

indicated on a grade not steeper than 1 in 60 on the straights, and compensated proportionately on curves; and when it becomes necessary to relay the line through the wearing-out of present rails and rotting of sleepers the new work can be done on the new formation without any more cost, and probably without as much as would be necessitated by the ordinary relaying operations.

In conclusion, I consider that the solution of the Rimutaka crossing by railway will be best solved by—

- Firstly, driving a tunnel on the lines indicated above, and utilizing the material to form a bank (the basis of a future deviation) between Cross Creek and Pigeon Bush. (Line 1.)
- Secondly, as business develops, construct a deviation between Upper Hutt and Mungaroa according to line 2.
- Thirdly, when ordinary maintenance requirements necessitate it, relay the line between Cross Creek and Pigeon Bush upon the formation previously referred to as having been made from the tunnel spoil. (Line 3.)

In this connection also the following extract from Mr. E. H. Hiley's 1914 report is interesting:—

Train-working on the Wairarapa line is greatly interfered with by the heavy gradients existing between Upper Hutt and Summit, and the Rimutaka Incline between Cross Creek and Summit. The grade of the latter is 1 in 15, and the length 2 miles 79 chains. Special engines have to be employed exclusively for this portion of the line. The maximum load per engine is 60 tons dead-weight (say, about 20 tons actual traffic); frequently four engines are employed to haul a train of 240 tons, dead-weight, from Cross Creek to Summit. The minimum time for the journey is forty minutes. Every train has to be remarshalled at the Summit and similarly at Cross Creek. This involves a loss of at least fifteen minutes to a train at each station. On an average one hour twenty minutes is required to negotiate the three-mile journey up the incline. This puts a definite limit upon the amount of business from the Wairarapa which can be dealt with. The cost per engine-mile is 3s. 1d. A special track with a third rail for gripping and braking purposes has to be maintained at considerable additional expense compared with the ordinary track. The importance of this route and the productivity of the country which the existing and projected railways will serve justify consideration of the abandonment of the incline and the construction of a deviation with gradients that will enable all trains to be worked with the standard types of engines. A really satisfactory service via the Wairarapa route is impracticable while trains have to be worked over the Rimutaka Incline. A considerable expenditure will be involved in carrying out the deviation, but the work, nevertheless, will have to be considered in the near future.

TAWA FLAT DEVIATION.

Report by Engineer-in-Chief, Public Works Department.

Before the Government makes any definite decision on the question of starting the Rimutaka Deviation, I am of the opinion that this should be considered in conjunction with the question of a deviation to avoid the very steep grades existing on the present line leaving Wellington for the west coast. I refer particularly to the grade between the Esplanade and Khandallah.

Before it is possible to compare any proposed line with an existing line it is necessary to recollect that the existing line is reaching the limit of its capacity, and consequently must be double-tracked within a short time unless some deviation is made; and in fact, if a deviation is made, it will still require to be a double-track line before many years. The present traffic at Thorndon Station amounts to 1,218,000 tons outwards and 1,186,255 tons inwards per annum, and the rate of growth since 1910 indicates that the traffic has been growing at the rate of 5 per cent. per annum, and it is quite reasonable to suppose that this rate of growth will continue. Therefore, by 1928 there will be approximately 1,500,000 tons to be coped with in each direction. On the present line the average gross load of tons is 161 tons, on which basis by 1928 there would be required at least thirty trains a day each way. The position is even worse than this might indicate, because the trains, owing to traffic considerations, cannot be run at regular intervals. As long ago as 1914 the General Manager of Railways stated that the line was reaching the limit of its capacity. Naturally, the position is very much worse to-day.

I do not think it is necessary to lay any stress on the question of danger due to the heavy grades and excessive curvature, because, although a steep and crooked line is not as safe as a level and straight one, there are nevertheless many lines in New Zealand worse than the line under review, and these are not considered dangerous; but for the purposes of this report I consider that sufficient has been shown to indicate that when comparing the financial results from various lines, the costs in connection with a new line should not be compared with the present line but with a double track on the present alignment.

An examination of the grades existing on the line from Wellington north to Marton, and also via the Manawatu Gorge to beyond Woodville, shows that it would not be advisable to adopt a grade much steeper than 1 in 100, and, as this grade would be on a practically straight line, its resistance to haulage would be approximately one-third of the present grade. Therefore, as far as investigations have gone in connection with possible deviations, it has been assumed that a maximum grade of 1 in 100 would be adopted; and in fact, owing to the large amount of tunnelling required, lines have so far been located on the basis of not steeper than 1 in 120 in tunnel. The configuration of the ground is such that a great deal of difference in cost is not made by a moderate variation of the grade in either direction.