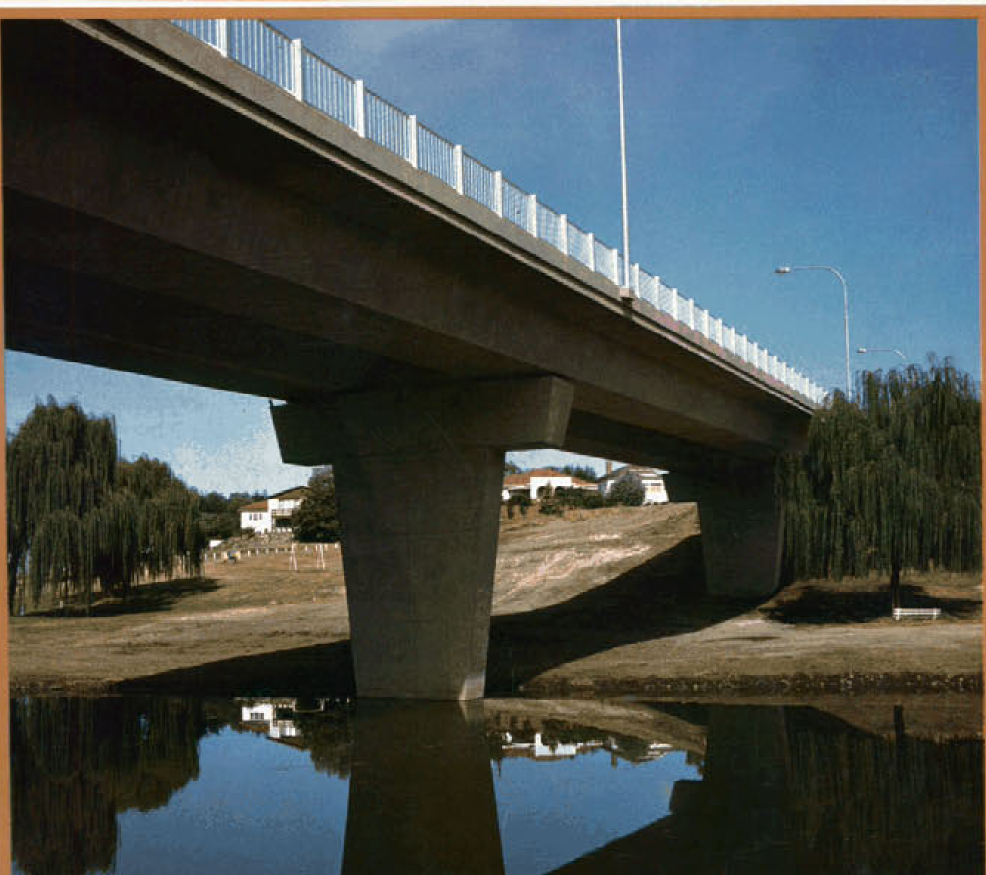
main roads

JUNE 1983



main roads

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES.

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CONTENTS

Front cover: the newly opened bridge over the Macintyre River at Inverell, with landscaping still in progress. Back cover: the Sydney Harbour Bridge now features in mural art. (See pp. 48-49.)

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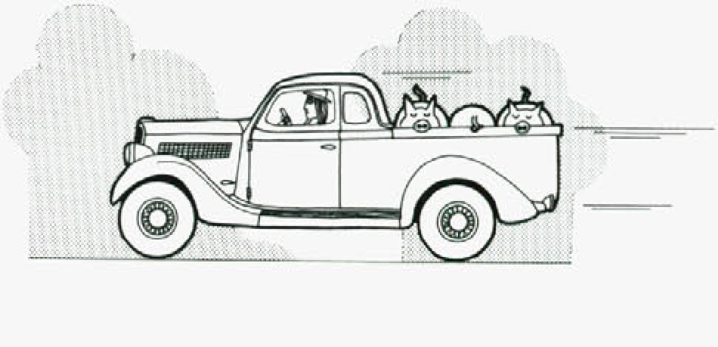
UTILITY

For many of us the word *utility* means a hybrid car/truck. To others it means the more abstract property of something being useful.

The world's first utility in the former sense was designed by Louis T. Bandt for Ford Australia in the 1930s. It followed a request from a Victorian pig-farmer's wife who wanted the comfort of a car combined with the utility of a truck.

Utility for cars in the second sense is more or less their ability to transport goods and people. Changes in technology over the decades has meant that cars can now transport goods and people more safely, more economically and more efficiently. Yet their utility remains the same: they are a means of transport.

As such, the utility of roads has not changed either. Roads have always existed for the passage of goods and people between one place and the next. Yet roads too have benefited from changes in technology. And like Bandt in the 1930s, our engineers and scientists have worked towards making roads more functional, more useful and more utilitarian for all people . . . irrespective of whether they're a commuter, holiday-maker or pig-farmer's wife.



VITAL BRIDGE LINK OPENS AT INVERELL

Early bridge building

New South Wales was blessed with an abundant supply of native hardwoods admirably suited to low cost bridge construction. These timbers, most notably ironbark, compare favourably in strength and durability with those found anywhere in the world, and grow to a height and girth well suited for use in bridges. Naturally this plentiful resource was well used by early bridge builders.

The simplest and most common type of timber bridge consisted of a timber beam deck supported by timber pile trestles. Such bridges were widely used for crossing rivers and creeks where floodwaters were not very deep, and had the advantages of low initial cost, ease of construction and adaptability to almost any site.

Until the establishment of the steelworks at Newcastle in 1915, most iron used in Australia had to be imported from Europe or North America at great expense.

The struggling Fitzroy Iron Works at Mittagong, which began production in 1848, was able to meet some of the early demand for iron, but production was short lived. Production costs were so high that the firm was unable to compete with the price of imported iron and the firm went out of business.

At sites where severe flooding was known to occur, iron was used to construct substantial piers. At the few sites requiring spans in excess of 30 m, iron superstructures were used. These were also used at sites requiring lift spans, often in conjunction with timber side spans. The truss was revived as a mode of bridge construction in the nineteenth century when methods were devised for determining the stresses in the struts.

Being inherently light and efficient in design, the truss enabled the spanning of much greater lengths than by using simple beam construction.

Timber truss bridge construction was taken up by the new Department of Public Works from the outset of its operation in 1859. In simple timber truss bridges, the deck was supported by cross girders slung across the deck from underneath. The cross girders were carried by the bottom chords of the trusses along either side, or hung directly from the vertical wrought iron suspension bolts. Sagging of the trusses could be removed by tightening the nuts at the ends of the suspension bolts.

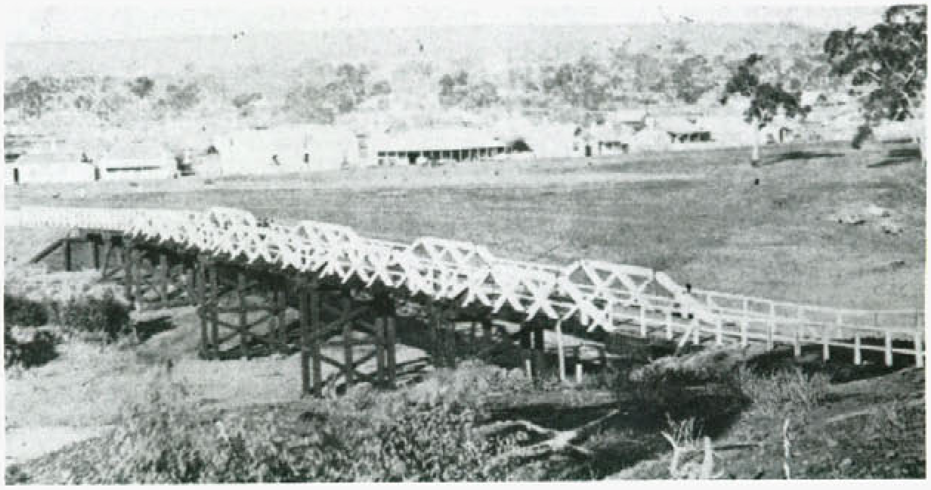
The Inverell-Glen Innes Road

In 1865 a line for a road from Glen Innes to Inverell was surveyed by District Surveyor Greaves. The route was classified as a subordinate road and had an annual allocation of £400.

The road formed an extension of the Newton Boyd line and shared in the generally increased traffic of this route following its development in the 1860s.

In 1870 a deputation of Inverell residents successfully petitioned for the promotion of the route from the schedule of minor roads to those under the control of the Department of Public Works. This entitled it to an annual expenditure of £50 per mile from the public purse and indicated official recognition of its importance.

The 1876 bridge was demolished 20 years later.



The 1876 bridge

Settlement at Inverell was established on the banks of the Macintyre River at the junction of the road from the coast and the main line of road for stock travelling north and south to and from Queensland. During the wet years of the 1860s and 1870s, the settlement was frequently divided by rises in the Macintyre River. A number of lives and vehicles were lost as people attempted to ford the river.

Residents successfully petitioned the Government to provide a bridge. Tenders for construction were called in 1875 and the bridge opened the following year.

The timber structure was 115m long with four main truss spans 23m long and 2.3m high. There were two timber beam approach spans on the eastern side and a single timber beam approach span on the western side.

Its piers and abutments were formed of braced timber pile trestles. In trusses of this type, problems were often experienced as shrinkage of the timbers caused the wrought iron suspension bolts to bend or break.

The original Ross Hill Bridge was apparently weakened by floods, as in later years raking piles were added as outriggers to the pier trestles to stabilize the structure. Nevertheless, the bridge deteriorated so badly that it was condemned in 1894.

From 1886 a strengthened and improved truss design known as the McDonald truss was introduced and overcame the former deficiencies.

Research involving the systematic testing of Australian hardwoods was carried out in 1886. With more accurate information on the behaviour of the timbers and the

instituting of a system of regular inspection, the life of timber bridges was greatly increased.

Twenty years later

In 1893 a revised and improved timber truss design for bridges, known as the Allan Truss, was produced. This design was used in the three timber truss spans of the second Ross Hill Bridge, designed in 1894 and opened in 1896.

The timber truss spans were supported on hollow cylinders of wrought and cast iron, filled with coarse concrete. At each end of the bridge were two timber beam approach spans 7.6m and 9.1m long, supported on timber pile trestles. The piers and abutments were founded in weathered basalt bedrock, an excellent foundation.

Following the passing of the Local Government Act of 1906, the greater part of the work formerly carried out by the Department of Public Works on Main Roads and bridges passed to local Shire and Municipal Councils.

Two hundred and fifty-six bridges proclaimed as National Works, including Ross Hill Bridge, were to remain under the control of the Department of Public Works. National Works were structures which, by reason of their cost, size and

Macintyre River, Inverell.
The new 148 m long bridge will provide a vital service for the people of Inverell as well as for long distance travellers.

importance extending beyond the local area, would constitute a strain on Council resources.

In 1928 responsibility for the proclaimed National Works passed from the Department of Public Works to the Main Roads Board.

The demise

By the 1970s the running surface of the deck had deteriorated and had become quite uneven.

In June 1977 the wheels of a semi-trailer broke through the timber decking of an approach span. Later in the year the bridge was closed for a month in order to replace timber decking in the approach spans. In 1978 the bridge was closed for a further five months to replace decking in the truss spans.

The deck timbers cost a total of $105,000 and were salvaged in the 1982-83 demolition works.

Two months after the bridge was reopened, the downstream truss of the centre truss span failed when a heavily laden cattle float crossed the bridge. When the timber bottom chord broke, the truss sagged 450 mm, triggering off a chain of damage. The truss principal shifted in its seating, splitting the cast iron seating shoe and causing the overhead brace connecting the upstream truss to split.

Failure in the downstream truss transferred load to the upstream truss, causing temporary distortion.

The bridge was immediately closed for repairs but re-opened a month later to a single lane of traffic, after a Bailey truss was erected.

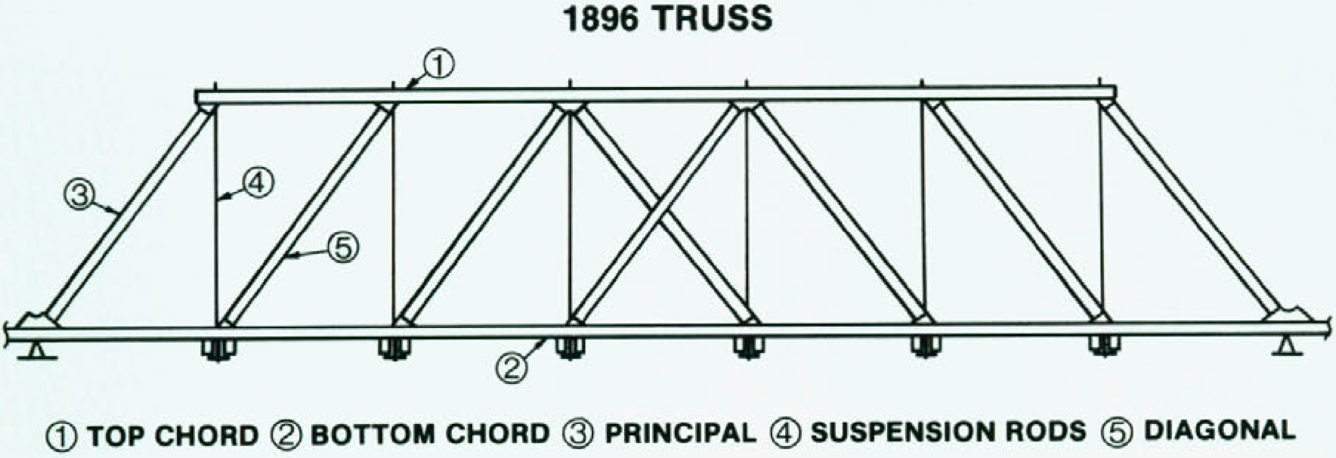
Three months after the initial accident the second lane was re-opened to traffic and the load limit was increased to 8 tonnes.

A new line and design

The decision to build a new bridge came in January 1979, following strong representations by Inverell citizens.

After considering the advantages and disadvantages of a number of possible alternatives, the most practical line was chosen. This allowed about 60% of the new bridge to be built before the existing structure had to be closed.

By diverging downstream from the line of the existing bridge, the alignment of the western approach was improved and re-



location of the Telecom coaxial cable was avoided. Nevertheless, relocation of other underground cables was necessary and was undertaken by Telecom at a cost of $48,000 before the bridgeworks commenced.

The new four span continuous post-tensioned concrete superstructure was designed by the Department's Bridge Section and provides a 148.3 m length at deck level. End spans are each 31.7 m long and the central spans are 38.5 m long, with a 3 m long approach slab provided at each abutment, built with one edge resting on the abutment wall and the remaining area resting on the approach fill.

Provision is for a single lane of traffic travelling in each direction, the deck being 9.2 m wide between kerbs, compared to 7.0 m wide in the truss span of the previous structure. There is a single footway 1.8 m wide which also carries electrical and other services in recesses underneath.

Construction begins

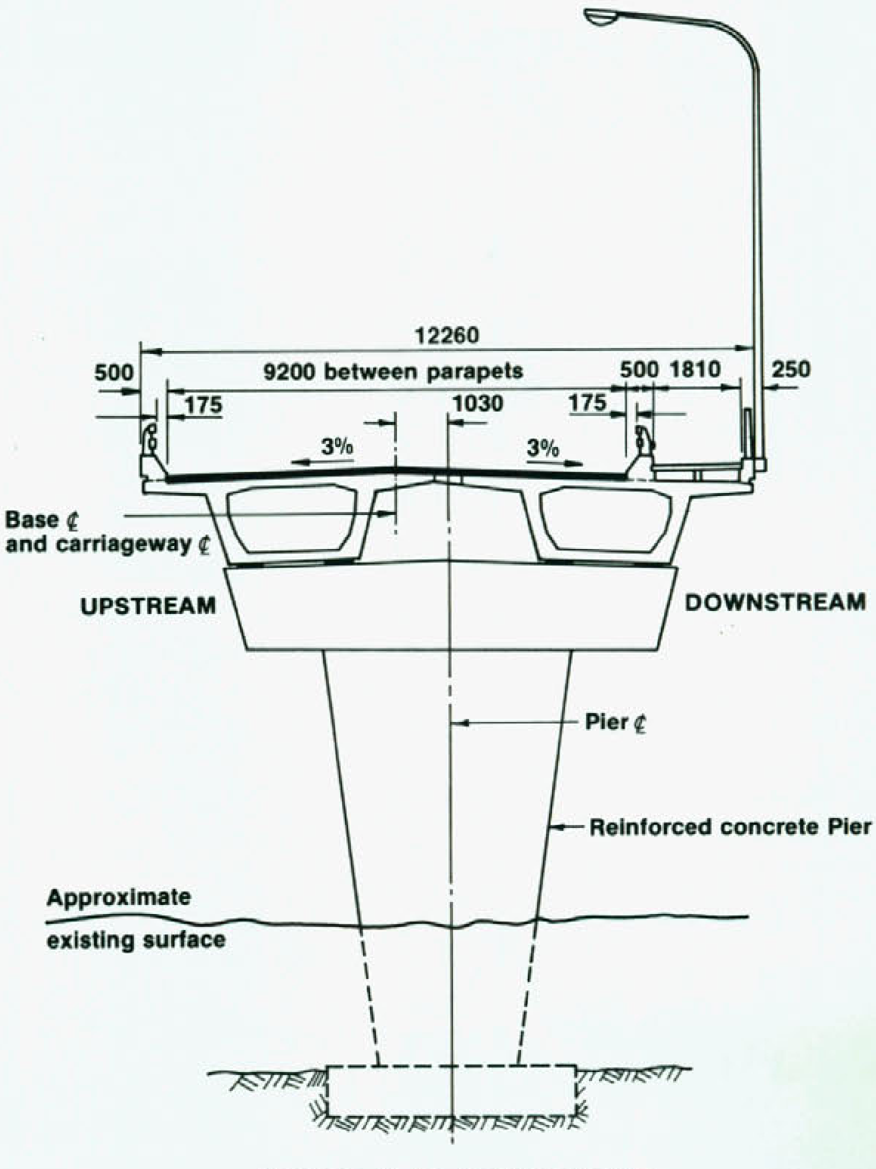
Demolition of the old bridge and construction of the new was contracted to ENPRO Constructions Pty. Ltd. of Unanderra for a tender price of $1,265,288.00.

Work under the contract began in October 1981, with the excavation of the pier footings, which were taken at least 0.5 m into the basalt bedrock. Some of the sawn-off ironbark piles of the 1876 bridge were unearthed in the excavations, still in a good state of preservation.

While the contractor proceeded with the reinforced concrete tapered rectangular pier columns and cantilever headstocks, Frankipile Australia Pty. Ltd. was brought in under sub-contract to construct the four piles at each abutment. These were each 9.2 m long at the western abutment and 10.6 m long at the eastern abutment.

A temporary footbridge was provided across the Macintyre River in Campbell Park to maintain pedestrian access during closure of the old bridge's footway.

In driving casings and excavating for piles at the eastern abutment, underground boulders were such a problem that an additional drilling rig was brought in to prebore the piles for the top 6 m. Steel pile casings were not extracted at the eastern abutment as they proved very difficult to remove.



CROSS SECTION AT PIER

After construction of the reinforced concrete headstock of the western abutment, work began on construction of the superstructure, which consists of two trapezoidal prestressed concrete hollow box girders of constant depth, built independently in four stages but joined upon completion.

When each of the four stages of the deck was completed, and the concrete had gained adequate strength, the four cables in the girder section just completed were stressed to 600 tonnes each. Cables were joined to the cables of the previous stage by couplers.

The ducts carrying the cables were then pumped full of cement grout which set to provide permanent protection from water penetration and corrosion.

To allow for expansion and contraction of the long deck under changes of temperature and for the normal shrinkage of concrete, the deck was constructed on sliding bearings at all supports except the central pier. The abutment bearings allow 50 mm for expansion or contraction from their initial setting.

On 24 May 1982, after completion of the first two stages of the superstructure, the old bridge was closed and partially demolished to allow construction to proceed.

Following completion of the new bridge, the contractor continued with the demolition of the old structure. After removal of the bridge decking, the trusses were disconnected and lifted out bodily, before being dismantled on the ground. Because of the difficulty of using oxyacetylene equipment to cut the thick cast iron sections, explosives were used to break up the footings and allow them to be cut off far enough below ground level.

Inverell Shire Council undertook work on the approaches to the new bridge, including extensive landscaping of the gully adjacent to Rotary Park. It also contructed an access pipe to the Telecom manhole buried under fill on the downstream side of the western abutment.

The new bridge was designed to be fitted with painted steel railings, but the contractor's alternative proposal to use unpainted aluminium was accepted. This bridge is the first built for the Department to use an aluminium pedestrian railing, and one of the first to use aluminium crash barrier railings. Aluminium has the advantage of not requiring expensive painting for corrosion protection. Also, aluminium railings are relatively light and easy to erect, yet still strong.

The township celebrates

On 14 March the township of Inverell celebrated the opening of the new bridge in true gala style. A crowd estimated at more than 5,000 attended the ceremony and watched the parade which followed, despite the 36° heat.

Officiating at the opening were the Minister for Roads, the Hon. R. F. Jackson, M.P., the Member for the State Electorate of Barwon, Mr. W. T. J. Murray, M.P., the President of the Shire of Inverell, Councillor B. C. Johnston, and the Commissioner for Main Roads, Mr. B. N. Loder.

After the ceremony had concluded, a parade led by three members of the Light Horse Association and featuring a wide range of historical vehicles crossed the new bridge and headed into the town centre, followed by a stream of spectators and schoolchildren. A community picnic for the townspeople, held in parkland near the eastern abutment, was a fitting end to the celebrations. ●

For many of these school childen, the opening was the biggest public event in their memory.
(Below) A procession of vintage and veteran cars crosses the newly-opened bridge.

BETTER ROADS FOR BICENTENNIAL

The theme of Australia's Bicentennial celebrations in 1988 will be "The Australian Achievement", and a significant step has been taken towards a high standard of achievement in road development.

In August 1982, the State Government announced a major initiative being undertaken by the Commonwealth Government to upgrade Australia's road system by 1988. The project, called the Australian Bicentennial Road Development Program, will make available an estimated $2,500 million nationally for road construction.

For 1982/83 and 1983/84 alone, New South Wales can expect to receive $92 million for national roads, $81.5 million for arterial roads and $22.5 million for local roads. In January this year the Commonwealth Government approved the first of these: 43 road construction projects to the value of $218 million. These funds will be in addition to Commonwealth grants provided under the National Roads Grants Act. The approvals were made and allocations granted immediately following passage of the enabling legislation through Parliament and the royal assent to setting up a trust for the program.

The trust fund, which is administered by the Commonwealth Department of Transport, guarantees that the money raised from the 1c a litre petrol tax (this will rise to 2c a litre from 1 July 1983) is spent on roads. Distinctive signs featuring the Australian Bicentennial logo will identify every construction project under the program, to let road users see that the small fuel surcharge is being put to good use.

It is expected that the program will create at least 20,000 more jobs throughout Australia, many of them in country areas, and will provide stable employment for people already in the road construction industry.

Duplication of the Hunter River bridge at Hexham should be completed by mid-1985.

New South Wales Projects approved for 1982/3

Urban Arterial Roads

Eleven projects in Sydney, Newcastle and Wollongong have been approved for urban arterial road construction involving an estimated total expenditure of $9.45 million in 1982/3

Two major projects will significantly reduce heavy traffic congestion in the

Urban Arterial Roads

Road	Project	Estimated Cost $000
Princes Highway	Duplication of bridge over Georges River at Tom Uglys Point.	11,000
Pacific Highway	Grade separation with Mona Vale Road, including railway overbridge.	7,100
Western Freeway	Construction of viaduct from Wentworth Street, Clyde, to Church Street, Parramatta.	26,000
South Western Freeway	Construction of approaches to bridge over Georges River at Casula.	2,600
Great Western Highway	Prospect deviation—strengthening and widening from 4 to 6 lanes including loading ramp for eastbound traffic at Church Lane.	2,000
Betts Road	Reconstruction and widening to 4 lanes Woodpark Road to Merrylands Road, including bridge over water supply canal.	1,930
Orange Grove Road	Reconstruction and widening to 4 lanes from Hume Highway to Cabramatta Creek.	1,200
Parramatta By-pass	Construction of 6 lane divided carriageway Harris Road to Great Western Highway.	5,000
Old Windsor Road	Construction of 4 lanes between Johnsons Bridge and Pyes Crossing.	2,100
Northern Suburbs Distributor, Wollongong	Grade separation bridge at the Princes Highway, Wollongong.	2,200
Pacific Highway	Duplication of bridge over Hunter River at Hexham.	8,000

Sydney area—at the bridge over the Georges River at Tom Uglys Point and at the junction of Mona Vale Road with the Pacific Highway. Seven other projects are located in Sydney's heavily populated western region.

Rural Arterial Roads

A total of $7.9 million has been allocated for construction works on rural arterial roads in 1982/3, with a major emphasis on bridgeworks.

New South Wales submitted rural arterial road projects estimated to cost $20.575 million, of which $6.3 million will be expended this financial year.

Projects approved for 1982/3 appear in the following table. The amounts shown against each project are a preliminary estimate only. In some cases, it may not be possible for the State to commence work in the current financial year.

Local Roads

Entitlements to city, municipal and shire councils for local roads total $7.7 million in 1982/3. This allocation is expected to increase to $14.8 million in 1983/4. ABRD Program funds will boost last year's Road Grants allocation to Councils.

The Department is inviting Councils to submit a schedule of local roads projects which they propose to undertake prior to 1988. Then the Department will prepare a final schedule of all Council submissions for consideration by the State Minister for Roads, Mr. Jackson, and the Commonwealth Minister for Transport, Mr. Morris. ●

Australia
1788-1988

This six lane divided carriageway, Stage 4 of the Parramatta By-pass, was opened in December 1981. Under the ABRD Program, the By-pass will be completed with the final link to the Great Western Highway at Wentworthville.

Rural Arterial Roads

Road	Location	Project	Estimate cost $000
Illawarra Highway	Sutton Forest	Construction of bridge over Medway Rivulet.	225
Illawarra Highway	Sutton Forest	Construction of approaches to bridge over Medway Rivulet.	200
Pacific Highway	36.0 km north of Taree	Construction of bridge super-structure over Stewarts River.	2,000
Pacific Highway	Taree	Construction of approaches to bridges over Stewarts River.	1,500
Pacific Highway	54.3 to 59.6 km north of Grafton.	Construction of Chatsworth deviation.	700
Pacific Highway	34.0 km north of Coffs Harbour.	Construction of Wedding Bells deviation.	1,200
Bruxner Highway	58.84 km west of Tenterfield.	Construction of bridge over Beardy River.	
	74.10 km west of Tenterfield.	Construction of bridge over Dumaresq River overflow 1.	700
	79.75 km west of Tenterfield.	Construction of bridge over Dumaresq River overflow 2.	
Mid Western Highway	Cowra	Construction of bridge over Lachlan River.	4,750
Sturt Highway	1.48 to 1.5 km north of Mildura.	Construction of bridge over Murray River.	4,500
Sturt Highway	North of Mildura.	Construction of approach bridges at 1.76 km, 2.02 km and 2.83 km.	800
Barrier Highway	11.0 to 14.25 km east of Wilcannia.	Approaches to bridges over Talyawalka Flood Plain.	2,000
Monaro Highway	34.6 to 40.4 km south of Canberra.	Reconstruction from A.C.T. border.	2,000

BRIDGING RIVERS IN THE DEEP SOUTH

In search of an inland sea

Rivers in the New South Wales colony had posed problems to explorers since the crossing of the Blue Mountains in 1813. West of the mountains the Lachlan, Macquarie and Castlereagh Rivers were discovered, but their destinations remained a mystery for some time.

Surveyor John Oxley's two expeditions following the Lachlan River in 1817 and the Macquarie River in 1818 resulted in several important discoveries, but failed in their purpose of locating the destination of the inland rivers. As a result of his exploration, Oxley propounded the theory that the westward-flowing rivers discharged into an inland sea.

In 1828 Governor Ralph Darling sent out a party under the leadership of Charles Sturt to explore the western rivers. Sturt returned with the discovery of another large river which he named in honour of the Governor. In 1829 he was assigned the task of tracing the Murrumbidgee, first sighted at its confluence with the Molonglo River by Charles Throsby in 1821. Sturt followed the Murrumbidgee and then the Murray to the sea, finally refuting Oxley's inland sea theory.

Further exploration and settlement

In 1836 Surveyor-General Thomas Mitchell traced the Lachlan River to its junction with the Murrumbidgee, following both it and the Murray by land to the Darling River confluence.

Following the discovery of gold in 1851, development in the Riverina district slowed, as road carriers and their bullock teams left to ply their trade in the more lucrative goldfields.

Stations were stranded without provisions and with their produce and woolclips uncollected for sale at markets. River transport soon began operating, and in August 1853 the first two steamers of William Randell and Captain Francis Cadell began to serve the Murray and the Murrumbidgee Rivers.

The establishment of river traffic had a rapid and widespread effect in southwestern New South Wales. Costs of living were reduced and the quality of stores was much improved by competition. Towns developed as stopping places along the rivers, but soon roads and railways extended to meet the needs of these rural centres.

The decks of the Murrumbidgee River and flood channel bridges are higher than the record flood level.

Narrandera is recorded as being a pastoral station held in the name of Edward Flood in 1848. Most of its early development took place due to its location on a stock route from the north. Surveyor Edward Twynham carried out a survey for a village at the site in 1859. Today, Narrandera is the gateway to both the Murrumbidgee and Coleambally irrigation areas, semi-arid regions transformed by river waters into luxuriant farmland.

A new approach

Apart from providing much of their livelihood the Murrumbidgee River also presented the townspeople with a problem: the need for a crossing. Until recently this need had been met by an old timber structure, built around 1890.

A small two span timber bridge over nearby Bundidjerry Creek and the adjacent concrete bridge over the main Murrumbidgee Irrigation Canal, coupled with the narrow Warren truss bridge, created a series of restricted traffic points. These restrictions have been eased as construction has recently been completed on the widening and realignment of the southern approach to Narrandera. This work included three new bridges, the widening of the concrete canal structure and raising the level of the roadway to provide flood-free access to Narrandera from the south.

Some 69 000 m³ of filling was used in the approaches for the new bridges.

The decks of the new structures over the Murrumbidgee River and its flood channel are higher than the record flood level which occurred in September 1974.

Design and construction

Design and construction for this project were undertaken by the Department of

Bridges of reinforced concrete represent well the technology of our age. They make a fair contrast to the technology of an earlier age when timber bridges were the norm. Yet another type of appropriate technology was the bark canoes used by the Australian Aborigines. These light but sturdy craft were well suited to the lifestyle of their designers.

Two plaques referring to the Aboriginal canoe tree in a park at Narrandera (pictured), bear the following inscriptions:

The Wiradjuri tribe, who once inhabited this district, made a canoe from the bark of this tree when it stood on Waterview, near Lake Talbot. The other tree trunk and 'face' were removed from Buckingbong.

Hunters were they, lithe, fleet,
With senses keen;
Their axes were of stone,
And they would hew
With skilful hand
Bark from an old tree
Such as this, and built with ease
A sturdy light canoe.

—Elizabeth Graham

Main Roads. Most of the 69 000 m^3 of filling needed to reconstruct the approaches was obtained from an adjacent river flat borrow pit, which will hopefully later be formed into a park lake. The resultant material, however, made poor filling. To seal the surface under the base metal to form a water barrier, a one per cent lime stabilisation mixture was added to the upper 150 mm over a 1.3 km length.

Both northern and southern flood plain approach bridges are standard structures comprising prestressed precast concrete planks with reinforced concrete decks.

The main four span bridge over the Murrumbidgee River has been designed in plate girders, 1200 mm deep by 300 mm wide flanges, fabricated by the contractor in Adelaide in segments to facilitate transporting, handling and launching.

A total bridge length of 106 m is achieved by providing two 30 m main spans and two 23 m approach spans with girders continuous over the piers. Each girder was fabricated in seven segments requiring six site welds to make up a girder. Six of these continuous girders were required for the whole bridge. Each girder was launched across the structure by winching. The deck consists of approximately 180 mm thick reinforced concrete and 50 mm thick asphaltic concrete wearing surface. A fabricated steel handrail system was also provided.

Built some 70 m upstream from the existing structure, the new bridge provides a 9.2 m wide two lane carriageway, with a 1.5 m wide footway on the upstream side.

The three bridges are founded on 900 mm diameter tubular steel piles driven to approximately 30 m and to 40 m for the main structure, with the upper 8 m filled solid with concrete.

Together the three bridges and approaches cost around $3.25 million. The bridge over the Murrumbidgee River was constructed by McDougall-Ireland Pty. Ltd. at a cost of $1.25 million; the southern approach bridge also by McDougall-Ireland Pty. Ltd. at a cost of $600,000; the northern approach bridge by Nelmac Pty. Ltd. at a cost of $450,000, and the approach roadworks by the Department at a cost of $950,000.

Official opening

On 18 February 1983, the new bridges were officially opened to traffic by the newly appointed Minister for Roads, the Hon. Rex Jackson, M.P. In attendance at the opening were also the Hon. Lyn Gordon, Minister for Local Government, Minister for Lands and Member for the State Electorate of Murrumbidgee, Mr. Noel Hicks, M.P., Member for the Federal Electorate of Riverina; Mr. Tim Fischer, M.P., Member for the State Electorate of Murray; Councillor Warwick Heckendorf, President of the Shire of Narrandera; and Mr. Bruce Loder, the Commissioner for Main Roads, together with over two hundred interested spectators.

Mr. Jackson spoke highly of all those involved in the project, and commented on the improvement these works would make to the Newell Highway route, particularly in providing a flood-free crossing of the Murrumbidgee River for the people of Narrandera. ●

THE DEPARTMENT'S REVIEW TEAM

Establishment

The Department of Main Roads has always recognised the need for continually adjusting the organisation to meet changing circumstances, and there have been many such alterations over the years.

However, a renewed impetus arose from "Directions for Change: an interim report by Prof. Peter Wilenski, Commissioner, Review of N.S.W. Government Administration who recommended the Department as one of the State Government Instrumentalities for a Management and Strategy Review. Management consultants W.D. Scott and Co. Pty. Ltd. were commissioned to perform the review and two Departmental officers were nominated to assist them. After the review was completed it was decided to continue the study of organisational issues and problems in the Department with a view to improving operational effectiveness and efficiency.

The purpose of a review is to achieve optimum use of resources. It involves studies of systems, methods, working relationships and organisational structures and may result in recommendations affecting work planning, the organisation or its management.

It was accordingly decided, late in 1978, that:

(a) a Review Team be established to study organisational issues and problems within the Department with the dual aims of promoting efficiency and increasing the effectiveness of organisational units;

(b) the Review Team report to a Steering Committee consisting of the Engineer-in-Chief, the Secretary and the Chief Accountant;

(c) the Review Team consist initially of a Supervising Engineer of the Engineer-in-Chief's Branch and an Administrative Officer (Clerical) Class VI of the Secretarial Branch.

A second Team began operation late in 1980 with one Team member nominated as co-ordinator to oversee the day-to-day running of both Teams. At the same time the steering committee was expanded to include the Chief Legal Officer and the Chief, Policy and Economics Unit.

Projects

Reviews completed or in progress are as follows:

- Goulburn Divisional Drawing Office
- Survey and Property Section
- Mechanical Section
- Central Workshop
- Standard Specifications and Technical Instructions Section
- Central Workshop Building Section
- Supply of Spare Parts for Plant and Motor Vehicles
- Property and Related Functions of Legal Branch
- Supply Section
- Works Office Operations
- Head Office Section Groupings
- Records Management
- Voucher Examination and payment of accounts
- The Department's total landscape function
- Registration and Storage of Plans and Drawings
- Microfilming of Documents

Review methods

The Review Teams act as catalysts in the process of organisational change. Divisional Engineers, Section Heads, supervisors and others are encouraged to become involved in projects within their operational areas in the expectation that with involvement will come a commitment for change. This involvement is essential because no matter how valid the Teams' recommendations may be, they will succeed only if they have the degree of acceptance necessary for successful implementation.

Defining problems within an organisation is not always the difficult part of a review. As is usually the case, officers in the Section under review usually have a fair idea of the problems in their operational area.

Because the Team members are not closely involved in the area under review a more objective, less defensive assessment is possible. Review Team members have been given the time to critically appraise a Section's operations, whereas Section members are heavily committed to their day-to-day operations and tend to continue doing tasks as they have always done.

Review Teams are not confined to any specific method in carrying out reviews. However, reviews are generally carried out along the following lines:

- *researching* files, documents, statutes, regulations and books of instruction.
- *discussions* with officers in the Section or office or anyone involved with the system under review either now or in the past.
- *reporting* the ideas gathered during the review to the people involved in the review for comment and correction prior to going to the Steering Committee for assessment.
- *follow-up* to determine if further investigation or consultation by the Team is needed, and to determine how the report has been received and what action has been taken so that the Team can modify its approach in subsequent reviews if appropriate.

Operation

The Teams were established as something new for the Department, and without any real experience in such a concept being available from within the organisation.

In December 1980 a document "REVIEW TEAMS—ESTABLISHMENT, DEVELOPMENT AND OPERATION" was produced, the basic operational philosophies of which are still considered to be appropriate. However, each project has different requirements and the method of carrying it out has to be determined in the light of available resources and project objectives.

It is worth noting that the Department's Review Team concept was the first of its type established in the New South Wales Public Service. Others have since been established, notably the Audit and Investigation Division of the Public Service Board (as distinct from Management Services) and a Review Team within the Water Resources Commission of N.S.W.

The following observations have been made on specific aspects of Team operation—

- A Team of two works very well. For a short period the Team number was increased to three (not including anyone from the area under review) but did not function as well. More co-ordination is required and a hierarchy tends to develop, contrary to the philosophy that Team members are equal.
- A flexible approach must be adopted and the number of Teams should either increase or decrease according to future needs.
- Team membership of an Engineer and an Administrative Officer (Clerical) has been most satisfactory. This is not to say that a particular individual representing another group within the Department could not have performed as effectively. However, it is true that the bulk of the Department's managerial and administrative responsibilities now rest with the engineering and clerical groups and a broad working knowledge of the Department as a whole is an essential prerequisite for Team membership, as is general acceptability within the groups being reviewed.
- All Review Team positions should be advertised, and within the approved professional groups should not be tied to a particular classification other than that they should be around "middle management".
- It would appear that the value of Review Teams is recognised throughout the Department.
  The general response to the Teams has exceeded expectations, particularly in the willingness of Officers to talk and respond to general requests, and in a willingness to provide specific information when approached.
- Internal publicity about the Teams' activities such as notification of new projects and invitations to participate should continue.
- The highly consultative approach adopted by the Teams has become an important part of their operational style and should continue.

Experience has shown that many people in the organisation have a valuable contribution to make and appreciate the opportunity to do so. Further, the process ensures that Team proposals are properly discussed and consequently have a better chance of acceptance when put forward.

As may be expected there are disappointments as well as successes. The team members generally have little if any previous experience in the areas examined, and as a consequence can inadvertently give undue weight to views expressed which are unacceptable to senior mangement. In order to avoid discouragement, the teams therefore need to meet regularly with senior management comprising the steering committee.

Summary

The Review Team concept within the Department has moved over the past five years from an idea to reality. Two fully operational Teams have been established which are accepted and respected within the organisation for the contributions they have made and have the potential to make towards the development of the Department.

The Teams have a commission to improve organisational effectiveness and efficiency, and to assume a catalytic role. As such, they probably have a more flexible charter than any other Departmental group—a vital characteristic for groups which must to some extent be considered as change agents. However, it must always be remembered that the review will have achieved nothing if problems identified are not corrected by implementing changes. The end product of a review should not be the report, but rather the achievement of the changes, which it deems beneficial. ●

Blacktown Division commences operation

Blacktown Division commenced operations on 14 February this year in direct response to the changing needs of Sydney's western suburbs. It was formed by re-allocating Local Government areas from Parramatta Division.

The new Division is responsible for the council areas of Baulkham Hills, Hawkesbury, Hornsby, Blacktown and Penrith. Responsibility for Gosford has now been transferred from Parramatta to Hunter Valley Division, which last year gave control of Great Lakes to Lower North Coast Division.

From 1 July 1983, Campbelltown and Camden council areas will be transferred from Illawarra to Parramatta Division, which will also acquire the Sutherland council area from Metropolitan Division. From this date, Metropolitan Division will become known as the Sydney Division.

With the completion of the F3—North Western Freeway over Darling Harbour and major sections of the F4—Western Freeway, Inner Freeways Division has been closed. Responsibility for continuing construction work on the F4 has been transferred to Parramatta Division.

Future boundary adjustments may be necessary and these are currently being investigated.

The new office at Blacktown is not expected to affect staffing levels within the Department. If a change is required, it would be to slightly increase the numbers of staff. ●

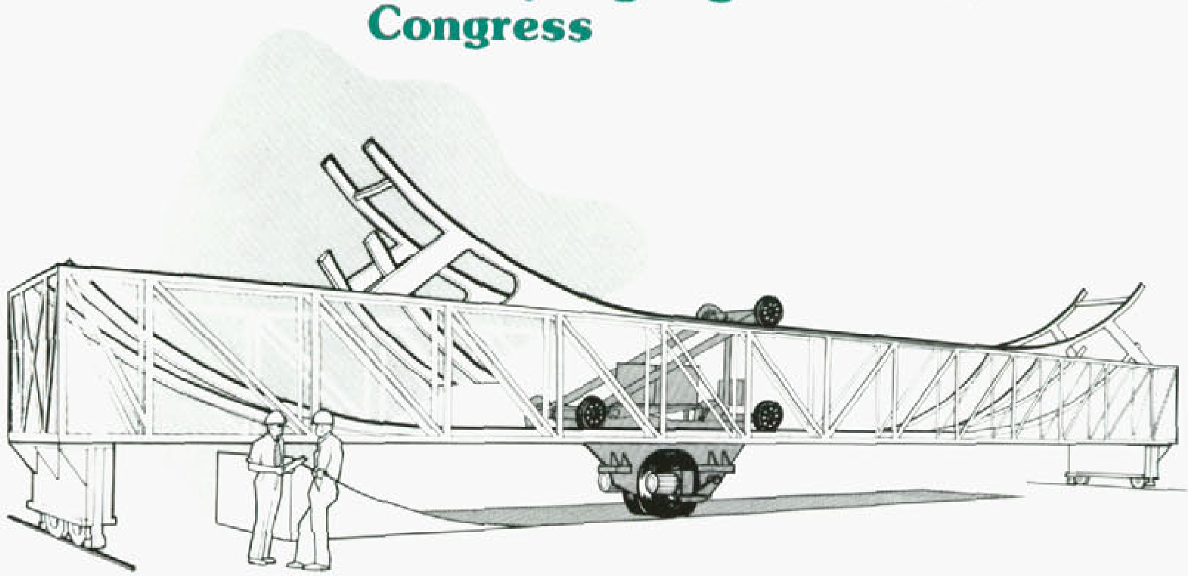
ROYAL VISIT

The Sydney Harbour Bridge, one of the city's truly great landmarks, was a fitting backdrop to the Royal visit of their Royal Highnesses the Prince and Princess of Wales (1) in March this year. Seen here (2 & 3) with Sydney Cove and the Opera House in the foreground, the bridge's size is difficult to appreciate. Just as an indication, one of its special flags, 10 m by 5 m in size, was borrowed by the Education Department for the Commonwealth Day ceremony held in Sydney Town Hall (4) just a fortnight earlier. The flag, which is flown from the bridge's arch during special occasions, was used as an effective backdrop to the Combined Choir and Sydney Schools' Symphony Orchestra.

Photo courtesy of Dept. of Education.

ALF GOES TO THE OPERA

Accelerated Loading Facility highlights PIARC Congress



Artist's sketch of the Accelerated Loading Facility pavement testing machine. The Australian-designed and built machine is to be displayed at the XVII World Road Congress of the Permanent International Association of Road Congresses at the Sydney Opera House, October 8-15, 1983.

One of the highlights of the XVII World Road Congress to be held by the Permanent International Association of Road Congresses (PIARC) at the Sydney Opera House, October 8-15, 1983 will be the display of a pavement testing machine designed and built in Australia for the National Association of Australian State Road Authorities (NAASRA) and the Australian Road Research Board (ARRB). The machine is being constructed at Central Workshop, Granville under the supervision of engineers of the Department of Main Roads, N.S.W.

Described as an Accelerated Loading Facility, the machine will be 26 m long, 5 m high and 2.5 m wide, which is about the size of two large semi-trailers.

It has been designed to test a road pavement using a wheel load of up to 10 tonnes running over the pavement to simulate actual truck loadings or greater, and to allow one million passes in 8½-second cycles without major overhaul. This means the machine can determine in a few months the life of a test road pavement which would otherwise take decades, and to allow engineers to substantiate or improve current theories on pavement design.

The machine will be cheaper to build, operate and maintain than overseas models because of its design, mechanism and low power requirements. It can be dismantled into smaller components for transport from site to site.

The outline specification for the machine, which was drawn up by a Working Group from NAASRA and ARRB, provided for:

Static Wheel Load:	40 kN (minimum) 100 kN (maximum) (The current legal maximum is 40 kN, thus a 250% overload can be tested.)
Load Wheels:	Say dual
Full Size Truck Tyres:	11.0 x 20 x 16 ply
Test Length:	10 m
Transverse Movement of Test Wheel:	0.8 m
Test Speed:	20 km/h (This is considered to be the practical maximum.)
Transverse Wheel Movement:	Normal distribution but applied in a random manner.
Suspension of Wheel Assembly:	Alternative suspension units required, say pneumatic and spring.

The design, which was approved by NAASRA last year, has a number of unique features:

- Stopping, reversing and re-accelerating of the trolley assembly is achieved without the use of brakes or any external energy. This is done by running the trolley assembly up and down ramps curved in the vertical plane, thus converting the kinetic energy of the trolley motion into potential energy and vice versa. The geared motors driving the test wheel only provide sufficient energy to overcome the grade, crossfall and rolling resistance as the loaded wheel runs over the test pavement.
- The geared motors run continuously at a constant speed in one direction only.
- The system of converting kinetic energy to potential energy and vice versa is combined with a unique third rail assembly which lifts the trolley assembly—resulting in the test wheel being clear of the pavement for the return cycle, and also causing the top of the test wheel to contact horizontal running plates in the mainframe assembly, providing traction in the reverse direction.
- The machine is designed for long life under continuous operating conditions in all weathers, and with low maintenance costs. A number of safety and fail-safe features are incorporated.
- Sophisticated instrumentation and facilities are provided to measure the record test cycles, dynamic wheel loads, pavement deflection and a number of other aspects of pavement behaviour.

An Australian Patent Application covering the machine has already been filed, and action has also been taken to obtain World Patents.

Congress details

The Congress itself has generated much interest overseas as well as in Australia. Final attendance figures will not be compiled until just before the starting date, but more than 1,000 delegates and accompanying persons have already signed up, even though the Congress is still more than three months off.

A World Road Congress is usually held every four years, and this year's will be the first in Australia, and only the second in the Southern Hemisphere since PIARC was founded in 1909. Australia joined PIARC in 1924 as a National Government member and in December 1979 offered to host the 1983 Congress.

Among the many delegates from overseas will be Mr. G. Arquie, Engineer-General of Bridges and Roads, France (chairing a special conference discussion on energy savings in roads and road transport); Dr. R. S. Millard from England, and formerly Highway Engineering Adviser to the World Bank (chairing another special discussion on the impact of road networks on economic and social life in industrialised countries and in developing countries); Mr. H. Hondermarcq, Director General of the Belgian Department of Roads and Bridges (Inter-urban Roads); Mr. E. Nakkel of the German Federal Republic (Flexible Roads); and Mr. R. Medeot of Italy (Road Bridges).

The complete agenda occupies most of a substantial booklet, and involves the planning output of nine working committees and 11 technical committees, and input from 19 specialist advisers ranging from the Association of Consulting Engineers of Australia to the School of Civil and Mining Engineering, University of Sydney.

The comprehensive technical program for the Congress includes:

EARTHWORKS, DRAINAGE AND SUBGRADE

Laboratory and in situ tests, remote sensing, stabilisation and reinforcement, use of industrial wastes, effect of water on bearing capacity, instability risk in slopes, new compaction methods, protection of subgrade, new drainage materials and methods, restoration of damaged subgrade, inspection instruments.

CONSTRUCTION AND MAINTENANCE OF PAVEMENTS

New techniques, fatigue, surface damage, deflection, skidding resistance, the Serviceability Index, noise levels, artificial aggregates, aerodromes, flexible pavements, new binders and additives, effects of de-icing salts, recycling materials, assessment of experimental methods and materials.

INTER-URBAN ROADS AND MOTORWAYS

Mathematical methods for forecasting, data handling, environmental problems, public consultation, safety assessment, geometric standards and driver behaviour, service levels, new information techniques.

ROADS IN URBAN AREAS

New design principles, consequences of energy restrictions, technical and financial measures to influence modal split, developments in noise reduction and other environmental/social considerations.

ROADS IN DEVELOPING AREAS

Evaluation of social and economic impact, chemical stabilisation, dry compaction, optimum levels of labour equipment, climatic factors.

Although not listed as a formal agenda item, the Australian Bicentennial Road Development Program (ABRD) will feature in Congress activities through a series of briefings available to delegates. The scale of the program and the road distances involved are unusual in overseas terms, and now that funding has been authorised and actual work scheduled, the program will become increasingly interesting for overseas roadmakers as well as local experts.

This interest will be heightened by the International Trade Fair, 'Road 83', which will be held from October 12-15 at Sydney's Royal Agricultural Society's Showground, in parallel with the Congress.

All enquiries and applications for the Congress should be made to:

Australian Organising Committee (PIARC),
G.P.O. Box 2609,
Sydney, N.S.W. 2001.
Telephone: (02) 241 1478 or 27 6940
Telex: AA-21825 (PIARC) ●

MURALS AND MUSINGS

Murals differ from other artforms in that they are conceived for a particular site and must be relevant to and enhance their surroundings. They often serve to break up an expanse of wall into something more personal or more easily assimilated.

A 2 000 square metre mural, the largest in Australia, now enhances the King George V recreation area at Cumberland Street, The Rocks.

The mural was painted on the walls of the southern Harbour Bridge approaches. The project was organised and funded by Sydney City Council and assisted by the New South Wales Government and both the Community Arts and Visual Arts Boards of Australia Council, following the Department's agreement to the use of walls.

The mural's basic *tromp l'oeil* pattern and surrealist tricks create a fantasy theme and wonder world which is able to reach through to the child in all of us. ●

1. Where does it start and where does it finish? The 2,000 square metre mural at Cumberland Street shown here nearing completion.
2. The Commissioner for Main Roads, Mr. Bruce Loder, with the Lord Mayor of Sydney, Ald. Doug Sutherland (in a painters' smock), and local schoolchildren.
3. Real competes with surreal in the recreation area.

4. How to see through a wall . . . the bridge being painted on its own southern approach walls.
5. Local schoolchildren contributed by painting a rainforest in one of the lower "arches".
6. The murals create vision and depth on what was previously a blank wall.
7. Community artists Peter Day, Paul White, Madeline Murray and Vernon Treweek directed the work's skilful design.

This mural at the Stanton Library at North Sydney features the Sydney Harbour Bridge in a dreamlike setting.

CROSSING A CONTINENT

According to Greek legend, an early attempt at travel was thwarted by the sun. It came about when Daedalus made a pair of wings for his son, Icarus, so that he could escape from Crete. Icarus put on the wings and flew so high that the sun's heat melted the wax holding the feathers together. He fell to his death in the sea.

In our contemporary world, the sun's rays are being harnessed to provide energy for a multitude of uses, including travel.

Trans-Australia trek

In January this year, the first crossing of the Australian continent by a solar-powered vehicle was accomplished in 172 hours. The 4084 km trip was completed by Hans Tholstrup and Larry Perkins, who took it in turns to drive the specially-designed one-man vehicle.

After leaving Perth on 19 December, the 'Quiet Achiever' crossed the Nullarbor Plain to Port Augusta, then continued east through Broken Hill and Dubbo.

By the time they reached Bathurst, the car was so far ahead of schedule that the crew decided to spend some time on the Mount Panorama circuit. It took 18 minutes 45 seconds to complete one lap, yet no fuel was used. Racing cars do a lap in about three minutes, but they use up three or four litres of fuel.

The climb up Victoria Pass on the western side of the Blue Mountains was the most difficult part of the trip. Despite the steep incline, the car managed to achieve 13 or 14 km/h. From there it was downhill nearly all the way to the Opera House, where the two drivers celebrated the historic crossing by pouring a bottle of water from the Indian Ocean into the Pacific.

Weather conditions posed some problems en route. At one stage, dust storms reduced visibility to only a few metres and the car had to stop for a while in case it became obscured to passing traffic. Despite some days of heavy cloud, there was enough radiation in the atmosphere to continue to power the vehicle.

'Quiet Achiever'

The solar-powered car was designed for the Perth to Sydney trip by brothers Larry and Garry Perkins. They knew what power could be produced by a practical-sized solar module. They determined the aerodynamic resistance, the rolling resistance and the approximate weight and then designed the vehicle characteristics to give an acceptable speed.

Costing $15,000 to build, the vehicle weighs 140 kg, stands one metre high and reaches speeds of up to 60 km/h. It has a space-frame tubular steel chassis, to which a glass-fibre body is attached. There are two tubular beam axles supporting four bicycle wheels.

The aluminium-framed solar collector carries 720 cells within 20 modules. These convert the sun's rays into electrical energy to charge two 12 volt batteries, which can be used singly or in tandem. The batteries drive a 24 volt, one-horsepower motor, the power being transmitted by chain drive to a sprocket which drives the left rear wheel.

Other features are a prominent ampmeter, a digital speedometer and a switch to turn the power off. It can be steered by either hand or foot and the braking system consists of calipers on both rear wheels.

'Quiet Achiever' performed to a high standard on this history-making trek, which was sponsored by BP Australia. One set of batteries and the same motor were used for the entire trip. The motor developed nearly four horsepower, or more than 2,000 watts, in favourable conditions.

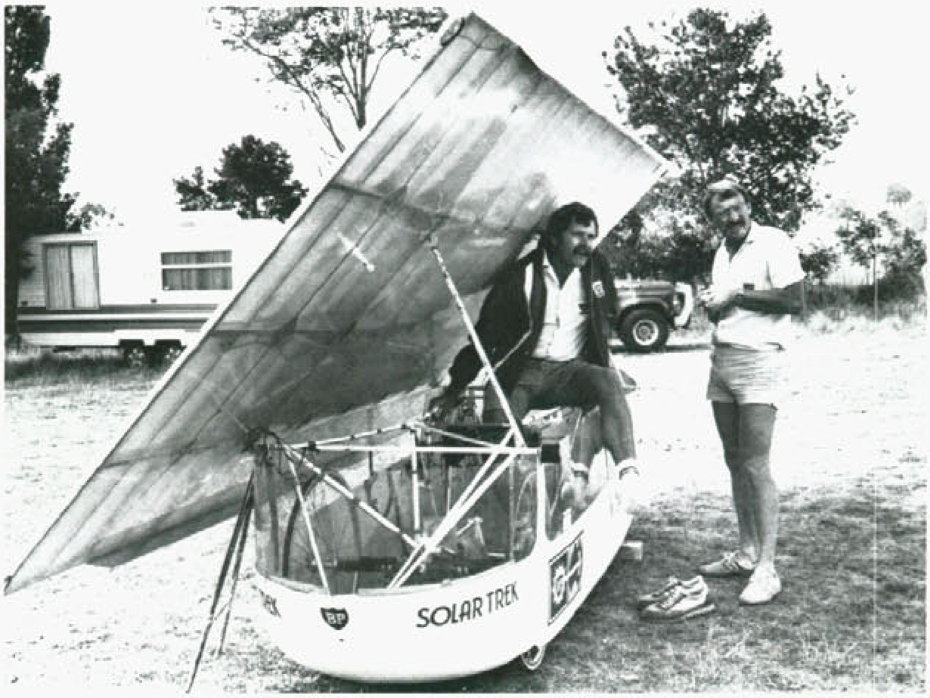
Only a few problems arose, including the torque developed by the small electric motor, five punctures and some broken spokes in the drive wheel, caused by rough road surfaces.

This record-breaking trip augurs well for the future application of solar power to transport needs. The main area of use will probably be small commuter cars and, here alone, the savings in energy costs and fuel reserves will be of immeasurable benefit to motorists everywhere. ●

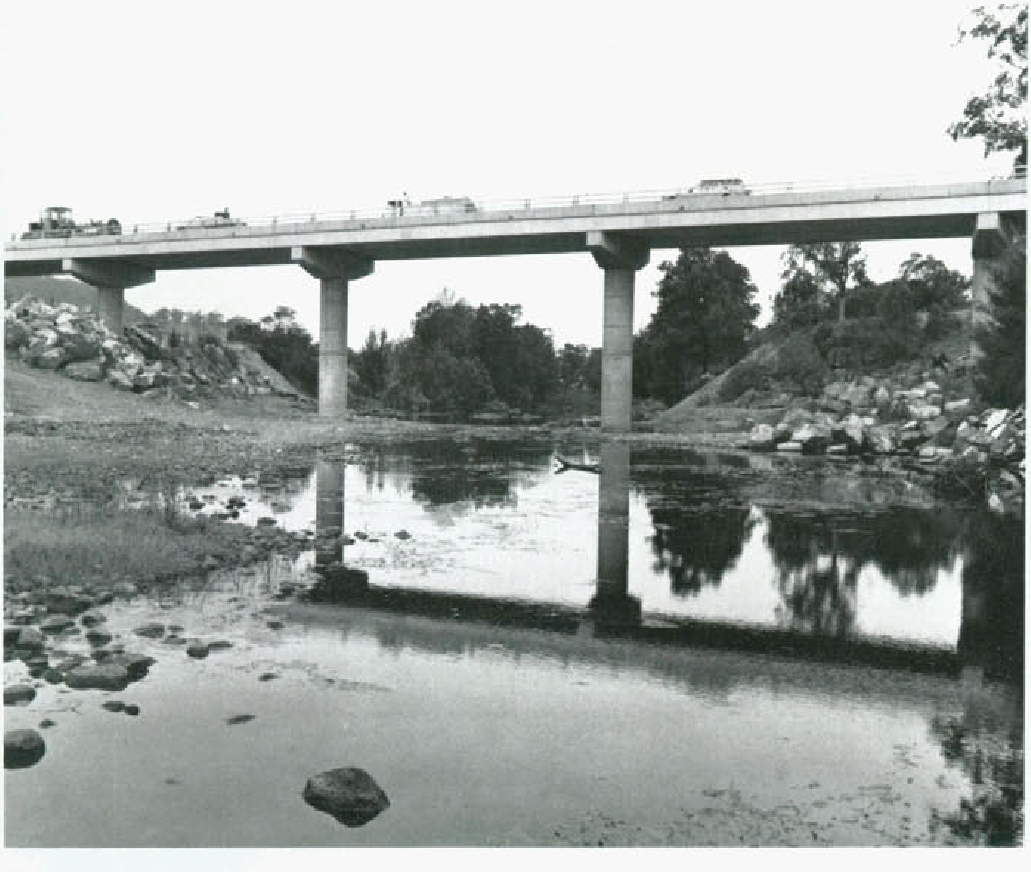
ON THE WINGS OF THE SUN

(Left) 'The Quiet Achiever' negotiating a steep incline on the Great Western Highway. Hans Tholstrup (left) and Larry Perkins run a last-minute check on the solar car before setting out on the final leg of the journey.

(Photographs reproduced courtesy of John Fairfax and Sons Limited.)



The new Washpool Bridge which carries M.R. 289 over the Karuah River north of Stroud was opened to traffic in October 1982. It is 100.7 m long and replaces a low level timber structure.



ON THE BUSES... ON THE ROADS

What's blue and white and runs around Sydney every day? Government Buses. Those of us with good memories can perhaps remember them as green and cream or even red and cream. But whatever the colour, the service has been running now for over 50 years, providing a vital support link in our city's transport needs.

Anniversary celebrations in January 1983 by the Urban Transit Authority were headed by a free service between Circular Quay and Railway Square. Several vintage buses and a gold painted current model gave passengers a rare riding experience.

Improvements to the bus fleet have not gone unnoticed. The frequency and choices of destination for services have also improved over the last 50 years.

Yet some of the more unobtrusive factors in keeping such a service going are undoubtedly the vast network of roads, bridges, clearways and transit lanes maintained by our Department. We too have been improving our services to meet the needs of both the public and private traveller.

We will continue to do so through careful planning and the responsible allocation of funds. ●

The buses at Railway Square: celebrating 50 years of service.

CONTROL CABIN ON GLEBE ISLAND BRIDGE...

On Friday, 26 November 1982 the control cabin on Glebe Island Bridge was destroyed by fire. The electrical equipment which operated the opening span was damaged beyond repair and temporary arrangements had to be made to allow the movement of shipping from Blackwattle and Rozelle Bays.

Electricians from Five Dock Works Office removed the controls from the now disused Pyrmont Bridge. These were installed at Glebe Island Bridge which was then operated from below deck level. However, it could be opened to shipping only in the day time, between 6.00 a.m. and 7.00 p.m.

Meanwhile, a new cabin was constructed at the Department's Central Workshop. In order to retain its historic character the design of the original structure, which was built in 1899, was adhered to as closely as possible.

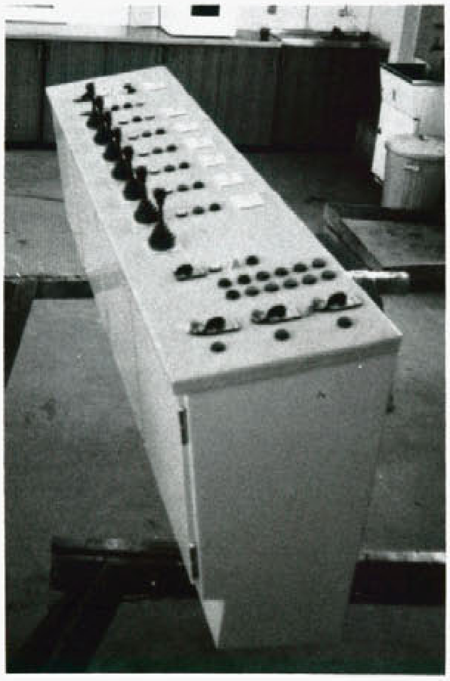
Features such as bay-end windows, weatherboard cladding, exposed post framing, carved exposed ends on rafters and copper roof shingles were retained.

Damage to the control cabin was extensive.

they do make things like they used to

The completed cabin, which was installed on Sunday, 19 December 1982, looks very much as its predecessor did when the bridge was opened in 1903. The main innovation was a modern split system air conditioner which was added for operator comfort.

Modern electrical control equipment was designed for the bridge opening mechanism. Small crane type "joy sticks" have replaced the old tram type controls for the traffic gates, lowering of the end bearings and slewing. The re-writing was sufficiently advanced by Wednesday, 22 December 1982 for normal opening of the bridge both day and night. All new work was completed by Friday, 24 December. ●



A modern control panel was designed for the bridge opening mechanism. (Below) Three weeks after the fire, the newly completed control cabin is installed.

KEVIN B. FORD

Chief Legal Officer

Kevin Ford was appointed Chief Legal Officer of the Department on 6 April 1983.

Kevin commenced his career with the Department in 1962 as a clerk in the Legal Branch. He was admitted as a Barrister-at-law in 1972, and was subsequently appointed as a Legal Officer.

In 1978, he was admitted as a Solicitor of the N.S.W. Supreme Court and also attended a Management Development course at the Australian Administrative Staff College at Mt. Eliza, Victoria. The following year Kevin was appointed as a Senior Legal Officer, and in 1981 was promoted to Supervising Legal Officer.

He was recently nominated by the Department and selected by the Public Service Board as one of the two Departmental participants in the Management Development Programme of the New South Wales Government's Senior Management Development Scheme.

Kevin Ford has lectured in Property Law at Sydney Technical College and Contract and Highway Law at the University of New South Wales. His interests include tennis, swimming, reading and skiing, and he is a Vice President of the Main Roads Recreation Club. Kevin lives in Chatswood with his wife Geraldine and their four children. ●

LENNOX ANNIVERSARY

This year marks the 150th Anniversary of Lennox Bridge, the oldest bridge on the Australian mainland, on Mitchells Pass Road between Emu Plains and Glenbrook. It was closed to traffic some years ago because of damage from heavy vehicles.

Last year the Blue Mountains City Council, in conjunction with the Public Works Department, arranged for extensive repairs to the bridge. About fifty cracked and broken stones were replaced by a granite and sandstone company, Loveridge and Hudson, and the bridge was re-opened to tourist traffic on 14 December 1982.

This year also marks 110 years since the death of David Lennox, the Scotsman who built Lennox Bridge. The following account pays tribute to the bridge and its builder.

Westward route

Following the first successful crossing of the Blue Mountains in May 1813 by Blaxland, Wentworth and Lawson, agriculturalist William Cox volunteered to supervise the construction of the vital road westward. This route was completed on 14 January 1815 as far as the site of Bathurst, but because it was a bush track barely 4 m wide, it soon fell into a state of disrepair.

The route was abandoned west of Mount York in favour of another that was credited to Lawson, which carried traffic westward from 1827 until 1832.

By this stage, Surveyor-General Mitchell was proceeding with a road via Mount Victoria, along a better route which he had discovered. Early in 1832, Mitchell suggested a deviation which would avoid the steep ascent of Lapstone Hill. The work went well until they reached the rather formidable gully through which Lapstone Creek flows. A superior stone bridge was required, but there was a scarcity of experienced stone masons and bridge builders in New South Wales at the time.

Chance meeting

Scottish-born David Lennox arrived in New South Wales in August 1832. He was a master mason and had 20 years' experience in the supervision of bridge construction, having worked under Thomas Telford on the erection of the Menai suspension bridge in Wales. Mitchell met Lennox by chance in Macquarie Street, where he was employed cutting coping stone for the dwarf wall in front of the present Parliamentary buildings. On learning of Lennox's previous experience Mitchell immediately recognised his potential to solve the problem of building more permanent bridges.

Speaking at a later date of this fortunate meeting, Mitchell stated: "*Mr. David Lennox, who left his stone wall at my request, and with his sleeves still tucked up, came with me to my office, and undertook to plan the stone bridges we required, make the centring arches, and to carry on such works by directing and instructing the common labourers then at the disposal of the Government. Thus originated all the bridges this Colony possess worthy of the name.*"

(Left) David Lennox, the Scottish-born master mason who was New South Wales' first Superintendent of Bridges, 1833-1843. The enduring quality of good workmanship: restoration work is now completed on Lennox Bridge, over Lapstone Creek at Glenbrook.

The Bridge and the Builder

Bridge over Lapstone Creek

The 45-year old Lennox was appointed Sub-Inspector of Roads on 1 October 1832 (he was given the additional title of Superintendent of Bridges in June 1833) and set to work immediately on a semi-circular stone arch bridge over Lapstone Creek.

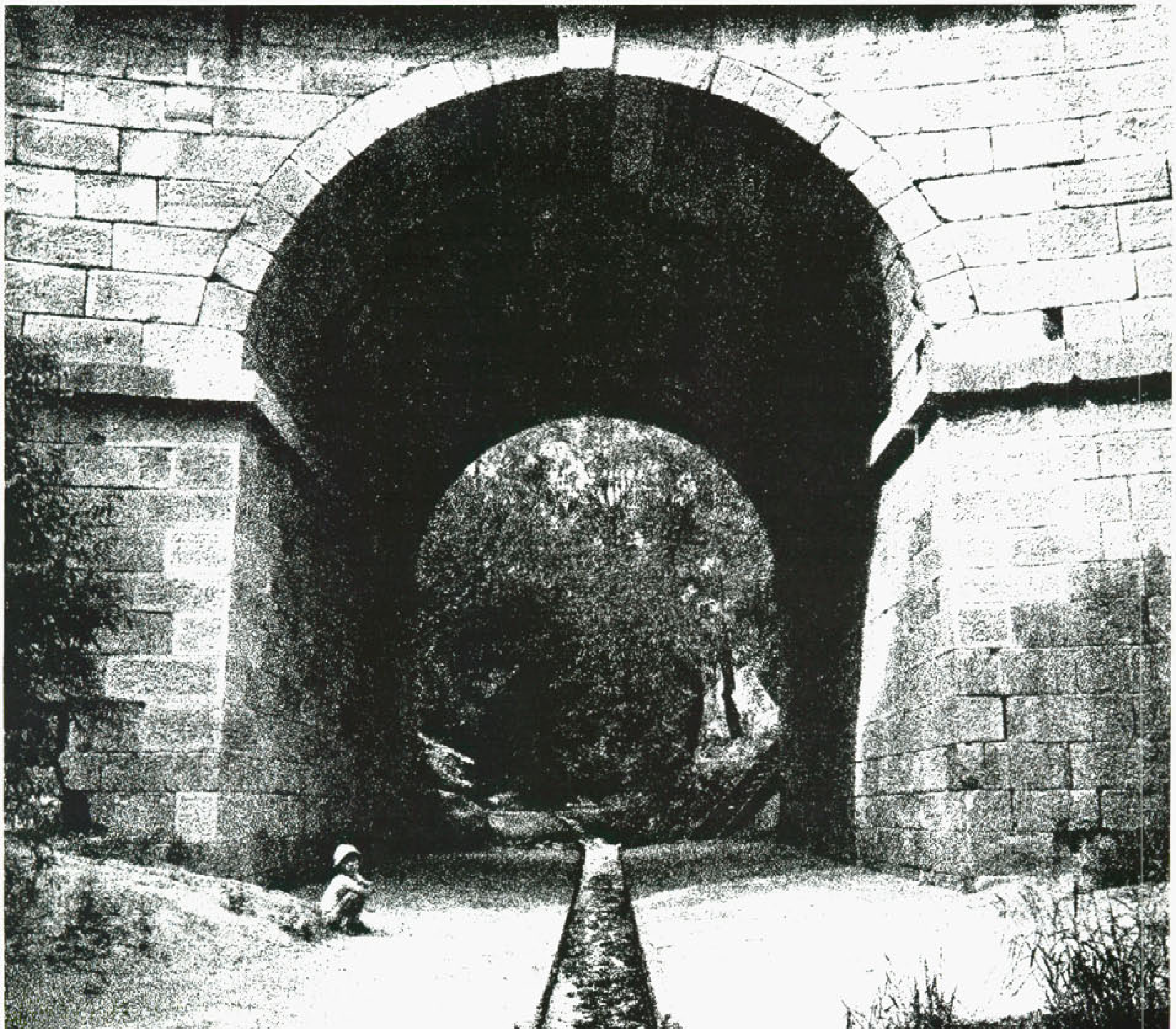
Mr. Abbot, Assistant Surveyor in charge of the road, reported to Mitchell on 10 November 1832: *"I trust it will be satisfactory to hear that having procured lime, Mr. Lennox is getting on in laying the stone, a great quantity of which is cut and ready. There are about 20 men selected by him from the gang, and he is indefatigable in instructing them how to work. His Excellency the Governor, the day before yesterday, made enquiries on many subjects, and stated that in the cases of men made useful by Mr. Lennox, steps should be taken to prevent their services being lost to the Roads Department."*

The training of a stone gang was extremely important to ensure the successful completion of future works, particularly as the colony had suffered for so long the absence of skilled craftsmen. Major Mitchell's awareness of this need is indicated by his comment that *"We had among the prisoners some tolerable stonecutters and setters, but until I had the good fortune to find among the emigrants a person practically acquainted with the construction of stone arches, their labours had never been of much benefit to the public."*

The bridge at Lapstone was set mainly by the convict James Randall and Lennox reported that it was complete in July 1833. The single arch of the bridge spans 6 m. The roadway is 9 m wide at the crown of the arch, and is 9 m above the bed of the gully. Mitchell described it as *"a somewhat experimental work, which Mr. Lennox executed extremely well"*. He directed that Lennox's name be inscribed on the keystone on the upstream side of the bridge and thereafter it became known as Lennox Bridge. It carried all the traffic from Sydney to the west until the construction of a new deviation in 1926.

Lennox went on to become the most renowned bridge builder of early Australia. In 1844 he moved to Victoria, where he built 53 bridges, including the first stone bridge across the Yarra.

He retired in 1853 and died at Parramatta 20 years later, aged 85. ●



40 YEARS OF NORFOLK ISLAND AIR LINK

A Lockheed-Hudson touched down at Norfolk Island on Christmas Day, 1942, on a runway which three months earlier hadn't existed. The Department's role in the construction of this work was a vital one.

In August 1942 the United States Army advised the Australian Government that it required an aerodrome on Norfolk Island. It had been the intention of the American forces to construct it using their own personnel and equipment but they were not available at that time. It was then proposed to construct the aerodrome using an Australian civilian force and U.S. equipment.

Departmental officers supervised the aerodrome's construction and other incidental works to the Army's requirements. Volunteers came from the then Water Conservation and Irrigation Commission, the Metropolitan Water, Sewerage and Drainage Board, the Hunter District Water Board as well as the Department of Main Roads. In the event of personnel being made prisoners of war, they were enlisted in the civil construction corps for the duration of the work with the right of discharge, if desired, on their return to Australia.

The Department sent an advance party to locate and survey the site. The main working party arrived from Australia at the end of August and the equipment from the U.S. at the end of September. A landing ramp and small jetty were constructed for unloading heavy equipment along the rugged coastline.

Earthworks began on 6 October. Regrettably, about 500 Norfolk Island pines had to be cleared before construction could start. Building the two runways involved moving more than 190 000 m^3 of earth. For the pavement of the first runway, limestone-sand was mixed with the natural surface soil to provide stabilisation. This was covered with a layer of sand on which was placed steel matting to form the runway surface. The second runway was stabilised in the same way but the runway surface consisted of crushed limestone rock instead of steel matting.

A Lockheed-Hudson was the first aeroplane to land on Norfolk Island.

Other work by the Department included the construction of five kilometres of access roads and the improvement of four kilometres of existing roads on the island.

The total number of Australian civilians who worked on this project was 246, and in addition 53 local men were employed. The men worked two ten-hour shifts each day, seven days a week.

All work at the aerodrome, including hard standing areas and drainage, was completed by the end of February 1943. Civil Construction Corps personnel left for the mainland early in March.

Norfolk Island's postal administration recently issued a philatelic series to commemorate the 40th anniversary of the completion of this work which has proved vital to the island's economy. ●

'DRIVING IS A HEALTH HAZARD'

Accident Reduction Through Road Improvements

K. W. Dobinson, B.E., M.Env.Stud., Dipl.Law, F.I.E.Aust., M.C.I.T., A.F.A.I.M., Chief Engineer (Services), Department of Main Roads, N.S.W.

(This paper was presented to a Seminar on the Community Benefits of Roads arranged by the Country Roads Board, Victoria, in association with the Local Government Engineers Association of Victoria and the Victorian Division of the Institution of Engineers Australia in Melbourne, on 16 March, 1982, and is reproduced with permission.)

Summary

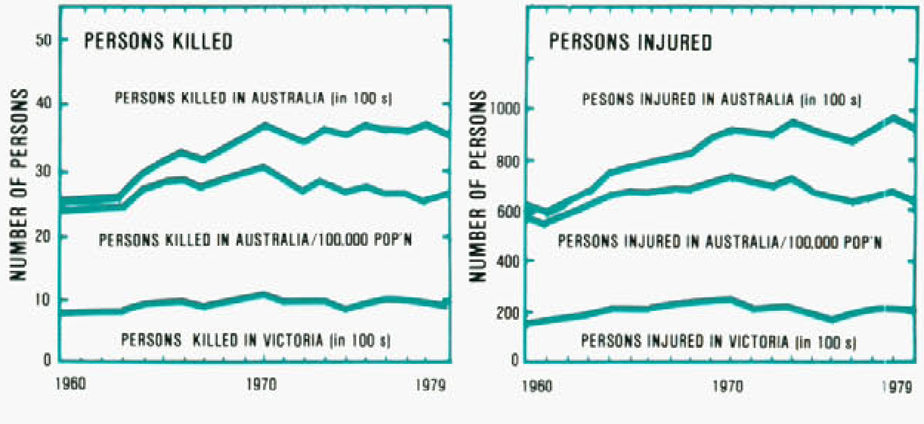
Road accidents are highlighted as a significant cause of death and injury in the community. It is postulated that it is preferable to remedy the cause of this disease through road improvements rather than mend the injuries and compensate the victims.

Road trauma—the modern epidemic

During the 1970s, over 36,000 persons (36,130) were killed and almost one million (917,500) were injured on Australian roads (Year Book Australia No. 65, 1981 and previous issues).

The Road Trauma Committee Royal Australasian College of Surgeons, and the Life Insurance Federation of Australia (Road Trauma 1980) described the road accident, or road trauma, as the modern epidemic in Australia.

The table below indicates the epidemic proportion of road accidents as a cause of death. Road accidents accounted for 3,840 deaths in Australia in 1978—3.5% of deaths from all causes. More significantly, road accidents were the major cause of death in the age group between 1 and 34, which group comprises more than half (58%) of the population (Road Trauma 1980).



Road Accident Injuries & Fatalities in Australia, 1960-1979

Source: Year Book Australia No. 65, 1981 and previous issues

Road accidents are a major health hazard. 95,301 people were casualties of road accidents in Australia during 1979 which represents 6.6 persons in every 1,000 of the population. This effect is most dominant in the 17-29 age group which makes up only 22% of the Australian population, but accounted for 43% of those killed and 47% of those injured on Australian roads (Road Trauma 1980).

Road accidents continue to kill and injure huge numbers of people in Australia each year. The figure above shows that these numbers continue to increase despite some most effective remedial measures.

CAUSES OF DEATH, AUSTRALIA 1978

Cause of Death	Total Deaths	%
Cancer	21,887	20.2
Heart Disease	32,532	30.0
Diseases of Circulatory System	24,390	22.4
Congenital Anomalies	1,025	0.9
Perinatal Mortality	1,188	1.1
Diseases of Respiratory System	7,491	6.9
Motor Vehicle Accidents	3,840	3.5
Other Accidents	2,773	2.6
Suicides and Self-inflicted Injuries	1,595	1.5
All Other Causes	11,704	10.8
All Causes:	108,425	100.0

Source: Year Book Australia No. 65 1981

The community cost of road accidents

The cost of road accidents to the community is high but road fatalities impose an especially high cost burden. The relative cost of individual accidents resulting in death, injury or property damage is shown in the table below (Troy and Butlin, 1971; Bureau of Transport Economics, 1978; Department of Main Roads, NSW, 1981).

COST IN INDIVIDUAL ROAD ACCIDENTS IN AUSTRALIA

	Dec. 1981
Fatality Accidents	
- Fatality Costs	$204,000
- Property Damage Costs	3,500
Total Cost	$207,500
Personal Injury Accidents	
- Personal Injury Costs	$5,700
- Property Damage Costs	3,500
Total Cost	$9,200
Property Damage Accidents	
- Property Damage Only	$1,600

COST OF ROAD ACCIDENTS IN AUSTRALIA 1978		
	$M	%
Police and Courts	26.3	2.1
Vehicle and Property Damage	535.0	42.8
Hospital and Medical	160.0	12.8
Short-term earnings loss	51.2	4.1
Residual cost—incl. long term earnings loss, pain, suffering, etc.	125.0	10.0
Insurance administration	87.5	7.0
Legal Costs	62.5	5.0
Fatalities	202.5	16.2
TOTAL:	$1,250.00	100.0

The Road Trauma (1980) Report estimated the cost of recorded road accidents for the whole of Australia in 1978 at $1,250 Million ($1,790M 1982). The figure of $1,250 Million covered the cost areas indicated in the table above.

This cost of road accidents represented an annual cost in 1978 of:

- $90 per head of population ($130—1982)
- $180 for every motor vehicle registered ($250—1982)
- $20,000 for every casualty accident ($29,000—1982)
- 1.6% of the Gross Domestic Product of Australia.

However, Searles (1980) in a study of insurance claims for Sydney has pointed out that—"More than four times as many crashes occur as those which are included in official statistics. Although crashes not included in the official statistics generally have lower mean costs and are less severe in terms of personal injury, their total cost almost equals the total cost of crashes which appear in the statistics". Assuming the relationship established by Searles between the number of persons injured in official statistics and actual crashes applies throughout Australia, the total cost of road accidents in Australia for 1978 would be $2,200 Million ($3,100M 1982) or almost twice the assessment in the Road Trauma Report.

The rising community cost of road accidents is, to some degree, reflected in the increases in health and social service costs over recent years, as shown in the figure below (Dobinson 1980).

It is disturbing to note the lack of any rise in expenditure on transport, of which road expenditure is about 75%. Despite all professions preaching the advantages of preventive measures over cures, Governments continue to allocate greater and greater amounts of their budgets to 'Health' to patch up the road casualty and to 'Social Services' to compensate the victim's dependents rather than to 'Roads' to alleviate the cause.

Accident reduction counter measures

Driving involves the interaction of:

- the driver,
- the vehicle, and
- the road

An accident results from a shortfall in performance of one or more of these three components, but more usually from a shortfall in the complex interaction of all three.

Governments concern themselves with road safety but invariably they seek cheap solutions—at least cheap to the Government budget—rather than broader permanent solutions which invariably require a commitment of large sums of public money to achieve worthwhile results.

(a) Assessment of Accident Reduction Measures

Usually the evaluation of an accident reduction measure involves an assessment of the accidents prevented or alleviated, with an attempt to value the savings and estimate the benefit/cost. This assessment can be difficult with the lack of reliable data and the problems of isolation of the effect of individual measures. The inadequacies of Police-reported data on accidents are well known as are the difficulties the Police would have in producing more comprehensive information.

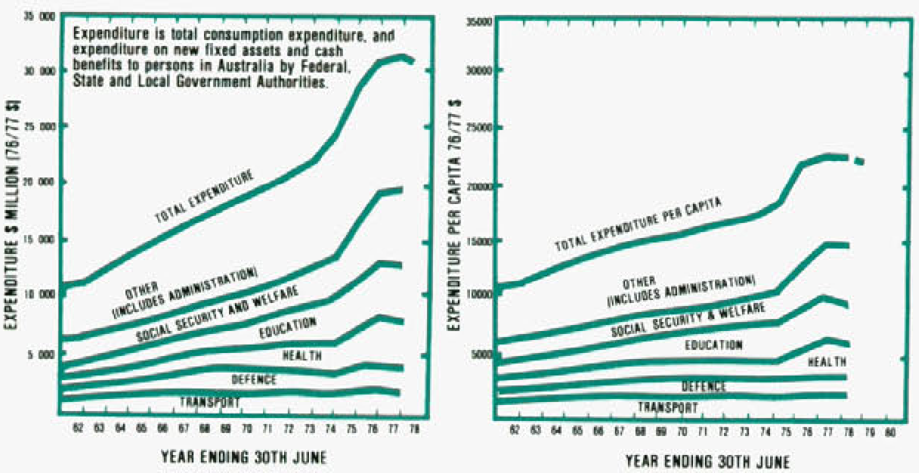
Johnston (1981) has highlighted the difficulty of assessing specific counter measures due to the lack of a compatible national data base, a problem common to other countries, particularly those with a federal-state system of government.

Johnston indicated that the alternative use of the Traffic Conflicts Technique as a predictor of accidents was not a valid substitute for accident data. Hence, any assessment of the effectiveness of counter measures to reduce road accidents must remain clouded by a high degree of variance.

(b) Attempts to Improve Driver Performance

Measures to improve driver performance have proved largely ineffective except where accompanied by extensive enforcement through legislation. It is difficult to change human behaviour except by some tangible incentive or disincentive.

Herbert (1981) indicated that existing driver training and education programmes have not proved successful in improving driver performance. Freedman (1979) reported that the 'SLOB' campaign of TV advertising had little impact in changing the present attitude to drink-driving even though it was considered it could have some effect in the long term.



Expenditure by all Public Authorities in Australia

In contrast, Sukhawan and Kichtham (1981) reported a trial combining an intensive anti-road accident publicity campaign with intensive enforcement in Thailand reduced accidents which reduction extended beyond the period of trial.

Similarly, legislation in Australian States to enforce the wearing of seat belts by motorists has proved successful in saving lives of those involved in road accidents. Herbert (1980) reported that when introduced in New South Wales at the end of 1971, compulsory wearing laws were credited with a 25% reduction in deaths among vehicle occupants in the first year of operation. He estimated that the total number of lives saved in New South Wales between 1972 and 1980 by this legislation was 2,411 or 24% per annum. Herbert also pointed to the high cost effectiveness of this measure—one life saved for every $25,000 spent on seat belts—which is ⅛th of the cost of a fatality indicated above.

Herbert also reported the even greater cost effectiveness of motor cyclist helmet legislation wherein he estimates one life saved for every $2,000 spent on helmets.

The significant impairment effect of alcohol on driving is well known. Lay (1980) points out that 50% of driver fatalities or 30% of fatalities overall involve alcohol-impaired drivers. Yet attempts to reduce the incidence of drink-driving, including the imposition of harsh legislation, have proved to have little, if any, long term effect anywhere in the world (Herbert 1980). This holds true even though intensified random breath testing by Police in selected areas of Melbourne during 1978 and 1979, coupled with harsh legislation, did decrease alcohol related accidents; but this was significant only at night in the study area itself and a little beyond, and the effect was sustained for only about two weeks thereafter (Cameron 1981).*

(c) Attempts to Improve Vehicle Performance

Vehicles have progressively been modified in two ways in the interests of traffic safety:

- Modifications to reduce the incidence of accidents, notably improved skid resistance of tyres, but also improved inspections programmes, running lights and signalling devices.
- Modifications to reduce injury to occupants in case of accident, e.g., collapsible steering columns, safety glass and laminated windscreens, headrests, and shock absorbing bumpers.

These countermeasures have been successful in reducing accidents and in reducing injuries occurring therefrom, but in the overall scene, their impact has been slight.

(d) Road Improvements to Reduce Accidents

Innumerable road improvement measures have been applied to reduce road accidents. Most have been successful in varying degrees and generally they have proved cost effective. Delaney (1972) reported a few of these as:

- Pavement widening on rural highways in Victoria reduced casualty accidents by 43%,
- Introduction of a median 3.7 m wide on an 18 km length of highway in U.S.A. reduced accidents by 40%,
- Conversion of 42 km of two lane highway to a four lane divided highway in Victoria reduced accidents by 30%,
- Removal of trees within 4.6 m of roadway in U.S.A. reduced accidents involving trees by 39%,
- Channelisation of eleven unsignalised intersections in Victoria reduced casualty accidents by 43%,
- Widening of eight bridges in Victoria reduced accidents by 47%,
- 'Stop' signs at 41 intersections in Melbourne reduced accidents 20% and 'Give Way' signs at 33 others reduced accidents thereat by 4%,
- Provision of traffic signals at 41 intersections in Melbourne reduced accidents by 32%,
- Introduction of advisory speed signs at curves on a rural highway in New South Wales reduced casualty accidents by 60% and total accidents by 45%, and,
- Priority Road conditions on 23 km of arterial road in Sydney reduced accidents by 20%.

Delaney indicated benefit/cost of a few measures from U.S. studies as:

• delineation	27
• protective guardrail	13
• intersection channelisation	2.4
• new traffic signals	1.9
• road widening	0.24

The basic road accident problem—the inadequate road network

Although all counter measures have contributed to road safety with varying success, road accidents overall in Australia persist at a high percentage of the population.

Concentration by Governments on road safety over recent years appears to have exhausted the cheap magical solutions, as were motor cyclist helmets, seat belt legislation and advisory speed signing on curves. But Governments will continue to seek these cheap panacea, for example, the current interest in 'Left Turn on Red' at Traffic Signals (Galin 1979). However, if the road epidemic is to be truly arrested, we must grapple with the basic problem—the inadequacy of the Australian road network.

(a) The Inadequacy of the Australian Road Network

Specific inadequacies in the road network that contribute to road accidents have been shown to include:

- Pavements of inadequate width—less than 6.8 m (Broughton 1976, Cowl 1965, Sinclair & Knight 1973).
- Inadequate shoulder width—less than 1.2 m (Cowl 1965).
- Curves on rural roads less than 600 m radius (Broughton 1975).
- Grades greater than 4% combined with curves of less than 450 m radii (Broughton 1976).
- Inadequate skid resistance of pavement (Sinclair and Knight 1973).
- Trees and poles too close to the roadway (Delaney 1972, Herbert 1980).
- Uncontrolled pedestrian movement across arterial roads (Delaney 1972).
- Lack of access controlled roads—too many driveways (especially commercial), median openings and intersections (Sinclair and Knight 1973, Delaney 1972, Head 1958).
- Lack of divided roads (Delaney 1972).

The overall inadequacy of the Australian road network is highlighted in the table below wherein fatal accident rates of the Australian system are compared with those of countries with a well developed road system.

The Road Trauma (1980) Report said of this situation "... the Australian rate is a national scandal ...".

Random Breath Testing was introduced in New South Wales in December 1982, after the preparation of this paper. Insufficient time has elapsed to comment on the results.

FATAL ACCIDENT RATES AUSTRALIA AND OVERSEAS			
Country	Per 1 million Population (1975)	Per 10,000 Regist. Vehicles (1977)	Per 100 million veh. km.
Australia	270	5.4	3.5 (1976)
United Kingdom	127	3.8	2.3 (1979)
West Germany	240	—	4.0 (1979)
Canada	264	—	2.9 (1976)
U.S.A.	212	3.3	2.0 (1978)

Sources: Road Trauma 1980, Herbert 1980, World Road Statistics 1980

The rates underlined can be looked at as targets for Australia. A reduction to these levels would have reduced deaths in 1979 by about 1,400, i.e., about 40%, and without savings from injury or property damage accidents, alone would have saved the community of the order of $200 Million.

(b) Overcoming the Inadequacies

To attain the targets in the previous table, a comprehensive improvement to the Australian Road network would be necessary. Such a network would include a significant component of divided roads with controlled-access freeways. This is especially so in urban areas where traffic demands are greater and where the fatal accident rate is 1¼ times that on rural roads: 64% of fatal and serious accidents in urban areas occur at junctions, compared with 33% in rural areas (Johnson and Garwood 1971).

The benefit of the divided, access controlled road—the freeway—over the conventional surface road is illustrated by the following studies:

- Dobinson (1971) reported accident rates on the Sydney/Newcastle Expressway (a rural freeway) compared to all other rural highways in New South Wales as –

	Fatal Accidents per 10^8 veh. km	Total Accidents per 10^6 veh. km
Sydney/Newcastle Expressway 1967-1970	2.4	0.9
N.S.W. Rural State Highways 1970	4.4	2.0

- Cox and Others (1979) in a study of the four freeways radiating from Sydney, the Sydney/Newcastle, the Western, South Western and Southern, of 78 km total length reported as follows –

	Casualty Crashes per 10^8 veh. km	Overall Crashes per 10^6 veh. km
Outer Urban Freeways	12	0.31
Adjacent Highways 'before' Freeways	59	1.67

- The Country Roads Board, Victoria (unreported, 1982) in recent studies found casualty accident rates for urban and rural freeways compared with a former rural highway as –

	Casualty Accidents per 10^8 veh. km
Urban Freeways—58 km on Eastern, Mulgrave, West Gate, Tullamarine and South Western	16.3
Rural Freeway—Hume Freeway	12.5
Hume Highway—undivided sections prior to conversion to freeway above	41.9

- Tindall (1974) in a theoretical determination of accident costs for alternative road types assessed the cost of accidents per km per 1,000 vehicles carried on a two lane road as 1.9 to 2.7 times the cost on a freeway.

The benefit to be derived from comprehensive improvement to the road network is illustrated by two examples, the first a relatively low cost network of co-ordinated traffic signals and the second the construction of a complete city network of arterial roads.

Example 1: S.C.A.T.—The Sydney Co-ordinated Adaptive Traffic System:

S.C.A.T. is a fully computerised co-ordinated system of traffic signals comprising over 1,000 sets of signals covering the entire Metropolitan Area of Sydney. Of the 8.8 x 10^9 km of travel in Sydney in 1977, 3.1 x 10^9 km, i.e., almost 40%, will be under S.C.A.T. control.

Sims and Dobinson (1979) estimated the cost of the co-ordination system (excluding the cost of the signal installations) in 1979 at $2.80M ($3.7M 1982). They estimated that over 1,000 casualty accidents per annum (representing 1,400 casualties or 7% of all casualties in Sydney) would be saved. The value of all accidents saved was assessed at $8.3M per annum ($11.1M, 1982).

Example 2: DaCRoN—A Road Network for Sydney:

DaCRoN is a comprehensive network of roads proposed by Dobinson and Carlisle (1982) for construction in Sydney in a single decade (1982/83 to 1991/92). It comprises –

Freeways	104 km
New Arterial Roads	82 km
Road Widenings	255 km
Total Length of New Roadwork	441 km

The cost of the DaCRoN network and the value of benefits to be derived therefrom are shown below.

The accident reduction includes a saving of about 5,000 deaths and 35,000 casualties.

BENEFIT/COST OF DaCRoN NETWORK TO YEAR 2000 ($M 1981/82)		
Cost of DaCRoN Network		$1,250M
Benefits 1982/83 to 1999/00		
Savings from Accident Reduction	$1,143M	
Travel Time Savings	$7,316M	
Operating Cost Savings	$2,907M	
Total Benefits	$11,366M	
Less Maintenance Costs	$198M	
Net Benefits		$11,168M
Rate of Return on Investment		46.3%
Benefit Cost Ratio		4.58

Conclusion

We have in Australia in the road accident, an epidemic of significant proportion. Yet year by year it is glibbly ignored by the community, each member considering he is not personally affected. But tomorrow each healthy young adult is the most likely to become a statistic of this epidemic.

The concern of Government in recent years appears to have soaked up all the 'cheap' solutions. The real task of overall improvement to the Australian road system must be tackled if this epidemic is to be brought under control.

The ability exists in the Road Authorities of Australia to provide an adequate system—all that is needed is adequate funds. In this respect I believe each Australian would prefer to see all of his \$130 per annum (vise Cost of Road Accidents)—or is it double that amount—allocated to 'Roads' to reduce road accidents rather than to 'Health' and 'Social Services' to repair the casualties and compensate the victims. And to provide an effective road network in Australia over a single decade, what is required? Just one quarter of each Australian's \$130 annual contribution to road accidents. ●

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ERRATUM

In the article "Arrestor Beds: Coming to Rest Safely" in the March 1983 edition of *Main Roads* (pp. 29-30), a formula was given to calculate the length of an arrestor bed. The formula should have read:

$$L = \frac{V^2}{26a + 2.55x}$$

As an example, with V = 100 km/h, a = 3.0 m/sec^2, and the bed being on a 5% downgrade (x = −5), the length of full-depth bed required would be 153 m. Adding a 50 m transition at the start would give a bed 203 m long. If the bed was on a 5% upgrade (x = +5), the length of full depth bed required would be 110 m, and the total length including a 50 m transition at the start would be 160 m.

Tenders Accepted by Council

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 March 1983.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
Balranald	Trunk Road No. 67	Resealing of road.	Emoleum (Aust.) Ltd.	$40,989.83
Bathurst	Russell Street	Reconstruction of bridge over Vale Creek.	Hornibrook Group	$178,712.00
Bland	Trunk Road No. 57 and Main Road No. 231	Supply and spray bitumen on both roads.	Allen Bros. Asphalts Ltd.	$51,210.29
Bogan	Various	Bitumen re-sealing of trunk and main roads in Council area.	Spraypave Pty. Ltd.	$19,216.22
Bourke	Rural Local Road No. 10	Construction of bridge over Talyawalka Creek 21.5 km from Developmental Road No. 1306.	Tamenco Pty. Ltd.	$114,700.00
Brewarrina	Various	Bitumen re-sealing of trunk and main roads in Council area.	Spraypave Pty. Ltd.	$66,342.00
Cessnock	Main Road No. 220	Construction of 3-span P.S.C.G. bridge over Wallis Creek, 16.5 km south of Cessnock.	Wrightson Contracting Pty. Ltd.	$318,296.00
Cobar	Trunk Road No. 61	Bitumen re-sealing.	Emoleum (Aust.) Ltd.	$76,574.95
Conargo	Various	Bitumen re-sealing of trunk and main roads in Council area.	Emoleum (Aust.) Ltd.	$94,550.55
Coolah	Various	Sealing of roads in Council area.	Spraypave Pty. Ltd.	$124,003.13
Coolah	Various	Supply of aggregate to various roads in Council area.	Toprock Industries	$30,175.00
Coolamon	Various	Bitumen re-sealing on various roads in Council area.	Canberra Asphalters Pty. Ltd.	$49,701.54
Coonamble	Various	Bitumen re-sealing of various roads in Council area.	Spraypave Pty. Ltd.	$139,137.00
Corowa	Various	Bitumen re-sealing of various roads in Council area.	Allen Bros. Asphalts Ltd.	$88,542.06
Culcairn	Various	Sealing and re-sealing of various roads in Council area.	Emoleum (Aust.) Ltd.	$62,454.17
Evans	Various	Sealing of various roads in Council area.	Spraypave Pty. Ltd.	$176,897.19
Gosford	Main Road No. 335	Widening of Punt Bridge over Erina Creek, 2.7 km east of Gosford.	Ermani Construction Pty. Ltd.	$281,554.00
Goulburn	State Highway No. 2	Supply and delivery of asphaltic concrete.	Allen Bros. Asphalts Ltd.	$247,746.20
Hastings	Rural Local Road	Construction of bridge over Wilson River at Ballengarra.	Mr. J. Parkinson	$77,844.00
Hay	State Highway No. 6 and Main Road No. 514	Supply, heat and spray C170 bitumen.	Emoleum (Aust.) Ltd.	$32,205.66
Hay	State Highway No. 6 and Main Road No. 514	Supply and deliver aggregate.	Lake Boga Quarries.	$20,899.00
Holbrook	Main Road No. 284	Supply and spray bitumen on reconstruction work 31 km to 32.7 km east of Hume Highway.	Emoleum (Aust.) Ltd.	$45,121.69
Lake Macquarie	Main Road No. 527	Construction of single span P.S.C.G. bridge over South Creek at Warners Bay.	Civil Engineering Newmac Pty. Ltd.	$125,945.00
Narrabri	Main Road No. 343	Reconstruction and bitumen surfacing 19.3 km to 38.5 km west of Wee Waa.	Robson Excavations Pty. Ltd.	$1,514,053.49
Oberon	Various	Sealing of various roads in Council area.	Emoleum (Aust.) Ltd.	$130,845.96
Parry	Trunk Road No. 63	Construction of bridge over Attunga Creek near Attunga 21.0 km north of Tamworth.	R. Bruno Pty. Ltd.	$362,409.00
Tumbarumba	Various	Bitumen surfacing of various roads in Council area.	Allen Bros. Asphalts Ltd.	$93,078.79
Wellington	State Highway No. 7	Construction of bridge over Bell River at Wellington.	Dallas Green & Co. Pty. Ltd.	$505,000.00
Wollondilly	Main Road No. 179	Reconstruction between Clifton Hill & Douglas Park Road.	E. E. Emmett & Sons Pty. Ltd.	$29,000.00

Tenders Accepted by Department of Main Roads

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 March 1983.

Road No.	Work or Service	Name of Successful Tenderer	Amount
Freeway No. 8	Wollongong Northern Suburbs Distributor. City of Wollongong. Construction of bridge over Freeway on Princes Highway at North Wollongong.	Leighton Contractors Pty. Ltd.	$1,394,397.00
State Highway No. 1	Princes Highway. City of Shoalhaven. Repainting of steelwork on steel truss bridge (southbound carriageway) over Shoalhaven River at Nowra.	Mr. I. Mondello	$372,890.00
State Highway No. 1	Princes Highway. City of Shoalhaven. Supply, fabrication and erection of steelwork for a cycleway on the southern carriageway of bridge over Shoalhaven River at Nowra.	Boweld Constructions Pty. Ltd.	$77,498.25
State Highway No. 2	Hume Highway. Shire of Gundagai. Earthworks, drainage of pavement construction for Tumblong deviation section 22.3 km to 27.7 km south of Gundagai.	Citra Constructions Ltd.	Schedule of Rates
State Highway No. 2	Hume Highway. Shire of Wingecarribee. Construction of duplicate bridge over Black Bobs Creek at 27 km south of Mittagong.	Gervay Constructions Pty. Ltd.	$560,000.00
State Highway No. 2	Hume Highway. City of Wagga Wagga and Shire of Holbrook. Earthworks and drainage in 34.8 km to 36.6 km section of the dual carriageway between 31.0 km and 37.7 km south of Tarcutta.	Thiess Contractors Pty Ltd. (Southern Region)	Schedule of Rates
State Highway No. 2	Hume Highway. Shire of Mulwaree. Supply and delivery of natural gravel and/or crushed rock suitable as a base.	M & N Haulage	$139,400.00
State Highway No. 2	Hume Highway. Shire of Mulwaree. Construction of SH & SP Gutter on southbound Carriageway between 7 km and 11 km south of Goulburn.	K. Morphett	$77,400.00
State Highways Nos. 2 and 15	Hume and Barton Highways. Supply and delivery of up to 1000 t of asphaltic concrete to various areas in the Southern Division.	Bitupave Ltd.	$55,060.00
State Highway No. 3	Federal Highway. Shire of Mulwaree. Supply and delivery of natural gravel and/or crushed rock suitable as base to 29.3 km to 30.6 km south of Goulburn.	M & N Haulage	$50,600.00
State Highway No. 3	Federal Highway. Shire of Gunning. Win, mix and stockpile natural gravel, load and haul stabilised natural gravel to sites between 55.9 km & 56.8 km south of Goulburn.	Stabilex Pty. Ltd.	$66,440.00
State Highway No. 6	Mid-Western Highway. Municipality of Cowra. Construction of bridge over Lachlan River at Cowra.	McDougall Ireland Pty. Ltd.	$3,427,959.00
State Highway No. 9	New England Highway. Supply and lay up to 1960 t of 5 mm, 10 mm and 20 mm asphaltic concrete from Mitchell Drive to George Street, Maitland, 28.6 km to 29.6 km north of Newcastle.	Bitupave Ltd.	$119,531.00
State Highway No. 9	New England Highway. Shire of Parry. Construction of bridges over MacDonald River at 40.0 km north of Tamworth and Parrys Creek at 42.1 km north of Tamworth.	Gervay Constructions Pty. Ltd.	$1,247,000.00

Tenders Accepted by Department of Main Roads

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 March 1983.

State Highways Nos. 9 and 10	New England and Pacific Highways. Supply and load up to 400 t of dense grade 10 mm asphaltic concrete for maintenance work on both Highways north of Newcastle.	Bitupave Ltd.	$20,680.00
State Highways Nos. 9 and 10	New England and Pacific Highway. Supply and load up to 600 t of dense grade 10 mm asphaltic concrete for maintenance work on both Highways north of Newcastle.	Boral Resources (NSW) Pty. Ltd.	$29,100.00
State Highway No. 9 and Main Road No. 503	New England Highway and Putty Road. Supply and lay up to 1330 t of 10 mm asphaltic concrete for maintenance on the Highway and Putty Road.	Bitupave Ltd.	$97,024.00
State Highway No. 10	Pacific Highway. Shire of Manning. Construction of superstructure for bridge over Stewarts River at Johns River, 37.8 km north of Taree.	Leighton Contractors Pty. Ltd.	$1,489,750.00
State Highway No. 10	Pacific Highway. City of Newcastle and Shire of Port Stephens. Construction of reinforced concrete cast-in-place piles and pile caps for bridge over Hunter River at Hexham.	Leighton Contractors Pty. Ltd.	$3,196,400.00
State Highway No. 10	Pacific Highway. Supply and delivery of up to 500 t of type FA cement to widening and reconstruction at intersection with Highway at Doyalson.	Kooragang Cement Pty. Ltd.	$41,195.00
State Highway No. 10	Pacific Highway. Supply and lay up to 300 t of 10 mm asphaltic concrete to Van Stappens Corner, 106.2 km to 106.9 km north of Sydney.	Bitupave Ltd.	$24,679.00
State Highway No. 10	Pacific Highway. Rotomilling, supply and lay 900 t of asphaltic concrete between Dudley Road and Charlestown Road, Charlestown.	Bitupave Ltd.	$73,425.00
State Highway No. 10	Pacific Highway. Haulage of 20 000 t of slag skulls to reconstruction and widening between 27.6 km and 30.5 km north of Newcastle.	Toll-Chadwick Transport Ltd.	$58,400.00
State Highway No. 10	Pacific Highway. Shire of Tweed. Supply and delivery of up to 1500m³ of 7 MPA ready mixed concrete between 103.7 km to 105.9 km north of Ballina.	B.M.G. Resources Ltd.	$68,857.60
State Highways Nos. 10 and 11	Pacific and Oxley Highways. Supply heat and spray C170 bitumen and incorporate the Department's cutter and/or additives during 1982/83.	Spraypave Pty. Ltd.	$152,735.71
State Highway No. 11	Oxley Highway. Shire of Warren. Construction of approaches to bridge over Macquarie River at Warren.	G. H. & W. B. Welling	$34,710.00
State Highway No. 14	Sturt Highway. Shire of Wentworth. Construction of bridge over Murray River at Mildura.	Transbridge—Division of Transfield (NSW) Pty. Ltd.	$3,595,726.00
State Highway No. 14	Sturt Highway. Shire of Wentworth. Construction of approach bridges Nos. 1, 2, & 3 over Murray River Flood Plain at Mildura.	Pearson Bridge Pty. Ltd.	$1,100,085.70
State Highway No. 16	Bruxner Highway. Shires of Inverell and Tenterfield. Construction of bridges over Dumaresq River Overflow Channel and Beardy River at 74.0 km, 79.8 km and 87.5 km west of Tenterfield respectively.	Hanna & Edmed (Constructions) Pty. Ltd.	$410,089.00
State Highway No. 19	Monaro Highway. Shire of Cooma-Monaro. Manufacture, supply, delivery, unloading and stacking of precast pre-tensioned bridge planks for bridge over Cooma Creek, 106.0 km south of Canberra.	E.P.M. Concrete Pty. Ltd.	$47,335.00
State Highway No. 21	Cobb Highway. Shire of Hay. Construction of bridge over Lachlan River at Booligal.	I. W. & K. M. Hunt Pty. Ltd.	$161,962.20
State Highway No. 25	Illawarra Highway. Shire of Wingecarribee. Construction of bridge over Medway Rivulet at Sutton Forest, 5.5 km west of Moss Vale.	Rimpa Constructions	$174,882.00
Trunk Road No. 54	City of Goulburn. Construction of Marsdens bridge at 3.2 km north of Goulburn.	Gervay Constructions Pty. Ltd.	$698,500.00
Trunk Road No. 90	Shire of Great Lakes. Construction of bridge over Mammy Johnsons River at Stroud Road, 76.1 km north of Newcastle.	A. R. Dickinson Construction Co. Pty. Ltd.	$473,054.70
Main Road No. 165	Municipality of Leichhardt. Fender repair on downstream side of Glebe Island Bridge.	Australian Wharf & Bridge Pty. Ltd.	$89,478.00
Main Road No. 198	Shire of Kempsey. Construction of bridge over Kinchela Creek at 6.7 km north of Gladstone.	J. B. Davies Enterprises Pty. Ltd.	$742,232.00
Main Road No. 253	Shires of Oberon & Evans. Construction of O'Connell Bridge over Fish River at O'Connell, 26.4 km north of Oberon.	Norwest Holst Australia Pty. Ltd.	$476,620.00
Main Road No. 256	City of Goulburn. Demolition of Old Kenmore Bridge.	J. S. Hollingworth	$21,777.00
Main Road No. 309	City of Parramatta. Construction of abutment A and Piers 1, 2 and 3 for bridge over Carlingford Railway Line and A'Becketts Creek in James Ruse Drive at Rosehill.	J. & P. Knight Bros. (Trading) Pty. Ltd.	$341,002.00
Main Road No. 309	City of Parramatta. Manufacture, delivery to site, unloading and stacking in precast deck slabs for bridge over Carlingford Railway Line and A'Becketts Creek in James Ruse Drive at Rosehill.	E.P.M. Concrete Pty. Ltd.	$145,705.94
Main Road No. 309	City of Parramatta. Manufacture, deliver to site, unloading and stacking of precast pre-tensioned concrete girders for bridge over Carlingford Railway Line and A'Becketts Creek in James Ruse Drive at Rosehill.	Humes Ltd.	$245,896.00
Main Road No. 503	Removal of chainwire fencing and erection of guardrail on Putty Road.	James Corlis	$20,725.00
Unclassified Road	Shire of Dumaresq. Construction of bridge over Gara River on Armidale-Kangaroo Hills Road at Thalgarrah, 18.4 km north of Armidale.	Civil Structures Division, Roberts Construction Ltd.	$247,019.10
Unclassified Road	Municipality of Hastings. Construction of bridge over Hastings River at 2.0 km east of Wauchope on Wauchope-Bellangry Road.	Hanna & Edmed (Constructions) Pty. Ltd.	$1,083,200.00