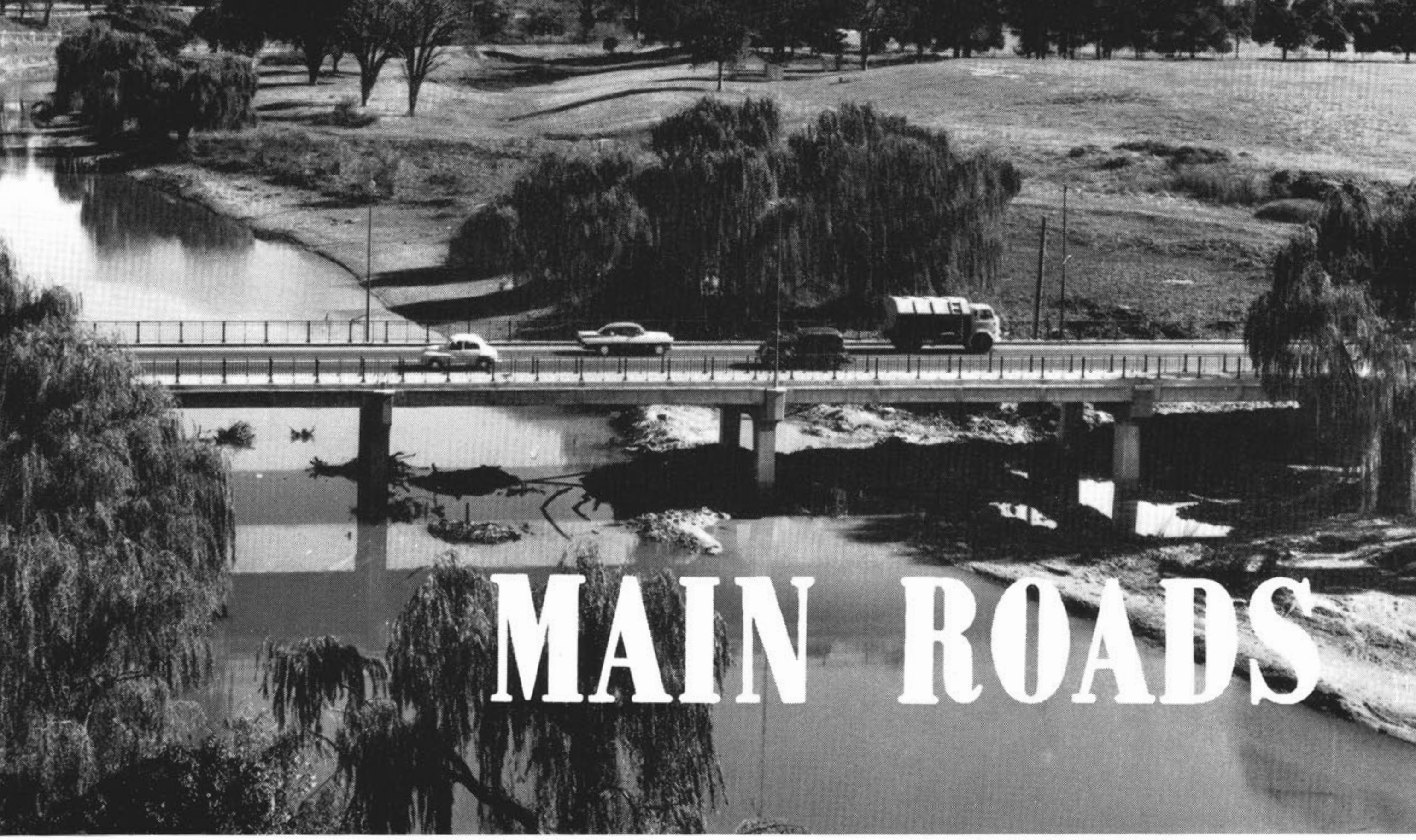
MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS · NEW SOUTH WALES

SEPTEMBER, 1962



MAIN ROADS

SEPTEMBER, 1962 Volume 28 Number 1

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COVER SHEET

An aerial view of the Parramatta River looking towards Sydney Harbour. In the foreground is the new bridge being constructed at Gladesville. The photograph was taken after the last concrete block of the first arch rib had been placed in position on the 13th July, 1962.

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DEPARTMENT OF MAIN ROADS
NEW SOUTH WALES

Issued by and with the Authority of the Commissioner for Main Roads

SEPTEMBER 1962

PRICE
Three Shillings

ANNUAL SUBSCRIPTION
Twelve Shillings
Post Free

Additional copies of this journal may be obtained from

Department of Main Roads
309 Castlereagh Street
Sydney, New South Wales
Australia

Box 3903, GPO, Telephone B0933
Telegrams "MAINROADS" SYDNEY

NEXT ISSUE
DECEMBER 1962

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Developmental Roads and Developmental Works

The opening up of new tracts of country for development and the provision of improved access for settlers in New South Wales have been greatly assisted by the proclamation and construction of selected roads and works (including bridges) as "Developmental Roads" and "Developmental Works".

A road or a road work is proclaimed as "Developmental", following application to the Department of Main Roads by the Shire or Municipal Council or Councils jointly concerned, provided—

(*a*) the road or work is not already constructed, and

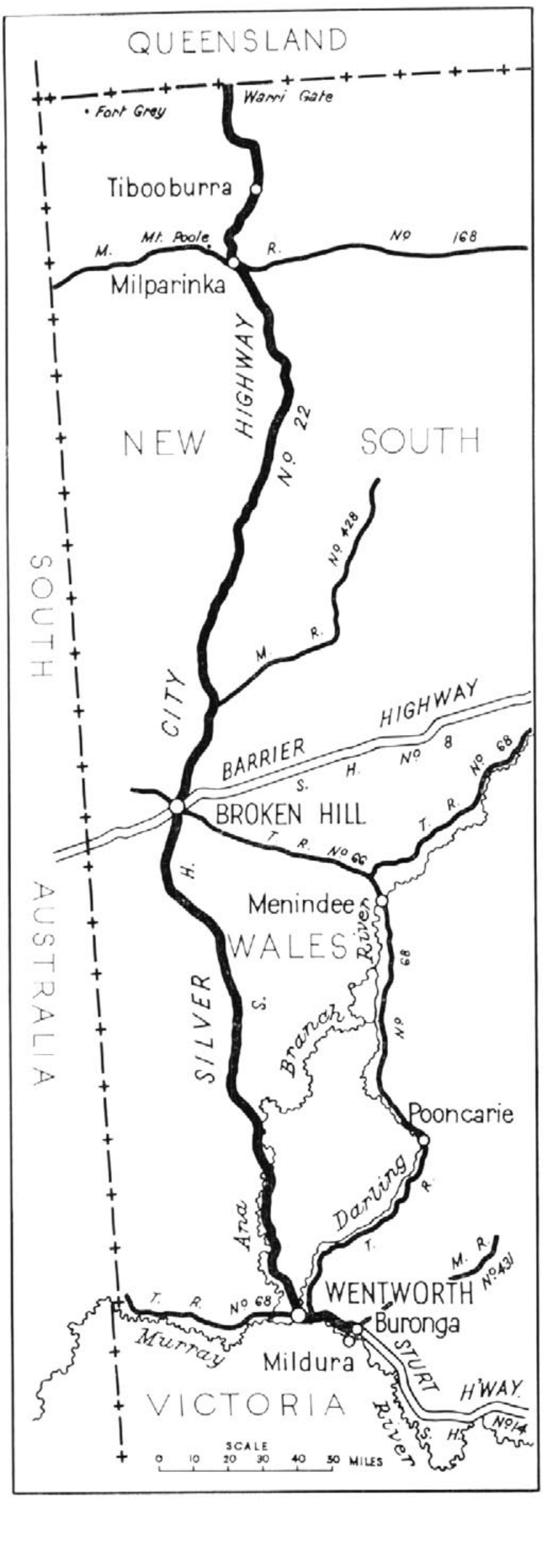
(*b*) its construction will lead to development warranting the expenditure to be incurred.

The cost of construction is met by the Department of Main Roads, generally the work being carried out by Councils.

Developmental Roads and Works have been of the greatest value in stimulating rural development and in serving settlers who would otherwise be isolated at times for lengthy periods. They have been built in the dairying districts of the coast, in the inland wheat growing areas, and latterly to an increasing extent in mixed farming areas. Some have been built to aid closer pastoral settlement in inland areas. Special consideration is always given to "ex-soldier" settlements and other closer settlement areas. In addition to the economic benefits conferred by these roads, settlers also obtain quicker and surer access to business centres, schools, medical care, hospitals and other community services, as well as social and recreational amenities.

Since the inception of the Main Roads Act in 1925, a total of 4,787 miles of road has been proclaimed as Developmental. In addition, 168 Developmental Works (including bridges) have also been proclaimed.

The funds which the Department has been able to allocate for construction of Developmental Roads and Works have averaged £480,000 per annum in the last three financial years. These funds, however, are not keeping pace with the demand and the need for developmental road construction, and there are many cases where funds are awaited to enable required work to be commenced or continued. It is estimated that the cost to complete construction on roads and works already proclaimed is between three and four million pounds in the 91 Local Government areas concerned.



Historical Roads of New South Wales

THE SILVER CITY HIGHWAY

ALTHOUGH another of the great highways of New South Wales carries the name of Captain Charles Sturt, the area served by the Silver City Highway will always be associated with the epic journey of Sturt and his companions in their heroic attempt to reach the centre of Australia and to resolve some of the geographical problems that were hindering the outward growth of settlement.

Commencing at the village of Buronga on the Murray River opposite Mildura, the Silver City Highway goes for 20 miles in a westerly direction to Wentworth, passing through a series of irrigation areas, then turns north to Broken Hill, running for approximately 70 miles parallel with and close to the Great Anabranch of the Darling River. From Broken Hill the highway continues in a northerly direction through Milparinka to Tibooburra and on to the Queensland border at the Warri Gate, a total distance of 446 miles from its starting point at Buronga. The country passed through by the Silver City Highway is of a generally arid nature, the average annual rainfall varying from 10·8 inches at Wentworth to 7·88 inches at Tibooburra.

Part of the business and shopping centre of Broken Hill

From Wentworth to Broken Hill the road passes through generally undulating country used for sheep grazing purposes. For some 50 miles north of Broken Hill, hilly country associated with the Barrier Range is encountered, but from there on the country is undulating except for some hills in the vicinity of Milparinka. " Gibber " country occurs near Tibooburra.

The name " Silver City Highway " was given to the road for the reason that its primary purpose is to connect the city of Broken Hill with points north and south and to serve the great silver-lead industry of the area. The road has a wider significance from an Australian point of view, as it connects directly with the road systems of Victoria and Western Queensland. At Broken Hill it intersects the Barrier Highway which, some 30 miles to the west, connects with the South Australian road system. In effect therefore, the Silver City Highway serves to connect the road systems of four of the States of the Commonwealth, and because of this, consideration was given, at one stage, to naming it the " Four States Highway ".

Northwards from Broken Hill the highway roughly parallels, and runs close to, the route followed by Captain Sturt in his last great journey of exploration.

Sturt arrived at Port Jackson in May, 1827, and shortly afterwards was appointed military secretary to Governor Darling. In November of that year, Darling informed the Colonial Secretary that the existence of an inland sea was so generally believed, that he proposed, as soon as the season permitted, to despatch an expedition in an endeavour to ascertain the facts. At about the same time, Captain Sturt wrote to a cousin in England informing him that he was shortly to take an expedition into the interior to ascertain the level of the inland plains and to determine the existence, or otherwise, of an inland sea. This expedition started from a point near Wellington, New South Wales, in December, 1828, and resulted in the discovery of the Darling River and other discoveries of great geographical importance. Whether or not an inland sea existed was not determined.

In the following year, Sturt carried out an exploration of the River Murray which he followed as far as Lake Alexandrina in South Australia. The great fatigue of his party and shortage of supplies compelled the abandonment of his attempt to reach the southern coast and he returned to Sydney disheartened and disappointed, according to his own account, with the result of his investigations. He nevertheless urged the Governor to direct a more thorough examination of the Encounter Bay district which he had been unable to carry out. An examination of the area was made in 1831 and it resulted in the founding of a settlement, five years later, at the present site of Adelaide.

In 1837 an expedition was fitted out by the Royal Geographical Society with the purpose of penetrating to the centre of the Australian continent from some point on the west or north-west coast of Australia. The expedition, however, failed in its principal objective and the project was abandoned.

In the following year, Sturt undertook to lead an " overlanding " party with cattle for the settlement in South Australia. Cattle had previously been successfully overlanded from Sydney to South Australia, but those responsible had avoided the upper branches of the River Murray and especially that part of the Murray known as the Hume. Sturt, wishing to combine geographical research with his private undertaking, commenced his journey at a point near to where Albury is now located and " in so doing connected the whole of the waters of the south-east angle of the Australian continent ". He later wrote, " in this instance, however, ... no progress was made in advancing our knowledge of the more central parts of the continent ".

Attempts to penetrate into the interior were made by E. J. Eyre in 1839 and 1840, but neither succeeded, and for several years no effort was made by the Government to further geographical inquiry.

In 1839 Sturt was invited by Governor Gawler to accept appointment as Surveyor General of the new colony of South Australia, but unknown to the Governor, an appointment to the position had already been made by the Colonial Office and although disappointed, Sturt agreed to occupy the position of Assistant Commissioner of Lands. In 1842 he was appointed Registrar General, but his zeal for exploration was so strong that in 1843 he offered his services to the Secretary of State for the Colonies, Lord Stanley, as leader of an expedition to undertake an extensive exploration of the interior. Sturt's proposal was strongly supported by the former Governor Darling and in May, 1844, Captain George Grey, who had succeeded Colonel Gawler as Governor of South Australia, was authorised to fit out an expedition to proceed under Sturt's command into the interior.

In a private letter to the Governor, Lord Stanley wrote—" what Captain Sturt will understand as absolutely prohibited, is any attempt to conduct his party through the tropical regions to the northward, so as to reach the mouths of any of the great rivers. The present expedition will be limited in its object, to ascertaining the existence and character of a supposed chain of hills, or a succession of separate hills, trending down from N.E. to S.W. and forming a great natural division of the continent . . . ."

Later, in his narrative of the journey, Sturt published the reasons which led him " After a repose of more than fourteen years " to enter again into the field of discovery.

" I had adopted an impression," he wrote, " that this immense tract of land had formerly been an archipelago of islands and that the apparently boundless plains into which I had descended in my former expeditions were, or rather had been, the sea beds of channels, which at one time separated one island from the other; it was impossible, indeed, to traverse them as I had done, and not feel convinced that they had at one period or the other been covered by the waters of the sea . . . . ."

The main body of the expedition, the largest and best equipped of any that had previously been despatched on a journey of exploration, left Adelaide on August 10th, 1844. Sturt, accompanied by his Second in Command, James Poole, and Surgeon J. W. Browne, left on August 15, 1844.

The route suggested by the authorities in London to be taken was northwards from Port Augusta, which Eyre had earlier attempted without success. Sturt's plan was to avoid the great salt lakes which had proved an impassable barrier to the earlier explorers, by following the Darling to its great bend near Menindee and then to strike north-west into the unknown.

Sturt followed the Murray River as far as its junction with the Darling River Ana-branch along which he travelled until it joined the main stream. He then followed the Darling to Laidley's Ponds (now known as Menindee) where he turned north-west into country dreaded even by the native inhabitants. In a letter to his wife he wrote—" The natives give a fearful account of the distant interior—but not worse than I expected. They shake their heads at me when I tell them I must go. In truth I believe it to be a fearful desert, the bed of a former channel between better lands . . . ."

Sturt was well aware that the greatest obstacle to the success of the expedition was the lack of water. He had to provide not only for the men of his party—twelve besides himself, but also for the livestock which was taken to provide transport and fresh food for the expedition. Sturt confessed to " a strange idea that there might (may) be a central sea not far from the Darling " and that he " should go prepared for a voyage ". The equipment carried by the expedition, therefore, included a boat as well as 200 sheep, 30 bullocks and eleven horses.

Laidley's Ponds was reached on October 11th and Sturt decided to make for some distant ranges which Poole had seen " rising like islands out of a vast sheet of water ". He reached them at a point near to where Broken Hill was later founded. The hills he named " Stanley's Barrier Range " after Lord Stanley.

For several days Sturt and his companions were engaged in exploring and surveying the surrounding country, but principally in a search for water, the lack of which had become serious. On the way to the range the expedition had passed over country that was grassed in places, but which consisted mainly of scrubby hills and stony sandstone gullies. In parts the ground was covered with several boulders of rock which made progress so difficult as to cause Sturt to write, " it appeared as if McAdam had emptied every stone he ever broke to be strewed over this metalled region ".

At this part of his journey, Sturt was near to the present location of Broken Hill, but he was preoccupied with his search for water and seems to have paid little attention to the metalliferous character of the country although he recognised that an ore body was present, for he wrote—" The veins of the metal run north and south as did a similar crop at the S.E. base of the ranges ". From a map included in his narrative, his route seems to have almost completely encircled the line of lode, the outcrop of which, like many who followed, he passed by without realising the vast potential wealth beneath his feet.

Still travelling towards the north, always lured a little further by the discovery of a small creek or pond, which dried up almost as soon as it was found, the party endured excessive heat and almost incredible hardship. During the afternoon of the 21st January, 1845, the thermometer registered 131° F. in the shade and 154° F. in the direct rays of the sun.

On January 27th, a rocky glen through which an apparently permanent stream was flowing was found and Sturt considered it a suitable resting place before his next advance. He little thought that he would be compelled to remain there for six weary months. His advance and his retreat were both cut off. To the north no water could be found and the drought had dried up all the pools by which he had been able to penetrate thus far. Sturt named the camping place The Rocky Glen. The site of this camp is in the extreme north-west of New South Wales near Mt. Poole.

The heat was terrific and to escape some of its effects, Sturt constructed an underground room in which his party could rest in comparative comfort. By April, 1845, no rain had fallen for nearly four months, and during their stay at the Depot, by which name the camp came to be known, a dew had never been experienced. "The ground was thoroughly heated to a depth of 3 or 4 feet," Sturt wrote, "and the tremendous heat that prevailed had parched vegetation and drawn moisture from everything . . . . Under its effects every screw in our boxes had been drawn and the horn handles of our instruments, as well as our combs, were split into fine laminae."

Sturt made several attempts to reach his objective. Taking small parties with him, he tried in several directions to penetrate the desolate country by which they were surrounded but on each occasion he was forced back. At last he decided to divide his party, retaining nine in all and sending the others back to Adelaide. By these means he hoped to be able to push his researches for a sufficient period to enable him to penetrate the "heartless desert" to such a distance as would leave no doubt with regard to the problem he had been sent out to solve. The water on which the lives of the party depended was getting lower every day. From its original depth of 9 feet it had sunk to less than two and instead of reaching from bank to bank of the creek it had fallen to a narrow line in the centre of the channel.

Rain commenced to fall on the 11th July, but not in sufficient quantity to enable the party to move from their camp except at tremendous risk. By the morning of the 14th, sufficient rain had fallen to allow the returning party to leave and after their departure, Sturt commenced preparations for striking camp.

The second in command of the expedition, James Poole, who for some weeks had been very ill, was included amongst those who Sturt had decided should return to Adelaide, but shortly after their departure, Poole died and the party returned to the Depot. He was buried at the foot of a Grevillia tree growing close to the underground room. The locality is now known as Mount Poole.

● A recent photograph of Preservation Creek ("The Rocky Glen") near Mount Poole

● The burial place of James Poole. The locality is now known as Mount Poole

● Mount Poole Station and the road in approach from Milparinka

The Silver City Highway south of Broken Hill prior to reconstruction and bitumen surfacing

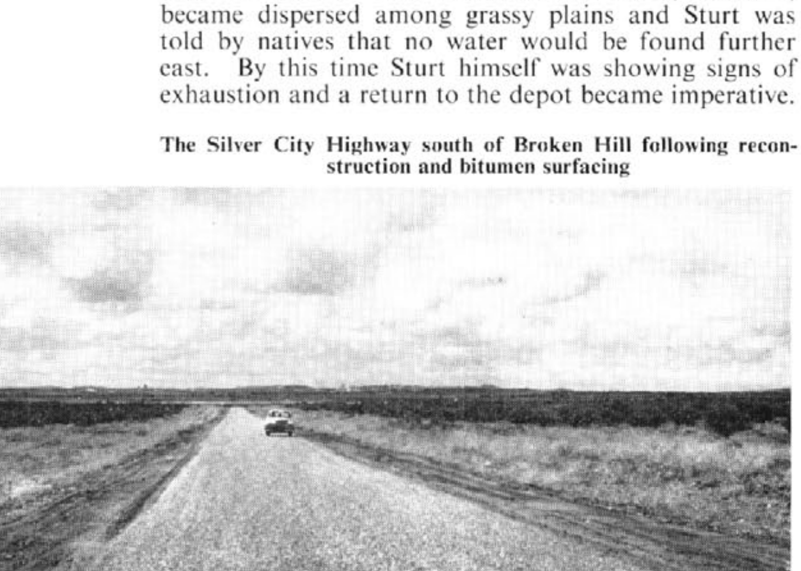
The next day the camp at Rocky Glen was abandoned and a new depot, which they called Fort Grey, was established at a point about 50 miles further north. From here, on July 18th, 1845, Sturt, with four men and provisions for fifteen weeks, started on a journey to the north-west with the object of finding out whether the country was practicable and whether it was connected in any way with any more central body of water.

Their hope of finding practicable country was not realised, but instead a stony desert and a succession of desolate sand hills and salty spinifex ridges barred their progress and rendered their situation dangerous. The rain which had fallen had not broken the drought, surface water was rapidly drying up and they were facing the risk that their retreat would be cut off.

At length, on the 8th September, 1845, Sturt and his companions reached a point " scarcely a degree from the tropic and within 150 miles of the centre of the continent ". But by now the position of the party was desperate. The depot was 443 miles distant and little hope of finding water remained. There was no choice but to retreat to the depot, which was reached on October 2nd.

A week later Sturt started on another attempt to reach the centre. This time he travelled due north but again found himself in the " stony desert " which for many years was to preserve his name on the maps of Australia. Again he was forced to retreat towards the depot, but finding comparatively permanent water at Cooper's Creek, he followed it in an attempt to trace its course. The waters of the creek, however, became dispersed among grassy plains and Sturt was told by natives that no water would be found further east. By this time Sturt himself was showing signs of exhaustion and a return to the depot became imperative.

The Silver City Highway south of Broken Hill following reconstruction and bitumen surfacing



The depot was reached on November 13th and was found to have been abandoned, the men left there having been compelled by the failure of their water supply to fall back on the depot at Rocky Glen. Here Sturt arrived on November 17th and at once collapsed.

No rain had fallen for more than five months and the drought was even worse than had already been experienced. To remain at the camp during another summer was to invite almost certain death. The alternative of venturing across 270 miles of probably waterless country was little better, but it was the lesser of two evils, and on 6th December, 1845, the party set out, Sturt being carried, for the first time, in one of the drays. Enough water was found along the route they followed to just keep the party alive, and on December 20th they reached the River Darling at Lake Cawndilla, where they camped. Here they were met by a party sent to their relief and by whom they were brought by slow stages to Adelaide, which was reached on January 19th, 1846.

Although Sturt did not succeed in reaching the goal of his ambition, he settled for all time, a geographical problem which had baffled all previous attempts at its solution.

Of Captain Charles Sturt, it has truly been said: " There were few men who so consistently worked for the public good. He could truthfully say that he had never been tempted to set out on his expeditions by mere love of adventure . . . . His impulses were the scientist's desire to extend knowledge and the humanist's eagerness to increase social wealth and happiness."

Sturt returned to England in 1853, where he died in 1869. In that year he was nominated for a Knighthood, but he died before the honour could be gazetted. His true honour, however, lies in the memory of his work and accomplishments and in the description applied to him—" the gentlest and bravest of Australia's explorers ".

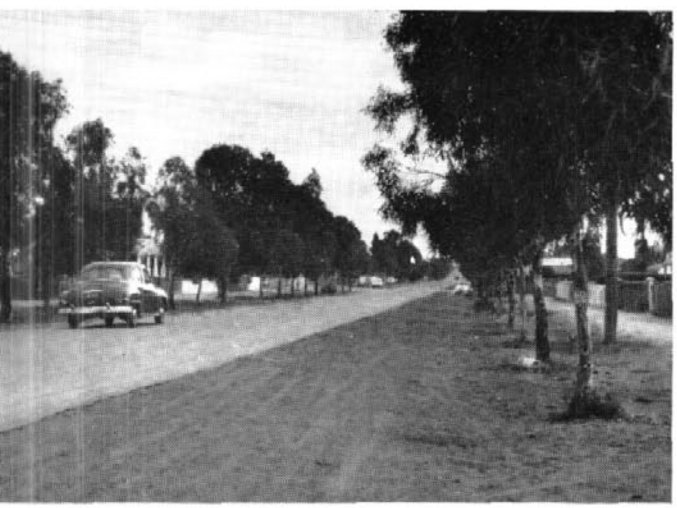
Throughout its length of 446 miles, there are only two major centres of population located along the line of the Silver City Highway—Wentworth and Broken Hill.

The site of Wentworth, at the junction of the Darling and Murray Rivers, was first visited by white men in 1836 when Surveyor General T. L. Mitchell reached the spot and buried a bottle in which he had placed a note stating that his party was surrounded by hostile natives and he was anxious for the safety of the party. Two years later, Joseph Hawden, with 300 cattle he was taking from Seymour to the settlement at Adelaide, reached the junction of the Murray and Darling Rivers and recovered the bottle which Mitchell had buried. Hawden added an account of his own journey and replaced the bottle, where it was later found.

The new South Australian settlement provided a developing market for cattle from the eastern centres and the tracks of the overlanders from Sydney and Melbourne met at the junction of the rivers. Pioneers pushing their way into the virgin lands and gold diggers seeking new fields also followed the well-defined tracks made by the cattlemen and to these, the Murray-Darling junction was a half-way house. In 1850, the Governor of South Australia, Sir Henry Fox-Young, travelled overland to the junction and settlers followed quickly in his steps.

In 1853 the Governor induced the South Australian Legislature to offer a bonus of £4,000 to the first person who succeeded in taking a steamer upstream as far as the Murray-Darling junction. The bonus was won by Captain Francis Cadell who with the Governor as a passenger, took the "*Lady Augusta*", which had been specially built for the purpose, to the junction settlement, passing, at Swan Hill, the "*Mary Ann*" of Captain Randell, with the first cargo of supplies for the settlers.

Three years after the opening of the "port", the River Murray Navigation Company established a depot



Typical street tree planting by the Broken Hill City Council

for supplying the settlers on the two rivers and to receive the wool brought down by steamers from the Upper Murray.

In the *Government Gazette* of June 21st, 1859, it was announced that a site had been decided upon for a town to be called Wentworth, at the crossing place over the Darling River at its junction with the Murray. In that year Captains Cadell and Randell penetrated, with their steamers, the upper reaches of the Darling River and commenced a river trade of considerable importance. By 1883, for example, 250 river steamers arrived at the "Port of Wentworth" with cargoes totalling 45,098 tons and valued at more than £458,000. Clearances outwards amounted to 242 vessels loaded with 42,726 tons valued at almost £900,000. In that year 92 steamers were regularly employed on the two rivers each having, with a towed barge, a carrying capacity of 200 tons. The extension of the New South Wales and Victorian railways systems to points on the Darling and Murray Rivers gradually brought river traffic to an end, but as late as 1929 a few steamers were still employed carrying passengers on the Murray and "wool ships" were operating on the Darling.

Wentworth was proclaimed a Municipality in 1879. The town now serves the adjacent irrigated fruit-growing areas as well as the surrounding pastoral area, and has a population of more than 4,000 persons.

"The Broken Hill" is so named from the rugged nature of its rocky summit. This hill is the highest point of a narrow ridge which forms a distinctive feature of the undulating plain country on each side. Its official name is "Willyama" an aboriginal word meaning "a youth".

There is a local tradition that from the crest of "the broken hill" Sturt made a sketch of the surrounding country. In the narrative published by Sturt following his return from his journey, there is a sketch of the outlook from the Barrier Ranges. Sturt, however, passed to the east of "the broken hill" and crossed the ranges to the north of where the city is located. It is improbable, therefore, that the sketch was made from the site of the city, but it is probable that the exploring party made their camp near to where the city now stands and under the shadow of a hill that formed the cover of one of the richest silver-lead deposits in the world.

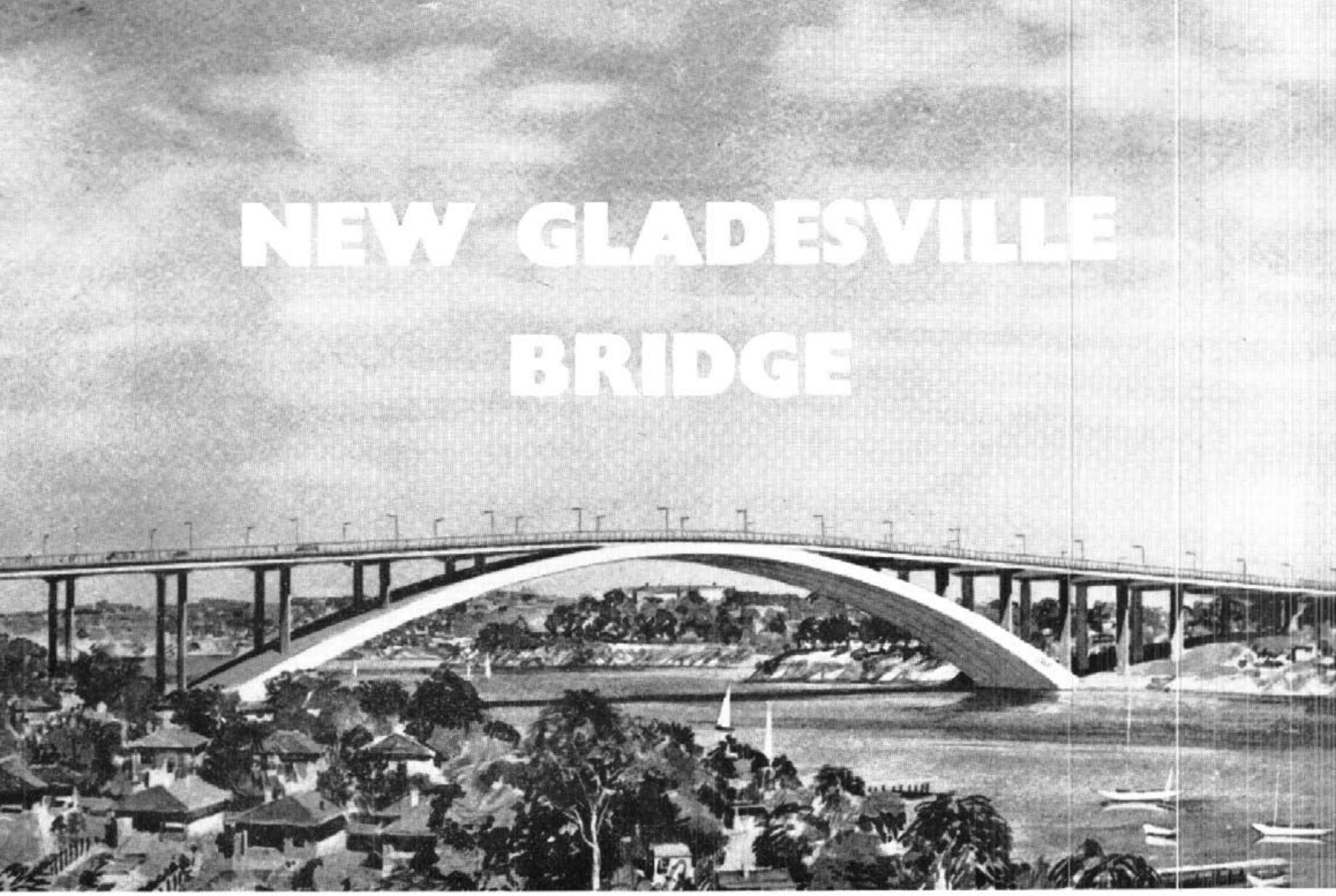
The existence of silver and lead in the area was first discovered in 1876 when one Paddy Green located a deposit at Thackaringa. A rush to the spot took place but the claims were not properly worked until 1880, when fresh shafts were sunk and a lode found, so rich in quality as to attract wide attention.

In 1883 a deposit was found at Silverton and another rush set in. While excitement over this find was at its height, a boundary rider, Charles Rasp, while mustering sheep in "the broken hill" paddock of the Mount Gipps run, noticed a similarity in appearance and formation of "the broken hill" with that of the outcrop at Silverton. In partnership with two contractors named Poole and James who were engaged in sinking wells on the sheep run, Rasp pegged out a claim. He mentioned the matter to George McCullock, manager and part owner of the Mount Gipps run, and together they pegged out further claims which took in the whole of "the broken hill" itself. The existence of silver chlorides was first noticed in a shaft sunk by Rasp on one of these claims in 1884.

From that beginning a vast industry of great economic importance to Australia has developed. Over the period that has elapsed since mining operations commenced, more than seventy-five million tons of ore have been raised, the value of the metal recovered from which has amounted to over £400,000,000. Average production throughout the period has amounted to 2,000,000 tons annually, the value of which, in one year, was more than £30,000,000. Within a little more than seventy years, a progressive city, with the amenities of modern life and a population in excess of 32,000 has developed in a semi-arid area lying within a rainfall belt of less than ten inches per annum.

A more appropriate name than the Silver City Highway, for the road that serves the "Silver City" and the area beyond, would be difficult to find.

NEW GLADESVILLE BRIDGE



INTRODUCTION

SPANNING the Parramatta River three miles from its junction with Sydney Harbour, a bridge is being built by contract by the Department of Main Roads, New South Wales. The contract is with a partnership of Stuart Bros. of Sydney, and Reed & Mallik of Salisbury, Great Britain. The Contractors are also responsible for preparing the design of the bridge, which has been undertaken for them by Messrs. G. Maunsell & Partners, Consulting Engineers of London and Melbourne. A concrete arch has been designed as an alternative to the steel cantilever bridge designed by the Department of Main Roads.

The new bridge is required primarily to take the place of a two-lane opening span bridge built in 1881. The old bridge is approaching the end of its useful life, and is inadequate for traffic. The new bridge will form part of the future North-Western Expressway which will serve a large section of the northern area of the metropolis. A bridge under construction over the nearby Lane Cove River at Fig Tree and a planned Tarban Creek bridge between Gladesville and Fig Tree will also be incorporated in the future Expressway. These three bridges, which all occur within a length of about 7,000 feet, and the associated road works, will greatly increase Sydney cross-harbour traffic facilities, and provide a favourable route for part of the traffic which otherwise would seek to use the Sydney Harbour Bridge about four miles to the east.

After acceptance of the tender for the arch bridge, an amended design differing somewhat from that originally proposed was submitted by the Contractors. The new design provides for the arch to be built on fixed falsework whereas in the original design part of the arch was to be built on floating falsework towed into position. The original design provided for an arch span of 910 feet, whereas the amended design increased the span to 1,000 feet. The new design eliminated the necessity for deep-water excavation for the arch foundations.

The Contractors' design was checked both by the staff of the Department of Main Roads, and by Professor Roderick and other members of the staff of the Civil Engineering Department of the University of Sydney. Subsequently the advice of the celebrated French Engineer, the late M. Freyssinet, was obtained on certain aspects of the design. Professor Roderick is assisting the Department of Main Roads as a general consultant during the construction of the bridge. Mr. Campbell-Allen of the University of Sydney is acting as a special consultant on concrete. M. Freyssinet's organisation, Societe Technique Pour L'Utilisation De La Precontrainte of Paris, is acting as a consultant at several important stages in the building of the arch.

The contract price for the bridge is approximately £2,560,000 but this is subject to variations from time to time due to alterations in wage rates and material costs, and to such changes as may be ordered during the course of the work.

DESIGN

General Description

The bridge consists of a four-ribbed concrete arch having a span of 1,000 feet and, on each side of the arch, four pre-stressed concrete girder spans each 100 feet long. The arch span of 1,000 feet is the longest concrete arch span yet built anywhere in the world. The thrust from the arch is supported by mass concrete thrust blocks founded on sandstone on either side of the river. The arch has a clearance above high water sufficient to allow shipping 120 feet high to pass beneath it over a width of 200 feet. Each rib is of hollow box sections 20 feet wide, with depths increasing from 14 feet at the crown to 23 feet at the thrust blocks, measured at right angles to the axis of the arch. The clearance between ribs is 12 inches. Transverse diaphragms at 50 feet intervals tie the four ribs together.

The deck system above the arch comprises, over the central 300 feet, an in-situ concrete deck slab resting directly on the ribs, and four pre-stressed concrete girder spans of 100 feet on either side of the central portion. The pre-stressed concrete girders are carried on transverse headstocks by pairs of thin wall-type columns seated directly on the arch ribs at alternate transverse diaphragms.

The 100 feet pre-stressed concrete approach spans are supported on twin column piers, identical with those on the arch itself, and by the abutments.

Expansion joints are provided in the deck at the junctions between the approach spans and the main arch section.

The overall length of the bridge deck is 1,901 feet 6 inches. The width of the carriageway is generally 72 feet between kerbs, and a six feet wide footway is provided on each side. At the Gladesville (or northern) end of the bridge, the carriageway is widened gradually over the four approach spans from 72 feet to 120 feet to provide for traffic turning movements, which cannot be fully provided for on the natural surface owing to the limited space available.

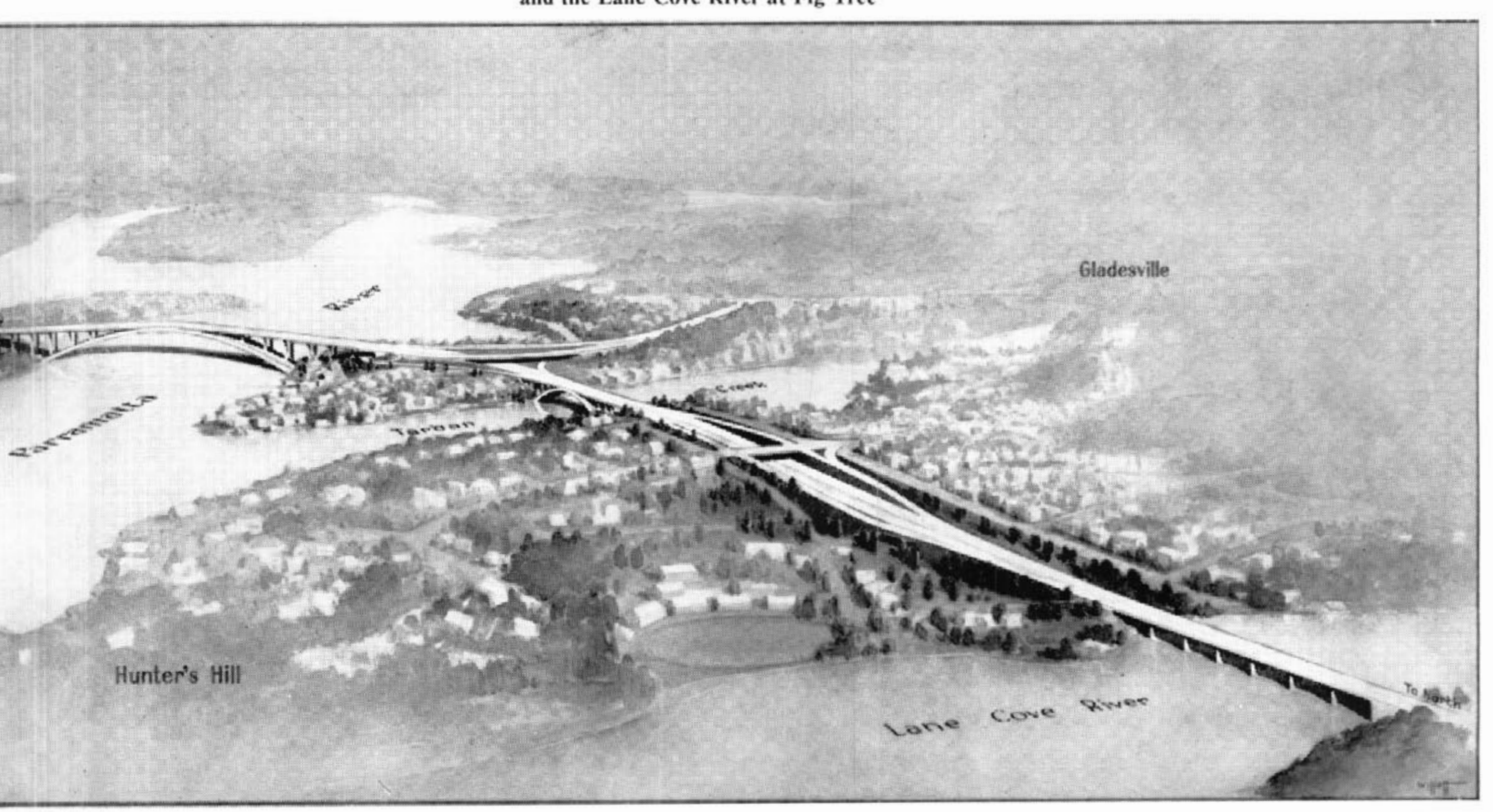
To obtain sufficient height to give the clearance of 120 feet required for navigation, the roadway on the bridge rises on a 6 per cent grade from either side, the grades being connected by a vertical curve 300 feet long over the centre of the structure.

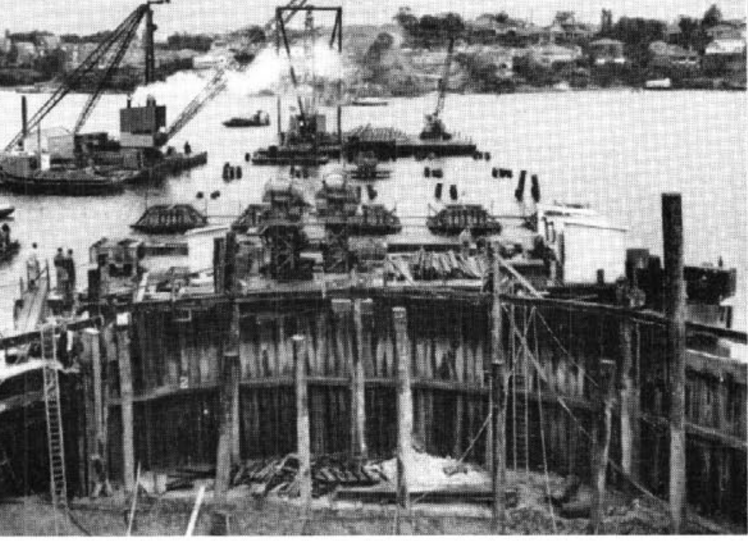
Arch

Each arch rib is designed as a plain concrete voussoir arch consisting of 108 precast hollow concrete blocks and 19 precast concrete diaphragm blocks, the blocks being connected by concrete joints three inches wide cast in situ. Concrete of 6,000 lbs. per square inch minimum compressive strength is specified throughout, with a normal working stress of 2,000 lbs. per square inch.

The weight of each rib block has been limited to 50 tons to facilitate handling, and each block is reinforced

An artist's impression of the new Gladesville Bridge in relation to the new bridges over Tarban Creek and the Lane Cove River at Fig Tree





Left:—Construction of coffer dam on the Drummoyne side of the river
Right:—Excavation for arch thrust blocks on the Gladesville side

sufficiently to resist handling stresses only. The ribs are so designed that there will be no tension in the concrete under any conditions of loading, and the handling reinforcement is not taken into account. The depth of rib at crown originally proposed was 12 feet. This was increased to 14 feet on the advice of the late M. Freyssinet.

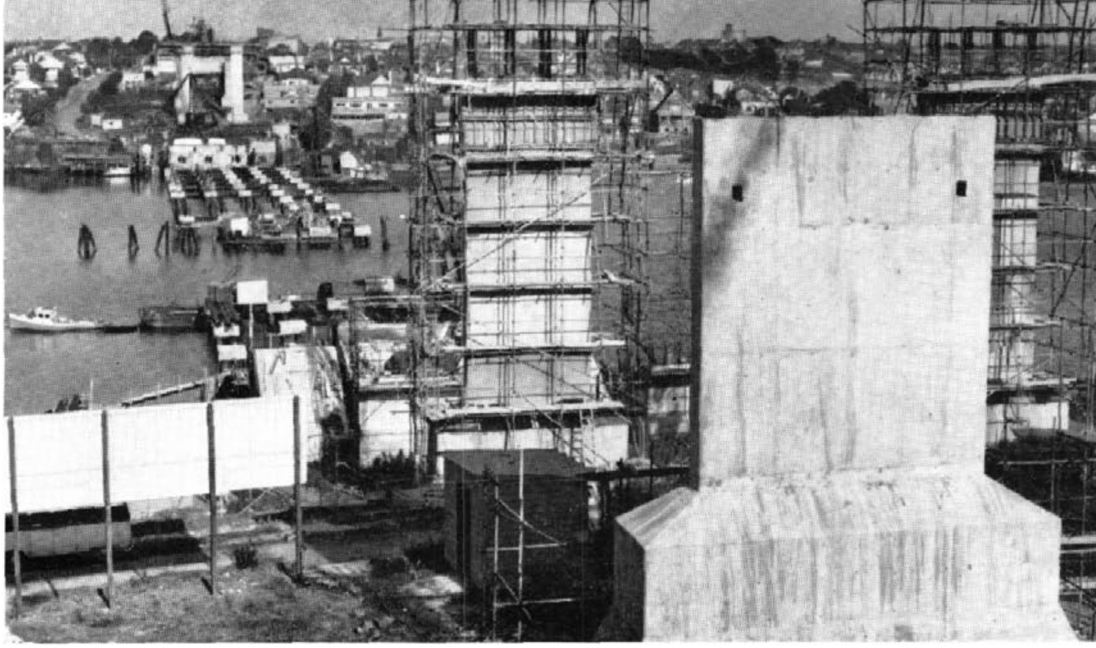
At the quarter points of each rib are inserted four layers of flat jacks, which will be used to apply thrust to the rib to render it self-supporting and to lift it off the falsework.

The precast diaphragm units in adjacent ribs are connected by in-situ concrete to form complete transverse diaphragms across all four ribs. The transverse diaphragms are post tensioned with cables and supply transverse stiffness to the arch as a whole. Additional transverse stiffness is provided by filling the spaces 12 inches wide between the tops of the ribs with concrete cast in situ. As an insurance against local vertical deformation, pre-stressing cables are placed in this in-situ concrete filling for the full length of the arch. These two latter provisions were also suggested by the late M. Freyssinet.

Arch Thrust Blocks

The thrust blocks at the ends of the arch are of mass concrete, and bear on steps cut in the solid sandstone of the river banks. Bearing pressure on the sandstone has been limited to 12 tons per square foot with an overload provision of 25 per cent., giving a factor of safety of at least 12 on strength tests of cores cut from the actual rock. This high factor of safety is necessary to insure against any foundation failure, which would be calamitous in a structure of this size, and takes into account variations in the quality of the sandstone across the foundation areas. Concrete in the thrust blocks is of three classes—Class A (2,500 lbs. per square inch) in the wide base against the sandstone, Class AA (3,000 lbs. per square inch) in the reduced intermediate portions of the tapering blocks, and Class PS (6,000 lbs. per square inch) at the necks of the blocks against which the arch ribs themselves bear. To prevent surface

The arch thrust blocks nearing completion on the Gladesville side



Pier columns approaching completion

cracking of the blocks, light stress distribution reinforcement is placed just below their exposed surfaces.

Abutments

The abutments at the two ends of the bridge are of reinforced concrete, and of box-type with earth filling. The side and front walls are designed to resist the load from the filling. They are founded directly on sandstone.

Piers

Piers are pairs of prestressed concrete thin-walled type columns. The wall thickness is two feet except in the tall piers (piers 4 and 11) at the ends of the arch where the wall thickness is increased to 2 ft. 6 ins. The column bases are widened to form plinths extending some 4 ft. 6 ins. above natural surface level. Vertical prestress by steel bars is carried into the bases of the columns in the approach piers, and into the transverse diaphragms in the case of the piers on the arch. There is a simple reinforced concrete headstock on top of each pair of columns.

Deck Girders

Deck girders are pre-stressed concrete T-beams, eight per span, each with four 12½ in. strand Freyssinet cables except those on the splayed northern approach which have three 12½ in. strand Freyssinet cables. A total of 143 girders is required. In-situ concrete is used to connect together the top flanges of the girders, in the end cross girders, and in the connections between the precast intermediate cross girder diaphragms, of which there are four in each span. Girder are connected longitudinally end to end to provide continuity throughout the four spans on each approach. The four girder spans on each end section of the arch are also connected longitudinally end to end, and the top flanges of these girders and the in-situ deck over the centre of the arch are also connected. The whole of the deck expansion is taken at two finger-type expansion bearings over Piers 4 and 11 respectively at the ends of the arch span.

Miscellaneous

The footways consist of precast slabs supported partly on the upper flanges of the outside deck beams and partly on cantilevered extensions of the cross girders. Provision is made for public utility mains in the cavities under the footways.

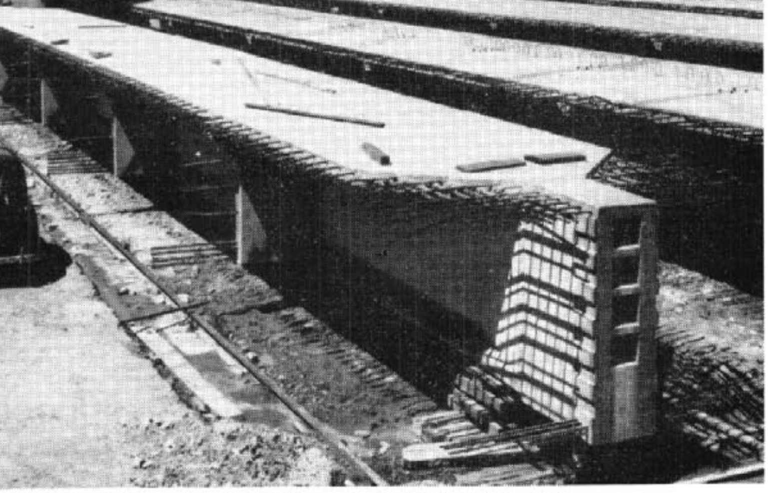
Handrails are of steel vertical bar and top horizontal rail type, the outside handrails being of anti-suicide design with rounded top rail to give no grip.

CONSTRUCTION

Foundations

Preliminary work on the foundations for the arch thrust blocks began in December, 1959 with the construction of coffer-dams on both river banks. Approximately 1,300 cubic yards of earth and 9,000 cubic yards of sandstone were excavated for the two thrust blocks, while 800 cubic yards of earth and 1,600 cubic yards of rock were excavated for the foundations

Erection of headstock on pier columns



Deck beams or girders manufactured at the casting yard on the Drummoyne side of the river

of the abutments and approach piers of the bridge. Explosives were used for breaking up the rock, which was loaded onto lorries for disposal by two stiff-legged cranes, one at each arch thrust block, and by mobile cranes in the case of the smaller foundations. After the foundations were excavated they were filled with ready-mixed concrete obtained from commercial suppliers.

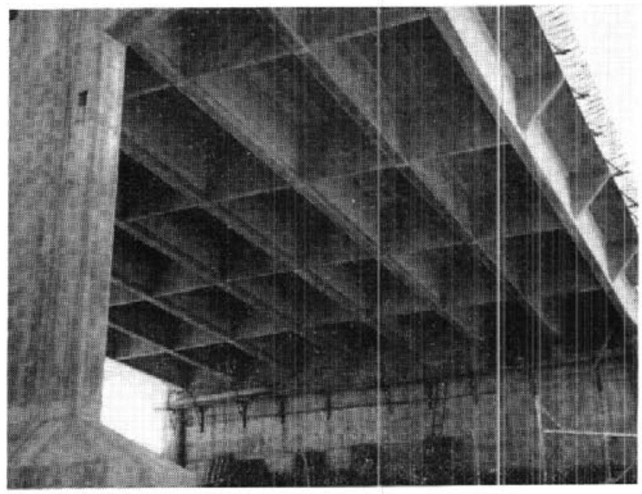
The concrete in the arch thrust blocks was placed in layers of about five feet average thickness and compacted by vibrators. Stepover procedure was adopted in placing concrete in each layer to counteract shrinkage and cracking. Three classes of concrete were used in the arch thrust blocks:—

1. Class A with a minimum 28-day strength of 2,500 lbs. per square inch.
2. Class AA—3,000 lbs. per square inch, and
3. Class PS—6,000 lbs. per square inch.

These mixes contain 6, 7 and 9¼ bags of cement per cubic yard respectively. The high strength PS mix is manufactured from sand obtained from the Nepean River about 35 miles west of the bridge site and aggregate obtained by crushing river gravel from the same source. This mix is also used in the construction of the piers, the main beams supporting the deck, and the arch ribs. Generally a water: cement ratio of approximately 0·38 is used, which gives an average slump of 2½ inches for concrete obtained from ready-mix plants, but for site-mixed concrete used in the beam manufacture and arch rib units a water: cement ratio of 0·35 has been adopted, giving a slump of 1 in. to 1½ ins. Nepean sand and gravel are also used in the manufacture of Class A and Class AA concretes but for these the gravel is not crushed. The quantity of 14,500 cubic yards of concrete was placed in the arch thrust blocks alone, and some 34,000 cubic yards of concrete will be used in the bridge as a whole.

Abutments and Piers

The abutments are of reinforced Class AA concrete on spread footings on sandstone foundation, the wing walls being almost parallel and at right angles to the front walls. The exposed faces of the wings and front walls are plain with strengthening counterfort ribs behind. Steel pipe falsework supporting lined timber forms was used for forming the abutments.



The underside of one of the approach spans

Similar forming was used in the construction of the approach piers. Stressing of the columns is by 1¼ in. diameter Macalloy bars, the number of bars ranging from 14 to 48, and is done in stages. The short length of column plinth is stressed first when the Class PS concrete has reached its 28-day strength of 6,000 lbs. per square inch. The next stage is the stressing of the main column section, and the third stage the tying-in of the headstock to the column. (Four stages may be used for the longest columns.) To allow for the extension of the Macalloy bars during stressing, they are encased, before the concrete is placed, in special wrappings which separate them from the concrete and permit relative movement. Bars are cut to specified lengths and joined together by special Macalloy coupling pieces into which they are threaded. The thread is rolled on at the suppliers' factory in Sydney. Each bar is stressed to a final force of 54 tons.

Launching a deck beam for an approach span

For the construction of the headstocks the reinforcement is prefabricated on the ground and lifted into position within the forms ready for concreting.

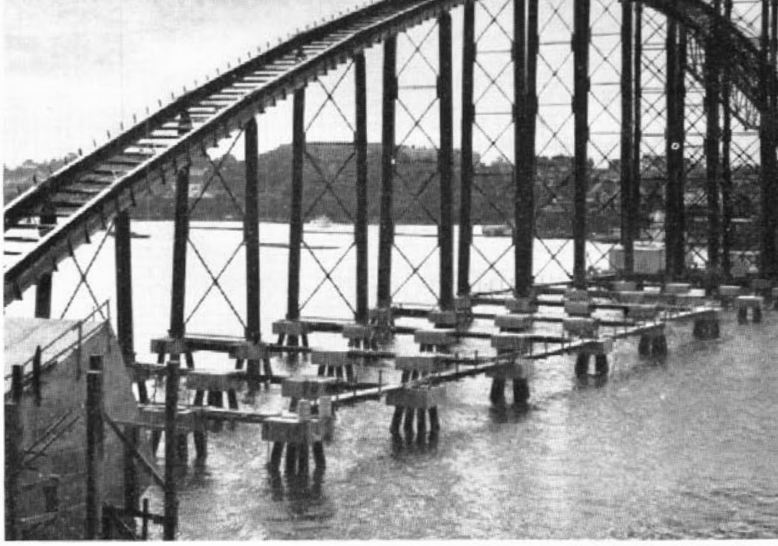
For the taller columns, temporary tubular steel braces, anchored to the ground, are attached to the column walls to steady them and prevent their movement under wind load.

Arch Ribs Falsework

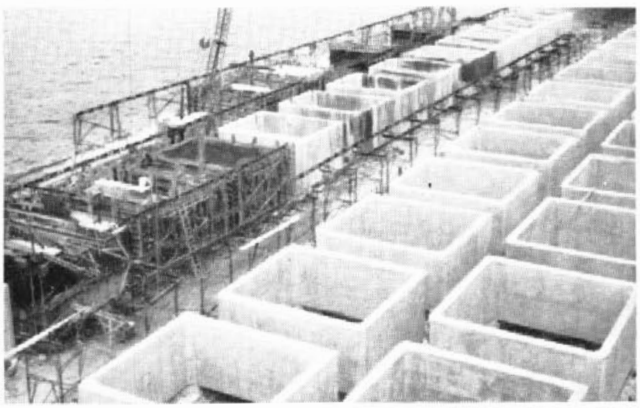
The falsework consists of spans of steel beams 60 feet long, with a steel truss span 220 feet long over a navigation opening in the northern half of the river crossing, all tied together and anchored at each end to Macalloy bars set in the arch thrust blocks. The falsework is supported on steel tubular columns founded on steel tubular pile bents, the piles being taken down to the rock of the river bed. At the centre of the span the steel columns form a braced tower extending the full width of the bridge, as do all the pile bents. The other columns and the girder system are wide enough to support only one rib at a time, and these portions will be moved sideways on rails on the pile bents to support each of the four ribs in turn.

Lifting gear installed on the central tower lifts the voussoir blocks into position. The tower is designed also to serve as a stay to prevent sideways movement of the individual free-standing arch ribs until they are tied together.

In the construction of the falsework it was found necessary to pot the piles into rock on the northern side of the river where the rock is close to the surface. The



Falsework ready to support the first rib of the concrete arch



Concrete units, or hollow blocks, at the casting yard, for the first rib of the arch

A concrete block being hoisted to the top of the falsework after transportation by barge from the casting yard to the bridge site

A block being lowered into position along the falsework

piles on the southern side of the navigation opening were driven to rock. The piles range in length from 33 feet to 165 feet and altogether 298 were driven and 140 potted. Each pile consists of a hollow steel cylinder of 19⅜ in. external diameter made from ¼ in. steel plate and designed to carry a maximum load of 85 tons. Driving was undertaken with a five-ton hammer from a floating rig and, where required, extensions were made by welding additional pile lengths in place over water.

A large floating crane was used for lifting the tall columns and the trusses into position, the height of lift being too great for smaller gear used near the shore.

Arch Ribs—Manufacture of Units

Units for the arch ribs are being made at a site on the river shore about three miles distant from the bridge, where the contractor has set up a casting yard. The yard is laid out to accommodate all the units required for one rib at a time. A pan-type mixing plant has been installed with mono-rail delivery from the mixer, to each of the unit positions.

As the units are manufactured and reach the specified minimum strength of 6,000 lbs. per square inch, they are loaded on to lighters, towed to the central falsework tower, and erected on the falsework.

Deck Beams

Deck beams or girders for the deck spans are manufactured at casting yards on the approaches at both ends of the bridge. Pan-type concrete mixing plants are used, and concrete is hauled to the forms by mono-rail.

In the manufacture of the deck beams the contractor pre-cast the end blocks and cross girder diaphragms, set them up in the forms, and then placed the remaining concrete in-situ. By this procedure the formation of shrinkage cracks in the long beams is minimised, and a further restriction to cracking is supplied by stressing the first of the four 12½ in. strand Freyssinet cables in each girder at 24 hours after the concrete is placed. The remaining three cables are stressed when the concrete has reached the minimum allowable 28-day strength. Water curing takes place for seven days.

To place the deck beams in position, they are loaded on rail bogies and hauled up the earth approach embankment to the abutments, where they are lifted by a special launching truss and placed in position on their seatings. A girder, weighing 65 tons, is used as a counterweight for the launching of the truss itself, and is then, after the truss has been landed on the next pier, winched through to position. Rails on top of the abutment and pier enable the truss to be moved laterally.

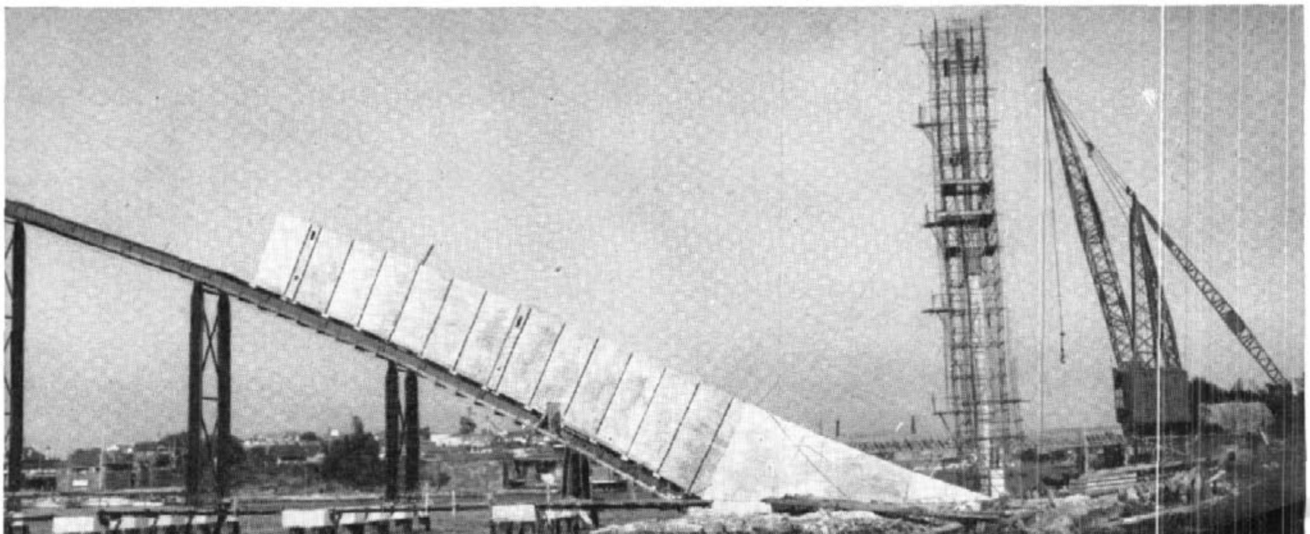
To facilitate erection of formwork for the in-situ concrete in the arch and cross girders between the deck beams, a movable transverse platform is slung below the beams. The in-situ concrete is placed from above.

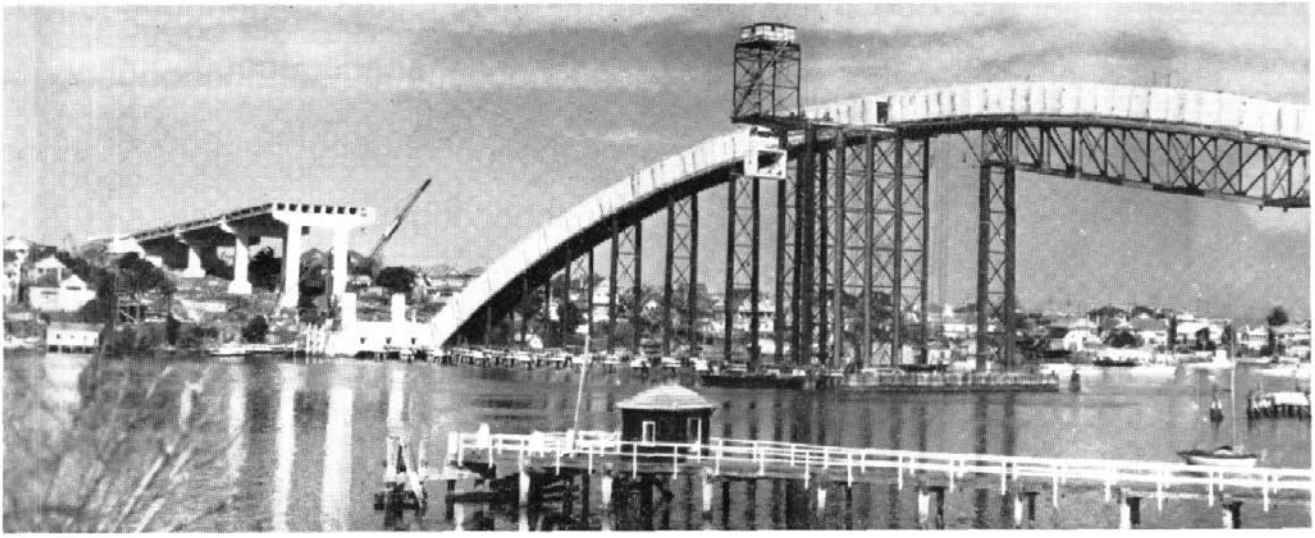
After all beams in adjacent spans have been put into position and the continuity reinforcement placed, the in-situ concrete in the cross girders over the pier is cast on previously placed concrete hinges.

Erection and Stressing the Arch Ribs

The Contractor's scheme for erecting the arch ribs is to lift the individual blocks from the lighters to the top of the arch falsework and winch them down on bogies to their correct positions on the falsework. In-situ concrete joints will be made progressively between the blocks as these are placed until the quarter points are reached, when Freyssinet flat jacks will be installed in four layers, after which the placing and jointing of the blocks will continue until they meet at the crown of the arch. Finally when the joint concrete has reached its specified strength of 6,000 lbs. per square inch, the rib will be placed in compression by inflating the jacks one layer at a time with oil, replacing the oil by grout, and allowing it to set in the first layer of jacks before inflating the next layer. The compressive force in the arch will cause it to lift off the falsework, which can then be moved sideways to take the next rib.

Concrete blocks and diaphragms in position on the falsework





The last concrete block for the first rib of the arch being hoisted to the top of the falsework

When all ribs have been placed in compression, the in-situ concrete will be placed in the transverse diaphragms, longitudinal cables between the top flanges of the ribs will be given a small tensioning force to tighten them, and the in-situ concrete between the top flanges of the arch ribs will be placed round them. The tensioning of the cables in the transverse diaphragms will follow.

Work will then proceed with the erection of the columns and deck beams on the arch and the placing of the in-situ concrete deck over the arch crown section.

Finally, the footways, handrailing and lamp posts will be erected, and the asphaltic concrete wearing surface will be laid on the carriageway.

SUPERVISION

The officer of the Department of Main Roads administering the contract for the construction of the Gladesville Bridge is Mr. R. W. P. Hirt, Metropolitan Engineer. He is assisted by a staff of engineers, surveyors and inspectors.

In view of the importance of controlling the quality of the materials being used in the structure, and particularly the concrete, a special concrete testing laboratory has been established at the bridge site. Equipment installed includes a 200-ton capacity Amsler testing machine, capping equipment, diamond saw, drying oven and mixing unit for investigation of the concrete materials and mixes used in the project.

Continuous testing is carried out on concrete aggregates, cement, and concrete samples from the job. Concrete test cylinders of 6 in. diameter and 12 in. length are made from each pour and cured in a fog room regulated to 99 per cent humidity and 70° F. The Department's research staff has been carrying out special long term creep and shrinkage tests on the concrete since the beginning of 1961, so that appropriate allowances can be made when the arch ribs are being jacked into position.

Testing of steel reinforcement and high tensile bar and strand is undertaken in the Department of Main Roads Central Laboratory at Milson's Point. The elastic properties of the bar and strand are obtained from tensile tests and the extensions required for specified design forces are calculated from these properties. The bar specimens are sampled from off-cuts during cutting and threading operations. The average elastic modulus at the design force has been 24·0 million pounds per square inch.

Two strand specimens are obtained from each coil and are tested individually. The Department has tested a completed 12-strand assembly and found the elastic modulus of this cable to be the same as the average of the individual strands or about 28 million pounds per square inch at the design load.

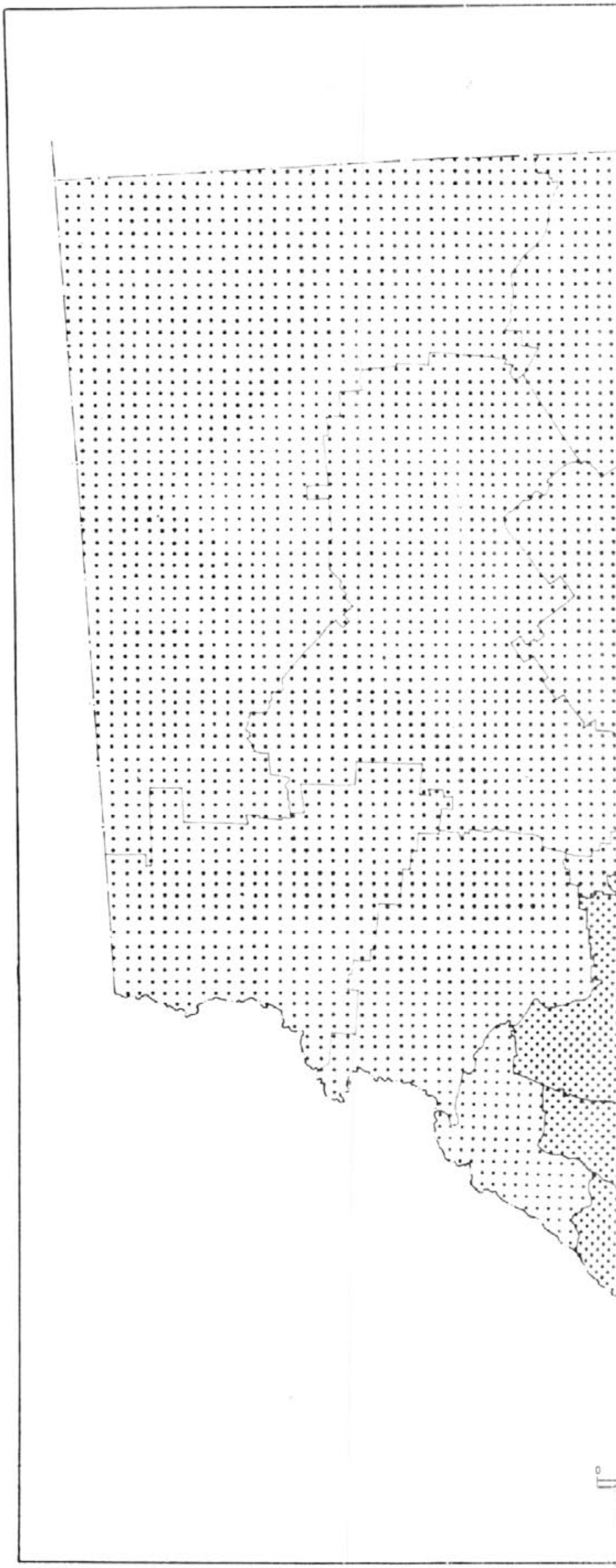
Testing of sandstone is undertaken in the Department's site laboratory. Extensive testing for compression and elastic properties has been carried out on 6 in. diameter cores removed from the foundations to ascertain bearing capacity and probable settlement under arch thrust.

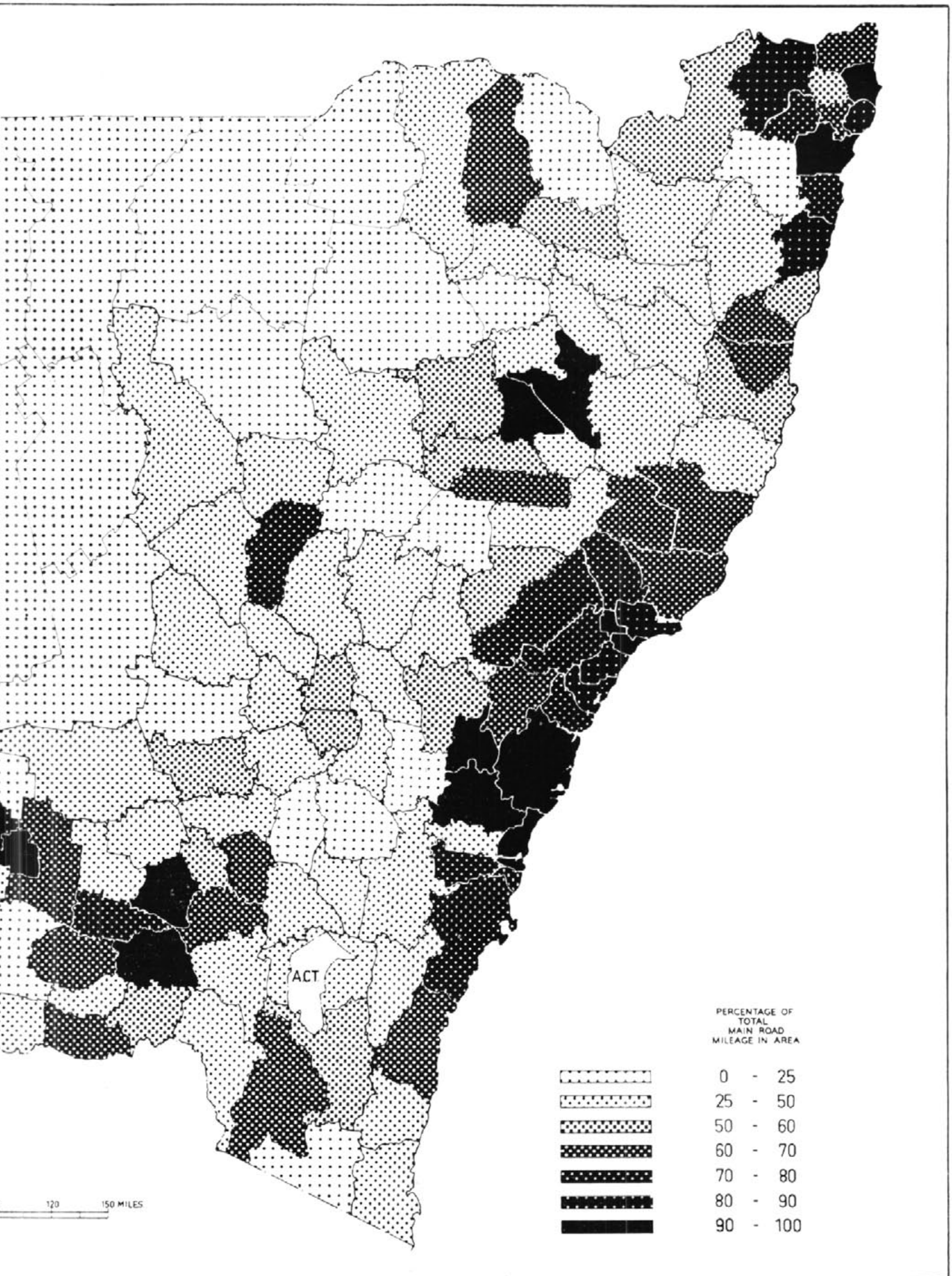
Special survey reference marks are being established to which observations of the movements of the arch rib, both during and after construction, will be related, thus enabling any unpredicted movements to be observed and corrected.

BITUMEN SURFACING OF MAIN ROADS

The map alongside shows the position in respect of bitumen surfacing of Main Roads, i.e., State Highways, Trunk Roads and ordinary Main Roads, in the various Local Government Areas in New South Wales at the 30th June, 1961.

The mileages of Main Roads which have been bitumen surfaced are expressed by various types of shading as percentages of the total mileages of Main Roads in the Local Government Areas.




ACT
120
150 MILES
PERCENTAGE OF TOTAL MAIN ROAD MILEAGE IN AREA
0 - 25
25 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100

HIGHWAY RECONSTRUCTION through the Foothills of the WARRUMBUNG

THE east-west Oxley Highway, which connects the north coast at Port Macquarie with the central western area of New South Wales at Nevertire, passes through the foothills of the Warrumbungle Ranges to link the towns of Coonabarabran and Gilgandra. This section of the Oxley Highway, 59 miles long, also serves as part of the route of the north-south inland Newell Highway.

Between Belar Creek, 9·5 miles west of Coonabarabran and Bidden Creek 13 miles east of Gilgandra, a distance of 36 miles, where the route of the Highway passes through rugged country, the Department of Main Roads is reconstructing or deviating the road to eliminate steep grades and numerous sharp curves. The reconstructed carriageway will have a sprayed-on bitumen surface.

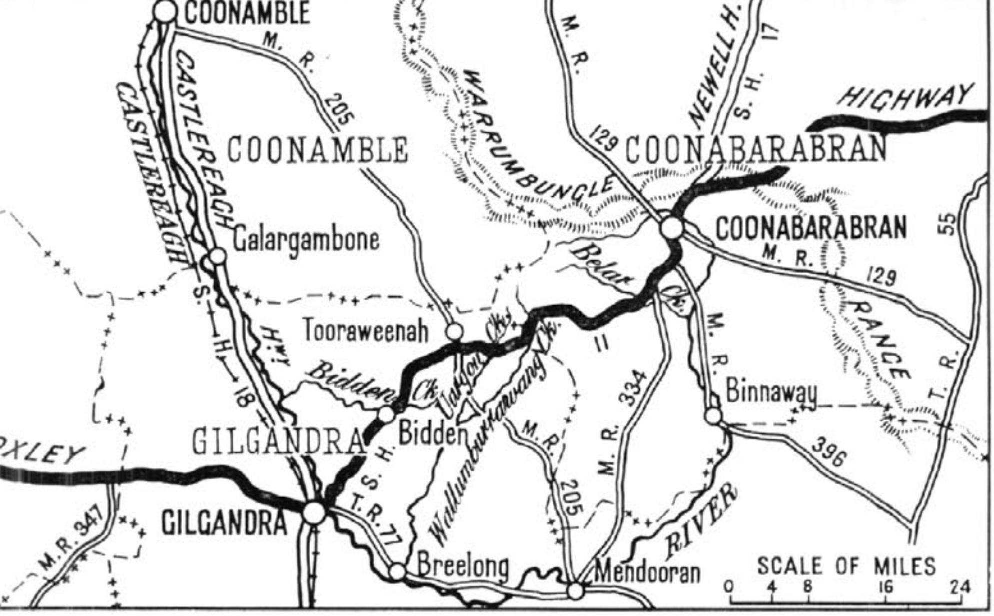
The earliest roads in use between Coonabarabran and Gilgandra connected the intervening pastoral stations and several devious routes existed between the two towns. The earliest and most frequented route followed the Castlereagh River from Coonabarabran via Binnaway, Mendooran and Breelong to Gilgandra. The more direct route via Belar Creek, Tooraweenah and Bidden appeared later but was for many years used more as a route for droving cattle and sheep than as an inter-town vehicular route because of the difficult nature of the country traversed.

Improvements to this section of the Oxley Highway have been carried out by the Department of Main Roads from time to time and these have included a number of deviations, one of which by-passed the village of

1. Looking towards the foothills of the Warrumbungle Ranges from the Oxley Highway 17 miles east of Gilgandra

2. and 3. Excavation work 17 miles west of Coonabarabran

4. The turn-off from the Oxley Highway to Tooraweenah on the right and to Mendooran on the left



Locality sketch

NGES

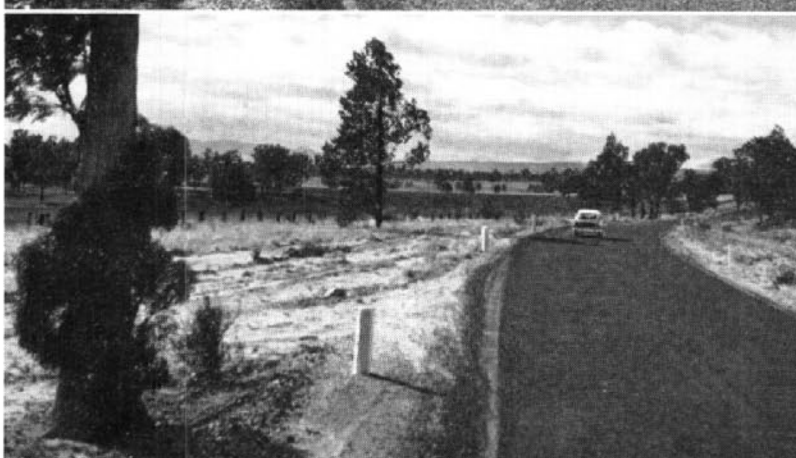
Tooraweenah. In recent years, however, the grades and alignment have been unsatisfactory for present-day motor traffic, and in 1959 the Department commenced the complete reconstruction of the Highway between Belar Creek and Bidden Creek. It is expected the reconstruction and the provision of a dustless surface will be completed towards the end of 1962.

Almost half the earthworks, about 112,000 cubic yards, has been carried out on a length of seven miles, the "heaviest" of which involved some 36,500 cubic yards of excavation. On the heavy sections approximately one-third of the excavation is in rock. Loosening of the rock is being done mainly by heavy tractors with built-in rippers, drilling and blasting being limited to locations where the tractors cannot cope with the work. Shifting of excavated material is being carried out by bulldozers or scrapers and, on fills built up with rock, considerable use has been made of a rock rake to remove boulders likely to affect compaction of the formation.

No major bridging has been necessary, the main streams being Nullen, Uargon and Wallumburrawang Creeks, where the existing structures were retained. Most of the minor structures were replaced with concrete box culverts or pipes.

A design speed of 60 m.p.h. has been adopted over the full length under construction except for one short length of 50 m.p.h.

The cost of the reconstruction and bitumen surfacing of this length of the Highway will be approximately £550,000. The work is being carried out by the Department of Main Roads under the supervision of the Department's Divisional Engineer, Parkes, who in the early stages of the work was Mr. L. W. Burgess, and latterly Mr. R. E. Playford.



The reconstructed Oxley Highway between 14 and 20 miles east of Gilgandra

Development of Accounting System

DEPARTMENT OF MAIN ROADS

by W. W. WEIR, CHIEF ACCOUNTANT

EDITOR'S NOTE:—The present accounting system explained under the "Third Phase" of this article was devised by Mr. Weir soon after his appointment as Chief Accountant.

Since its inception in 1925 the Department has tried three general accounting systems, but it was not until the last change made in 1959 that results satisfactory to the Department's needs were obtained. The systems referred to were (*a*) Income and Expenditure, (*b*) Receipts and Payments and (*c*) a somewhat unorthodox system intended to eliminate the shortcomings of (*a*) and (*b*). The non-technical reader may not be aware of the difference between the Income and Expenditure system and the Receipts and Payments system; definitions are therefore given below which may make the Department's approach to this matter more readily understood.

An *Income and Expenditure* accounting system is one designed to deal with the *whole* of the income and expenditure for the financial year, whether actually received and paid or not. This system also permits of a Balance Sheet or a Statement of Assets and Liabilities being prepared.

A *Receipts and Payments* accounting system is one designed to deal with only *part* of the income and expenditure for the year, namely, that part actually received and actually paid. The Receipts and Payments system deals with cash transactions only. This system does not provide for the preparation of a Balance Sheet or a Statement of Assets and Liabilities.

First Phase—The Income and Expenditure System

The Income and Expenditure system was adopted by the Main Roads Board in 1925 and was carried on by its successor, the Department of Main Roads, until 1941. Although this system offered the advantage of presenting the Department's revenues and expenditures precisely in the annual accounts and of presenting balance sheets, several serious objections were present, first the preparation of the annual accounts involved a considerable amount of delay in attempting to achieve the preciseness referred to (i.e. in obtaining information necessary to effect book entries at the end of each financial year). Secondly, that having achieved a measure of preciseness and having produced Income and Expenditure Accounts and balance sheets with a good deal of effort, these documents proved to be of little practical value in the affairs of the Department and thirdly, as the Department operated a cash budget it was necessary at regular intervals during the year to convert Income and Expenditure transactions to a cash (or Receipts and Payments) basis in order that a comparison might be made with the budget estimates. This conversion was undertaken each month; it was a slow and tedious operation, particularly as five different funds were in use at that time.

Second Phase—The Receipts and Payments System

In 1941 consideration of its disabilities led to the abandonment of the Income and Expenditure system in favour of the Receipts and Payments system. This change, while removing certain objections to the earlier system, brought other disabilities common to a cash system of accounting, e.g. it was not possible to present in the annual accounts a true picture of the Department's financial operations, because duplications of cash receipts and payments and items which in normal bookkeeping would go into the balance sheet could not be excluded from Receipts and Payments statements. In addition, reliable financial statistics to form the basis of year to year comparisons were not available from the annual accounts.

Third Phase—The Present system

The two systems already tried and found wanting were standard text book systems; thus if a further change was to be made it seemed that some liberties would have to be taken with orthodox accounting procedures, nevertheless retaining as far as possible the principles of the Receipts and Payments system. On this basis a system was devised and brought into operation in 1959 which provided for the Department's financial operations being divided into two parts, namely General and Special. Whereas previously one bank account had served for all purposes, a bank account was established for General Purposes and a separate bank account was established also for Special Purposes. Each bank account was to be supported by a separate set of books and separate Receipts and Payments Statements would be presented for General Purposes and Special Purposes transactions. As moneys were received they were to be paid into the appropriate bank account. In order to determine what moneys should be paid into each of these bank accounts, General Purposes was defined as representing those regular sources of revenue available for carrying out the normal purposes of the Main Roads Act. Special Purposes was defined as representing moneys which come to the Department for special road and bridge works (particularly for works on non-Main Roads), the earnings of the Department's plant and of all Departmental assets in respect of which a charge is made for their use, moneys appropriated from revenue (i.e. General Purposes Account) for various reserves, transactions affecting Creditor and Debtor accounts and "balance sheet" accounts generally.

In accordance with the foregoing the General Purposes bank account receives the Department's basic revenue, i.e. Motor Vehicle Taxation, Commonwealth Aid Road Grants and contributions by Councils for roadworks. The Special Purposes bank account receives Government loan allocations and Government grants in respect of specified road and bridgeworks, contributions from the Government and other sources for Expressways construction, Commonwealth Aid Grants for rural roads other than Main Roads, revenue moneys allocated for the purchase of assets, revenue moneys to be placed in reserve until required for projected large road and bridge works and to support the general works programme in contingent circumstances, moneys for suspense accounts and generally money for extraneous purposes which if dealt with in the General Purposes Account, would impair the clarity of the Department's principal operations as revealed in that account.

It has been said that the two systems first tried fell short of requirements in certain directions. Some of these shortcomings are set out below and comment is given in italics as to the extent to which the present system has remedied the earlier deficiencies.

(1) The period immediately before the end of the financial year was, in Head Office, always one of high tempo and some apprehension while endeavouring at this busy time of the year to ensure that various moneys received for purposes of a trust nature had not been inadvertently over-expended or expended for some other purpose. This danger arose, of course, from all moneys, of whatever nature, being banked together.

The special effort referred to has been eliminated as the segregation of the two classes of cash prevents the moneys becoming "mixed". Accounting work and cash control before the end of the financial year is now little different to the position in any ordinary month of the year.

(2) The Department's annual works programmes had to be varied because of appropriations for large roadworks and for the acquisition of valuable assets (e.g. Plant) falling within one or two financial years. If cash reserves could be built up in anticipation of forthcoming specific heavy commitments the possibility of embarrassment would be avoided.

The objective sought has been achieved. During the past three years the Department has undertaken very large projects including the construction of a new bridge and approaches over the Parramatta River at Gladesville, and the construction of an additional building for Head Office. Cash placed in separate reserves has been available as and when required to meet the cost of these projects. The same procedure is currently being followed in respect of large bridges to be built over the Clarence River at Harwood and over the George's River at Taren Point; also in respect of the acquisition of land for further Head Office building extension in the future.

(3) The Main Roads Act is rigid in its financial provisions. It does not give the Department power to work on overdraft and consequently the financial management of works programmes which amount to over £20,000,000 per annum and which cover hundreds of works, large and small, carried out by Councils, contractors and the Department itself, is a rather complex matter. If the Department could establish a reserve on the lines mentioned in (2) in lieu of an overdraft some flexibility would be afforded the financial side of works management.

A start has been made on this objective. A first instalment towards a general works reserve was provided from revenue during 1962. The reserve will be strengthened as finance permits.

(4) The clarity of annual Receipts and Payments Statements had been impaired by the inclusion of such items as Treasury cash advances, capital receipts and payments, trust moneys and generally such items as would appear in a balance sheet.

If extraneous transactions of this type could be excluded from the annual Receipts and Payments Statements it would be more accurate and informative as to the Department's normal operations from its ordinary revenues.

The annual General Purposes Account now resembles an Income and Expenditure Account. It shows the Department's real revenue and expenditure in respect of Main Roads as distinct from expenditure on non-Main Roads which is presented in the Special Purposes Accounts. Extraneous transactions are kept out of sight. Information for statistical purposes is available directly from the accounts, further analysis being unnecessary and the information shown is comparable from year to year.

The annual Special Purposes Account includes all the Department's transactions outside the General Purposes Accounts. Here also the account has been made to resemble as nearly as possible an Income and Expenditure Account—all balance sheet and extraneous items being kept apart. It was intended that the Special Purposes Account should not include any expenditure on Main Roads (i.e. that General Purposes in addition to being restricted to revenue expenditure would also show all *Main Roads expenditure) but this has not proved wholly possible as special money is received for specific Main Road works and this expenditure appears in the Special Purposes Account.*

(5) The Department had a large quantity of road making plant and a fleet of cars, vans and light trucks, the replenishment of which required cash appropriations each year and in years when purchases were heavy the effect was to interfere with works programmes. If all plant operations could be isolated, that part of hire earnings which represented depreciation would be available to purchase new plant and reduce the amount required from revenue.

Internal funds of a circulating nature have been set up in Special Purposes Account for plant, for cars, for trucks and for a number of other activities such as residences which the Department provides for officers, for the Central Workshop and for the Central Store. The financial operation of these activities no longer interferes seriously with the revenue position; depreciation in usage charges is available to wholly replenish assets or to reduce the amount required from revenue for this purpose. The plant position in the current year may be quoted as an example. £275,000 is required for plant replacements, but an appropriation from revenue will not be necessary as this sum (more if required) is available in the Plant Funds.

(6) The difficulties associated with the "mixing" of revenue and special moneys.

The setting up of Special Purposes Accounts solved this problem. Each kind of special money received is now automatically controlled and separate balances of this cash are available daily.

(7) Budgetary control of revenue and cash outgoings had been made difficult by the inclusion of suspense accounts, trust and extraneous items in the budget.

The new system allowed of these items being removed from the budget and the result is greater clarity and simplified control. Receipts and Payments in the Special Purposes Account need little attention as they practically look after themselves.

In conclusion it can be said that experience of the past three years has proved the present system to be quite satisfactory. No disadvantages of any importance have shown up and it seems that a permanent general accounts structure has now been achieved.

SYDNEY HARBOUR BRIDGE ACCOUNT

Receipts and Payments for the period from 1st July, 1961 to 30th June, 1962

Receipts	£	*Payments*	£
Road Tolls	1,569,879	Cost of collecting road tolls	204,199
Contributions—		Maintenance and minor improvement	287,308
Railway Passengers	143,335	Interest, exchange and management expenses on loans	560,690
Omnibus Passengers	16,129	Alterations to archways for occupation by tenants	4,364
Rent from properties	40,604	Administrative expenses and miscellaneous charges	21,894
Other	1,280	Transfers to Expressways Fund	892,865
		Provision of traffic facilities	40,323
		Alteration to toll gates	879
		Land Acquisitions	17,626
	£ 1,771,277		£ 2,030,148

NEW COOK'S RIVER BRIDGE

PRINCE'S HIGHWAY AT TEMPE

Historical

Botany Bay, into which Cook's River flows, was first entered by white men on the 29th April, 1770, when the " Endeavour ", under the command of Lieutenant (later Captain) James Cook, anchored at a point opposite Kurnell. Cook and his party spent about a week exploring the neighbourhood before the " Endeavour " again set sail on the 7th May.

Cook's favourable report on the quality of the soil in areas adjoining the harbour is thought to have influenced the British Government in ordering Governor Phillip to establish the first settlement in New South Wales in this locality. Phillip, however, after reaching Botany Bay on the 18th January, 1788, decided to establish the settlement at Port Jackson.

The name of Cook's River appears to have been first recorded on a chart of the settlements in the new colony, which was sent by Governor Hunter to the Duke of Portland with his despatch of 10th January, 1798.

A road from Sydney to Cook's River, approximating the present route of the Prince's Highway, existed as early as 1833. The " Sydney Gazette " on the 12th September, 1833, commented that " The Cook's River road is every day becoming more a favourite drive with our Sydney folks. The fast increasing pretty village of New Town, and further on the starch manufactory of Mr. Wilson . . . . . . render it particularly attractive at this time of the year." On the 1st August, 1833, the " Gazette " stated that a " Mr. Prout has just finished a large and substantial punt at his residence, Cook's River, capable of conveying a loaded waggon and a team of bullocks across the river. This will no doubt prove of very great advantage to the settlers in that district, as they may thus save a distance of six miles in their journey to Sydney, and avoid a long range of bush road, at times almost impassable, owing to the want of necessary repairs. Indeed, the settlers in the district of Cook's River have long complained of the want of a proper road to the capital; much of the inconvenience hitherto sustained, however, will now be remedied through the exertions of Mr. Prout."

In 1831, Surveyor General Mitchell put forward a proposal for a direct road from Sydney to the Illawarra district. Mitchell proposed that the road " . . . . . would cross the lowest ford on Cook's River, and George's River by a ferry . . . . . . to the heights over O'Brien's land at Illawarra . . . . . . ". It is likely that the lowest ford over Cook's River mentioned by Mitchell was at Tempe near the site of the bridge which was subsequently built to carry the road which became the Prince's Highway. The course of the new road from Cook's River to the top of Bulli Pass was eventually marked out by Mitchell in 1843.

The New Bridge

The new bridge to carry the Highway across Cook's River at Tempe is a six-lane, prestressed concrete structure which was opened to traffic on 16th May, 1962. The bridge replaced a three-lane timber structure built in 1897, which had reached the end of its structural life and had become inadequate in width.

The new bridge has an overall length of 300 feet comprising two shore spans each 84 feet long and a centre span of 132 feet between river piers. The centre span consists of a suspended section 90 feet long and two cantilever arms each 21 feet long, the cantilevers being a continuation of the shore spans. The carriageway is 60 feet between kerbs. The ducts and cables of public utility services have been laid beneath the two footways, each of which is nine feet wide.

The new bridge provides a clearance of nine feet above high water level to enable small boats to pass under it.

The substructure of the bridge is founded on 120 octagonal pretensioned concrete piles each measuring 16 inches across. The piles supporting the abutments and piers were driven to a soft sandstone at the southern end of the bridge and to a tight sand-bed at the northern end. Each of the two river piers rests on a single row of vertical piles which permit a degree of flexibility in order to allow for expansion or contraction in the shore spans. All abutment piles are driven on a slope (battered) to resist horizontal longitudinal forces.

The piles at the river piers are concealed by pre-cast skirting units which were cast into the pier head-stocks above high water level, thereby obviating the need for cofferdams during construction.

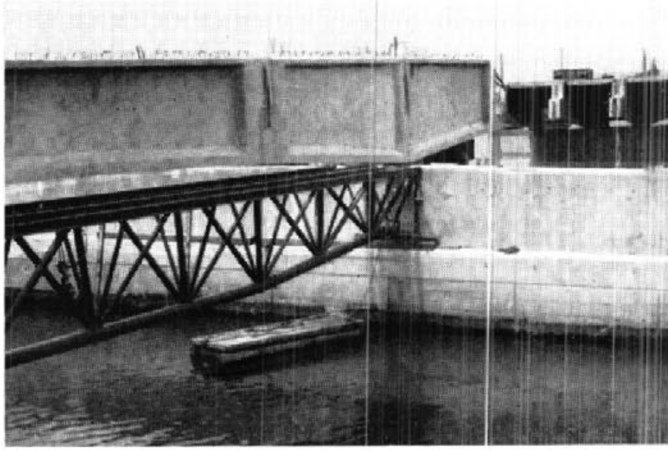
On the piers and abutments, which are constructed in reinforced concrete, Neoprene bearing pads have been used to support the beams of the superstructure. Each pad measures 1 ft. 9 in. by 1 ft. 6 in. by $2\frac{3}{8}$ in. and was designed to provide sufficient thickness to accommodate temperature effects, normal creep, shrinkage and deflection movements in the deck system before and after the final prestressing operations.

The cantilever arms in the centre span support the suspended section on stepped end blocks. The suspended section is restrained at the northern extremity but is free to move on a rail section at the southern end. This is the only expansion joint in the bridge as the deck system was fixed at both abutments by the use of mild steel bars, which were cast into the bottom flanges of the beams at one end and into the abutment endwalls at the other.

The superstructure consists of a reinforced concrete deck $6\frac{3}{4}$ inches thick, cast in place on the top flanges of the beam system. There are nine lines of prestressed concrete I-section beams in each span, of which the inner seven support the carriageway and the remaining two support the outer edges of the footways.

Each cantilever beam unit, 105 feet in length and weighing 42 tons, was factory precast in two segments, 42 feet and 63 feet in length but of the same weight. The segments were delivered to the site from a factory casting yard at Villawood. The two segments were set up on blocks behind the abutment in line with the final beam position in the structure, and then sufficient prestressing was applied to enable the beam to carry its own weight.

Each beam in the suspended section (or span) is 90 feet long, weighs 27 tons and was factory precast in three 30 feet segments.



Cantilever beam in the northern approach span of the new bridge showing launching truss

The beam depths and lengths of segments were so designed that only three sets of 30 feet lengths of form-work were required for the manufacture of all beams.

The Freyssinet system of prestressing was employed as follows:—

1. *Cantilever beam units.* Each beam contained eleven cables, each consisting of 12 wires 0·276 in. diameter, the average force in each cable after anchoring being 44·1 tons. Five cables were stressed after the jointing of the segments but prior to launching. The remaining six cables were stressed after each unit had been positioned, the precast cross-girders placed and stressed and the deck concreted.

2. *Suspended span beams.* Each beam contained twelve cables each consisting of 12 wires 0·276 in. diameter, the average force in each cable being 44·1 tons. Eight cables were stressed prior to launching. The remaining four cables were anchored in the deck to facilitate stressing and were stressed after casting the centre half of the deck slab.

3. *Cross-girders.* These were factory precast in sections, placed in position between the seven internal rows of beams and prestressed before the deck slab was cast. With the exception of the single cable cross-girders at the abutments, each cross-girder contained three cables, each consisting of twelve wires 0·200 in. diameter, the average cable force being 25 tons after anchoring.

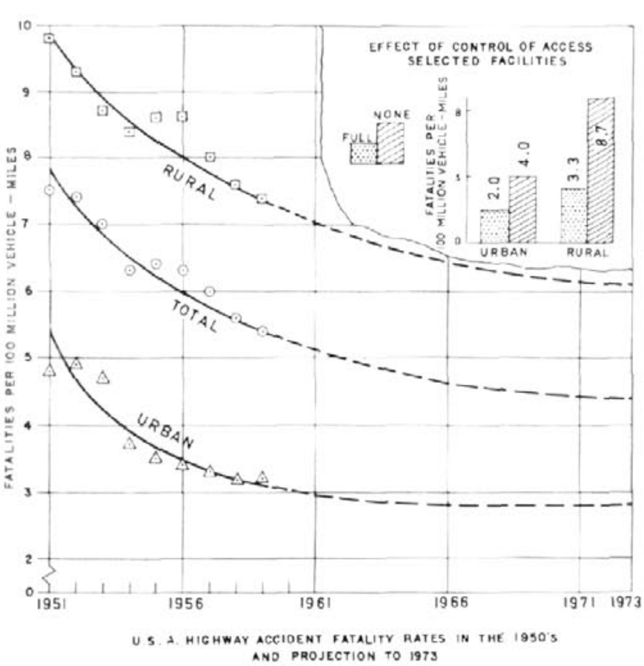
For the placing of the beams, a truss of triangular section was fabricated in tubular steel with a total weight of $6\frac{1}{2}$ tons. The truss consisted of a main section 81 feet in length with two 5 feet extensions which were added for the launching of the beams in the suspended span. Rails were welded to the top chords, so that each beam could be moved across the truss on straddle trolleys to its ultimate position. The truss was moved transversely by winching from one beam position to another as required.

The Department obtained architectural advice on the appearance of the bridge, and as a result the soffit line of the spans is pleasingly curved throughout the bridge. The general appearance is further enhanced by the bridge having been placed on a vertical curve with both approaches on a $4\frac{1}{2}$ per cent grade, and by the blending of the suspended span with the soffit line and the vertical curve. The stepped blocks at the ends of the suspended span are concealed by cover slabs so that the bridge appears to be continuous.

The construction of the bridge was carried out by John Holland (Constructions) Pty. Ltd. to a design submitted by that firm to meet the Department's requirements. The approaches were constructed by the Department's day labour forces, and the total cost of bridge and approaches was approximately £260,000. The work was carried out under the supervision of the Department's Metropolitan Engineer, Mr. R. W. P. Hirt.

Accident Reduction from Expressways in U.S.A.*

In each year of the past decade, traffic accidents on all roads and streets in the United States have taken 35,000 to 40,000 lives. The total annual number of fatalities has fluctuated within this range during the decade and while it has been increasing somewhat during the past few years, this increase has by no means matched the concurrent growth in the number of vehicles registered annually and the miles that they travel. A reasonable and widely accepted measure of highway safety is the number of fatalities per 100 million vehicle-miles of travel. With this measure showing a fairly steady decline from 7·5 in 1951 to 5·4 in 1959, the record of progress in highway safety provides some encouragement.



U.S.A. HIGHWAY ACCIDENT FATALITY RATES IN THE 1950'S AND PROJECTION TO 1973

There is much greater promise for the future. The 41,000-mile National System of Interstate and Defense Highways, now being built with a target date of 1972 for completion, represents only 1·2 per cent of the Nation's total road and street mileage, but it will carry 21 per cent of all motor-vehicle travel. The Interstate System, therefore, has a key role in highway safety. Features being built into the system, such as control of access, divided roadways independently designed, and carefully planned interchanges, are expected to have a favourable and lasting impact on the traffic accident problem.

From examination of available facts, it is conservatively estimated that completion of the Interstate System will each year thereafter spare the lives of at least 5,000 persons who otherwise would have died in traffic accidents.

The accident experience on highways having Interstate System freeway design has already been carefully compared with that on conventional highways carrying major traffic loads in the same area. In urban areas the Interstate type of highway has a fatality rate of 2·0 deaths per 100 million vehicle-miles of travel, as compared with 4·0 for conventional highways; in rural areas the rates were 3·3 and 8·7, respectively.

From analysis of these data, national trends in accidents, and forecasts of traffic, it appears that Interstate freeways are about two-and-one half times as safe as the highways of earlier design they are replacing. This is an overall relationship. The nature of the benefits varies somewhat between the city and the open country-side. Judged by the number of accidents and deaths per 100 million vehicle-miles of travel, the total accident reduction benefits of freeways are greater in the cities, but their life-saving values are higher in the rural areas.

** The information contained in this article was extracted from an article published in the February, 1962 number of " Traffic Engineering " under the title " Life Saving Benefits of the Interstate System " by Charles W. Prisk, Deputy Director of Highway Safety, Bureau of Public Roads, Department of Commerce, United States of America.*

NOVEL DESIGN

OF A FERRY VESSEL

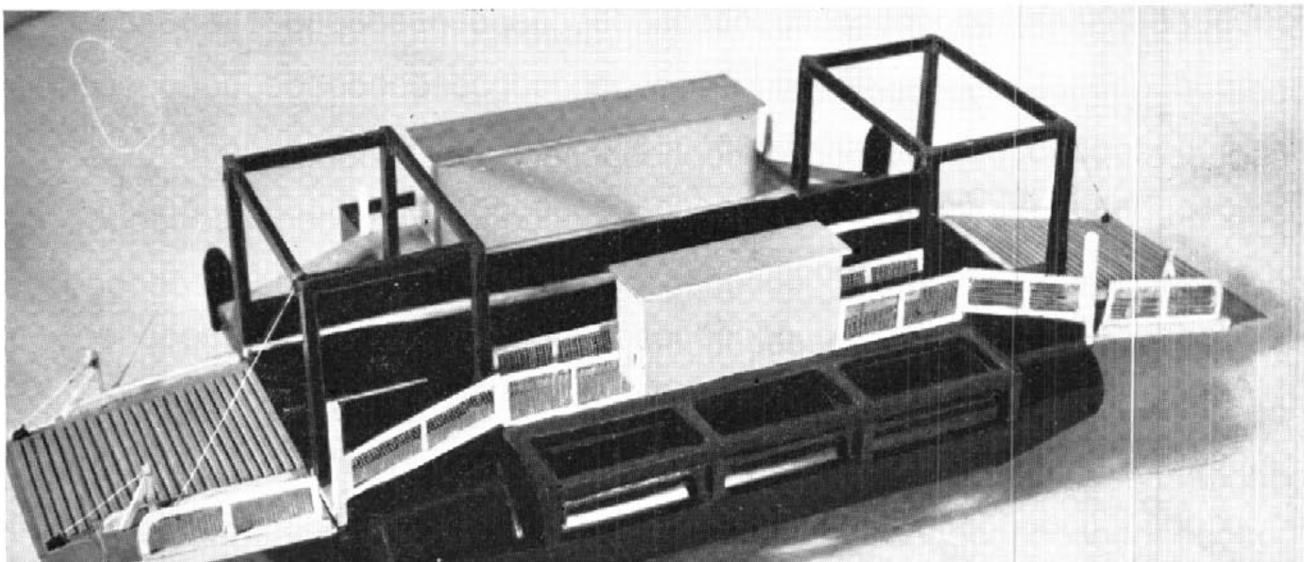
Mr. J. S. WINNING

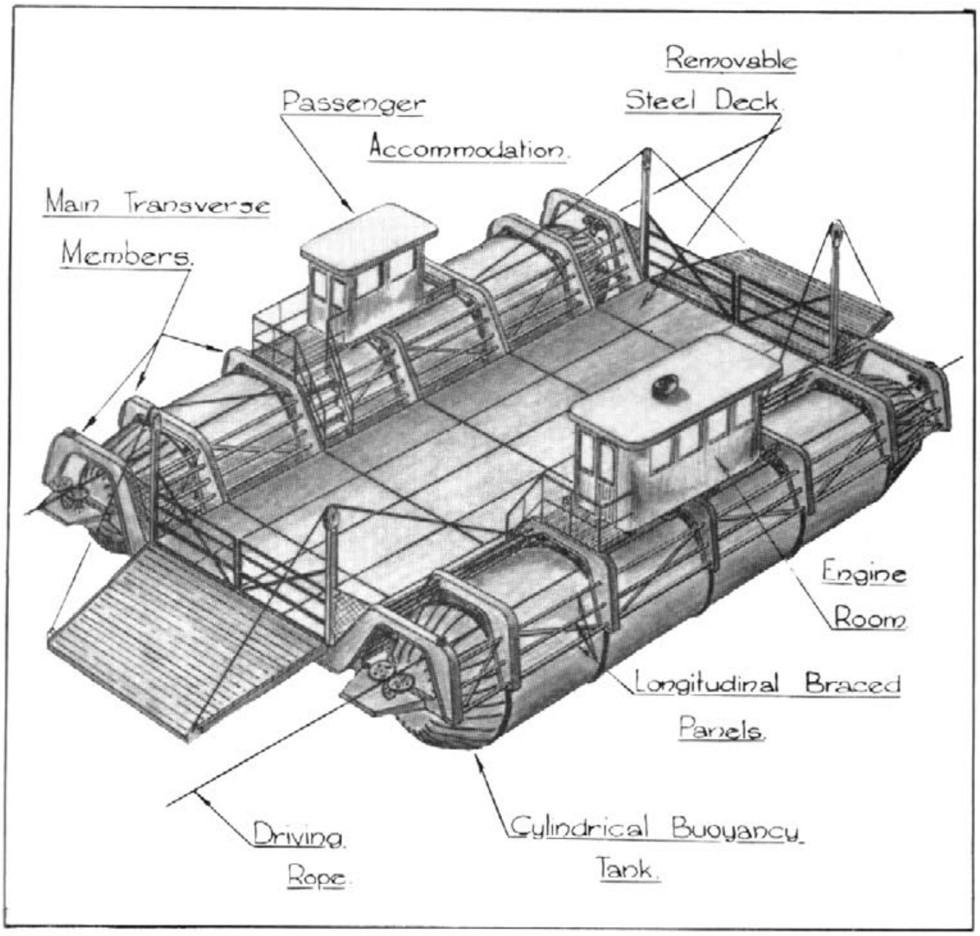
A NOVEL design for a river ferry vessel for operation on a rope has been originated recently by a senior Mechanical Draftsman on the staff of the Department of Main Roads, Mr. J. S. Winning.

The design (see Fig. 1) comprises a deck resting on transverse members supported on and between two longitudinal cylindrical steel pontoons. Additional buoyancy is provided by a number of buoyancy tanks of fibre-glass attached beneath the deck. The buoyancy obtained from the fibre-glass tanks has special value in relation to longitudinal stability should all the live load be at one end of the vessel. Longitudinal stiffness is provided by braced panels which are bolted between the main transverse members along both the outer and inner sides of the pontoons.

Ferry vessels on ropes at present used for river crossings in New South Wales (see Fig. 2) are, in effect, rectangular pontoons, with ends tapered to suit approach ramps. The hulls comprise either steel plating or timber planking fixed to a series of longitudinal and

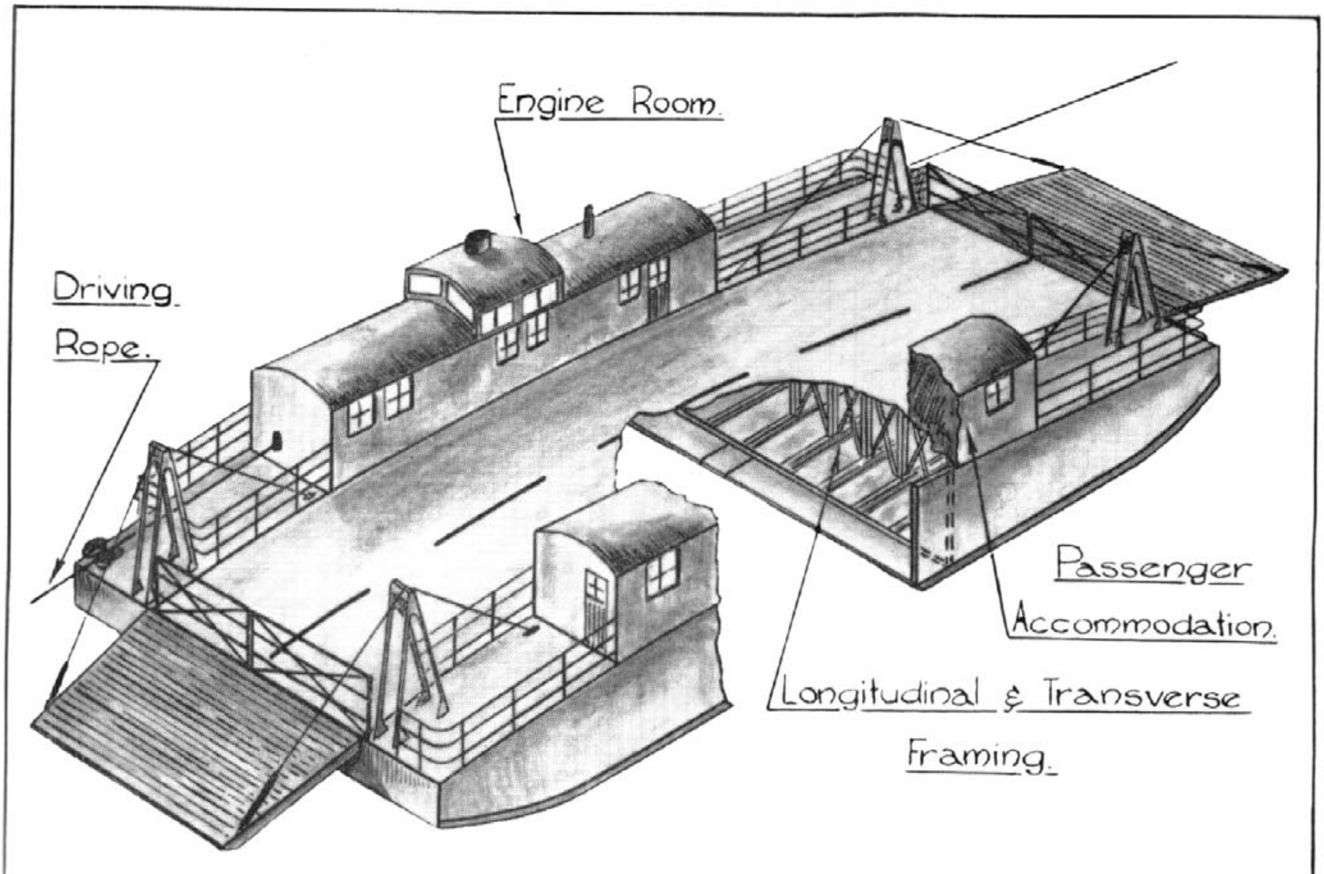
Model of proposed ferry

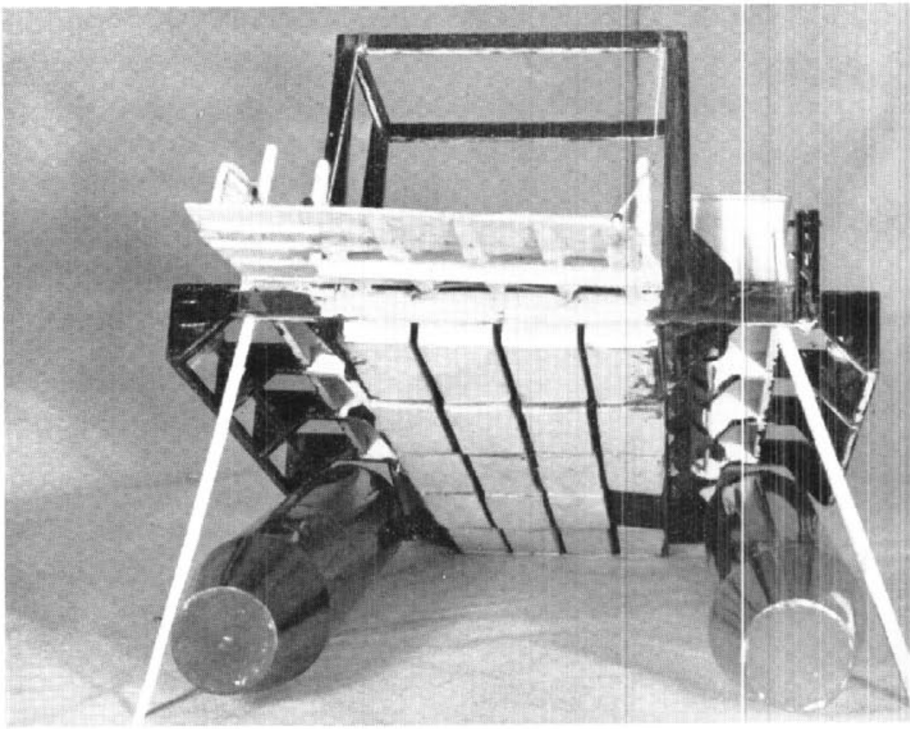




Left:—Sketch of proposed ferry

Below:—Sketch of ferry vessel now used on river crossings





Photograph of model showing underside of deck and cylindrical pontoons

transverse frames built in ship fashion. Ferries operated with vessels of this type present the following operational disadvantages:—

(*a*) At every crossing a relief vessel needs to be available for use when the regular vessel is undergoing maintenance or overhaul.

(*b*) A slipway must be available to enable the underside of the vessel to be inspected, cleaned and repaired from time to time. This has particular application in tidal waters where rapid marine growth necessitates regular and frequent slipping.

(*c*) Unless there is a waterway from the works of a builder of ferry vessels to the site of use, then a ferry vessel must be built close to the site. Under New South Wales conditions this often means at a location remote from workshop facilities and from sources of skilled labour.

The outstanding advantage of the ferry vessel designed by Mr. Winning over the local conventional design for a ferry vessel is that its maintenance and repair can be carried out while the vessel continues in use. This obviates the need for a relief vessel and for a slipway. Further, the vessel can readily be taken apart and transported by road.

The following are some of the features of the design:—

(1) The pontoons which provide the main buoyancy have been designed of cylindrical shape to enable them to be rotated when desired. Any part of the surface of a pontoon affected by marine growth can thus be brought above the water surface, and is available for cleaning either from the vessel itself, or from a working barge towed alongside the vessel. The cylinders rest against rollers attached to the main transverse members, and rotation is effected by hand by using a lever.

(2) The deck consists of steel panels which can be lifted out to permit removal of the fibre-glass buoyancy tanks for maintenance and simultaneously provide access to the deck framing below. This feature of the design and the fact that all supporting steelwork is above the laden water-line make it possible both for that part of the steelwork under the roadway, and for the fibre-glass tanks, to be given maintenance attention while the vessel continues to operate although at reduced capacity.

(3) The vessel is planned to be a welded and bolted prefabricated unit, built in sections suitable for transport to the site by road. If a ferry is superseded by a bridge, a ferry vessel of this type may be dismantled, transported to another site, and reassembled.

Mr. Winning's design was referred to a naval architect, who reported favourably on it. A model was also built. As a result, the Department of Main Roads proposes to adopt the design and build a vessel of this type when a suitable opportunity occurs.

GROWTH OF TRAFFIC ON MAIN ROADS IN NEW SOUTH WALES

THE rate of growth of traffic is largely dependent upon four main influences, viz:—

(1) **Population.** As the human population increases so does the vehicle population, resulting in increased traffic on the roads.

(2) **Vehicle Ownership.** A rising standard of living means that more people can and do afford motor vehicles, with a consequent increase in traffic volumes. For comparative purposes this influence is expressed as a ratio of the number of human beings per motor vehicle i.e. the Vehicle Ownership Index. Thus the higher the number of vehicles in proportion to human beings, the lower the Vehicle Ownership Index. Australia is already near the top of the World Vehicle Ownership Index Table i.e. already has a high number of motor vehicles in proportion to the human population, so that it is reasonable to assume that the influence of this factor on future traffic growth will be a declining one.

(3) **Vehicle Use.** Road use will continue to increase so long as the reliability and range of motor vehicles improve, making this means of transport more widely acceptable to the human population.

(4) **Road improvements.** A continuing programme of road improvements and extensions will continue to increase road use. Improvements, e.g. bitumen surfacing of a particular road, make that road more attractive to drivers. Increased traffic will result not only from diversions from other less improved roads but also from additional traffic generated by the availability of an improved facility.

The figures given below have been assembled from the Department's traffic counting records to give an indication of the growth of traffic on the principal State Highways and some Main Roads.

Traffic volume surveys have been carried out by the Department of Main Roads at locations throughout the Main Road system since 1928 but prior to the mid-1950's they were on a limited scale only. In the earlier years these counts were generally of one day's duration at a number of selected points. However, continuous daily records have been kept on ferries under the Department's control since approximately 1930, with the exception of the war years. Since 1955, the Department has been establishing permanent automatic traffic counters and now has approximately 50 such counters giving a continuous record of traffic growth. In conjunction with these permanent counts systematic short counts, generally for one week, have been made throughout the rural State Highways.

Prior to 1959 the results of the various one-day or one-week counts were not adjusted for seasonal variations. However, now that considerable detail has been amassed from permanent stations on the seasonal fluctuations on various roads, this information is used to adjust the figures from short counts. These figures are then expressed as the annual average daily traffic (A.A.D.T.) for the year in question.

It should be noted that although the 1960 figures are A.A.D.T. figures, the earlier figures, other than at ferries, could not be adjusted for seasonal variations and should only be regarded as indicative of the general order of the volumes and not as accurate annual average daily volumes. Where figures are given for ferries, however, they can be considered to have a high order of accuracy.

The years 1935 and 1949 have been chosen for comparison as these are years during which considerable traffic counting activity took place. In a few instances where figures were not available for these years they have been interpolated from prior and subsequent years.

Station No.	Location	Year			No. of Times Increase 1960 over	
		1935	1949	1960	1935	1949
STATE HIGHWAY No. 1—PRINCE'S HIGHWAY						
23.01 ..	Bridge over Cook's River at Tempe.	9,000	..	38,000	4	..
36.01 ..	Bridge over George's River ..	2,700	7,400	44,000	16	6
36.12 ..	West of Port Hacking Road, Sylvania.	1,300	3,800	21,400	16	6
78.14 ..	North of Lawrence Hargrave Drive.	700	1,600	5,700	8	4
78.19 ..	South of Sturdee Ave, Bulli ..	1,400	2,500	9,700	7	4
I.1 ..	1 mile south of Kiama ..	1,000	..	2,800	3	..
I.52 ..	3·5 miles south of Nowra ..	1,100	1,600	3,000	3	2
S.C.3 ..	Bridge over Nelligen River at Batemans Bay.*	120	330	1,200	10	4
S.C.97	Just north of Victorian Border	30	50	85	3	2
**Formerly a Ferry.*						
STATE HIGHWAY No. 2—HUME HIGHWAY						
62.01 ..	East of York Street, Cross Roads.	1,500	2,950	12,000	8	4
85.15 ..	North of Edward Street, Camden.	1,250	2,500	7,000	6	3
I.24 ..	5 miles south of Camden ..	830	1,300	3,600	4	3
I.32 ..	2·3 miles west of Mittagong ..	300	660	2,100	7	3
S.38 ..	·25 of a mile north of Marulan Railway Bridge.	230	660	2,920	13	4
S.44 ..	Just east of Federal Highway	350	590	2,670	8	5
S.47 ..	Just west of Federal Highway	160	390	1,290	8	3
S.29 ..	·5 of a mile south of Sturt Highway.	70	260	970	14	4
STATE HIGHWAY No. 3—FEDERAL HIGHWAY						
S.46 ..	South of Hume Highway ..	140	200	870	6	4
S.63 ..	South-west of Trunk Road No. 52 at Sutton.	82	200	810	10	4
STATE HIGHWAY No. 4—SNOWY MOUNTAINS HIGHWAY						
S.C.68	2·75 miles east of Monaro Highway at Nimmitabel.	10	80	300	30	4
S.C.80	3·8 miles west of Cooma ..	50	270	1,730	35	6
S.C.90	Just north of Southern Road to Yarrangobilly Caves.	20	10	128	6	13

STATE HIGHWAY No. 5—GREAT WESTERN HIGHWAY

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
02.21 ..	West of Missenden Road, Camperdown.	16,000	..	31,500	2	..
25.02 ..	East of Dalhousie Street, Ashfield.	15,000	..	35,000	2	..
27.21 ..	East of George Street, Homebush.	7,400	..	37,000	5	..
68.11 ..	East of Woodville Road, Granville.	6,100	..	32,000	5	..
50.11 ..	Church Street, north of Rosehill Street, Harris Park.	6,500	..	37,000	6	..
87.01 ..	Victoria Bridge over Nepean River, Penrith.	960	..	7,170	7	..
C.43 ..	2·5 miles east of Wentworth Falls.	870	1,200	3,780	4	3
C.59 ..	·75 of a mile east of Yetholme	350	370	1,760	5	5
C.62 ..	·75 of a mile east of Bathurst	1,000	1,300	2,125	2	2

STATE HIGHWAY No. 6—MID-WESTERN HIGHWAY

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
C.67 ..	2·2 miles west of Mitchell Highway at Bathurst.	280	540	660	2	1

STATE HIGHWAY No. 7—MITCHELL HIGHWAY

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
C.65 ..	5·6 miles west of Mid-Western Highway at Bathurst.	440	780	1,240	3	2

STATE HIGHWAY No. 9—NEW ENGLAND HIGHWAY

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
L.N.3 ..	2 miles east of Mudies Creek, east of Singleton.	200	600	1,840	9	3
L.N.40..	3·5 miles south-east of M.R. No. 209 at Muswellbrook.	150	400	1,580	11	4
N.W.34	3 miles south of Bendemeer..	90	280	1,100	12	4
U.N.60	18 miles north of Deepwater..	80	180	650	8	4

STATE HIGHWAY No. 10—PACIFIC HIGHWAY

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
01.01 ..	Sydney Harbour Bridge ..	15,000	30,000	80,500	5	3
53.14 ..	East of Pennant Hills Rd., Wahroonga.	2,000	3,400	16,500	8	5
74.11 ..	North of Pennant Hills Rd., Wahroonga.	2,100	3,700	15,000	7	4
76.01 ..	Peat's Ferry Bridge over Hawkesbury River.	370	1,600	7,200	19	5
L.N.25..	·25 of a mile south of Catherine Hill Bay Rd.	380	860	3,380	9	4
L.N.1 ..	Bridge over Hunter River at Hexham*.	400	670	5,300	13	8
L.N.4 ..	Ferry over Hastings River at Blackmans Point.	100	200	800	8	4
N.E.4 ..	Ferry over Clarence River at Harwood.	210	290	1,200	6	4
N.E.3 ..	Ferry over Richmond River at Burns Point.	100	170	870	9	5
N.E.90..	12.8 miles north-east of Murwillumbah.	200	770	4,200	21	5

* *Formerly a Ferry.*

STATE HIGHWAY No. 13—WOODVILLE ROAD—PENNANT HILLS ROAD

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
68.21 ..	Woodville Road south of Parramatta Road, Granville.	3,200	..	21,000	7	..
74.28 ..	Pennant Hills Road south of Pacific Highway, Waitara.	1,350	2,400	12,000	9	5

STATE HIGHWAY No. 14—STURT HIGHWAY

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
S.W.30	·5 of a mile west of Hume Highway.	70	200	425	6	2

TRUNK ROAD No. 51

From Prince's Highway (S.H. 1) at Bateman's Bay to Australian Capital Territory Boundary near Queanbeyan

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
S.C.4 ..	Nelligen Ferry on Clyde River at Nelligen, Eurobodalla Shire.	35	85	216	6	3

MAIN ROAD No. 104

From New England Highway (S.H. 9) at East Maitland to the Pacific Highway (S.H. 10) at Raymond Terrace

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
L.N.10..	Raymond Terrace Ferry on Hunter River at Raymond Terrace, Port Stephens Shire.	151	206	319	2	2

MAIN ROAD No. 108

From Pacific Highway (S.H. 10) at South Adamstown via Newcastle, Stockton Ferry to Nelson Bay

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
L.N.12..	Stockton Ferry on Hunter River, City of Greater Newcastle.	520	1,130	3,292	6	3

MAIN ROAD No. 168

From Prince's Highway (S.H. 1) at Arncliffe via Forest Road to George's River at Lugarno Ferry

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
37.03 ..	Lugarno Ferry on George's River at Lugarno.	..	127	592	..	5

MAIN ROAD No. 199

From Prince's Highway (S.H. 1) at Moorefield via Rocky Point Road, Taren Point Ferry to Kingsway (M.R. 227) Caringbah

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
36.02 ..	Taren Point Ferry on George's River at Taren Point.	..	333	1,023	..	3

MAIN ROAD No. 225

From M.R. 181 at Village of Wiseman's Ferry via Wiseman's Ferry to Pacific Highway (S.H. 10) approximately 4 miles west of Gosford

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
73.61 ..	Wiseman's Ferry on Hawkesbury River at Village of Wiseman's Ferry.	25	51	180	7	4

MAIN ROAD No. 556

From M.R. 198 at Gladstone via Smithtown Ferry to Pacific Highway (S.H. 10) at Seven Oaks

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
L.N.11..	Smithtown Ferry on Macleay River at Smithtown, Macleay Shire.	..	137	345	..	3

COUNCIL ROAD

Station No.	Location	Year 1935	Year 1949	Year 1960	No. of Times Increase 1960 over 1935	No. of Times Increase 1960 over 1949
L.N.9 ..	Nelson's Plains Ferry on Williams River at Nelson's Plains, ·75 of a mile west of S.H.10 and M.R.517 intersection, Port Stephens Shire.	..	104	285	..	3

MAIN ROADS FUNDS

Receipts and Payments for the period from 1st July, 1961 to 30th June, 1962

General Purposes

Heading	County of Cumberland Main Roads Fund	Country Main Roads Fund
	£	£
RECEIPTS—		
Motor Vehicle Taxation (State)	1,816,131	7,264,524
Charge on heavy commercial goods vehicles under Road Maintenance (Contribution) Act, 1958 (State)	720,516	2,882,063
Commonwealth Aid Roads Act, 1959	1,635,533	6,336,133
Commonwealth Aid Roads Act, 1959 for expenditure on Rural Roads	11,542	750
From Councils under Section 11 of Main Roads Act and for cost of works	2,209,523	57,630
Other	319,583	169,047
Total Receipts £	6,712,828	16,710,147
PAYMENTS—		
Maintenance and minor improvement of roads and bridges	1,294,656	5,257,314
Construction and reconstruction of roads and bridges	3,218,135	8,829,231
Land acquisition	1,279,242	256,601
Administrative expenses	305,753	808,255
Loan charges—		
Payment of interest, exchange, management and flotation expenses	29,955	275,769
*Miscellaneous	569,296	1,310,795
Total Payments £	6,697,037	16,737,965

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

TENDERS ACCEPTED BY DEPARTMENT OF MAIN ROADS

The following tenders (in excess of £3,000) for road and bridge works were accepted by the Department during the three months ended 30th June, 1962.

Work or Service	Name of Accepted Tenderer	Amount
		£ s. d.
State Highway No. 1—Prince's Highway; State Highway No. 2—Hume Highway; Main Road No. 261—Fitzroy Falls Road—Shires of Shoalhaven and Wingecarribee. Bitumen surfacing 166,291 square yards.	Allen Bros. (Asphalting Contractors) Pty. Ltd.	3,869 13 9
State Highway No. 17—Newell Highway. Shire of Boolooroo. Supply and delivery of 4,050 cubic yards of ¾ inch and 1,650 cubic yards of ⅜ inch crushed aggregate.	Mr. R. E. Johnstone	12,183 15 0
State Highway No. 22—Silver City Highway. Broken Hill District Supply of aggregate to stockpile sites between 80 m. and 94 m. south of Broken Hill.	Frazer and Adams	5,018 15 0
Main Road No. 108—Newcastle—Williamtown Road. City of Greater Newcastle. Supply of coal for Newcastle-Stockton Ferry for the year ending 30th June, 1963.	R. W. Miller and Company	19,581 0 0

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of £3,000) were accepted by the respective Councils for Road and Bridge Works during the three months ended 30th June, 1962.

Council	Road No.	Work	Name of Accepted Tenderer	Amount £ s. d.
Bogan S.	8	Reconstruction of road formation and provision of culverts, etc., from 26.0 m. to 28.0 m. west of Nyngan.	J. L. Johnston	20,813 8 0
Bogan S.	57	Reconstruction, strengthening and bitumen surfacing from 0.80 m. to 3.04 m. south of Mitchell Highway.	J. L. Johnston	15,442 3 4
Dumaresq S.	75	Construction of 4-span prestressed concrete bridge over Blackbird Flat, 69.25 m. from Armidale.	Central Constructions Pty. Ltd.	19,100 0 0
Goobang S.	61	Winning, loading, hauling and tipping of approximately 12,390 cu. yds. of gravel 5.05 m. to 14.96 m. west of Parkes.	J. and J. R. Brown	8,172 2 5
Kyeamba S.	1,117	Bridge over Tarcutta Creek near Belmore. Supply of prestressed deck units and piles.	Monier Pipe Company	3,984 13 0
Kyeamba S.	1,117	Erection of bridge over Tarcutta Creek near Belmore	Siebels Bros. Pty. Ltd.	6,494 9 6
Kyogle S.	1,141	Construction of bridge over Eden Creek near Ettrick	J. I. Miller Pty. Ltd.	19,712 10 0
Maclean S.	1,245	Construction of bridge over Esk River between Mororo and Iluka.	C. & B. King Constructors	33,569 10 0
Merriwa S.	62, 209	Priming and bitumen surfacing various lengths during 1962.	Shorncliffe Pty. Ltd.	6,919 9 7
Mitchell S.	543	Supply and delivery of 2,000 cu. yds. of aggregate to various stockpiles.	Murrumbidgee Sand & Gravel Company.	3,400 0 0
Mitchell S.	543	Bitumen surfacing of various lengths	B.H.P. By-Products Pty. Ltd.	7,014 11 5
Muswellbrook S.	208	Construction of 4-span R.C. bridge over Spring Creek near Wybong.	A. Goor Pty. Ltd.	15,158 6 0
Port Stephens S.	101	Construction of 4-cell 7 ft. x 7 ft. R.C. box culvert over Albion Drain at 0.4 m. west of Woodville.	Donald Gardiner	4,951 0 0
Queanbeyan M.	51	Construction of 2-cell 10 ft. x 8 ft. R.C. box culvert at Buttle's Creek, Queanbeyan.	W. A. Winnett & Sons	6,043 1 0
Tumbarumba S.	1,265	Haulage of gravel from O'Hare's Pit to stockpiles	Tommaso Sarchese	4,200 0 0
Tumut S.	4, 278, 279	Supply of aggregate to various stockpiles	J. Henrick & Sons	4,675 18 0
Tweed S.	1,217	Construction of bridge over Cudgera Creek at Hastings Point.	Kennedy Bros.	21,533 15 0
Weddin S.	236	Supply of ¾ in. aggregate to stockpiles between 10.36 m. and 14.79 m. north of Grenfell.	Crushed Aggregate Pty. Ltd.	3,140 0 0
Weddin S.	236	Bitumen surfacing between 10.36 m. and 14.79 m. north of Grenfell.	B.H.P. By-Products Pty. Ltd	3,168 9 8
Wellington S.	7, 233	Bitumen surfacing of various lengths of Mitchell Highway and Wellington—Parkes Main Road.	B.H.P. By-Products Pty. Ltd	7,258 9 6

MAIN ROADS STANDARD SPECIFICATIONS DRAWINGS AND INSTRUCTIONS

NOTE: Drawings are prefixed by letter " A ", instructions are so described; all other items are specifications or forms. Year of revision, if within last 10 years, is shown in brackets.

Form No.

ROAD SURVEY AND DESIGN

A 478 A 478A	Specimen drawings, country road design.
A 478C	Specimen drawing, flat country road design.
A 478B	Specimen drawings, urban road design.
A 1645	Stadia reduction diagram.
355	Design of two-lane rural highways. (Instruction.)
369	Design of urban roads. (Instruction.)
288	Design of intersections. (Instruction.) (1952.)
402	Design of acceleration and deceleration lanes. (Instruction.)
499	Design of kerb-lines and splays at corners. (Instruction.) (1952.)
A 1614	Widening at points of " A " sight distance.
A 83	Earthwork quantity diagram.
A 1640	Mould for permanent mark block.
	Manual No. 2—Survey and design for main road works*.
	Policy for geometric design of rural roads—State Road Authorities*

STREET DRAINAGE

243	Integral concrete kerb and gutter and vehicle and dish crossing, and drawing. (A 134A.)
245	Gully pit and drawings: with grating (A 1042); kerb inlet only (A 1043); with grating and extended kerb inlet (A 1352) extended kerb inlet (A 1353), (1956).
A 190	Gully grating.
A 1418	Concrete converter.
A 3491	Perambulator ramp.
A 3536	Mountable type kerb with reflectors.

CULVERTS

138	Pre-cast concrete box culvert (1957) and drawing: 12 in., 18 in., 24 in., and 30 in. high (A 3847).
206	Re-inforced concrete culvert (1948) and instruction sheets. (A 304, A 305, A 306, A 359.)
A 1012-20	Single cell reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A 1012); 1 ft. 4 in. to 3 ft. (A 1013); 4 ft. (A 1014); 5 ft. (A 1015); 6 ft. (A 1016); 7 ft. (A 1017); 8 ft. (A 1018); 9 ft. (A 1019); 10 ft. (A 1020); 11 ft. (A 1020A); 12 ft. (A 1020B).
A 1021-29	Two cell, reinforced concrete box culvert: 6 in. to 1 ft. 3 in; (A 1021); 1 ft. 4 in. to 3 ft. (A 1022); 4 ft. (A 1023); 5 ft. (A 1024) 6 ft. (A 1025); 7 ft. (A 1026); 8 ft. (A 1027); 9 ft. (A 1028); 10 ft. (A 1029).
A 1031-36 A 1038 A 1040	Three cell, reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A 1031); 1 ft. 4 in. to 3 ft. (A 1032); 4 ft. (A 1033); 5 ft. (A 1034); 6 ft. (A 1035); 7 ft. (A 1036); 8 ft. (A 1038); 9 ft. (A 1040).
25	Pipe culverts and headwalls, and drawings: single rows of pipes: 15 in. to 21 in. dia. (A 143); 2 ft. to 3 ft. dia. (A 139); 3 ft. 6 in. dia. (A 172); 4 ft. dia. (A 173); 4 ft. 6 in. dia. (A 174); 5 ft. dia. (A 175); 6 ft. dia. (A 177); Double rows of pipes: 15 in. to 21 in. dia. (A 211); 2 ft. to 3 ft. dia. (A 203); 3 ft. 6 in. dia. (A 215); 4 ft. dia. (A 208); 4 ft. 6 in. dia. (A 207); 5 ft. dia. (A 206); 6 ft. dia. (A 213). Treble rows of pipes: 15 in. to 21 in. dia. (A 210); 2 ft. to 3 ft. dia. (A 216). Straight headwalls for pipe culverts: 15 in. to 24 in. dia. (A 1153) (1957).
A 1	Joint for concrete pipes.
A 142	Inlet sump for pipe culvert 3 ft. dia. or less. (1947.)
139	Timber culvert (1950) and drawings, 1 ft. 6 in. high (A 427); 2 ft. (A 428); 3 ft. (A 429); 4 ft. (A 430); 5 ft. to 8 ft. high (A 431).
A 1223	Timber culvert 20 ft. roadway. (1949.)
A 3472	Timber culvert 22 ft. roadway. (1949.)
303	Supply and delivery of pre-cast reinforced concrete pipes.

BRIDGES AND FERRIES

18	Data for bridge design. (1948.)
371	Waterway calculations. (Instruction.)
300	Pile driving frame, specification for 25 ft. and drawings for 50 ft. (A 209); 40 ft. (A 253); and 25 ft. portable (A 1148).
A 3693	Pontoon and pile driving equipment.
164	Timber beam bridge (1947) and instruction sheets, 12 ft. (A 3469); 20 ft. (A 70) (1949); and 22 ft. (A 1761) (1949).
326	Extermination of termites in timber bridges. (Instruction.)
350	Reinforced concrete bridge. (1949.)
495	Design of forms and falsework for concrete bridge construction. (Instruction.)
314	Regulations for running of ferries. (1955.)
A 4	Standard bridge loading. (Instruction.) (1957.)
A 26	Waterway diagram. (1943.)
A 1886	Arrangement of bolting planks. (1948.)
A 45	Timber bridge, standard details. (1949.)
A 1791	Timber beam skew bridge details. (1949.)
A 3470 A 3471	Low level timber bridge, for 12 ft. and 20 ft. between kerb. (Instruction.) (1949.)
A 1216	Running planks.
A 1207	Reinforced concrete pile—25 tons. (1945.)
A 1208	Reinforced concrete pile—35 tons. (1957.)
A 1621	Reflector strip for bridges.
	Highway Bridge Design Specification of State Road Authorities.*

FORMATION

70	Formation. (1955.)
520	Sub-soil drains. (1957.)
A 1532	Standard typical cross-section.
A 4618	Flat country cross-section, Type A. (1955.
A 4619	Flat country cross-section, Type B. (1955.)
A 4620	Flat country cross-section, Type C. (1955.)
A 4621	Flat country cross-section, Type D. (1955.)

Form No.

A 1101	Cross-section one-way feeder road.
A 1102	Cross-section two-way feeder road.
A 114	Rubble retaining wall.

PAVEMENTS

71	Gravel pavement. (1949.)
228	Reconstruction with gravel of existing pavement.
254A	Supply and delivery of gravel.
72	Broken stone base course. (1956.)
216	Telford base course.
68	Reconstruction with broken stone of existing pavement to form a base course.
257	Haulage of materials
65	Waterbound macadam surface course.
230	Tar or bitumen penetration macadam surface course, 2 in. thick.
66	Tar or bitumen penetration macadam surface course, 3 in. thick.
125	Cement concrete pavement, and plan and cross-section. (A 1147.)
A 380	Galvanised iron strip for deformed joint.
A 381	Bituminous filler strip for transverse expansion joint.
493	Supply of ready mixed concrete.
266	Asphaltic concrete pavement.

SURFACE TREATMENT

93	Surfacing and resurfacing with bitumen, tar-bitumen mixture, or tar. (1957.)
466	Fluxing of binders for bituminous flush seals and reseals. (Instruction.)
351	Supply and delivery of cover aggregate for bituminous surfacing work (1957.)
167	Resheeting with plant-mixed bituminous macadam by drag spreader. (1951.)

FENCING AND GRIDS

141	Post and wire fencing (1947) and drawings: plain (A 494); rabbit-proof (A 498); flood gate (A 316).
143	Ordnance fencing and drawing. (A 7.)
144	Chain wire protection fencing and drawing. (A 149.)
246	Location of protection fencing. (Instruction.)
224	Removal and re-erection of fencing.
A 1705	Plain wire fence for use in cattle country.
A 3598	Wire cable guard fence.

ROADSIDE

A 1337	Concrete mile post, Type A.
A 1338	Concrete mile post, Type D.
A 1366	Standard lettering for mile posts.
A 1367	Timber mile post, Type B1.
A 1368	Timber mile post, Type B2.
A 3497	Timber mile post, Type B3.
A 2815	Concrete kerb mile block.
A 1420	Steel mould for concrete mile posts.
A 1381-3 A 1452-5	Tree guards, Types A, B, C, D, E, F, and G.
	Manual No. 4—Roadside Trees.

MATERIALS

296	Tar. (1949.)
337	Residual bitumen and fluxed native asphalt.
305	Bitumen emulsion. (1953.)
349	Light and medium oils for fluxing bitumen. (1948.)
A 27	Slump cone for concrete.
A 178	Mould for concrete test cylinder.
76	Design of non-rigid pavements. (Instruction.)
	Manual No. 3—Materials.*

TRAFFIC PROVISION AND PROTECTION

121	Provision for traffic (1954) with general arrangement (A 1323), and details (A 1325) of temporary signs. (1947.)
252	Supply and delivery of guide posts.
253	Erection of guide posts. (Instruction.)
A 1342	Temporary warning sign, details of construction.
A 1346	Iron trestle for road barrier.
A 1341	Timber trestle and barrier.

PLANT

A 1414	Gate attachment for lorries with fantail spreader.
A 1450	Half-ton roller with pneumatic tyres for transport.
A 2814	Two-berth pneumatic tyred caravan.
A 2828	Multi-wheeled pneumatic tyred roller.
A 2976	Fantail aggregate spreader.
A 3530	Benders for steel reinforcement.
A 3547	Steel bar cutter.

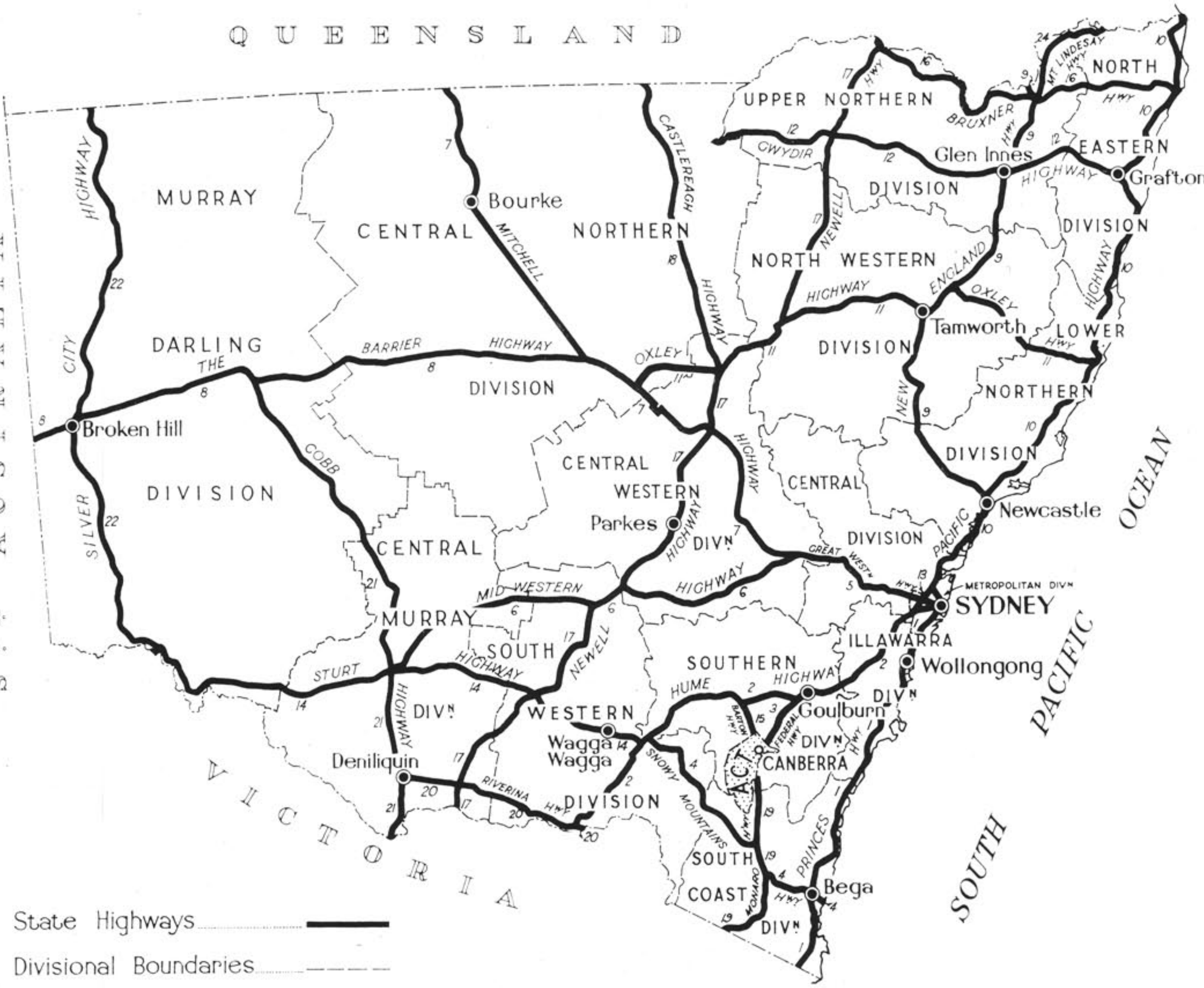
CONTRACTS

24B	General conditions of contract, Council contract. (1956.)
342	Cover sheet for specifications, Council contract. (1950.)
64	Schedule of quantities form.
39	Bulk sum tender form, Council contract. (1946.)
38	Bulk sum contract form, Council contract.
193	Duties of superintending officer. (Instruction.)
498	Caretaking and operating ferry.

All Standards may be purchased from the Head Office of the Department of Main Roads, 309 Castlereagh Street, Sydney. Single copies are free to Council except those marked *.

Sydney: V. C. N. Blight, Government Printer—1962

State Highway System of the State of New South Wales



State Highways

Divisional Boundaries

Divisional Offices

SCALE OF MILES

40 20 0 40 80 120 160 200

Area of New South Wales, 309,433 square miles.

Length of public roads within New South Wales, 129,763 miles.

MILEAGE OF MAIN AND DEVELOPMENTAL ROADS, AS AT 30th JUNE, 1962.

State Highways	6,493
Trunk Roads	4,163
Main Roads	11,647
Secondary Roads (County of Cumberland only)	100
Tourist Roads	54
Developmental Roads	3,082
	25,539
UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act	1,031
TOTAL	26,570