphaltic concrete was placed, all the surfaces of in-place concrete which were to be covered by it were coated with bitumen-rubber latex emulsion to seal any cracks against water penetration.●

The daylight roads of the Bega District

Bega's early roads were strictly *daylight* roads. Those foolhardy enough to venture onto their frightful surfaces at night had to pay the consequences in damaged vehicles or miserable dark hours spent waiting for rivers to drop or for cart wheels to be extracted from bogs and ruts.

The first settlers entered the Bega Valley in 1829, and were followed during the 1830's by an influx of cattlemen and their stock from the drought-affected Braidwood District. The population gradually grew and in 1851 a township was laid out at North Bega. Repeated flooding there forced removal of the town south to higher ground.

FROM TRACKS TO ROADS

Communications with the outside world were very limited at first and relied heavily on ships coming to Twofold Bay and Tathra and the subsequent conveyance of mail and goods to Bega along rough tracks. Mails also came from the west on horseback through the Monaro Range.

In 1857, a road was constructed from Bega to Tathra at private expense. A few years later the government constructed a road from Moruya to Bega. There was also a road to the South about this time and travellers from Merimbula to Bega could take advantage of its weekly eight-horse waggon service. The Merimbula road was apparently in such poor condition that travellers are reported to have frequently walked the distance in preference to experiencing a "*rough and tumble*" waggon ride. Many years later the route of that road and of the northern road to Moruya were to approximate the route of the Princes Highway.

Criticisms of Bega's roads during the mid-1800's clearly show what conditions were like. A settler named Alexander Weatherhead contributes this picture of the road from Wyndham to Bega in the early 1840's.

"*I saw a man mending some of the worst places by putting bushes in the holes and then covering them with earth so that it looked better till a heavy load came along. One always expects to see things better as they come towards a town, in that I was not disappointed, at least I saw that they had a different way of filling up the bog holes. There was then a nasty hole on the south side where Frog's Hollow bridge is now, when I got there the hole was filled up, not with bushes, but with a dead bullock, a worker I suppose, it appeared to fill the hole nicely.*"

The road from Moruya to Bega occasioned a similarly critical observation from the "Moruya Examiner" in 1875, when it was claimed that "*the Bishop of Goulburn had to travel in his carriage escorted by a body of armed attendants, that is armed with axes to clear the way*".

In December, 1877, the "Bega Gazette" contained a short description of the road southeast of Tathra.

"*The Tathra Road—Many portions of this highway, one of the most important and frequented in the district are in a dangerous condition. It is at considerable risk that a drive to the port can be undertaken. Ruts, holes and blind stumps abound. In some parts where the foundation of the road consists of logs, these logs have caught fire, and, as they burn, the superincumbent earth cracks and falls destroying the roadway*".

In wet weather, the roads to and from Bega became almost impassable. The following extract from the "Bega Gazette", September, 1880, describes the road southwest to Candelo during heavy rains.

"*The main line of road connecting the two important most towns in the electorate of Eden (Bega and Candelo) to be eminently dangerous to ordinary traffic. In wet weather a man is forced to get out of his trap and quietly lead his horse*".

BRIDGING THE RIVERS

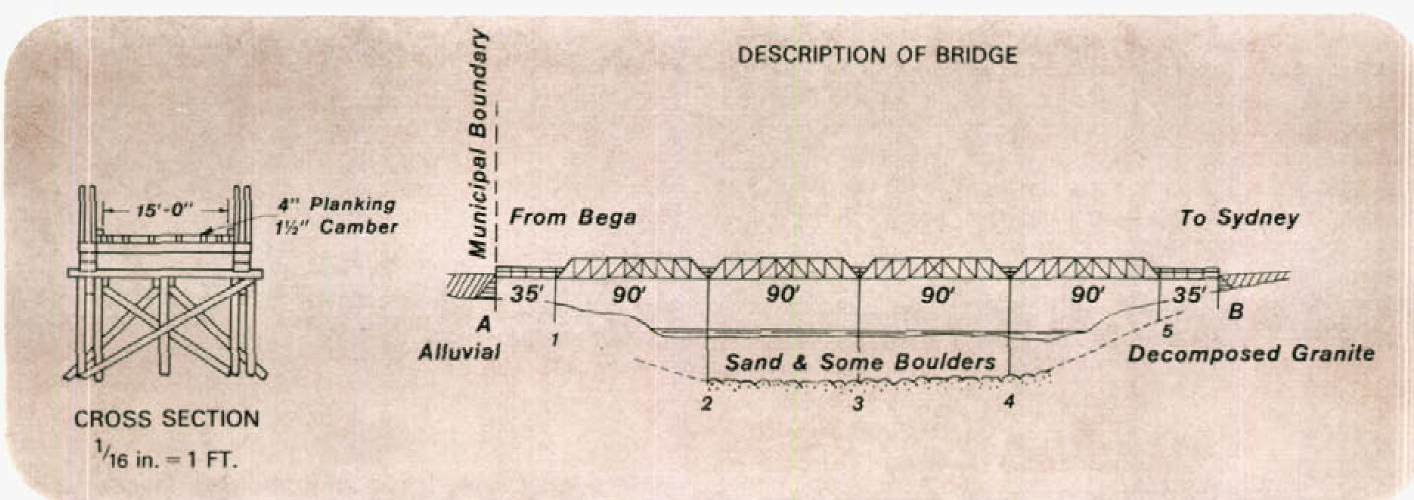
The lack of bridges in the district at this time also posed severe problems. It was a common occurrence for men and beasts of burden to be bogged down in water crossings. A quotation from the "Bega Gazette" of 1871 again describes the scene.

"*A day or two ago (a lady) saw a heavily-ladden bullock team crossing the Bega River. Notwithstanding a liberal dose of whip, and a horrible stream of lurid profanity from the driver, the load remained stationary. Several ladies and children were walking in the neighbourhood and had to listen to the bad language. Whip and swearing having no effect, the driver obtained a heavy waddy and sent a shower of crushing blows upon his team, the ribs of which must be strong if some of them were not broken.*"

A ford across the Tarraganda River at Tarraganda became the site for frequent crossing accidents as noted by the "Bega Gazette" 1883.

"*Tarraganda Crossing—On my way home from Bega, it was nearly dark when I reached Tarraganda, and, to my surprise, found a team of powerful horses fast in the treacherous river bed. Another strong team was hitched on, but all was no use; there were men and horses perishing in the cold water at a time when the hour was late and the teamsters ought to have been at home. Presently a bullock team came along, and by its aid the triply-banked dray was hauled ashore, but with difficulty. Such events happen daily in the Tarraganda River for days after heavy showers.*"

Whenever the level of the Tarraganda River rose, traffic between Tarraganda and Bega was suspended and consequently it was



Top left: When this six-span, 126-metre long bridge at North Bega was completed in 1878 it was said to have the largest spans in the Colony (three spans being 30·5 metres long). The "Bega Gazette" of 23rd October, 1878, described the opening, which was performed by Daniel Gowing, local pioneer. "About noon a procession—consisting of the Brass Band, the Oddfellows, and the R.C. School Children, etc.—started from the School of Arts. At the junction of Auckland and Bega Streets the Public School children joined the cortege, which was still further increased by people in vehicles, horsemen and pedestrians . . . The bridge was decorated with ferns and flags, and a large painting of the Australian coat-of-arms, with the motto, 'Advance Australia'." (Photograph from Public Works Department Album which is now held in this Department's Archives.)

Top right: This Government Printer photograph, taken in 1926, shows the timber truss bridge over the Bega River at Tarraganda, about 1·6 km from Bega. It was built in 1894 and is still in use on Main Road No. 272.

Centre left: Big branches were needed to get his vehicle out of the bog at Lawler's Creek, near Narooma, on the way to Bega in 1913. (Reproduced by courtesy of Balmain Bros (Bega) Ltd.)

Left: This glorious giant of a machine waited patiently for its passengers in Carp Street, Bega, 1910. (Government Printer photograph.)

estimated that some 2 000 people lost communications with the Bega township.

NORTH BEGA BRIDGES

With the expansion of the dairy industry and the subsequent opening of butter factories, better roads and bridges became even more urgently needed. The Bega River at North Bega was first crossed by a log raft which was put into use in 1867. It was not replaced by a bridge until 1878. Known as the Queen's Truss Bridge, this first bridge served the district for twenty years before being replaced by the bridge that was in use until this year.

By the turn of the century it was apparent that the hoped-for railway to Bega would not eventuate and the importance of improving the roads was soon further heightened by the coming of the first "horseless carriages". By the time the Princes Highway was named in 1920 (see description in December, 1970 issue of "Main Roads", Vol. 36, No. 2, pp. 40–1), the notoriety of Bega's roads had dimmed and travellers no longer had to worry that they might run out of daylight while travelling along one of those *nightmare* roads.

* * *

Sources used in the preparation of this article include "W. H. Balmain Looks Back" in Bega District News, 29th May, 1959; "Princes Highway" article in "Main Roads", March 1951, Vol 16, No. 3, pp. 73–84; "The Story of the Settlement and Development of Bega" by W. A. Bayley (William Brookes 1942).

BEGA OVER 100 YEARS AGO

This interesting description of Bega in 1866 comes from F. F. Bailliere's "New South Wales Gazetteer".

"Bega is situated on the banks of the Bemboka river at the junction of the Brogo river, the two forming the Bega river. The Mumbulla mountain rises to a height of about 2000 feet above sea level, at a distance of about 5 miles N., and the Wolumla peak lies about 14 miles distant S. There is one steam flourmill in the town, and one at a distance of about 3 miles; there is also a steam saw mill, and a printing office. The district is an agricultural and pastoral one. It is occupied by a number of farmers and graziers on a small scale, occupying land that formerly constituted the run of a company. Considerable quantities of grain, cheese, butter, and wool, of excellent quality, are exported. The river lands are equal, in their producing capabilities, to any in the colony. Coal and kerosine shale mines have been discovered about 10 miles distant from the township on the road to Merimbula. The nearest gold diggings are those at the Gulf, distant 51 miles N.W. The nearest places are Pambula, 25 miles S.; Merimbula, 21 miles S.; Tathra, 9 miles E.; Eden, the finest sea port in the S. district, 37 miles S.; and Bodalla, 70 miles N. There is also a new township laid out about 12 miles S.W., and called Candelo. With Eden the communications is by sailing vessel from Tathra, the port of Bega; and with Merimbula, by weekly steamer from the same place. The mail is carried on horseback to Eden via Merimbula and Pambula; and also to Bodalla, on the Tuross river, twice a week. With Sydney, 250 miles N., the communication is by steamer from Tathra or Merimbula, weekly; or, from Eden, fortnightly. The hotels are, the Victoria (Mrs. White's); The Bega Family (Rixon's); and the Traveller's Home; also a new hotel in course of erection.

There is a carrying office at the Bega stores, whence a horse dray conveys goods to Merimbula once a week. A coach for passengers also runs from the post office stores occassionally, usually when ordered only. Bega has a new court house, a church of England, and a Roman catholic church; also 1 national and 2 denominational schools. It contains 6 stores, and the other usual buildings in a small flourishing town. A court of petty sessions is held twice a month; the nearest district court being at Eden. The surrounding country is elevated, there being several mountain ranges in the district, the principal of which are the coast range and the Monara mountains. The country in the neighbourhood of Bega is formed of low undulating hills, not unlike the scenery in parts of Sussex and Kent. Since the passing of the new land bill, 50,000 acres have been taken up in the locality, by free selectors. The geological formation of the district is principally trap and porphyritic granite. The population of the township and its immediate neighbourhood, is about 600; and of the entire district about 2000".●

New works and works in progress around the State

At Ettamogah, near Albury

At Ettamogah, 12 km north of Albury on the Hume Highway, motorists are now using a new 67·6 metre long bridge over the Main Southern Railway Line. This photograph was taken some weeks prior to its opening to traffic on 3rd October, 1975.

The design of the bridge, which is unique in Australia, was undertaken within the Department. The superstructure comprises a composite steel beam and reinforced concrete deck which is continuous for the whole length. The three piers are fixed into the superstructure so that there are no joints in the whole bridge except at the abutments.

The central pier is a steel box section member straddling the railway track and providing sufficient clearance for a second railway track in the future. The other two piers and the abutments are of reinforced concrete.

The concrete blocks shown in the above photograph are independent of the piers themselves, and are designed to prevent damage to the bridge should a railway truck be derailed. This bridge is in stark contrast to the old brickwork arch structure in the background, which it replaced.

Airspace development proposals at Kings Cross

The air-space above the Kings Cross Road Tunnel is suitable for a variety of developments but the major concern is to ensure that the right type is chosen to blend visually and sociologically with the surrounding high density area.

Students at the University of Sydney recently prepared models of possible developments as part of their Architectural Course and these were exhibited to the public at Sydney Town Hall during October, 1975. Two of the proposals are illustrated here.

The development site is bounded by Victoria Street, Kings Cross Road, Kellett Avenue and Craigend Street. An underground railway station will be located nearby when the Eastern Suburbs Railway Line is completed.

The air-space will be leased by the Department, although the size, height and general configuration of the development will be subject to the requirements of the Council of the City of Sydney and the State Planning and Environment Commission.

The diagram shows the various height limitations of the future development. These were calculated during the initial planning of the Tunnel Project to ensure that suitable foundations were constructed for such eventual development of the air-space.

The Sydney City Council has also

Near Wagga Wagga

In recent years extensive up-grading of the Sturt Highway (State Highway No. 14) east of Wagga Wagga to the junction with the Hume Highway, has been in progress. This work has included a 7 km deviation of the Sturt Highway at Guys Hill, 22 to 29 km west of the Hume Highway.

Further east, from 2 km to 7 km west of the Hume Highway, reconstruction and bituminous surfacing are currently in progress. This involves cut and fill earthworks such as those in the photograph on the left.

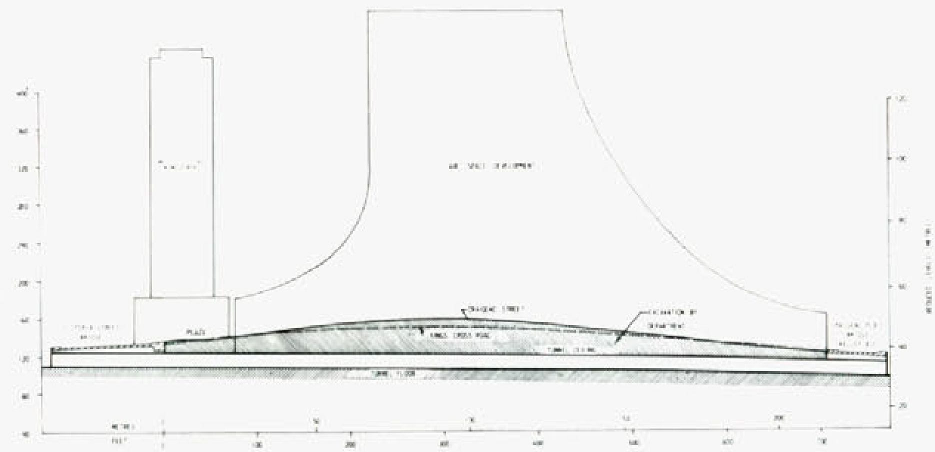
At Gundagai

Work is progressing on the bridge over the Murrumbidgee River at Gundagai (see photograph at left). This composite steel and concrete structure is 1 134 metres long (only 15 metres shorter than the Sydney Harbour Bridge) and will consist of 27 spans, 3 of which extend over the river and the remaining 24 over the floodplain.

At high floods, the velocity of the water crossing the floodplain becomes greater and provision for this has been made in the design of the single column "T" shaped piers.

Associated with the bridge is a 7·4 km deviation of the Hume Highway, including the approaches to the bridge. This deviation has been designed to ultimate dual carriageway standard, the northbound carriageway on which the bridge is located being built first.

announced its intention to bring about other changes in the Kings Cross area, made possible by the opening of the tunnel and the resulting drop in traffic volumes using other roads in the area. For example, Darlinghurst Road in the future is expected to become part of a closed-off mall for pedestrians. The intention is to encourage people to stroll freely and leisurely around the commercial heart of Kings Cross without the *hassle* and worry of competing with through vehicular traffic, most of which can now by-pass the area altogether by using the road tunnel. A major article on the completion of the construction of the road tunnel appears on pages 34 to 38 of this issue.



PACIFIC HIGHWAY PROBLEM
Clybucca Flat North of Kempsey

When a section of major highway is subjected to frequent flooding, the solution to the problem usually involves either raising the level of the affected route to a flood-free design, or constructing a deviation to avoid the flood prone locality.

However, where the Pacific Highway (State Highway No. 10) crosses Clybucca Flat between 14 and 20 km north of Kempsey, neither of these solutions are practicable.

The Problem

North of Kempsey, the Pacific Highway traverses a flood plain of the lower Macleay Valley for about 20 km. The Highway follows a route to the north of the Macleay River and avoids the low lying swamps as much as possible. At Clybucca Flat which is formed from saturated flood silts, the highway crosses an area regularly inundated by flood waters, which break the river bank at Seven Oaks just upstream from Smithtown. The water crosses and re-crosses the Highway between 14 and 20 km north of Kempsey as the adjacent swamps flood and drain. As the water recedes, it clears from the flooded road along North Clybucca Creek and South Clybucca Creek at 20 km north of Kempsey.

The existing highway consists of a bitumen flush seal on a shale pavement 450 to 1 000 mm deep and rests on the natural silts. With repeated flooding and heavy loading there have been major maintenance problems over a number of years.

Finding a Solution

Reconstruction of the Pacific Highway at Clybucca Flat on a raised formation in its present location to avoid flooding altogether was not practicable. It is necessary for flood waters to have a free passage across Clybucca Flat as a vital part of the flood mitigation in this area.

A deviation provided no solution either, because the most suitable flood-free alignment would require the construction of a deviation approximately 35 km long. While a deviation would cater for the needs of through traffic it would still leave the problem of providing a service road across Clybucca Flat for those communities which use the highway to gain access to Kempsey.

With the need to keep the highway at existing levels and close to its present route there remained the solving of the engineering problem—the construction of a stable, long-wearing and relatively maintenance-free pavement, built on a saturated silt, where the water table regularly rises to within 100 mm of the surface. Under these conditions, a rigid type of pavement was preferred and investigations into methods of construction were commenced.

Investigation Procedures

Investigation of the subgrade of Clybucca Flat proceeded over a number of years. Intensive sampling of material from holes one metre deep was undertaken. Routine testing of these samples indicated that a minimum cover of naturally occurring material one metre thick was required even under well-drained conditions which could not be provided in this flood prone area.

In situ California Bearing Ratio (CBR) tests and Dynamic Cone tests were also carried out. CBR values as low as 1% confirmed the results from soil testing that at least one metre of cover was required for flexible pavement construction.

Trial sections were excavated at this stage to investigate possible construction techniques. Satisfactory compaction of material on top of the saturated silts was found to be impossible as even light rollers caused excessive heaving when attempting to compact 450 mm of crushed rock placed over the silt.

Design

In the light of all the considerations associated with the construction of a road across this flood plain it was decided to adopt the design of a rigid pavement using *continuously reinforced concrete*. This is a relatively new concept in concrete pavement construction. The control of shrinkage cracking by continuous steel reinforcement eliminates the need for transverse joints which have been an undesirable characteristic of cement concrete pavements in the past.

To overcome the inability to compact a gravel base on the silt, a base of mass concrete 130 mm deep and 13·4 metres wide is being constructed. A continuous reinforced concrete pavement 230 mm deep and 7·4 metres wide, with bitumen sealed shoulders of fine crushed rock 3 metres wide, is being placed over the base.

The trimmer-spreader at work. Electronic sensors activated by a surveyed stringline keep the machine accurately positioned in relation to line and grade.

Steel formwork rails are accurately positioned for the spreading of the mass concrete base.

The ready mixed concrete is tipped onto the subgrade and spread by hand ahead of the spreader-finisher (right).

Provision for Traffic

Traffic flow along the Pacific Highway must be maintained during the work. The sequence of the work has been so arranged to provide for two sealed travel lanes for traffic at all times during construction.

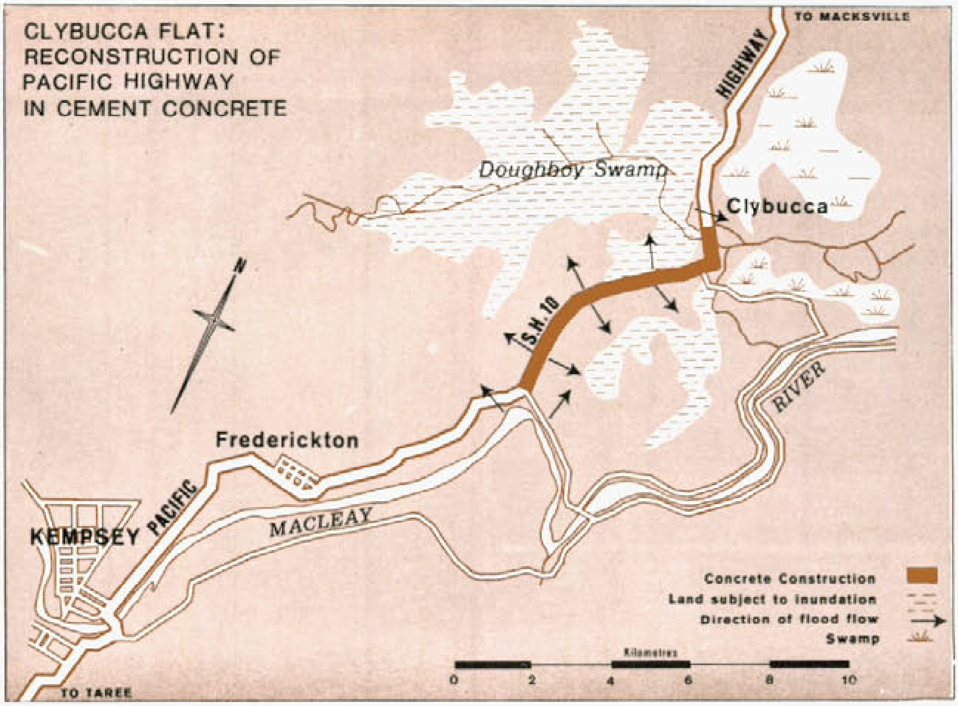
The available road width is restricted by Menarcobrinni Lagoon on the eastern side of the highway and on the western side by utility services (water, telephone and electricity) in the road reserve. Construction is therefore being carried out in stages to allow for one lane of traffic in each direction in addition to the working areas. To provide for the free flow of traffic at the commencement of the work it was necessary to widen the pavement on the western side by 3·7 metres over a length of 5 500 metres.

Construction

In use on the construction are two items of equipment not commonly used on roads in country areas.

The preparation of the sub-grade, 4·3 metres wide, to its design line and grade is being carried out by an electronically controlled single lane trimmer spreader which excavates and trims the sub-grade to fine tolerances ready for placing the mass concrete base. The trimmer spreader is kept on correct line and grade by electronic sensors which are activated by a tight nylon string line accurately positioned along each side of the length to be excavated. The second item of equipment is a concrete spreader-finisher which travels on the steel side paving forms which are accurately located on the excavated sub-grade.

The base course of 8MPa strength concrete is being laid in three parallel passes, and the 23MPa strength continuously reinforced concrete surface course in two passes, with the longitudinal joint of the latter, keyed and dowelled.



Pouring of concrete commenced on 19th August, 1975.

About 20 000 cubic metres of concrete will be required to complete the work and the successful tenderer for supply of this material was B.M.G. Concrete-North. The firm has established a production plant at Frederickton for the supply of concrete.

Crushed rock for the shoulders will be provided by local contract. The remainder of the work is being carried out by the Department's own forces.

Longitudinal reinforcement for the continuously reinforced concrete pavement consists of 16 mm diameter cold worked deformed steel bars placed at 140 mm centres. Transverse reinforcing consists of 10 mm diameter bars at 500 mm spacing. A total of 500 tonnes of reinforcing steel is required.

Prior to the commencement of the work relocation of water mains, electricity mains and telephone cables was carried out by the Macleay Shire Council, the Macleay River County Council and Telecom Australia, respectively.

The work is expected to extend over a period of approximately twelve months and the estimated cost of the project is $2 million.

Research Information

As the construction of continuously reinforced concrete pavements is relatively new to Australia, special instrumentation to record strain in the steel and temperature in the concrete is being installed. Detailed information about the pavement surface is also being recorded. This information will aid in the design of similar pavements in the future.●

The concrete spreader-finisher can be seen in the top right-hand corner.

Chlorinated rubber curing compound is sprayed onto the wet concrete.

Stone crushing plant provides aggregate for concrete used in the pavement.

This article discusses the role of roads in metropolitan transport. Some popular concepts are questioned and examined.

The article was prepared by the Department's Advance Planning Engineer, Mr B. N. Loder, B.E., Dip.T.C.P., M.I.E. Aust., and the Department's Urban Investigations Engineer, Mr K. M. Anderson, B.E., Dip.T.C.P. It was presented as a paper to the conference "Metropolitan Transport—The Way Ahead?" which was organized by The National Committee on Transportation of the Institution of Engineers, Australia, and held in Melbourne during November, 1975.

The views expressed in the article are those of the authors and should not be regarded as necessarily reflecting the Department's view in relation to Main Roads in New South Wales.

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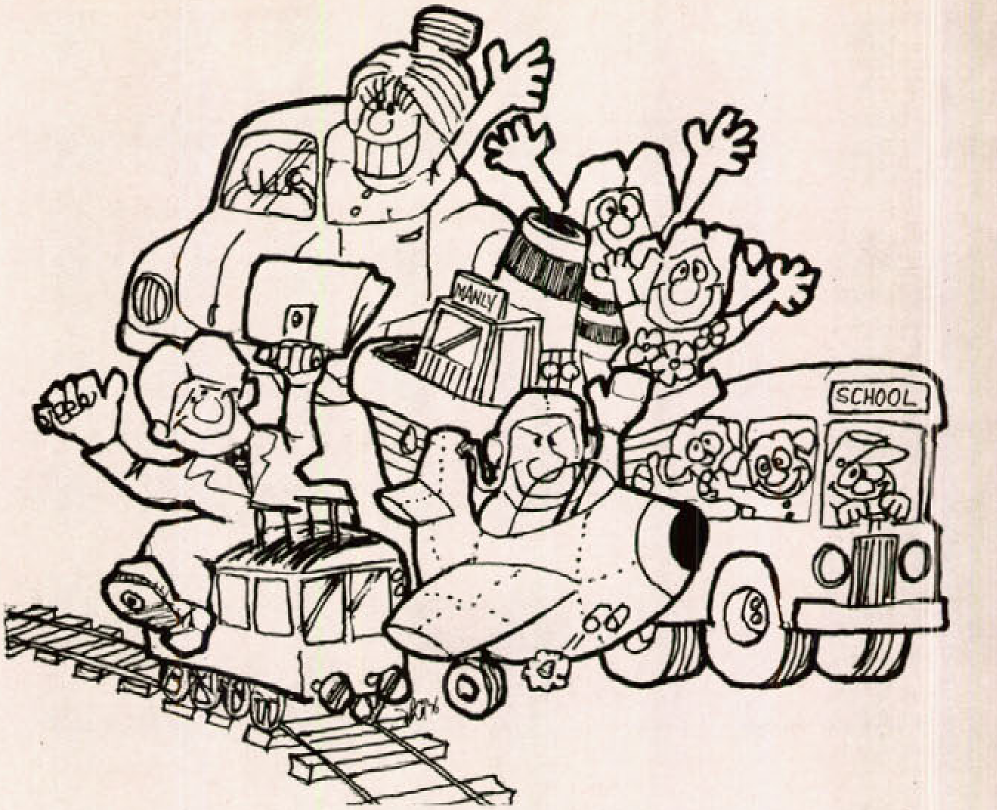


WHO GOES WHERE - HOW, WHEN AND WHY?

Transport absorbs a large proportion of the Gross National Expenditure. Of this, road transport and, in particular, urban road transport are significant parts.

Recent past growth in transport has tended to be exponential. Because of this there has been a real problem in planning the way ahead. Planning involves forecasting; and the major tool for forecasting is extrapolation of trends.

The dangers of extrapolation are particularly well known to Engineers. Irrespective of the field of engineering, situations regularly occur which indicate that gross extrapolation is fraught with grave risk. In metallurgy there are distinct crictical temperature boundaries for structural change. In hydraulics relatively abrupt change occurs between turbulent and streamline flow. Materials testing has distinct changes from elastic, through yield to plastic states. In order to plan purposefully for the way ahead it is necessary to look at the fundamentals of transport. Why does so much movement of people and goods take place?

Why Travel?

On the material side one very profitable aspect of transport is the exploitation of the economies of scale and the efficiency of specialisation. By concentrating operations at a central point the use of specialized machinery is justified, and high through-put results in lower production costs—at least up to the point where distribution costs and congestion become significant disadvantages. The economics of this factor are basically objective.

On perhaps a higher plane, transport provides the medium for distributing the products of man's industry—so that we can enjoy in our every day lives produce gathered throughout the whole world. In order to assess the whole profit of this exercise some subjective judgement is involved.

On an even more subjective plane, transport enriches life. It increases the range of experiences available to all individuals and even the act of movement itself can be a stimulus.

It is because of these real benefits—the more economical use of resources and the enrichment of life—that the movement of people and goods will continue to be a major factor in life which no amount of planning will abate. However, good planning and wise investment in transportation intrastructure will increase the surplus available for movement.

A major reason why transport facilities fill up quickly when constructed is that people take the public benefit in increased mobility rather than a higher travel speed or less congestion. It is a sure sign that the facility was a wise investment although no evidence that it was necessarily the best.

Transport and City Structure

It is generally accepted that transport is a major factor in city structure. However, transport is not necessarily the determinant of city form but is more likely merely to be the medium through which the composite wishes of society are translated. One hears criticism of the urban sprawl, of the way in which the centre dies at night and of the lack of heart in automobile serviced cities such as Los Angeles, but these are almost certainly the consequences of society achieving its objectives.

The sprawl was first permitted by the mass transit systems of the late 19th and early 20th centuries. These enabled tongues of development to extend out from the centre where people could live and still have good access to the centre for shopping, work and entertainment.

The role of the centre has changed considerably with increase in mobility enjoyed by society. For instance, alternative services for night life are more readily available—perhaps those few who bemoan the change really do not know what they are missing.

Los Angeles, one of the fastest growing cities in the western world has been severely criticized by casual visitors for lacking a true centre in the conventional sense. On the other hand those who have lived there are strong in their praise of the convenience and amenities enjoyed there.

The world wide trend is away from a dominant central city focus towards a more uniformly dispersed city complex.

This is a manifestation of composite community aims aided and abetted by the motor vehicle—it has not been forced upon an unwilling society by the motor vehicle.

Future Trends

For the future, then, in cities we must expect a diminution in the concentration of development in major centres and pressure for greater uniformity in accessibility throughout the whole metropolis; in other words, the movement pattern will become even more dispersed than it is today. Coupled with our apparent desire to match the vastness of our country by living at quite low density phenomenon. There seems little point therefore in trying to solve urban transport problems by building more railway lines except in special cases, because railways are high density carriers. Where railways already exist, we need to be quite sure that they are the most appropriate means of transport and then ensure that they incorporate everything that modern rail technology has to offer. But the means of transport that seem to be most capable of providing for the future city are the bus, the truck, the car, the jitney—type of taxi, the motor cycle, and for short journeys in good weather, the pedal cycle.

Restraint is appropriate in providing any new major traffic conveyor to serve the dominant centres of the older, large cities such as the Australian State Capitals. Although some improvements will be justified, these should not receive undue precedence, bearing in mind that the total journeys to and from the dominant centres are now only a small portion of the total journeys in a metropolis (in Sydney 10%) and are likely to become less.

Planning should incorporate a grid of communication corridors which can carry major roads and trunk utility lines, and provide wedges of open space to break the continuity of building development. This would tend to cater for the anticipated pressure for more uniform accessibility throughout the metropolis. However, in doing so reason must prevail. Urban areas are not homogenous flat areas—there are constraints militating against equal accessibility. Some are economic in the guise of rivers and other topographical features, some are aesthetic, historic or cultural such as areas of great beauty and some are social such as intensive traffic generators like airports or seaports.

Where reason suggests, firm decisions need to be taken against improving accessibility. Where this results in severe congestion an equitable rationing system needs to be devised and imposed to avoid the situation where those to whom time is of most value are the first to be deterred from travel.

Determining Needs

Transport needs in urban areas are normally determined by a transportation study. With the development of electronic data processing these have become highly specialised; and elaborate investigations are common. While these studies provide a wealth of valuable data on travel habits and patterns, and the forecasts are an aid in planning, past studies appear to have been given more weight than justified by their integrity.

There are two major aspects in which transportation studies are open to serious question. Firstly, they rarely give enough weight to constraints, such as budget limitations or community resistance. Secondly, they extrapolate the past without due regard to the reasonableness of the result or the changes in conditions which would need to occur before the forecast movements could eventuate. Both shortcomings bias the recommendations of the studies towards overstating the needs thus providing unattainable goals to be striven for. As a consequence there is little hope of ever achieving an optimum solution nor are we likely to be able to provide the best interim conditions in our staging.

To best serve the community interest, we need to re-appraise the traditional approach. Realizing that some of the more ambitious proposals, and particularly those nearest to the major centres of urban areas, are unlikely to be achieved within a reasonable period, we need to consider whether the need for those works could, as a result, diminish with time. Some such proposals might well be abandoned completely, while others might well be substantially changed.

The Future Vehicle

Before undertaking such a fundamental reappraisal there is a need to predict the relative roles of the various modes of transport in the future. People want transport, they want it to be convenient, safe and comfortable. The mode which best fulfils that specification is the motor vehicle.

The motor vehicle is a most maligned piece of machinery. People feel so strongly about it that they tend to imbue it with human characteristics. They even talk about man's love affair with his motor car. It has become a popular pastime amongst some social groups to decry the motor vehicle. With lyrical disdain they refer to the "great god car". However, the accompanying verbiage is always lacking in logic and fact. It is perhaps significant that no recognized authority supports that particular brand of philosophy. In an article entitled "Some Thoughts about the Motor Car", Professor Colin Buchanan has presented a very rational appreciation of that vehicle. He points out:

"I have never managed to make very much money and for the most part in my half a century of motoring I have made do with second hand cars. But what an enrichment of life has resulted! Marvellous holidays, camping, caravanning, much of Europe at our disposal in a three week vacation"

and again

"for all kinds of modest services, taking the parents out when they were alive, taking aunty out now, rushing the kids to the doctor or dentist in some childish emergency"

and also speaking of the critics of the motor car

"They do not seem to understand what people are, where they live, how they live, what they do with themselves, where and how often they move around nor how a community functions".

The motor car has emancipated the average person. At one time youth looked forward to reaching 21 when the key of the door was presented. Now youth looks forward eagerly to the vital age of 17 when the key of the car gives an even wider degree of freedom. There is little likelihood that the motor vehicle will be supplanted as the principal people mover and goods distributor in the foreseeable future.

Of course the present motor vehicle has some very bad faults. It takes up a lot of space, it is noisy and it emits noxious gases. In addition motor vehicles collectively devour great quantities of petrol thus imposing a threat to world supplies. Improvement is needed. However, as those improvements will cost something, it is unlikely that any serious action will be taken before they become absolutely necessary—but it is certain that they will come.

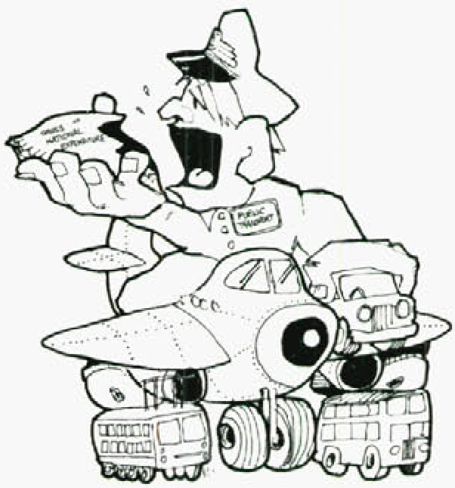
For better or for worse modern technology has got us to the situation we are now in and the motor vehicle is a major part of that technology. But for the motor vehicle and the other associated technological achievements many of us would not be attending this symposium today. In fact the chances are that many of us would not have survived childhood. It was interesting to note in a film on China by Antonioni, that the Chinese way of life, with very little dependence on modern technology, requires an agricultural work force of 500 million or about two-thirds of the population. It was also featured that 50% of the population was under the age of 20. Comparable figures for New South Wales, are 2½% and 35%.

While on this aspect let us dispel another popular misconception. It is often advanced by detractors of the motor vehicle that it serves only the more affluent components of the community. Five groups are frequently listed as being under-privileged in this respect. These are the young, the old, the poor, the housewife and the sick. Let us examine this rather more closely.

The young very rarely travel far from home unless accompanied by a responsible adult. They profit from shopping trips, from trips to museums and to the beach, from picnics in the country and a variety of excursions involving travel, and almost always they are taken by car. Indeed responsible parents are loath to allow even adolescents to travel indiscriminately on their own in public transport.

The old in some ways are like the very young. When they do travel they are surely entitled to the best method available at the cheapest price. Indeed, it is a source of amazement how, from the comfort of his motor vehicle, the average person cheerfully condemns the old and the poor to travel the greatly inferior public transport system, which seldom does nor ever can fulfill all their transport needs.

The poor present a challenge in any society. However, good road access will give them greater mobility—remember buses travel on roads. In any case society's objective surely is to eliminate poverty by positive programmes rather than to curtail benefit for the vast majority merely because some benefit less than others.



"Transport absorbs a large proportion of the Gross National Expenditure."

Anyone who can remember housewives in the 1930's struggling into the city by tram with young children, some of them babies in arms, and on the return trip, while loaded down with parcels, trying to tend youngsters suffering from travel sickness—surely would not campaign for a return to those good old days of central shopping fed by mass public transport. The modern dispersed shopping centre, although not a complete answer, has characteristics making it more desirable than the old style centralised system evolved around a strong mass public transport system. The dispersed shopping centre is, of course, a product of the motor car age which in itself requires better roads for more efficient operation.

The sick obviously do not need transport unless it is to rush them to hospital when an ambulance service could be the means of saving their lives. If they require medical attention then this could be brought to them more safely and more certainly with better road access.

In the face of such overwhelming advantage it is inconceivable that any form of mass transit will supplant the motor vehicle from its dominant role in urban transport. In fact, the sooner the motor vehicle's special advantages are given unreserved recognition and its adverse features eliminated, the greater the benefit which society will derive from exploiting its full potential.

One of the factors which makes the motor car so competitive is that in almost every instance the driver is also a passenger. In times when wages are becoming an even more significant cost factor, this favours the motor vehicle more and more—and it becomes less likely that any form of automated guidance system will supplant it. Even though no driver is needed actually in the cab of a personal rapid transit system, there is a need for some equivalent (in part at least) in operating and maintaining the guidance system. That this cost becomes significant except on very heavily trafficked sections is bourne out by the experience of the San Francisco Bay Area Rapid Transit.

One factor which does favour automatic guidance systems is safety. However, in practice the road vehicle accident rate is substantially higher on lightly trafficked routes than on heavily trafficked routes. It is sad but true that even suffering has a price and it is unlikely that the community will change its attitude sufficiently to deprive itself of its present standard of living to eliminate all accidents.

However, good roads can help the safety aspects while providing greater comfort and convenience. Hence it is inevitable that urban road systems will be improved. In doing so it will not be necessary to provide greatly increased areas of road. The need will be to re-distribute road space in a more efficient manner.

The Right of Way

Let us accept that more efficient road space is needed. Where should this be provided and what form should it take?

". . . transport provides the medium for distributing the products of man's industry—so that we can enjoy in our every day lives produce gathered throughout the whole world."

Roads are used to transport goods as well as people. And they are used to take people and products out of the city as well as move them into it. It is interesting to note that while some residents of inner suburbs object vehemently to people from outer suburbs crossing their territory they have no compunction in dispatching their garbage across adjoining suburbs for disposal in outer areas.

When we provide road space we should do so in the best possible way. We should endeavour to provide something of sufficient capacity to cater efficiently for the road user and so situated as to cause minimum disadvantage to the balance of the community. If the demand is high enough the freeway provides the only realistic answer. If we were to provide the extra space by widening existing roads the cost of both construction and operation would be greater, more people would be affected and the community would be divided into smaller areas by a grid of busy arteries. In addition the road system would produce more accidents and give rise to greater pollution.

We need also to clarify the concept of the freeway. People—and in many cases those who should know better—often speak erroneously of the "freeway system". This is quite wrong. A system is a complex whole, a co-ordinated arrangement of parts which work together. Freeways are only part of the complex road system needed to support a city—without the vast mileage of other roads freeways would not perform their true function. Nor, indeed, can the other roads and streets perform their function effectively without freeways. Although freeways are the most sophisticated type of road and in their place provide the cheapest and safest road travel, they are just one of the many types of road needed in cities of today.

So the question whether or not to build freeways is basically a question whether or not to provide extra road capacity in its most efficient and compatible form. It is also a question of whether residential neighbourhoods should enjoy peace and quiet with access roads arranged to discourage through movement or have their streets choked with a seething mass of vehicles. And further it is a question as to whether commerce and industry should be given the opportunity to operate efficiently to the benefit of all or not.

The Way Ahead

What then of the future?

- ☐ We see flexible individual transport becoming more dominant, with public transport moving towards buses, dial-a-bus supplemented by conventional and jitney type taxi services.
- ☐ We see a more rational and more efficient road system being developed with more attention to road pricing techniques to encourage more responsible use in conformity with accepted community goals.
- ☐ We see substantial changes in motor vehicles, with accent on less pollutant power units and inbuilt safety devices. With greater emphasis on running cost more specialised units will be available. Entry to some areas will be restricted to certain types of vehicles and multiple vehicle ownership will be common.
- ☐ We see continuing change in the structural form of cities. Under an evolutionary process dominant single centres will gradually be phased out. Cities will tend to comprise small more specialized centres located at access hubs in general low density development.

It is a fact of life that a price must be paid for everything. Frequently people's requirements are mutually incompatible—"you can't have your cake and eat it too". Despite this it is possible by good management to get good results.

There is no option but to adjust with the times. The people eventually get what they want and the popular vote is for better transport. Let us accept the inevitable and help make an even better future.●

"The motor vehicle . . . People feel so strongly about it that they tend to imbue it with human characteristics."

Cartoons by Phil Eldridge, Public Relations Section.

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 30th September, 1975.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
Western Freeway F4	Municipality of Auburn. Construction of Eastern Abattoirs Railway Line Bridge—stone pitching of abutment of bridge.	B. G. Ayoub	21,600.00
Southern Freeway F6	City of Wollongong. Construction of piles on twin bridges over Northcliffe Drive, Berkeley, 90·5 km south of Sydney.	Frankipile (Aust.) Pty Ltd	110,734.00
State Highway No. 1	Princes Highway. Municipality of Bega. Supply and delivery of up to 840 tonnes of asphaltic concrete for the deck and footway of the new bridge over Bega River at Bega.	Bitupave Ltd	22,962.00
State Highway No. 5	Great Western Highway. City of Lithgow. Construction of 3 cell 2·7 m x 2·1 m reinforced concrete box culvert at approximately 2·34 km west of Lithgow.	Hornibrook Group	107,806.00
State Highway No. 8	Barrier Highway. Shire of Central Darling. Construction of four new bridges over the Darling River flood plain east of Wilcannia.	L. M. Robertson Construction Co.	365,533.00
State Highway No. 9	New England Highway. Shire of Denman. Construction of 3 cell 3·05 m x 2·75 m reinforced concrete box culvert at Muscle Creek Road, 5 km south of Muswellbrook.	Concast Pty Ltd	26,813.00
State Highway No. 9	New England Highway. Shire of Murrurundi. Construction of new bridge over Campbell's Creek at 63·7 km north of Muswellbrook.	L. G. Rixon	63,551.60
State Highway No. 10	Pacific Highway. Shire of Port Stephens. Erection of guardrail protection fencing on reconstruction work between Balickera Channel and Twelve Mile Creek Bridge.	G. McFadden	30,606.00
State Highway No. 10	Pacific Highway. Municipality of Kempsey. Supply and delivery of ready mixed concrete for construction of road pavement at Clybucca Flat, 14·0 km to 19·5 km north of Kempsey.	B. M. G. Concrete (North) Pty Ltd	552,610.00
State Highway No. 10	Pacific Highway. Shire of Ulmarra. Construction of new bridge over Swan Creek, approximately 5·8 km north of Grafton.	Bridge & Civil Pty Ltd	964,138.00
State Highway No. 11	Oxley Highway. Shire of Peel. Construction of new bridge over Menedbri Creek at 44·3 km west of Tamworth.	Messrs W. H. Marshall & Son	59,674.82
State Highway No. 17	Newell Highway. Municipality of Narrabri. Construction of new bridge over Narrabri Creek and widening of bridge over Narrabri Rivulet at Narrabri.	Peter Verheul Pty Ltd	863,369.92
Main Road No. 199	Municipality of Rockdale and Shire of Sutherland. Rectification work on the southern abutment of Captain Cook Bridge, Taren Point.	V.S.L. Prestressing Pty Ltd	22,000.00
Main Road No. 609	Municipality of Fairfield. Piling of pier No. 1 on bridge over Main Southern Railway Line at Fairfield.	Godfreypile Pty Ltd	25,820.00
County Road No. 5013	Municipality of Canterbury. Manufacture, supply and delivery of 66 pre-cast bridge planks for use at the stormwater channel bridge in Parry Park, Lakemba.	Hastins Prestressed Concrete Pty Ltd	23,197.00
Various	Pacific and Gwydir Highways. Supply, heat and spray of R. 90 bitumen.	Q.A.R. Road Services	69,069.50
Various	Pacific and Gwydir Highways. Winning, crushing and stockpiling of conglomerate.	M. & M. Quarries	47,340.00

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 30th September, 1975.

Council	Road No.	Works or Service	Name of Successful Tenderer	Amount
				$
Baulkham Hills	M.R. 157	Sheeting of existing pavement with asphaltic concrete between Cattai Creek and Old Northern Road.	Emoleum (Aust.) Ltd	27,075.00
Baulkham Hills	M.R. 160	Sheeting and strengthening of existing pavement with asphaltic concrete.	Emoleum (Aust.) Ltd	66,915.00
Hornsby	Various	Asphaltic resheeting of various main and secondary roads in the Shire of Hornsby.	Asphalt Concrete Ltd	117,912.00
Liverpool	M.R. 535	Widening and reconstruction of Judds Hill between 722·5 m and 2·4 km including provision of climbing lane.	Pioneer Asphalts Ltd	57,119.00
Penrith	M.R. 155(S)	Reconstruction south of the Great Western Highway. Asphaltic concrete resheeting between Batt Street and Rodley Street.	Pioneer Asphalts Ltd	30,090.00

MAIN ROADS STANDARD SPECIFICATIONS

Note: Imperial drawings are prefixed by letter A, metric drawings by the letters SD, instructions are so described, all other items are specifications.

ROAD SURVEY AND DESIGN

	Form No.
Design of two-lane rural roads (Instruction—1964)	355
Data for design of two-lane rural roads (1973)	892 (Metric)
Flat country cross sections—bitumen sealed pavement (Instruction—1972)	A 6132
Plan and longsection—Two lane rural roads	SD 6215
Standard cross sections for bitumen surfaced two-lane rural roads (1973)	SD 6056

URBAN DRAINAGE

Concrete converter	A 1418
Concrete work other than bridges	738 (Metric)
Design of subsoil and subgrade drainage (Instruction—1973)*	513 (Metric)
Gully grating (1969)	A 190
Gully pit with grating	A 1042
With kerb inlet only	A 1043
With grating and extended kerb inlet	A 1352
With extended kerb inlet only	A 1353
With grating for mountable kerb	A 4832
Kerb and gutter shapes (1975)	SD 6246
Perambulator ramp	A 3491
Vehicle gutter crossings (1974)	SD 6247
Waterway calculations for urban drainage (Instruction—1963)	371B

CULVERTS

(a) Cast in place reinforced concrete box culverts—	
Box culverts with wearing surface	SD 6270
Single cell box culvert under fill from 1 m	SD 6271
Single cell box culvert under fill from 0·3 to 1 m	SD 6272
Multiple cell box culvert under fill from 1 m	SD 6273
Multiple cell box culvert under fill from 0·3 to 1 m	SD 6274
(b) Precast reinforced concrete box culverts—	
Erection of precast concrete box culverts	138B (Metric)
Supply of precast concrete box culverts	138A (Metric)
(c) Pipe culverts—	
Construction of concrete pipe culverts (1974)	25 (Metric)
Design of concrete pipe culverts (1974)	25A (Metric)
Headwalls for pipe culverts—	
Single row—	
600, 750, 900 mm dia.	SD 139
375, 450, 525 mm dia.	SD 143
1 050 mm dia.	SD 172
1 200 mm dia.	SD 173
1 350 mm dia.	SD 174
1 500 mm dia.	SD 175
1 800 mm dia.	SD 176
Supply and laying of asbestos cement drainage pipes (1972)	861

BRIDGES

	Form No.
Concrete work for bridges (1974)	350 (Metric)
Data for bridge design (1973)	18 (Metric)
Erection of precast, prestressed concrete bridge units and planks (1975)	557 (Metric)
Erection of precast, prestressed concrete piles (1966)	558
Erection of precast, prestressed concrete bridge girders	561 (Metric)
Excavation for bridges (1974)	563 (Metric)
Extermination of termites in bridges (Instruction—1958)*	326
Erection of structural steelwork	262 (Metric)
Manufacture of precast or cast-in-situ, prestressed concrete bridge members (1970)	556
Manufacture of elastomeric bearings for bridge units and girders (1967)	562
Preparation and pretreatment of metal surfaces prior to protective coating or painting—Method Selection Guide	1032 (Metric)
Protection angles for bridges or culverts with concrete wearing surfaces (1960)	A 1272
Prestressed concrete bridge drawings—	
(a) Prestressed concrete piles—	
12 in x 12 in—35 tons	A 4764
14 in octagonal—45 tons	A 4943
16 in octagonal—50 tons	A 4944
(b) Test load diagrams for prestressed concrete piles—	
12 in x 12 in	A 5601
14 in and 16 in octagonal piles	A 5828
Reinforced concrete piles 35 and 45 tons (1963)	A 1207 8
Reinforced concrete piles (precast) for bridge foundations	564
Superstructure for bridges	568
Supply of high strength steel bolts (1968)	261
Supply of ready mixed concrete, for bridgeworks (1975)	895 (Metric)
Timber for bridges	140
Waterway diagram (0 to 200 acres)	A 26

BITUMINOUS SURFACES

Bituminous emulsions (cationic) (1973)	304 (Metric)
Bituminous emulsion (anionic) (1973)	305 (Metric)
Bituminous surfacing daily record (1974)	400 (Metric)
Bituminous surfacing job summary (1974)	1011 (Metric)
Cutback chart for bitumen seal coats (1973)	466 (Metric)
Performance requirements for mechanical sprayers	272 (Metric)
Sprayed bitumen surfacing (1974)	93 (Metric)
Sprayer loading slip (1974)	401 (Metric)
Supply and delivery of bitumen (1974)	337 (Metric)
Supply and spraying of bitumen (1973)	898 (Metric)
Supply and delivery of aggregate for use in bituminous plant mix (1975)	952 (Metric)
Supply and delivery of asphaltic concrete (1975)	953 (Metric)
Supply and laying of asphaltic concrete (1975)	612 (Metric)
Supply and laying of dense graded tar plant mix (1975)	954 (Metric)
Supply and delivery of dense graded tar plant mix (1975)	955 (Metric)
Supply and laying of open graded bituminous plant mix (1975)	956 (Metric)
Supply and delivery of open graded bituminous plant mix (1975)	957 (Metric)
Supply of prepared cutback bitumen for sealing purposes (1965)	740
Supply and delivery of cover aggregate for sealing and resealing with bitumen (1975)	351 (Metric)
Tar	296

FENCING

Chain wire guard fencing—erection (1974)	144 (Metric) SD 149
Chain wire—supply—(1974)	132 (Metric)
Corrugated steel guard rail—supply—(1975)	SD 5595
Corrugated steel guard rail—erection (1975)	680 (Metric) SD 5829
Drawings: Sheep fence (1974)	SD 494
Rabbit-proof fence (1974)	SD 498
Cattle fence (1974)	SD 1705
Floodgate (1974)	SD 316
"Manproof" pipe and chainwire boundary fence	611 (Metric) SD 6278
Ordnance fencing	143, A 7
Post and wire fencing (1974)	141 (Metric)
Removal and re-erection of fencing (1974)	224 (Metric)
Warrants for use of guard fences (Instruction—1973)	246 (Metric)

FORMATION, INCLUDING EARTHWORKS AND RURAL DRAINAGE

	Form No
Corrugated PVC subsoil drainage pipe (1972)	907 (Metric)
Earthworks and formation including surface drainage (1974)	70 (Metric)
Installation of lateral drains (1974)	1013 (Metric)
Shoulders and table drains (1973)	827 (Metric)
Standard rubble retaining wall (1941)	A 114
Standard mass concrete retaining wall (1959)	A 4934
Standard cantilever retaining wall (1959)	A 4935
Subsoil drains (1973)	528 (Metric)
Waterway calculations for bridges and culverts (1964)*	371 A

PAVEMENTS

Cement concrete pavement (1960)	A 1147
Construction of natural gravel or crushed rock road pavement (bitumen surfaced) (1975)	743 (Metric)
Construction or resheeting of natural gravel or crushed rock road pavement (not bitumen surfaced) (1975)	800 (Metric)
Preformed expansion joint fillers (1962)	610
Supply of natural gravel or crushed rock for road pavement (bitumen surfaces) (1975)	744 (Metric)
Supply of natural gravel or crushed rock for road pavement (not bitumen surfaced) (1975)	801 (Metric)
Supply of ready mixed concrete (1973)	609 (Metric)

ROADSIDE

Roadside fireplace (1974)	SD 4671
Roadside litter bin (1975)	SD 5841

TRAFFIC PROVISIONS AND PROTECTION

Control of traffic at Roads and Bridgeworks (1975)	121 (Metric)
Guide posts—supply (1973)	252 (Metric)
Guide posts—erection (1973)	253 (Metric)
Manufacture of warning signs (1971)	682
Motor grids—24 ft (1964)	A 5770
Plastic guide posts (1972)	880
Roadmarking paint (1966)	671

CONTRACTS

Bulk sum tender form, Council contract (1966)	39
Bulk sum contract form, Council contract (1975)	38
Cover sheet for specifications, Council contract	342
Caretaking and operating ferries	498
General conditions of contract, Council contract (1966)	24B
Schedule of quantities (1966)	64

MANUALS *

Manuals, No. 1—Plant; No. 3—Materials; No. 4—Roadside Trees; No. 5—Explosives; No. 6—Bridge Maintenance; No. 7—Road Maintenance.

D.M.R. BOOKLETS

Guide to Main Roads Administration.
Duties of a Superintending Officer.

N.A.A.S.R.A. BOOKLETS

Guide to Publications and Policy of N.A.A.S.R.A.
List of current publications.

All standards may be purchased from the **Plan Room** at the Department's Head Office, 309 Castlereagh Street, Sydney. Single copies are free to Councils except those marked *. A charge will be made for sets of standards.

G 5558 D. West, Government Printer, New South Wales—1976

Left to dream of years gone by

The Great Western Highway (State Highway No. 5) no longer passes directly through the historic town of Hartley since the opening to traffic of a deviation and a new bridge over the Lett River. (See article commencing on page 44.)

Three old buildings which are features of picturesque Hartley are the Court House (1836), right, the Royal Hotel (1840's), below left, and the Farmers' Inn (c. 1850), below right.