

MAIN ROADS

A month to month account of the activities of
THE MAIN ROADS BOARD OF NEW SOUTH WALES

Issued by and with the authority of the Board

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April, 1931.

News of the Month.

Metropolitan Division.

While expenditures on large works are restricted, a number of minor improvements to roads in the outer parts of the Division have been carried out. In Nepean Shire, for instance, the Council has recently completed improvements to Park-road (Main Road No. 155), between Luddenham and Wallacia, by cutting down several steep grades and filling in depressions. Wollondilly Shire Council has improved the bends on the Appin-Bulli road (Main Road No. 177), east of King's Falls Bridge, and also on the Appin-Broughton Pass road (Main Road No. 179). Blue Mountains Shire Council has continued useful work in improving the Richmond-Bell-Mount Victoria road by widening bends and formation between Mount Victoria and Mount Bell. The steep grades over Mount Tomah have also been given attention.

During the month the programme of reconditioning and surfacing the Great Western Highway within the Blue Mountains districts has been completed by the Board's Maintenance Branch. Over 100,000 square yards of the carriageway have been treated with a coat of "Duratenax" (a mixture of tarpitch and bitumen), and some 8,000 square yards have been re-conditioned with a mixture of "Duravia" and metal. Prior to treatment the surface was dragged with a heavy steel-bladed timber drag, which removed any small irregularities and so improved the riding qualities of the road.

Outer Metropolitan Division.

Contractors Caratti and Johnson have completed the construction of 2 miles 4,280 feet of formation and waterbound macadam pavement on the Bullahdelah,

via Waukivory, to Gloucester developmental road (No. 1110), in the Shire of Stroud. The stone used for the pavement was a mixture of quartz and felsite, obtained near Bullahdelah, which has high cementitious properties. A length of about 1 mile of this class of construction was carried out on the Booral-Bullahdelah road (No. 110) many years ago, and still retains a good running surface, having required but little maintenance.

Extensive repairs to the Redbourneberry Bridge over the Hunter River, on the Singleton-Gresford road (No. 128), are in hand. The bridge consists of an iron continuous lattice truss in three spans over the river, with timber beam spans in the approaches, making a total length of 1,215 feet. The bridge is thirty-nine years old, and much of the timber which is being replaced is in a decayed condition.

The reconstruction in tar penetration macadam of the length of the Macquarie Pass road (No. 262), in the Municipality of Shellharbour, has been completed by the Board by day labour. Funds were provided by the Unemployment Relief Council.

The construction of a further 3 miles of pre-mixed bituminous macadam pavement on the Great Northern Highway, from the Wyec turnoff northerly towards Newcastle, is in hand.

Upper Northern Division.

In the Shire of Kyogle, a grant of £2,000 for the relief of unemployment has been expended in clearing and forming 6 miles and gravelling 3 miles 20 chains of the first-mentioned length, on the Baryulgil-Woodenbong developmental road (No. 1,050), between Woodenbong and Urbenville.

Contractors Caddell Bros. have completed the construction of 3,355 feet of waterbound macadam on the Casino-Spring Grove developmental road (No. 1,132), in the Shire of Tomki.

The construction of a deviation, comprising 1,400 feet of gravel pavement, at Tiger's Gap, on the Gwydir Highway, between Inverell and Wyallda, has been completed by Contractors Addison and McGregor.

The second section of the Korora Deviation, on the North Coast Highway, in Dorrigo Shire, comprising 1 mile 570 feet of waterbound macadam pavement and two timber beam bridges, has been completed. This, together with a first section, which was finished some time ago, completes the whole deviation, which is now available throughout its whole length to through traffic.

causeways that require to be negotiated slowly by cars to avoid damage to springs and shock absorbers. Between Somerton and Gunnedah, a further section of unformed road about 30 miles from Tamworth is being constructed to standard width by the Council by day labour. The pavement is to be of gravel, and will be tar-surfaced in the low-lying sections to enable flood waters to flow over without scour. The work is a continuation of the length of 1 mile 520 feet recently completed by Contractors J. and V. McIlwain.

The Oxley Highway is intended ultimately to provide an easy means of communication from the Pacific coast at Port Macquarie through Walcha, Tamworth, Gunnedah, and Coonabarabran to the west, and it is noteworthy that, even at this stage, with a gap of 12 miles of bush track between Yarrowitch and the end



Completed 160 ft. reinforced concrete arch span, Koreelah Creek bridge, Great Northern Highway, Shire of Tenterfield.

Between Guyra and Glen Innes, on the Great Northern Highway, in the Shire of Guyra, a length of 1 mile of light bitumen penetration macadam has been completed by the Council under its current maintenance programme.

Lower Northern Division.

On the Gunnedah-Boggabri road (No. 126), in Liverpool Plains Shire, some 6 miles of black soil road have been formed and surfaced with fine river gravel under the current maintenance programme, rendering this section trafficable under ordinary conditions. This work links up with the black soil formation constructed by Namoi Shire during the previous year, and traffic will now be able to reach Boggabri without difficulty, except after heavy storms.

Systematic maintenance during the past few months has effected a considerable improvement in the running surface on that section of the Oxley Highway between Tamworth and Somerton, in Peel Shire. This length of highway possesses good alignment and is well graded throughout, but there are still several short

of the constructed portion of Tobin's Creek Deviation, cars are, every fine day, making their way down to the coast and back by this route. The track is impassable in wet weather.

Central Western Division.

A two-span timber bridge on the Coonamble-Walgett trunk road (No. 56) at Kennedy's Creek, in Wingadee Shire, has been completed, and the approaches are now under construction.

A section of gravel pavement from 6 miles 3,800 feet to 8 miles 152 feet on the Gollan-Murrumbong developmental road (No. 1,004), in the Shire of Cobbora, has been completed by Contractor Joseph Bryant.

Southern Division.

The Tallaganda Shire Council has practically completed the reconditioning with gravel of 8 miles of the Doughboy-Tarago road (No. 269). The work was financed from funds supplied by the Unemployment Relief Council.

The divisional bridge gang has completed the repairs to the timber truss bridge over the Bega River at North Bega.

Jones Creek bridge, on the Mount Darragh-Wyndham developmental road (No. 1,041), near Wyndham, has been completed and opened to traffic. This is the last work of those listed in the April, 1930, number of *Main Roads* as being undertaken to eliminate the steep grades on Tantawanglo and Big Jack Mountains, which formerly barred reasonable access between the Bombala and Eden districts.

At Alsop's Creek, on the Prince's Highway, in Mumbulla Shire, approximately 10 miles north of Bega, a new four-span concrete bridge 140 feet long has been completed by Contractor John Dunton and opened to traffic. This structure replaces a very old timber bridge which was in bad order. A deviation 2,100 feet long, paved with granite gravel, was included in the work to improve the alignment and grading of the approaches to the new bridge.

Riverina Division.

A deviation has been completed and opened to traffic on the Coolamon-Junece road (No. 243) in Coolamon Shire. The roadway, 4,980 feet in length, was constructed upon an abandoned railway embankment, and widened to carry a 16 feet pavement of ballast from the old railway track, suitably blinded.

Banna-avenue, Griffith (Main Road No. 254), in Wade Shire, has been reconstructed, and arrangements have been made for the surface treatment of the pavement in a strip on each side of the garden plots.

Contractor R. Curran has completed the construction of 4,950 lineal feet of forming and gravel pavement, together with four causeways, near Rankin's Springs, on the Rankin's Springs-Hillston developmental road (No. 1017), in Bland Shire.

Arrangements are being made for the carrying out of repairs to the bridge over the Edwards River at Deniliquin, on the Hay-Deniliquin-Echuca trunk road (No. 60), in the Municipality of Deniliquin.

Expenditure from 1st July, 1930, to 28th February, 1931.

	Expenditure from 1st July, 1930, to 31st January, 1931.		Expenditure for month of February, 1931.		Total Expenditure to 28th February, 1931.	
	£	s. d.	£	s. d.	£	s. d.
COUNTY OF CUMBERLAND MAIN ROADS FUND—						
Construction of Roads and Bridges	166,306	4 5	23,333	8 7	189,639	13 0
Cost of Land Resumptions	75,062	1 2	9,188	2 7	84,250	3 9
Maintenance of Roads and Bridges	107,657	15 10	14,891	17 0	122,549	12 10
Repayment of Loans	118,013	15 9	11,532	15 7	129,546	11 4
Survey, Design, Supervision and Administration	27,631	16 8	3,416	7 3	31,048	3 11
Miscellaneous	26,937	17 6	4,125	10 7*	22,812	6 11
Totals	521,609	11 4	58,237	0 5	579,846	11 9
COUNTRY MAIN ROADS FUND—						
Construction of Roads and Bridges, including Resumptions	294,455	2 7	114 19 1*†		294,340	3 6
Maintenance of Roads and Bridges	466,947	14 6	32,807	4 8	499,754	19 2
Repayment of Loans	36,824	8 9		36,824	8 9
Survey, Design, Supervision and Administration	66,536	5 0	6,154	14 1	72,690	19 1
Miscellaneous	31,187	16 5	12,666	4 0*	18,521	12 5
Totals	895,951	7 3	26,180	15 8	922,132	2 11
FEDERAL AID ROADS FUND—						
Construction of Roads and Bridges, including Resumptions	399,347	8 10	69,963	3 4	469,310	12 2
Miscellaneous	13,119	5 4	1,974	1 7	15,093	6 11
Totals	412,466	14 2	71,937	4 11	484,403	19 1
DEVELOPMENTAL ROADS FUND—						
Construction of Roads and Bridges	145,730	2 3	7,767	13 11	153,497	16 2
Survey, Design, Supervision and Administration	4,580	11 2	3,186	13 4	7,767	4 6
Miscellaneous	10,577	15 11	157	16 11	10,735	12 10
Totals	160,888	9 4	11,112	4 2	172,000	13 6
SUMMARY ALL FUNDS—						
Construction of Roads and Bridges, including Resumptions	1,080,900	19 3	110,137	9 4	1,191,038	8 7
Maintenance of Roads and Bridges	574,605	10 4	47,699	1 8	622,304	12 0
Repayment of Loans	154,838	4 6	11,532	15 7	166,371	0 1
Survey, Design, Supervision and Administration	98,748	12 10	12,757	14 8	111,506	7 6
Miscellaneous	81,822	15 2	14,659	16 1*	67,162	19 1
GRAND TOTAL	1,990,916	2 1	167,467	5 2	2,158,383	7 3

*Credits.

† During the month an amount of £24,751 3s. 2d., expenditure on Tobin's Creek Deviation, State Highway No. 11, Hastings Shire, was transferred to Federal Aid Fund.

The Organisation of Road Works in the Shire of Tintenbar.

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Tintenbar Shire Engineer.

GENERAL Topographical and Other Conditions of the Shire.—To the north of New South Wales and along its eastern border lies the beautiful district of the Richmond River, and situated midway between the busy centre of Lismore and the coast, a distance of 20 miles, with Alstonville as its administrative headquarters, 500 feet above the sea, stand the fertile lands of the Tintenbar Shire with its 179 square miles of hilly and undulating country. Once covered with thick tropical scrub, it is now cleared and grassed and a closely settled farming and dairying district, its rich red volcanic soil and copious rainfall offering splendid possibilities to the man on the land.



Locality sketch, Tintenbar Shire. The Shire boundary is shown hatched.

The Richmond River, running from Lismore on its tortuous way to Ballina on the coast, divides the Shire. Skirting its eastern bank runs the North Coast Highway, crossing the river near its mouth at Burns Point and proceeding northward through Ballina and Bangalow by one of its tributaries, the Emigrant Creek, until higher ground is reached beyond the village of Tintenbar, where it takes to the hills and gives a commanding view of the coastline and a beautiful panorama of the surrounding countryside. The shire boundary is reached 3 miles south of Bangalow.

From Ballina, one of the northern ports of New South Wales, through Alstonville and Lismore and on to Tenterfield runs Trunk Road No. 64, making out of Ballina by the State Highway until the turn-off to Burns Point is reached, whence it then carries on approximately due west and at right-angles to the State Highway. This road carries fairly heavy continuous traffic, especially along that portion through the Shire.

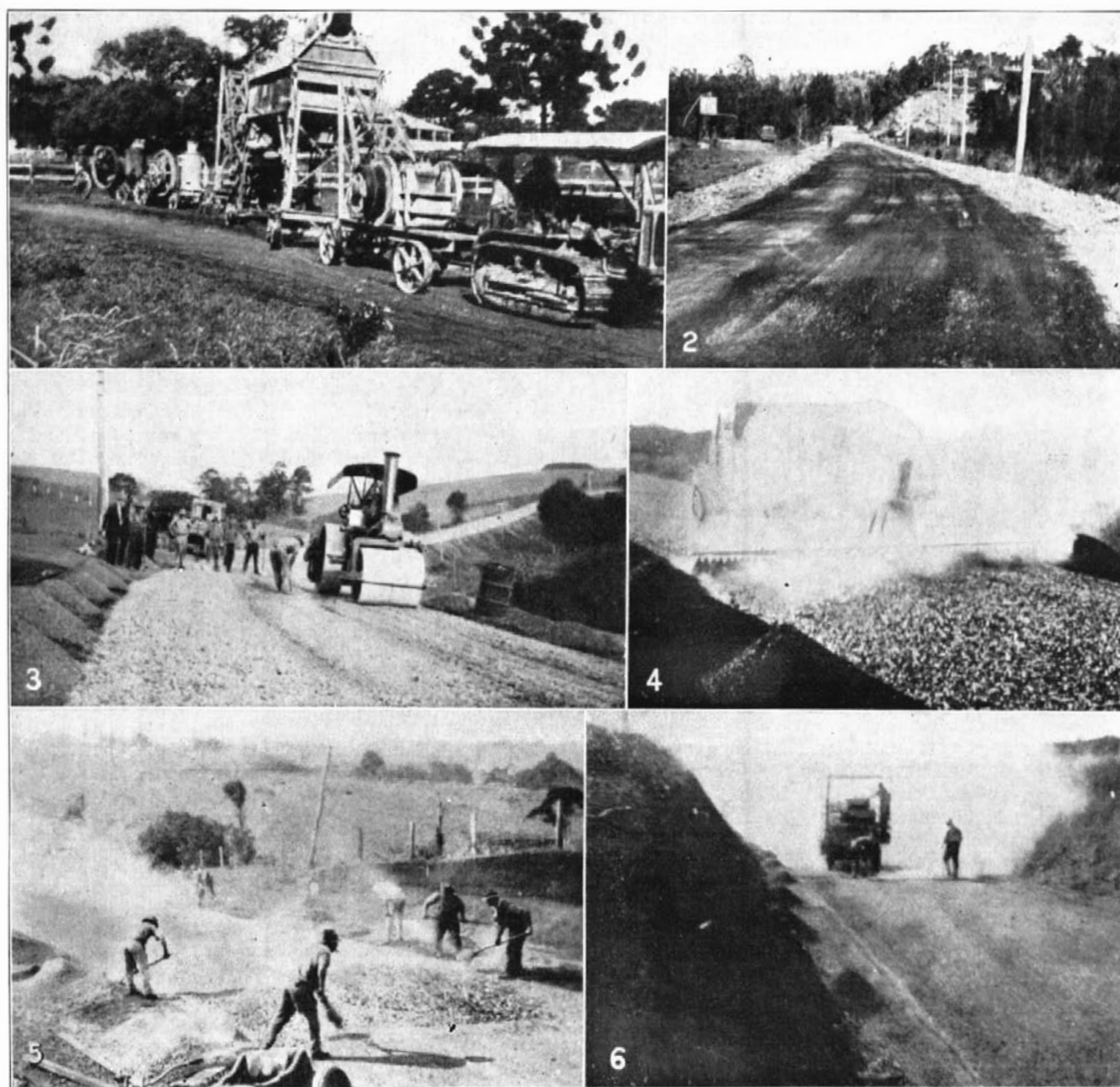
Branching off to the north from the Ballina-Lismore Trunk Road, about $3\frac{1}{2}$ miles from Ballina, is Main Road No. 146, leading to Booyong and Eltham on the North Coast railway line.

The total mileage of State highway in the Shire is 21.58 miles, of trunk road 9.16 miles, and ordinary main road 7.78 miles. The other roads total 231.88 miles.

The Shire is limited practically to one class of road material, namely, basalt, ample quantities of which are to be found north of the Richmond River as surface stone and solid outcrops, the latter in places having a defined columnar structural formation. Gravel is notably absent, and the little available on the south-western corner is of very poor quality and only suitable for very light traffic and for blinding waterbound macadam. For this latter purpose good use of gravel is made along the water-bound sections of the North Coast Highway. To the present, works have been able to draw largely on surface stone, the spalls being of a size suitable for the crusher, and obtainable at a moderate figure. These are now getting scarce, and, furthermore, though of good quality, are not the best for bitumen work (though of necessity at times they have to be used) due to the weathered incrustation on the outside resulting in dirty and dusty crushed metal. The quarry spalls are clean and sound and the graded crushed metal obtained therefrom clean and sharp and of first-class quality.

The subsoil foundations for road work are, on the hills, very good, being of red loamy volcanic porous soil, liable neither to shrinking nor cracking, and for a foundation, almost the equal of compact sand. On the low-lying sections fronting the Richmond River, and along the Emigrant Creek, which are subject largely to tidal influence, the subsoil is black water-logged pug many feet thick and quite unstable. Here by far the major cost of any road work is in the foundation and base course, which has to be drained and considerably strengthened. Furthermore, if the work is carried out in the rainy season, much more trouble is experienced and the cost mounts considerably. These are contingencies which cannot be overlooked nor underestimated.

Climatic conditions are such that in the early portion of the year little progress can be made with works



Works on the Ballina-Lismore trunk road.

1. Some of the Council's plant.
2. Water-bound macadam base course.
3. Preliminary rolling of surface course.
4. Penetrating surface course with bitumen.
5. Spreading key stone after penetrating.
6. Blowing dust off surface course prior to sealing.

owing to the continuous wet weather. The rainy season sets in about the beginning of the year and continues on to beyond the half year, leaving only the latter portion from July to December, to obtain any satisfactory progress and results. The average annual rainfall is 62.17 inches. During 1930, Alstonville registered 69.75 inches for the half-year, comprising eighty-eight wet days. This hampers, disarranges and disorganises the gangs and the work, and is a constant source of expense. Temperature conditions and changes have little effect on the work of the Shire.

The Formation of a Policy.—The main roads of the Shire have always been a particular point of inter-

est with the Council, and every endeavour has been made, even prior to the creation of the Main Roads Board, to keep them in good trafficable order. With the advent of the Board and its available subsidies, the Council saw the possibility of carrying out added improvements on a larger scale and of securing more permanent and better riding surfaces, while at the same time reducing maintenance costs. With this end in view, it set about dealing with the North Coast Highway and the Ballina-Lismore road.

The State Highway was reconstructed in places and surfaced with tar and bitumen, those low-lying sections fronting the Richmond River and the Emigrant Creek

receiving first attention so as to place these bad portions in good order and relieve the Council of the constant worry and drain on the finances to maintain. In doing so, the level of the road was raised above flood-tide level. Simultaneously, the Ballina-Lismore road was given attention. This road, as has been already stated, carries very appreciable traffic—in fact, it is the most heavily trafficked road in the Shire. Heavy buses run to and fro between Lismore and Ballina at all hours of the day, together with heavy cream and timber lorries and numbers of cars. The water-bound



Formation built by tractor and grader only, without use of plough or scarifier.

macadam pavement demanded constant attention and repairs, and it was early recognised that it would have to be replaced with a more permanent surface to withstand the ravelling action of fast-moving vehicles and the constant attrition of heavy bus traffic. Sections were reconstructed in water-bound macadam and surfaced with tar and bitumen, and a comprehensive policy outlined to further the advancement from year to year.

Towards the close of 1926, more definite steps were made to deal with the main roads, and additional plant was purchased to handle more effectively the larger



On the North Coast Highway at Cumbulum. Using fascines of mangrove bushes and spalls to prepare a road foundation on waterlogged clay.

works and expedite and facilitate the problem of maintenance. This plant consisted of two new crushers (a primary 16 inch x 10 inch and a secondary 24 inch

x 6 inch), new portable bins and screens, a Fowler 10-12 ton steam road roller, a 30 h.p. Caterpillar tractor and an 8 feet Adams heavy duty leaning wheel grader, and a U type loader. The crushing plant was designed to turn out a better and cleaner grade of material than had formerly been available, and a dust screen was incorporated to eliminate dust, as far as is practicable with a portable plant. The quality of the material was thus much improved. The secondary crusher was installed to turn out the requisite amount of $\frac{3}{4}$ -inch material.

This plant now made possible larger works. In 1927, therefore, the Council took up the matter of the reconstruction of the balance of the Ballina-Lismore road, a distance of 6 miles, and because of the importance of the road, decided, after much discussion, to deal with it on broader lines than formerly and to endeavour to find the means to reconstruct the whole length without delay. The necessary survey, plans and estimates were prepared for $3\frac{1}{2}$ miles and after approval by the Board, work was put in hand by the Council in July, 1929, with its own forces. It has since been completed (August, 1930) at a cost of £21,505 3s. 4d., as follows:—

			£	s.	d.
Section 1,	4 m. 35.37 chs.—5 m. 6 chs.	...	4,260	12	4
" 2,	7 m. 56.85 chs.—8 m. 49.64 chs.	...	4,994	9	6
" 3 & 3A,	9 m. 48.89 chs.—11 m. 37.35 chs.	12,250	1	6	

Totals ... 3 miles 31.88 chains £21,505 3 4

* Inclusive of cost of resumption.

The work done consisted of the forming and grading of the road and the laying of a bitumen penetration wearing course 3 inches thick on a base course $10\frac{1}{2}$ inches thick where a deviation was constructed (from 9 m. 66.89 chs. to 10 m. 10.89 chs.), or where the original line of the road was followed and there was a certain amount of material in the road, 6 inches thick. The deviation substituted a 1 in 18 grade for an original 1 in 11, and at other points the grades were reduced to 1 in 16. Recently authority has been received from the Board for the carrying out of a further short section of work from 4 m. 29.45 chs. to 4 m. 35.37 chs. at an estimated cost of £486 9s. 2d.

While the above work was proceeding, the preparation of plans and estimates for the balance of this length of road—known as the Ballina Cutting, and extending from 5 m. 6 chs. to 7 m. 51 chs.—was put in hand. Up to date, the Board has not been able to authorise this section.

The remaining main road in the Shire, viz., the Ballina-Eltham road (No. 146), carries little traffic and has been deemed worthy only of maintenance of the present surface until such time as the trunk road is completed.

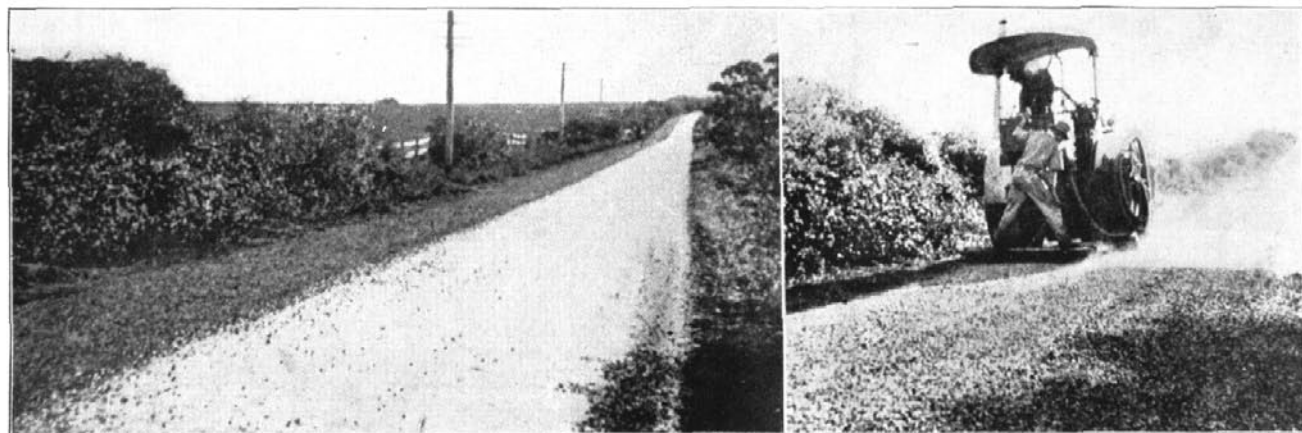
In like manner as the road surface and new pavement has been given thought and attention, so the bridges and culverts have been dealt with. Many of the culverts on the State highway south of Ballina, constructed of timber many years ago, were decaying and calling for repairs and renewals. All were carefully inspected and during the past four years the more urgent ones, as far as funds would permit, have been included in the yearly programme for either complete repair or renewal. Much has been done in this way

and it is hoped the remainder will receive attention before long. Along the water-front of the Richmond River, subject to the action of cobra, all timber renewals have been placed above water level, by using longer girders and resting them on the ground sill placed well back on firm ground. The smaller timber openings have been replaced by concrete pipe culverts.

Though the Ballina-Eltham road has only been listed for maintenance and minor reconstruction, two waterways, subject to quick flooding and blockage of cream traffic for days at a time, were given early consideration, and to date two four-span timber bridges have been constructed with the Board's assistance. Also at the northern end of the State highway a waterway causing much inconvenience was eliminated by a double reinforced concrete culvert with earthwork approaches. At other waterways elsewhere in the Shire, Council has adopted the policy, where money will not permit of a more elaborate course, of a high-level crossing of concrete causeways. These have received much favour.

state of the highway and culverts is noted and the programme adjusted as necessary. A similar attitude is adopted in the preparation of this programme as on the main and trunk roads.

The Conduct of the Work.—The work of the Shire is carried out by day labour, supplemented at times by smaller contract works where such have been proved to be handled by contractors more economically or where a definite figure of cost, due to a number of contingencies, is desired beforehand. Two experienced road gangs, complete with their own separate plant, are employed. The gangers are trained and experienced men, and each man in the gang knows and carries out his particular set job. The plant of each comprises a portable engine, crusher, screens and bins, motor lorries, road roller, water tank, engine and pump and watering spray tank mounted on truck. The screen gives a grading of $5/16$, $3/4$, $1\frac{1}{2}$, $2\frac{1}{2}$ inch sizes and oversizes, numbered 1, 2, 3, 4, and 5. No. 1 plant is composed of a 16-inch x 9-inch Hadfield crusher driven by a 28 horse-power Tangye engine,



Bituminous re-surfacing on the Ballina-Lismore trunk road. Left, bitumen applied, and aggregate spread on far side of road only. Right, rolling and sweeping the aggregate.

The Yearly Programme.—Towards the close of each calendar year the programme for the trunk and main roads is mapped out for the following year, from January to December, and is submitted to Council for consideration with the annual estimates during December. The essential works, such as repairs to bridges and culverts and general maintenance to carry on through the year, take first place, other desirable works, such as bitumen surfacing and resurfacing and reconstruction, being given secondary consideration. The endorsed programme submitted by Council to the Main Roads Board is determined by the Council's ability to pay its share, and those items ultimately decided upon and retained in the programme are considered to be the essential works of maintenance for the year, together with other desirable works that the Council anticipates being able to finance. At times the programme is curtailed; at other times fully endorsed, in which latter case a special effort is made to finance and carry out the secondary works.

The State highway programme from July to June of the following year is prepared early in the year but held over for consideration until June, when the actual

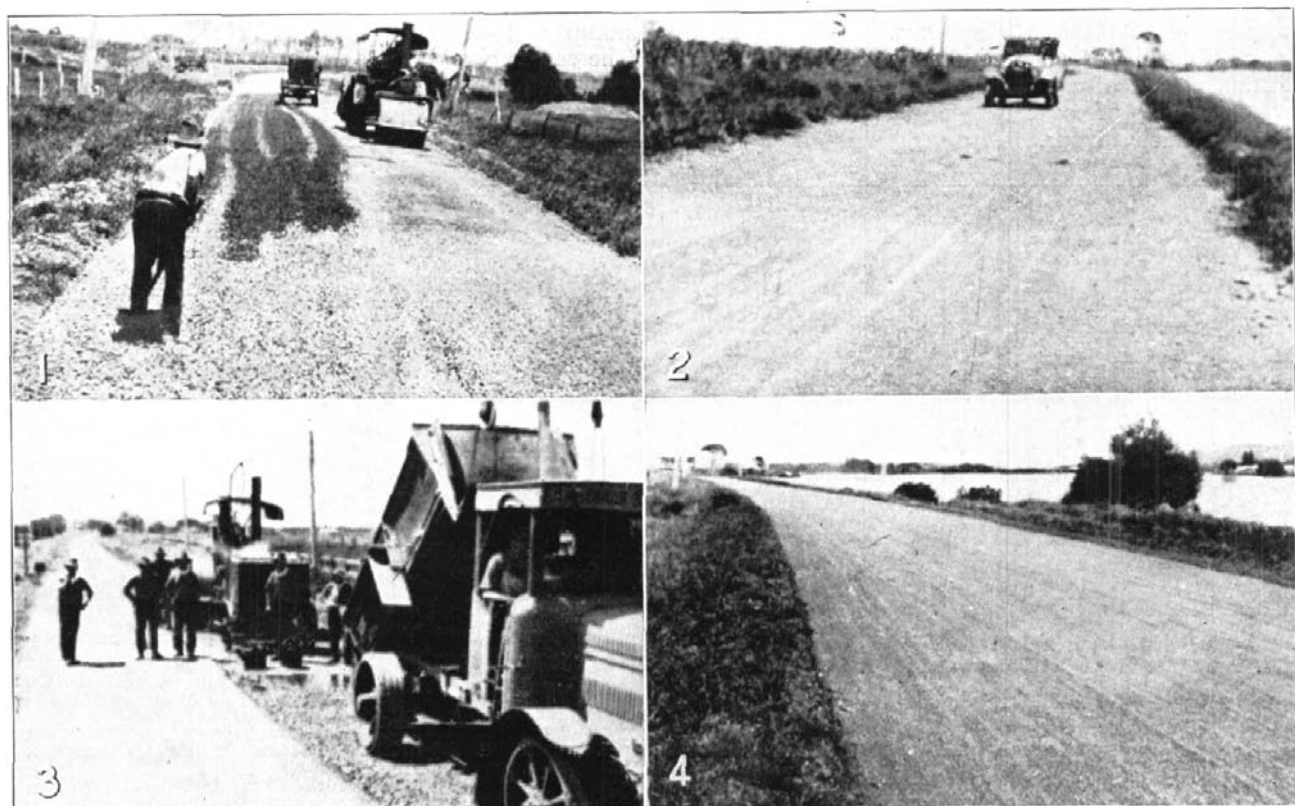
screens, and 16 cubic yard bin divided into five compartments, a 24-inch x 6-inch Hadfield secondary crusher with elevator, loading and tip stages, one each $1\frac{1}{2}$, $2\frac{1}{2}$, and 4-ton lorry, water tank and stand complete, $1\frac{3}{4}$ horse-power engine and pump, a 200-gallon ship's tank with spray for mounting on the general utility $1\frac{1}{2}$ -ton truck, Fowler steam road roller, and portable plant and store shed. No. 2 plant is composed of a Robey 16-inch x 9-inch crusher driven by a 2-ton Caterpillar tractor off power pulley, screens and bins, loading and tip stages, an A.E.C. 5-ton truck and two hired trucks, usually of 2 cubic yard and $1\frac{1}{2}$ cubic yard capacity, a water tank and stand complete, pump and engine and necessary piping, waterspray tank, a McDonald super-diesel 10-ton roller, and portable plant and store shed. Each plant is supplied, as required, with two 400-gallon ship's tanks complete with 2-inch piping and pump for boiling bitumen, a 12-feet x 12-feet cutting up board, a 200-gallon ship's tank with mounting for a truck to gravitate hot bitumen from the stationary bitumen boilers to the portable boiler, and a 200-gallon portable bitumen boiler with pump and spray outfit. The bitumen plant moves

to the job as required. The 400-gallon tanks are set in position on concrete blocks and surrounded by corrugated iron sheets to give a good heating surface. Both No. 1 and No. 2 plants are assisted by a heavy duty 8-foot grader and 30 horse-power Caterpillar tractor as required for formation and scarifying. This is a complete unit of plant in itself and, together with its tractor-drawn roller of 6-8 tons, camping outfit and table-top lorry for stores and materials, moves around the Shire from one job to another as required.

On construction or reconstruction jobs the gangs work as one unit. Basalt spalls are supplied at a suitable crushing site as close to the job as possible. In some instances surface spalls, gathered and supplied under contract, are used. At other times a quarry is

the shoulders as far as possible, and then moves off the job. Filling in formation and shoulders is carried out by scoops, drays, or lorries, as deemed most efficient according to the lead.

For bitumen penetration work the base course is not completed as a whole, but only laid in part when the bitumen course is begun, so as to use the full output of the crushing plant. The full use of the output of the portable crushing plant is not possible unless the whole work of construction is combined and carried out simultaneously. The work is so prepared and apportioned that all is thoroughly well consolidated before the next course is laid. This is soundly instilled into the minds of all gangers and workmen, and at times all work must stand aside to thoroughly



Works on the North Coast Highway.

1. Filling, watering and rolling the water-bound macadam intermediate course.
3. Constructing 2-in. light penetration macadam surface course.

2. Completed intermediate course.
4. Completed surface course.

opened and spalls stacked close to the crushing site prior to the commencement of the job, provided the quarry is not so close that double handling of the spalls can be avoided. Drays deliver the spalls to the crusher, and lorries deliver the crushed metal from the crusher to the road. Prior to the placing of any metal the formation and shoulder work are carried out well in advance by the grader unit and 6-8 ton tractor roller. This unit scarifies and reconditions the existing road surface, additional metal being added and compacted true to line and grade and cross section at the required depth below the finished surface to serve as the reconditioned sub-grade or sub-base for the new work of reconstruction. The grader also assists with

strengthen any weak or unstable spots in the sub-grade and base course, well in advance of the next course.

The bitumen plant, as described previously, moves to the site early in the job. The stationary boilers are assembled on concrete blocks, surrounded with corrugated iron sheets, banked with earth to give a good heating surface, covered with an iron roof against rain, and guarded against any inflow of water, which seriously hampers boiling operations. The hot bitumen is pumped by a No. 8 rotary pump through a 2-inch diameter pipe to a transport tank mounted high on a lorry or dray (according to the haul), and is transported and discharged into the portable bitumen

boiler by gravity feed. A constant hot supply of bitumen is thus maintained at the portable boiler, which in itself keeps up the temperature and makes possible a continuous spraying operation. The bitumen is applied to the road by hand spray in preference to bucketing, as a more uniform and even spread is found to be obtained thereby. A check of the amount of bitumen applied is made by measuring the amount used out of the portable boiler by means of a calibrated iron rod. Buckets are kept handy to the work for use if need be. The commercial bitumen is supplied in casks to a specification to meet the requirements of the Main Roads Board. The proprietary company with which the order is placed is advised of this, and is held responsible that such is up to standard. Samples are taken and forwarded to the Board.

Gangers are held responsible for all stores and materials supplied to the job, they passing on the responsibility to each man receiving stores for use on their own particular piece of plant. Petrol for the lorries is supplied directly to the site of the works, and each man is held responsible for the amount received and used. Other stores are issued out and are either kept in the portable stores shed or close to the plant for immediate use.

The quarry gang is composed of men experienced in such work under the charge of a reliable ganger. The results of its operations have been very satisfactory. The quarry plant consists of a Schramm portable compressor capable of working one jackhammer, piping, hose, and fittings, machine and hand steel, anvil and forge, and the necessary sharpening tools and shed. Explosives are stored in a magazine close to the quarry site. In commencing a new quarry, care is taken that it is opened at the correct level and the floor afterwards maintained at such, special care being taken that the holes are well placed and well down so that no toe is left to increase the cost. Drainage is another consideration which has had to be attended to, especially with the heavy rainfall of this district; otherwise working would be greatly hampered. Another important factor in the cost and successful working of the quarry has been the selection of a suitable machine drill steel and of a man skilled in the sharpening and the tempering of the steel. Mainly the double chisel bit is used for the machine drills (not the star bit), they being found to give the best cutting edge and the best results. The stone, however, varies in hardness, some being so hard that only a single chisel bit with heavy shoulder has been found to stand the strain.

Timber and concrete culvert repair work is attended to by a small unit of men with the necessary plant and tools and equipment, designated the "Bridge and Culvert Repair Unit." General maintenance of the State highway, trunk and main roads is attended to mainly by the two grader units and a flying maintenance unit, assisted by the crushing plants to provide the necessary maintenance metal.

Ferries and River Bank Erosion.—Three vehicular ferries ply across the Richmond River at different points of the Shire, the one at Burns Point serving the State highway. This is a double rope ferry worked by a Standard petrol engine, on which, for more efficient service, a high tension magneto and impulse starter have been installed. Each year the punt is painted and

every half-year laid up for a day and the engine overhauled. An endeavour is made every eighteen months to place it on the slip for thorough overhaul and repairs, but the actual time is determined by the availability of the only relieving punt that can be called upon. A continuous service is maintained by this ferry day and night.

The erosion of the river bank along which the State highway runs requires continuous maintenance, and each year the rubble facing wall is repaired and added to.

Supervision and Administration.—The many works of reconstruction and maintenance call for constant supervision by the Engineer who is assisted largely in the matter of costs by the systematic information returned to the office each week. On all construction jobs a daily time sheet is used. This details the total hours worked by each man and also the equivalent hours at a flat rate of pay, and, further, shows the actual times spent each day by each man on the different classes of work he is engaged upon. This is arranged by index numbers supplied to the gangers, the numbers signifying the different classes of work which are clearly specified. This, together with the crusher returns, the lorryman's and drayman's daily log, the weekly stores return and the quarry return, renders to the office a complete check of the times spent on the different items of work, the amount of work done and the materials used. The storeman, who also acts as timekeeper, collects the daily time sheets and enters the information on a monthly time sheet, detailing the full index numbers for the job, which shows at a glance the times spent on each separate item of work and which can be totalled up each day, week or month with the least possible time and trouble. From this the different items of cost of the work can be watched and checked.

The lorrymen's and draymen's daily log details exactly where from and where to, and for what purpose any material is carted. This, in conjunction with crushing operations, shows where the metal is placed, whether directly to the road, to the stock pile, or to maintenance heaps and again, whether drawn from the stock pile and used elsewhere. The quarry return shows, in detail, the actual work engaged upon, the explosives used, the length of drill holes, the steels sharpened and the amount of spalls drawn from the quarry.

The stores depot and yard is in charge of the storeman, and nothing leaves it or is returned without a complete check. The stores record shows the purpose for which each item of stores or tools is issued and is initialled by the storeman and receiver. This return is rendered to the office from which a complete card system in connection with stores and materials is in operation and from which can be seen the purchases, the unit costs, the issues and the stock in hand.

Finally, the whole costs of works are clearly shown in the works cost book, detailing wages, plant hire, and stores and materials and showing, not only the total cost of the work, but a detailed cost of each item of work connected with the job. From this the monthly certificates of expenditure to the Main Roads Board are rendered.

Tram Tracks and the Transport Act.

UNTIL the passage of the Transport Act, 1930, the legislation governing the maintenance and construction of those portions of any roads occupied by tram tracks in this State, was out of date and not such as took into account the stages to which both road and tram traffic had now developed. It was, in fact, practically, if not wholly, identical with that which had been enacted when the first trams were laid, and the traffic, both trams and other, was horse-drawn. Under those original conditions, when the hoofs of the horses drawing the trams pounded on the roadway

along definite lines, and the class of pavement laid either between the tracks or outside them was water-bound macadam, it was reasonable that the tramways should bear the whole cost of the construction and maintenance of the roadway between the rails and for a distance of 18 inches beyond them. With the coming of self-propelled trams, the wear and tear on the pavement from the tram-horses was removed, and the original legislation began to be anomalous. This was not of great moment while other vehicular traffic was horse-drawn, since, as a means of mass-passenger

	Obligation of Transport Trust.	Obligation of Road Authority.
1. Maintenance of tracks and road alongside	To maintain the road pavement within and for 18 inches beyond the rails, in a manner not inferior to the adjacent road.	To maintain in good repair a width of 10 feet on each side beyond the area for which the Trust is responsible.
2. Reconstruction of tracks when due for renewal—		
(a) Where class of new pavement is the same as the old pavement.	To bear full cost	Nil.
(b) Where class of new pavement is the same as the adjacent road but superior to the old pavement.	To bear full cost, subject to contribution by road authority.	To contribute one-half estimated cost of similar area of new roadway.
(c) Where class of new pavement is superior both to adjacent road and old pavement (and the road authority undertakes to reconstruct the adjacent road in a similar class within twelve months).	To bear full cost, subject to contribution by road authority.	To contribute one-half estimated cost of similar area of new roadway.
3. Existing tram tracks centralised or levels altered but not due to road widening—		
(a) When track is due for renewal and—		
(1) Open ballast track is adopted; or	To bear full cost	Nil.
(2) Class of pavement is not altered; or	To bear full cost	Nil.
(3) New pavement is superior to old pavement ...	To bear full cost, subject to contribution by road authority.	To contribute one-half estimated cost of similar area of roadway.
(b) When track is not due for renewal, and—		
(1) Open ballast track is adopted; or	To bear full cost unless Minister otherwise determines.	Nil, unless Minister otherwise determines.
(2) New track is not required and class of pavement is not altered; or	To bear half cost	To bear half cost.
(3) New track is required and class of pavement is not altered; or	To bear full cost less one-half residual value of discarded track.	To bear one-half residual value of discarded track.
(4) New track is required and new pavement is superior to old pavement.	To bear full cost subject to contribution by road authority.	To contribute one-half residual value of discarded track and one-half estimated cost of similar area of roadway.
4. Alteration of tracks due to road widening by road authority—		
(a) When track is due for renewal and—		
(1) Open ballast track is adopted; or	To bear full cost unless Minister otherwise determines.	Nil unless Minister otherwise determines.
(2) Class of pavement is not altered; or	To bear full cost	Nil.
(3) New pavement is superior to old pavement ...	To bear full cost subject to contribution by road authority.	To contribute one-half cost of similar area of roadway.
(b) When track is not due for renewal, and—		
(1) Open ballast track is adopted; or	To bear full cost unless Minister otherwise determines.	Nil unless Minister otherwise determines.
(2) New track is not required and class of pavement is not altered; or	Nil	To bear full cost.
(3) New track is required and class of pavement is not altered; or	To bear full cost less residual value of discarded track.	To contribute residual value of discarded track.
(4) New track is required and new pavement is superior to old pavement.	To bear full cost subject to contribution by road authority.	To contribute residual value of discarded track and one-half estimated cost of similar area of roadway.
5. Replacement of road vacated by tram tracks on account of alteration of position within roadway.	Nil	To bear full cost.
6. Abandonment of tram tracks—		
(a) Where road reconstruction does not take place simultaneously and class of pavement is not altered.	To bear full cost	Nil.
(b) Where road reconstruction takes place simultaneously or pavement is superior to the adjacent road.	To contribute one-half the estimated cost of work otherwise necessary.	To bear full cost subject to contribution by Transport Trust.

transportation, the trams were still vastly superior to other means of road transport, and continued to monopolise this work. With the advent of motor traffic, however, the position rapidly became onerously unjust. A superior class of pavement was required to serve, not the trams, but their competitors, and the whole cost of this continued to be borne by the former. Further, in many places, local authorities, relying on the existence of the paved tram tracks, neglected to construct any pavement on the sides of the road, so that the tramway passenger had to pay the whole cost of providing the pavement for those persons who elected to use the newer form of transport, as well as for private vehicles.

The injustice, however, was not all on one side. The tramway authorities were equally neglectful in their disregard of the needs of other transport. The tracks were, in many places, instead of being along the centre of the road, laid in an irregular manner along it. Corners were cut, and spaces left too small for other vehicles to pass around simultaneously with the trams. In some cases, the tracks swung from side to side of the road. These conditions made the roads unsafe for both pedestrians and road transport, without any compensating advantages.

In the Transport Act (see sections 50 to 54 inclusive) an endeavour has been made to adjust the situation equitably, and to gradually eliminate the undesirable features outlined above.

Under its provisions, the tramway authority is required to maintain its tracks in a condition not inferior to the road alongside, but the road authority is also required to keep, in a not inferior condition to the tracks, a 10 ft. width of pavement on either side of them (unless they are in ballast or special conditions prevent this). Half the cost of maintaining the tracks is debited to the Road Transport and Traffic Fund (constituted under the Act) which is contributed by road users.

The road authority is also given the right if, due to the needs of road traffic, it finds it necessary to lay down a high-class pavement alongside the tracks, to ask the tramway authority to improve its tracks accordingly. In return for this right, however, the road authority has to contribute to the reconstruction of the tram tracks an amount equal to half the cost of construction of an area equal to that of the tram tracks in a class of pavement similar to that of the roadway alongside, and also half the residual value, if any, of the track which will have to be discarded.

The road authority is also empowered to ask for any adjustment of the position of the tracks, if these are not suitably placed in any road, in which case each authority, *i.e.*, road and tramway, provided the class of pavement adopted for the tram tracks is not altered, has to contribute one-half of the cost of the adjustment (unless the tracks are due for renewal, under which circumstances the whole cost is borne by the tramway authority) or if an improved class of construction is also required, the road authority has to contribute one-half of the residual value of the tracks, together with the quota previously mentioned on account of the higher class of pavement.

Similarly, if any road carrying trams is widened by the road authority, it can require (subject to the decision of the Minister) the tram tracks to be removed to their appropriate position in the widened road, towards which it has to contribute along analogous lines to those which rule in the case of the adjustment of tracks in a road which is not being widened, except that it has to pay for the whole residual value, if any, of the tracks discarded.

The basic principle of these divisions of the costs of works between road and tramway transport is that the road traffic is entitled to, and, in general, has an equal use with the trams of the area occupied by the tram tracks. Hence the road user is required to bear one-half of the cost of the maintenance of the area of the roadway occupied by the tracks and in any reconstruction involving the use of a superior class of pavement to that previously existing, the road authority is required to contribute one-half the estimated cost of construction of an area equal to that of the tram tracks in a class of pavement similar to that of the roadway alongside. In this way, a greater area of smooth surfaced road will be available for travelling upon, and the traffic capacity of the roads carrying tram tracks greatly improved. The need for widening many of the outlying metropolitan roads carrying trams will thus be postponed.

The obligations of both tramway and road authorities under the new Act are summarised in the table on page 122.

It will be seen, therefore, that the Transport Act arranges for the complete co-ordination of the activities of both authorities and fixes their respective responsibilities to the general public in a manner which is considered to be both fair and equitable.

It may be anticipated that as the policy laid down by that Act gradually comes into effect, a transformation of the condition and arrangement of many of the tram tracks will take place, which will be of immense benefit to the metropolitan transport systems of both Sydney and Newcastle.

Two Metropolitan Road Junctions.

THERE are in the metropolitan area a number of places where groups of main roads junction, and which, because of no attempt having been made to organise by the layout of the junctions the routing of traffic passing through them, constitute points of either danger or confusion. One of these is the Gardener's road-Bunnerong road-Anzac parade junction at South Kensington. Of these, the first two are Main Roads (Nos. 183 and 171 respectively). In addition, two other roads of lesser importance, *viz.*, Rainbow-street and Harborne-street, junction with Anzac-parade slightly north of Gardener's-road. One line of trams passes from the City along Anzac-parade. Another line branches from Anzac-parade to Gardener's-road, while there is also a loop between Gardener's-road and Anzac-parade. The layout of the tram tracks is such that traffic proceeding southwards

(Concluded on p. 127.)

Relief Work on the Culcairn-Walbundrie Road.

BY J. W. STRONG, M.C.E.,

Culcairn Shire Engineer.

ON 26th July, 1930, the Main Roads Board informed the Culcairn Shire Council that a sum of £2,500 had been allotted from the Unemployment Relief Fund for construction works on the Culcairn-Walbundrie developmental road (No. 1,012). The grant, which was subject to the general conditions prevailing at that time,* was immediately accepted by the Council, and a proposal submitted to and approved by the Board for the construction in gravel of a section of the road commencing 6½ miles east of Walbundrie and extending towards Culcairn.

Notification that work was to be provided, and information regarding the procedure in applying for it, were given to unemployed men throughout the Shire by means of advertisements in the local papers and notices exhibited at post offices. The men were required to register at the local labour bureau, and were engaged through that office. Registrations at the com-

dock was obtained for the horses. Tent poles were supplied, and the erection of a blacksmith's shop for sharpening tools, and the provision of adequate water supply and sanitary arrangements completed the camp. Chaff was carted free to the works by the chaff mill proprietors, and tradesmen quickly established the camp in their rounds, enabling the men, if they so desired, to obtain provisions on the spot.

The road, at the section proposed for construction, passes through undulating country devoted to wheat and wool growing, and is subject to very heavy steel-tired wheat and hay traffic. The surface is of loam with a friable subsoil of clay, so that breaking of the surface is liable to cause severe water erosion and create deep scours, which, eating back rapidly through the wheat paddocks, seriously impair their value. The road, over most of the section constructed, had suffered considerably from this erosion.



Views of completed relief work on the Culcairn-Walbundrie developmental road.

mencement of operations totalled 104 men, of whom forty-nine were married and fifty-five single, but the total increased as the work went on, till finally 126 men were employed. On account of the number of men to be employed and the conditions of employment restricting their engagement to not more than four days (thirty-five hours) per week, which precluded continuous work if they were engaged in one gang, two gangs were formed, the first made up of married men and returned soldiers working eight days per fortnight, and the second of single men, working four days per fortnight. A camp was established adjacent to the site of the works. The use of a house and outbuildings was obtained for men not possessing camping equipment, and straw and chaff bags provided for mattresses. As the site of the works was a considerable distance from any town, arrangements were made for motor trucks to convey men without other means of conveyance to and from the camp at the beginning and end of each four-day period. The use of a pad-

A flat country type of cross-section was adopted, with gravel 16 feet wide and 8 inches deep (consolidated). On account of the liability to erosion, particular care was taken with the drainage. Where any likelihood of scour existed, sump inlets were provided at culverts, and sharp dips in the drain were concreted.

The Council possesses two quarry sites in this vicinity, but as most of the gravel had previously been taken from these, further supplies were required. Search of the locality revealed two good surface deposits of granitic gravel on private property, with average leads to the works of approximately 1 mile and 1½ miles, and these, with the Council's pits, furnished gravel for the whole of the work. Royalty was paid on the gravel taken from private property.

Forming, grading, and boxing was started with a small gang on 11th August. Two grader teams were kept continuously at this work, but were unable to keep ahead of the gravel, and it was found necessary later to bring the Council's tractor-grader plant to the

* See *Main Roads*, p. 8, September, 1930.

works. This soon opened up sufficient boxing to ensure that there would be no delay in the gravelling. The gravel, after ploughing, was loaded by hand. To ensure sufficient transport it was necessary to work all vehicles continuously, the drivers being changed with the change of gangs. No difficulty was experienced in obtaining drivers satisfactory to the owners of the vehicles when the relieving gang took over. The gravel at the tiphead was spread by hand in two layers, each layer being consolidated by being trafficked over by the transport vehicles while being kept in shape by means of a small drag hauled by two horses. In this way a very satisfactory consolidation was obtained over the whole work, though the success of this method depends greatly upon the skilful handling of the drag, and the extent to which the drivers can be induced to travel over the whole width of the road, instead of keeping to one track, as they tend to do.

The first large gang commenced work on 18th August, and thereafter the work continued in full swing till 2nd October, when it ceased owing to the exhaustion of the grant. The men engaged worked well, considering that few of them were experienced in road work, and some had scarcely handled a shovel before. The understanding was given them at the outset that no man would be dismissed on account of his inability to do a normal day's work, but that each would be expected to give service to the best of his ability, and would be put off unless this were done. This may have contributed largely to the result. A total length of 3 miles 51½ chains of road, with the necessary side road junctions, and five reinforced concrete pipe culverts with concrete headwalls, was constructed, and maintenance material provided throughout with the grant of £2,500.

The cessation of the work left a gap of 1 mile 29 chains to junction with the metal road, constructed under previous grants, which then stretched continuously to Culcairn. Application to the Board for a grant for the closing of this gap was rewarded by the allocation of a further £1,000. Construction was recommenced on 22nd October under very similar arrangements to those obtaining under the previous grant, but, owing to the large registrations, married men and returned soldiers only were employed. They were divided into two gangs, working four days alternately, and employment was given to eighty-three men. It was necessary, for this further work, to find fresh supplies of gravel, and a deposit of similar quality material to that previously used was found at an average lead of 2 miles from the works, and all requisite supplies obtained from this place. Work ceased on 15th November. In addition to 1 mile 29 chains of gravelling, one turnoff to a side road, and four reinforced concrete pipe culverts with concrete headwalls were constructed, and maintenance gravel provided throughout. The cost of this section was £1,076. Plant hire was borne by the Council in the case of both grants.

Prince's Highway.

A gang has commenced the widening of the road over Jigam Hill, between Pambula and Eden.

Pig-rooting.

INSTANCES have come under notice where material for forming or surfacing roads has been obtained, in connection with maintenance operations, by digging in an irregular manner into the batter of a cutting, by ploughing an irregular and undrained borrow pit elsewhere within the road reservation, or by mutilating table drains and catch drains. Such action is commonly described as "pig-rooting." Excavations of this character add an element of danger to the road by their presence, as well as providing opportunity for scour, slipping of banks, and subsidence of fencing, and their untidy appearance often leads to unfavourable comment upon an otherwise satisfactory length of road.

Borrowing for any purpose on main roads must always be carried out in conformity with the relevant clause in the Board's standard specification for formation, which reads as follows:—

10. Borrowed Material. Cuttings may be uniformly widened to provide extra material, if required, for embankments. The widened cutting shall be finished with batters and crossfall as herein specified, and shall have catch drains not closer than five (5) feet to the boundary of the road reserve, and not closer to the top of the batter than herein specified.

Borrow pits shall be made only at such sites as may be approved in writing by the Engineer, shall have edges more than three (3) feet from any fence line, route of traffic, line of earthworks, or road reserve boundary; shall have batters not steeper than two (2) horizontal to one (1) vertical, with approved drainage outlets; and shall be left by the Contractor in a tidy and safe condition.

The widening of cuttings is the most satisfactory method of providing additional material. The removal of the spoil definitely adds to the value of the road by increasing the formation width, there are no drainage difficulties, and if the work is carried out uniformly the increased width at the widened cutting is not noticed. By "cutting" is meant not only the relatively high slope of a side or through cutting in undulating country, but the lower slopes at either edge of the formation in flat country also.

Where the distance to the nearest cutting precludes the haulage of spoil from it to the site of a deficiency in material, then the opening of a borrow pit may be necessary, but there is no justification for working such a pit to the danger of traffic or property, or leaving it in an untidy, undrained, or unsafe condition.

The Board desires to stress to all concerned the necessity for paying due regard to the location and working of borrow pits. The aim should be to not only carry out the letter of the specification, but to appreciate its spirit also, by limiting the occurrence of borrow pits to a minimum and by ensuring positively, when they are unavoidable, that they are as unobtrusive as possible.

Hume Highway.

Repairs are being carried out to the bridge over Muttama Creek, on the Hume Highway, near Coolac, in the Shire of Gundagai.

Relief Work on the Inverell-Auburn Vale Road.

BY A. E. TAYLOR, A.M.I.E. AUST.

Bannockburn Shire Engineer.

THE Inverell-Auburn Vale developmental road (No. 1,119) is a direct feeder road to the railway, traversing very heavy black soil to about the 8½-mile, the worst section being from Inverell to the 7-mile. From 3 miles 100 feet to 6 miles 1,500 feet had been constructed, half in metal and half in gravel, besides 1 mile in the Inverell Municipality, constructed in gravel, with grants in 1928 and 1929. Plans for the section from 6 miles 1,500 feet to 7 miles 800 feet, were in the hands of the Board, and on the 25th July, 1930, notification was received from the Board that a grant of £1,750 from the Unemployment Relief Council had been made available for further works. Work was commenced on 18th August, 1930, and completed on 9th December, 1930.

avoid loss of time in starting the fresh gangs, a few experienced men were kept on throughout, one with reliable horses on the forming and draining, &c., one good trimmer, one spreader, another man in charge of a cutting, and two men on pipes and concrete work. When a new gang of men arrived they were split up in batches under these, and thus no time was lost. Good spreaders proved to be essential. At one stage, when spreading was going on in two or three places at once, inexperienced men were used and extra work was required in straightening up the base course after rolling, due to poor spreading.

The base course material was close to the job and was carted by drays. The surface course material had to be drawn 5¼ miles. Tenders were called and a contract let at 4s. 6d. per cubic yard for carting only.



Gate, with motor by-pass on left.

Pipe culvert headwall of rubble set in cement mortar.

Concrete causeway, 70 ft. x 16 ft.

Brief particulars are: Length, 4,580 feet; earth-works, 2,000 cubic yards, including about 800 cubic yards rock; pavement, 16 feet wide; formation, 24 feet wide; base course (decomposed basalt), 5½ inches consolidated thickness; surface course (ironstone gravel), 4 inches consolidated thickness; culverts, one double 24-inch pipe, and five single 18-inch pipes; one concrete causeway, 70 feet x 16 feet.

One of the council's regular hands was placed in charge as ganger, he and the roller driver being the only shire men on the job. Men were engaged through the State Labour Exchange in Inverell, being put on in batches of thirty men with ten to sixteen drays as required. The gangs were changed every fortnight and paid fortnightly, advances being made to those who desired it on the intermediate Saturdays. To

One man was allowed in the pit (a picking pit) for each 2 cubic yard truck employed.

Pipes were made on the job, a carpenter and good concrete mixer being selected for the work. After a few hours' experience, the various little wrinkles were picked up and a good product turned out, the men taking a great pride in their work. Rubble end walls in cement mortar were used for the pipe culverts instead of concrete. Concrete gravel had to be carted 8 miles, while stone and a fine sand for mortar were handy, so that the stone walls gave a maximum expenditure on labour and were therefore desirable on this work.

The concrete causeway was originally designed to have a slab top 7 inches thick, reinforced with ½ inch bars at 12-inch centre lines each way, with

vertical walls at each side, carried down to rock or to 4 feet below top of slab. To increase labour as against materials, the walls were built of rubble grouted in cement, carried down to rock or 4 feet below slab. The slab was built 6 inches thick, reinforced as designed. Owing to a constant stream of water down the gully (which is normally dry), an 18-inch pipe had to be laid for construction purposes while the causeway was being put in. The top of the concrete is carefully graded to a 100 feet vertical curve joining two grades of 6.3 per cent. and 5.8 per cent., and can be crossed at any speed without feeling a bump.

The final cost, including the causeway, was £1,750 15s. 10d. Council supplied all tools, made no charges for hire of plant and paid workers' compensation insurance as well as part of the wages of the ganger and roller driver. We were fortunate in drawing most of our labour from Tingha and Gilgai, two mining districts, about 75 per cent. being miners, and all familiar with explosives. (About three cases of gelignite were used.) Allowing for a few weak, though willing, townsmen, the efficiency as compared with experienced roadmen is estimated at about 85 per cent. to 90 per cent., and this has been the experience of other shire engineers in this district who have been agreeably surprised at the amount and class of work done by the unemployed under good supervision. The main trouble on small relief works is the weak horses brought along by some of the men who can hardly be expected to feed them up beforehand for one or two weeks' work. This necessarily leads to light loading, and other men with better horses tend to follow suit so as not to fall behind in the number of loads put out. Nevertheless, the work done on this occasion was most satisfactory and is a credit to the men engaged.

Two Metropolitan Road Junctions.

(Continued from p. 123.)

along Anzac-parade towards the junction and desiring to pass to Bunnerong-road does not know whether it should go straight across the tram tracks traversing the area or keep as far to the left as possible, and pass around the curve which gives connection to Gardener's-road. Traffic going eastwards from Gardener's-road and wishing to proceed to Anzac-parade does not know whether to take the shortest possible route or a more devious one. Apart from these difficulties, there are a number of poles in the carriageway, supporting the span wires of the overhead electric system which supplies power to the trams, which are arranged more or less indiscriminately so far as road traffic is concerned. The Board has been informed by the Tramway Department that frequent representations have been made to it with a view to placing these in such positions as would present less hazard to traffic, but owing to the wide area of the junction a satisfactory solution had not previously been arrived at. A number of means of organising the layout of the junction have been prepared, and the one illustrated in Fig 1 has been selected by the Board as being the simplest and most readily capable of progressive development. This has been agreed to by the tramway and electricity

authorities and the Randwick Council, with whom arrangements for the necessary paving are now being made.

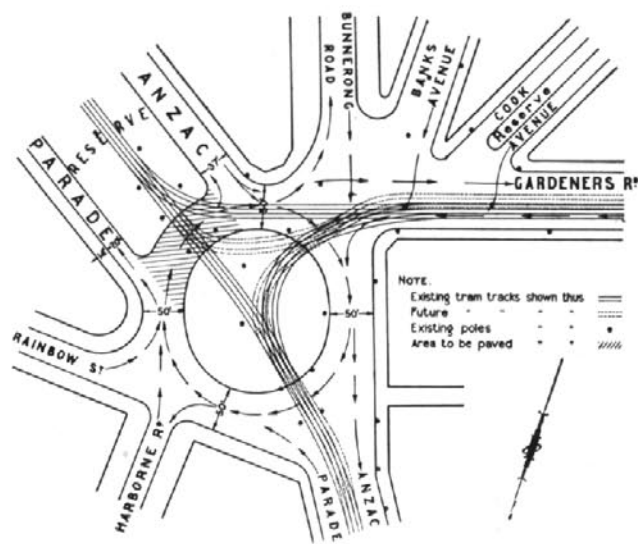
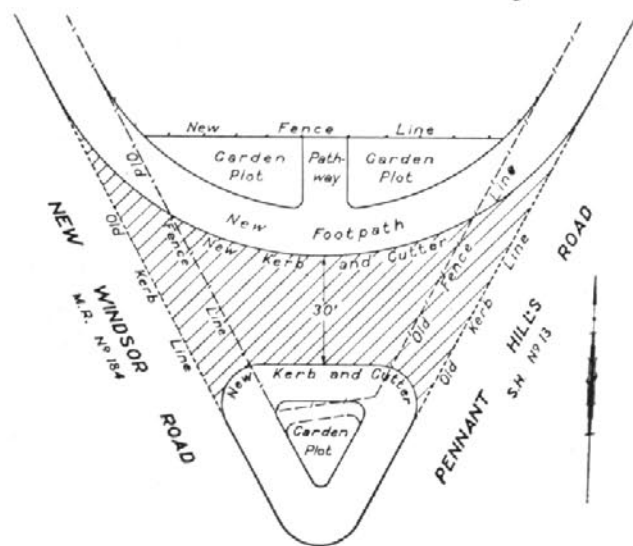


Fig. 1.—The Gardener's-road—Anzac-parade—Bunnerong-road intersection, South Kensington.

The proposal is that a central garden or grass area shall be established, with kerbs on its boundary, through which the tram tracks will continue to pass (but on open ballast foundation). Any poles now in the carriageway and outside the boundary of this area will be transferred within it or to the footpaths. All



New Connection shown thus (hatched area)

Fig. 2.—The Pennant Hills road—New Windsor road intersection, Parramatta.

road traffic approaching the junction and wishing to pass to one of the other roads branching from it—other than that passing between Gardener's-road and Bunnerong-road—will be required to do so by passing around the circle to the left until it comes to the road it desires to take. In order that this may be done, it will be necessary to pave the area shown

hatched on the sketch, and the Board has offered assistance to the Randwick Council to do this. Certain minor amendments of the tram tracks, as illustrated in Fig. 1, will be required in due course, and will be made by the Tramway Department when the tracks become due for renewal. That Department, however, is willing to arrange immediately for the adjustment of its poles as soon as the circular kerbing has been constructed. The Traffic Department has been consulted as to the proposal, and has indicated that it considers the scheme will provide a great improvement in the traffic so far as Anzac-parade, Harborne-street, and Rainbow-street are concerned, and that no difficulty should be experienced in inducing motorists to keep to the left around the grass plot to enter either Anzac-parade or Bunnerong-road. It considers, however, that traffic from Gardener's-road desiring to enter Anzac-parade or Bunnerong-road should not be expected to proceed around the garden plot.

A second junction on which improvement works have been completed is in Parramatta, at the point

of connection of Pennant Hills road (State Highway No. 13) and New Windsor-road (Main Road No. 184). At this place, the two roads make a sharp angle, in the apex of which a cemetery is situated. The council of the Municipality of Parramatta arranged with the authorities controlling the cemetery to transfer to the council a suitable area at the point for road purposes in return for the council undertaking to erect an ornamental fence on the new boundary, to construct certain footpaving, kerbing and guttering, and road pavement, and to generally improve the area. The council then asked the Board to bear half the cost of the works involved, and in view of the benefits to main road traffic the Board agreed to do this. Figure 2 illustrates the project. The class of road pavement laid consists of a 6-inch broken stone base course with a 3-inch premixed bituminous macadam wearing course. The cost of the road works, including the adjustment of public utilities, was £853 1s. 4d.

Tenders and Quotations Accepted.

The following Tenders and Quotations were accepted by the Board during the month of February, 1931:—

Tenders.

Work.			Name of Successful Tenderer.	Amount of Accepted Tender.
Municipality or Shire.	Road No.	Description.		
Kearsley ...	1,124	Single span timber beam bridge at Phillips Creek...	T. S. Brown ...	£ s. d. 298 13 8
		Single span timber beam bridge at First Creek ...	T. S. Brown ...	360 3 2

Quotations.

No. of Quotation.	Description of Article.	Name of Successful Tenderer.	Amount of Accepted Quotation.
1	Blue metal—300 tons, $\frac{3}{4}$ in.; 300 tons, $\frac{5}{16}$ in. ...	State Metal Quarries ...	£ s. d. 157 10 0
3	Bridge timber—15 in. x 12 in.—107 ft.; 14 in. x 12 in.—165 ft.; 12 in. x 12 in.—596 ft. 6 in.; 12 in. x 6 in.—37 ft.; 1,000 sup. ft., 16 ft. 6 in. x 4 in. x 8 in. to 10 in. wide.	Maxwell Porter and Son Ltd. ...	173 10 0
5	Concrete pipes—24 ft. x 21 in. dia.; 44 ft. x 24 in. dia.; 36 ft. x 36 in. dia.	Hume Pipe Co. ...	73 6 0
6	Concrete pipes—50 ft. x 42 in. dia. ...	State Monier Pipe Works ...	59 14 3
9	Concrete pipes—157 ft. x 15 in. dia.; 89 ft. x 18 in. dia.; 60 ft. x 21 in. dia.	State Monier Pipe Works ...	84 6 10
11	Bridge timber—19 in. dia., 64 ft.; 16½ in. dia., 298 ft.; 15½ in. dia., 30 ft.; 14½ in. dia., 25 ft.; 16 in. dia., 158 ft.; 12 in. dia., 20 ft.; 14 in. x 14 in., 190 ft.	Maxwell Porter and Son ...	149 4 2

The acceptance by the respective Councils of the following Tenders has been approved by the Board during the month of February, 1931:—

Work.			Name of Recommended Tenderer.	Amount of Recommended Tender.
Municipality or Shire.	Road No.	Description.		
Nambucca ...	1,078	Gravel construction, 2,100 ft. ...	Bugden & Bugden ...	£ s. d. 636 12 0
Peak Hill ...	56	Gravelling and culverts ...	J. E. Puckeridge ...	1,143 2 0
Liverpool Plains ...	11	Gravel construction, 2,100 ft. ...	A. and G. Patterson ...	413 0 10
Kyogle ...	1,050	W.B. Macadam base course, 1 m. 3,588 ft. ...	F. E. Bown ...	2,726 17 8