

being considerably cheaper than an open cut undertaken by any methods that had up to this time been used by the Department. However, boring tests revealed the ground to be of a most suitable nature for earthworks on a large scale, and this, combined with the level nature of the country under which the tunnel passed, led to the examination of the problem from an entirely new angle. As time was a vital factor and the removal of some 400,000 cubic yards of spoil was involved, some novel methods of spoil removal were obviously necessary if the earthworks were to be considered in preference to a tunnel. After full consideration, it was decided to remove the spoil from this extremely large cutting in three lifts working from both ends. On the bottom lifts three power shovels were employed and the materials hauled away by trains to form embankments. On the top lifts two $1\frac{1}{2}$ -yard drag-lines were to be used working in tandem to handle the spoil back to a safe distance from the edge of the cut, while a small $\frac{3}{4}$ -yard oil drag-line was employed for trimming the side slopes. By this arrangement of plant, it was anticipated that a monthly output of between 50,000 and 60,000 cubic yards would easily be reached and that the total time involved would not exceed nine months as against fifteen months for the fastest methods of completing the approach cuts and tunnel. Up to the time of closing down, the excavation at the southern end of the cut had just been organized on an efficient basis in the first and second lifts with two shovels, and even by these means the estimated monthly production allowed in the estimate for these units has been greatly exceeded, and so favourably did the country prove to lend itself to this method of attack that it is more than certain that a considerable saving over the tunnelling method would have been achieved.

The deviation to avoid bluffs on the originally surveyed line between 54 m. and 55 m. was completed chiefly by the aid of a large power drag-line excavator in quick time and at reduced cost.

The programme of culverting was curtailed during the year owing to the uncertainty of the work proceeding, and owing to very little new formation being opened up. The main work in addition to minor pipe culverts was a 11 ft. by 9 ft. water-drive 140 ft. long at 55 m. 40 ch. Other major works completed were a 6 ft. by 5 ft. water-drive, 98 ft. long, at 44 m. 73 ch., and an 8 ft. by 6 ft. water-drive 90 ft. long, at 55 m. 17 ch.

The road overbridge at 47 m. 45 ch. was completed, being a skew arch in mass concrete.

Approximately 7 miles of permanent fencing, both sides, was completed.

A considerable amount of groyning work between 52 m. 30 ch., and 55 m. 30 ch. was carried out during the period, twenty-one groynes being built.

Oaro Section (56 m. onward).—Formation work has been in hand over 4 miles of this section, about $2\frac{1}{2}$ miles have been completed, but this comprises the easier portion, the heavier cuttings being all opened up, but not very far advanced.

The culvert and fencing work is well in hand.

An average number of 310 men was maintained during the period.

CONSTRUCTION AND MAINTENANCE OF ROADS AND BRIDGES.

WHANGAREI DISTRICT.

Huehue-Waimatenui Road (Bay of Islands County).—This road has been widened to 18 ft. for a further mile and culverted. 2 m. was metalled 12 ft. by 6 in., and top course placed over whole length of 11 m. Numerous slips were cleared throughout.

Kaikou-Opahi (Bay of Islands County).—3 m. 48 ch. was formed 16 ft. wide, and 3 m. 40 ch. metalled 9 ft. by 6 in. Relief workers were engaged on the work.

Motatau to Maromaku (Bay of Islands County).—1 m. 68 ch. of road was formed 14 ft. wide and metalled 9 ft. by 9 in.

Owae Valley Road (Bay of Islands County).—Relief workers formed 1 m. 11 ch. to a width of 14 ft. and metalled new formation.

Preston Road (Bay of Islands County).—5 m. 5 ch. of 12 ft. formation was completed by relief workers.

Tokawhero Road (Bay of Islands County).—2 m. 33 ch. 16 ft. formation, 5 m. 11 ch. bottom-course metalling 9 ft. by 6 in., and top course 9 ft. by 3 in. were completed. Two bridges, totalling 80 ft., in rolled-steel joists and New Zealand timbers were erected.

Waikare to Kawakawa (Bay of Islands County).—Three bridges, totalling 265 ft., in rolled-steel joists and mixed Australian hardwood were erected. Slips were cleared from 7 m. of road, and base-course metalling 9 ft. by 6 in. was placed on approximately 10 m. of road.

Donnelly's Crossing-Tutamoe-Waimatenui (Hobson County).—6 m. of road was widened to 18 ft. and culverted. Base-course metalling was completed on whole length of 13 m. to a width of 10 ft. by 6 in., and top course 10 ft. by 3 in. is within 40 ch. of completion. Relief workers were engaged on this work.

Te Kopuru to Poulu (Hobson County).—1 m. 23 ch. of road was formed 16 ft. wide.

Te Kuri Block (Hobson County).—4 m. 77 ch. of road was formed 16 ft. wide and culverted.

Whatoro-Opouteke Road (Hobson County).—5½ m. of road was widened to 18 ft., culverted, and provided with stone drains. 7 m. 43 ch. of bottom-course metalling was completed 9 ft. by 6 in. and 7 m. top course placed 9 ft. by 3 in.

Donnelly's Crossing-Mangatu-Awatuna (Hobson County).—1 m. 72 ch. of road was metalled 10 ft. by 9 in.