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BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

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1967/25

GEOLOGICAL INVESTIGSTION OF THE GOROKA - DAULO PASS - CHUAVE ROAD, EASTERN HIGHLANDS DISTRICT, NEW GUINEA.

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by

J.P. MacGregor and J.R.L. Read

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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GEOLOGICAL INVESTIGATION OF THE GOROKA - DAULO PASS - CHUAVE ROAD, EASTERN HIGHLANDS DISTRICT, NEW GUINEA

by

J.P. MacGregor and J.R.L. Read

Summary

A brief geological investigation of the existing section of the Highlands Highway between Goroka and Chuave was carried out in September 1966 at the request of the Commonwealth Department of Works.

The road has been constructed across a ridge in deeply dissected terrain, with considerable depths of overburden underlain by weathered volcanic and sedimentary bedrock. Side-slopes are steep, and numerous slips have taken place over a distance of some 24 miles of the 39 miles of road between Chuave and Goroka.

Improvement of the standard of the road would involve considerably increased amounts of cut and fill which would immediately lead to major stability problems over a greater part of the road. It is considered that it would be very expensive to stabilise some sections of the road under these conditions and impossible to guarantee stability of the complete road. It is concluded that the improvement of the road to suitable all-weather standards is not geologically feasible.

Introduction

The existing section of the Highlands Highway between Goroka and Mount Hagen crosses the Bismarck Range from the Asaro Valley to the Wahgi Valley via the Daulo Pass. This section of road crosses a deeply dissected terrain and is underlain by weathered rocks; many slopes are unstable and the resulting landslides often close the road.

As an alternative to the present road a route from Goroka to Chuave via Lufa has been proposed. A geological investigation of this route was carried out by J.R.L. Read in May 1966.

In order to assess the relative difficulties and cost of constructing the new section of road as compared with re-aligning and improving the existing road, a brief survey of the Chuave-Daulo Pass-Goroka road was carried out in September 1966 at the request of the Director, Commonwealth Department of Works, Port Moresby.

Topography and General Geology

The portion of the Bismarck Range crossed by the Daulo Pass road consists of a north-west trending ridge, with peaks at about 9000 feet, between the Wahgi and Asaro Rivers. The valleys of the two rivers are at an elevation of about 5000 feet. The range is deeply dissected by numerous tributaries of the Mai River in the west and the Asaro River in the east. The dissection has produced many steep-sided valleys many of which are heavily wooded.

The road from Chuave (5097 feet) follows the western bank of the Mai River as far as Kenangi (5520 feet) then turns east along the northern bank of a tributary as far as Watabung (6280 feet). From Watabung it climbs northwards to the Daulo Pass at 8175 feet and descends the eastern flank of the range on the northern side of a tributary of the Asaro River. From the Asaro cross-roads (5240 feet) the road crosses the floor of the Asaro valley to Goroka (5130 feet).

The regional geology of the area has been described by McMillan and Malone (1960). The section of the range crossed by the road is composed of Tertiary shale, mudstone, sandstone, conglomerate and limestone with a thick series of interbedded volcanics which have been called the Daulo Volcanics. There is some structural variation, but in general the sediments dip to the north-east or east. Many of the contacts between the volcanics and the sediments are faulted. The older rocks have been intruded by several acid and basic minor intrusions; they are overlain in the Asaro valley by the Goroka Beds which are almost horizontal unconsolidated gravels and clays of lacustrine origin.

No attempt has been made in this brief survey to discuss the geological history and succession in the area, and the rocks are described only as they may affect the road construction and stability problems.

Engineering Geology

The traverse from Chuave to Goroka has been divided into several sections and these are described separately. Detailed traverse notes taken at each station, with appropriate mileages, are given in Appendix 1. The location of the stations and the general rock types observed are shown on Plate 1.

Chuave to Kenangi Bridge

The road from Chuave (mileage 0.0) to the Kenangi bridge (5.2) follows the western side of the Mai River. The road rises from 5097 feet at Chuave to 5850 feet about 4 miles to the north and then descends to 5520 feet at the river crossing.

From Chuave to Station 4 the road crosses naturally cemented scree from the high cliffs of the Chimbu limestone and then passes through the notch in the scarp caused by the river. Side slopes range from 10°-40° and cuts in the scree are fairly stable.

From Stations 5 to 9 the road winds around a series of sharp spurs and gullies underlain by a well-cemented green conglomerate with pebbles up to 2 inches in diameter. Side-slopes vary from 20°-35° and overburden ranges from 3 to 10 feet. Some minor slipping of overburden has occurred.

From Stations 9 to 11 the green conglomerate outcrops are replaced by weathered red-brown shale with occasional thin bands of conglomerate. A sharp spur at Station 11 is underlain by limestone. Side slopes vary from 10°-35° and slipping has taken place in the shale in cuts as little as 10 feet deep.

From Stations 12 to 16 the road crosses a steep side-slope, composed of up to 10 feet of overburden on a weathered intrusion of diorite. Side-slopes are from 35°-45° and the weathered surface of the diorite is roughly parallel to the hill slope. In this section there are several large slips, notably at Station 12: 150-200 feet high, and at Station 13: 400 feet high. Between Stations 15 and 16 there are some shale outcrops and at Station 16 there is an intrusion of light-coloured siliceous porphyry. The porphyry is relatively strong and is covered by 3-4 feet of overburden.

Kenangi Bridge to Watabung

From Kenangi bridge (mileage 5.2) to Watabung corner (10.6) the road follows first the southern and then the northern bank of a westerly flowing tributary of the Mai River. The road rises steadily from 5520 feet at the Kenangi bridge to 6280 feet at Watabung.

From the bridge at Station 16 to the bridge at Station 19 the road is cut into fresh siltstone, sandstone and shale with porphyry intrusions. Sideslopes are from 35°-50° and at Station 18 a 50-foot-high slide has occurred in weathered shale and siltstone. In this section the overburden contains many rock fragments and is more stable in cuts than in other sections.

From Stations 19 to 22 the road follows the northern bank of the creek in porphyry, black shale and sandstone. Side-slopes range from 35°-40°. Cuts in fresh rock are stable but near Station 21 slips up to 100 feet high are found in weathered rock and overburden. Beyond Station 22 the valley narrows and the road climbs above the creek bed and cuts across a series of spurs and gullies in weathered shale with some minor igneous intrusions. At Station 27 there are two slips in deeply weathered volcanic rock with 6 feet of overburden on a 45° side slope. From Station 27 to Watabung at Station 29 the road again follows the creek bank. It is founded on deeply weathered volcanic rock and crosses side-slopes which range from 0° - 30°. Minor slips have occurred.

Watabung to Daulo Pass

From Watabung (mileage 10.6) to the top of the Daulo Pass (17.1) the road in general follows the western slopes of a southerly-flowing creek which eventually joins the Mai River. The road rises steadily from Watabung at 6280 feet to the top of the Pass at 8175 feet.

From Watabung at Station 29 to Station 32 the road cuts across side-slopes of 10° - 30° with up to 10 feet of overburden on weathered shale and mudstone. Minor slips and slumps were observed on this section. At Station 33 an outcrop of strong, red-brown siliceous limestone was found; between Stations 34 and 35 there are several outcrops of a coarse massive igneous rock - probably gabbro. The igneous rock is weathered and jointed, and has 6-10 feet of overburden which shows minor slipping and accumulation in gullies. Side-slopes range from 30° - 40°.

Between Stations 35 and 37 the road rounds the end of a spur formed by weathered and weak shale; all the sedimentary rocks dip to the north. Cuts of up to 6 feet are stable in this material. Between Stations 37 and 38 weathered gabbro once again underlies the road which cuts across side-slopes of 25°-35°. Only minor slips have formed.

From Station 38 to the top of the Pass, at Station 46, the road winds round a succession of steep spurs and gullies underlain by weathered volcanic rock - ash, tuff and lavas. Between Stations 39 and 42 side-slopes range from 35° - 50° with overburden up to 15 feet thick in gullies. At Station 39 there is a 30-foot-high slip, at Station 40 a 150-foot-high slip, and at Station 41 a 70-foot-high slip. All these slips have taken place on the sides of steep gullies where the cut to form the road pavement has undermined stability.

At Station 42, in addition to a slip above the road, tension cracks in the pavement indicate instability of the road surface, which may be lost in the next heavy rain. From Stations 42 to 43 the road is close to the top of a spur and less slipping has occurred, but in one gully at Station 43 there are three 25-foot-high slips. Again, at Stations 44 and 45 numerous slips have formed in steep gullies. Between Stations 45 and 46 slipping has been less serious as the road approaches the top of the Pass and side-slopes are lower.

Daulo Pass to Asaro

From the Daulo Pass (mileage 17.1) to the Asaro crossroads (27.5) the road crosses the headwaters, and then follows the northern slopes, of a tributary of the Asaro River. From the Pass at 8175 feet the road descends steeply to Station 71 (mileage 24.2) at 5830 feet and then more gradually to Asaro at 5240 feet.

From the Pass at Station 46 as far as Station 50 the road descends across side-slopes underlain by volcanic rocks similar to those on the western side of the Pass. At first, side-slopes are low but at Station 47 there is a 50-foot-high slip on the side of a gully with 35°-40° slopes. Erosion is removing the pavement, which is built on fill. Between Stations 47 and 48 the road is near the top of a spur but at Station 48 it cuts into a slope of 40° which extends for at least 500 feet above the road. Here a 150-foot-high slip has occurred in 5-15 feet of overburden which overlies weathered volcanic bedrock. Additional major slipping above the road is likely in this area.

At Station 50 there is a faulted contact between volcanic rock and weathered black, brown and purple shale. From Station 50 to Station 63 the road follows the northern slopes of the creek and is underlain by shale interbedded with siltstone and mudstone and by occasional weathered intrusions of porphyry and dolerite. The shale is well jointed and dips consistently to the east or north-east at 25° - 35°, in many places parallel to the hillside. Slips have formed in overburden and along bedding and jointing even in small cuttings. Overburden ranges in depth from 2 to 8 feet and all side-slopes over the 3 miles of road are between 30° and 40°.

At Station 53 there are 30 to 50-foot-high slips and some pavement has been eroded away; at Station 54 an area of slips, on a moderate slope, is 300 feet wide and extends for a distance of 900 feet from the road. At Station 58 a box-cut over 20 feet deep is being cut through a spur composed of weathered and slipped material.

The porphyry intrusions, although deeply weathered, produce a more stable material than the shale; at Station 59 a slip 150 feet high has developed in a valley underlain by shale between two spurs of porphyry. There is 20-30 feet of overburden in the toe of this slip. In other places there are minor slips in overburden, and rock falls in cuts due to failure along joints and bedding planes.

Between Stations 63 and 70 the road crosses the lower slopes of the range and although the bedrock is still shale the side-slopes are less steep. Overburden contains many rock fragments and is commonly stable in cuts up to 15 feet deep. There are, however, slips into steep gullies. Between Stations 67 and 70 the road runs near the top of a low ridge with side-slopes of 0° - 20° and is underlain by a red clayey soil over shale and mudstone. Cuts are small and slipping negligible.

At Station 71 the road crosses onto almost horizontal lake sediments overlain by a red clay and for the next mile runs straight, down a gentle gradient to the east. Between Stations 72 and 74 it descends through the higher gravel and clay horizons of the lake beds, through side-slopes of 10° - 20° which are relatively stable.

Between Stations 74 and 76 the road crosses a ridge; it has cuts, 10-20 feet high, in weathered and fresh shale in which few slips have developed. Overburden is 3-4 feet thick. North of the ridge the road crosses horizontal lake sediments to the Asaro cross-roads at Station 77.

Asaro to Goroka

From the Asaro cross-roads (mileage 27.5) to Goroka (39.3) the road crosses to the eastern side of the Asaro Valley and follows it to the south-east. In this section the only variations in grade from Asaro at 5240 feet to Goroka at 5130 feet are the descents into, and climbs out of, the various river crossings.

The section of the road from Asaro at Station 76 to Goroka at Station 85 is underlain by horizontal gravels and clays of the Goroka Beds. These are overlain by up to 10 feet of red clayey topsoil which has been used successfully for fill on some of the bridge approaches. The only evidence of instability observed in this section of road was slumping in the red topsoil on the bank of a creek at Station 80.

Conclusions

The geological traverse along the road from Chuave to Goroka has shown that for a great part of its length the road cuts across steep side-slopes underlain by deeply weathered bedrock. There should be no difficulty in constructing a suitable standard road in the section underlain by lake sediments between Station 70 (mileage 24.0) and Goroka.

Of the 24 miles between Chuave and Station 70 more than 12 miles are across side-slopes greater than 30° and some as high as 50°. 25% of the route is underlain by volcanic rock, 15% by intrusive igneous rock and the remaining 60% by shale and mudstone with minor quantities of sandstone, siltstone, conglomerate and limestone.

The general topographic pattern of deep dissection produces steep river valleys, flanked by a succession of sharp spurs and narrow gullies. The present road contains unacceptable grades and curve radii as cut and fill was kept to a minimum during construction. Even so there have been many serious slips. Sliding was found in almost every cut over 15 feet high and in many much lower cuts.

The deeply weathered nature of the rock, produced by its original broken nature and the effects of the climate, has greatly contributed to the instability of the slopes. Overburden depths vary; most of the slips are in deep overburden but in several places deep-seated slips through bedrock were observed.

It was found that there is little difference in the engineering properties of the various rock-types. The shales resist weathering to a greater extent than the volcanic rocks, but prominent bedding planes and closely spaced joints provide planes of weakness that considerably contribute to instability. The igneous intrusives generally produce a more stable

profile; none-the-less, between Chuave and Kenangi, at Station 13, there is a large slip area in overburden over weathered diorite.

Any attempt to improve the grade or the alignment of the road would greatly increase the amount of deep cut and fill on the road. This would create major problems of instability. Although it would be possible in some places to stabilise the slopes by extensive drainage, removal of overburden and benching of batters, the extent of this problem - for almost the full 24 miles of road - would render treatment uneconomic. In many sections underlain by shale the attitude of the bedding and jointing would produce instability even if all overburden was removed and the road benched in bedrock.

It is considered that improvement, at acceptable cost, of the road between Chuave and Station 70 to suitable all-weather standards is not geologically feasible.

References

McMillan, N.J. and Malone, E.J., (1960) - 'Geology of the Eastern Central Highlands of New Guinea', Bur. Miner. Resour. Aust. Rep. 48.

Read, J.R.L., (1966) - 'The geological investigation of the proposed Lufa-Chuave Road.' Department of Lands, Surveys and Mines, Geological Section. Note on Investigation No. 66404.

APPENDIX 1

GEOLOGICAL TRAVERSE NOTES, CHUAVE-DAULO PASS-GOROKA

Station & Mileage	Description	Side-slope (Degrees)
(1) 0.0	Cross-roads at Chuave. Limestone scree from spur.	10
(2) 0.4	Recemented limestone scree below cliff. Slope relatively stable. Scree rests on horizontal shale.	40
(3) 0.6	Massive limestone. Dip north-east 20°.	
(4)	Top of massive limestone. Next section covered by at least 15 ft of red-brown silty clay.	10
(5) 1.2	Weathered green conglomerate. Pebbles up to 2 inches; well cemented.	20
(6) 1.6	Green conglomerate dipping north-east 20° with interbeds of grey shale. Overburden 3-5 ft with minor slipping. Spurs and gullies.	20-30
(7) 2.5	PEG 795. Spurs and gullies underlain by green conglomerate and shale. Up to 10 ft of completely weathered conglomerate. Filling of gullies would present major problem.	25-35
(8) 2.8	Bridge. Green conglomerate, in river, dipping north at 20°. Bridge on firm bedrock.	
(9) 3.0	Weathered red-brown shale with thin bands of green conglomerate. Overburden 3-4 ft. Minor slipping in 10 ft cuts.	25
(10) 3.6	From 9 shale, weathered with occasional bands of sandstone. At 10 gully with scree and loose material which would become unstable in heavy rain.	10-20
(11) 3.8	Limestone cliff. Rock dipping north-east at 25°. Recemented scree in places on spur.	35

Station & Mileage	Description	Side-slope (Degrees)
(12) 3.9	Contact of shale and broken limestone with diorite. Diorite weathered and covered by 3-4 ft of overburden. Slip from 150-200 ft above road - unstable in wet weather.	40-45
(13)	Large slip of overburden over diorite. 10 ft of overburden. Slip from 400 ft above road and continues to river 400 ft below. Fresh diorite surface parallel to slope.	35-40
(14) 4.2	Steep gully flanked by diorite. Potential slip area.	40-45
(15) 4.6	Standing cuts in moderately weathered diorite. Minor slips along road.	45
(16) 5.2	Porphyry. Light coloured and siliceous; covered by 3-4 ft of clayey overburden which is unstable.	35-40
(17) 5.4	Porphyry. Cuts for road in fresh rock. At corner near river junction contact with shale and siltstone dips north-east at 20°.	45-40
(18) 6.3	From 17 road beside river in siltstone, sandstone and shale. Cuts are in fresh rock. At 18 50-ft-high slip in weathered shale and overburden.	30-40
(19) 6.7	At bridge, porphyry. From 18 at least 10 feet of overburden with many rock fragments but cuts are stable.	
(20) 6.9	Contact of porphyry with shale dips north at 5°. Porphyry well jointed. Road cut in bedrock on slope.	40
(21) 7.4	From 20 weathered black shale and sandstone. Cuts in fresh rock are stable but slips up to 100 ft high near 21 in weathered rock and overburden.	40
(22) 7.9	Porphyry outcrop with 2-3 ft overburden. Last shale seen at 7.6.	35-40
(23) 8.1	Weathered porphyry with a surface slip above road in gully. Contact with shale.	

Station & Mileage	Description	Side-slope (Degrees)
(24) 8.3	PEG 886. Shale.	
(25) 8.5	Weathered basic igneous rock with 3-6 ft. of overburden. Probably dyke.	20
(26) 8.8	Weathered shale	
(27) 9.0	Two slipped areas in weathered red-brown igneous rock. May be spilite. Overburden 6 ft.	45
(28) 10.0	From 27, beside river, in weathered volcanic rock. Depth of weathering up to 20 ft. Minor slipping.	30
(29) 10.6	Watabung. Station on valley-fill beside river.	0-10
(30) 10.9	Cutting in well-cemented deep scree. Stable	10-20
(31) 11.0	At bend shaly mudstone dips to north at 20°. Rock red-brown and weathered; some slumping.	25
(32) 11.7	PEG 975. Deeply weathered red-brown shale and mudstone. Some slipping in at least 10 feet of overburden. No major slips.	20-30
(33) 11.9	Exposure of siliceous limestone - weathers brown and dips north at 10°. In road cutting.	30-40
(34) 12.1	Coarse massive gabbro. Jointed and slightly to moderately weathered. Slopes mostly stable.	40
(35) 12.5	End of gabbro. Replaced by limestone then shale. Over gabbro 6-10 feet of overburden with accumulation in gullies.	35-40
(36) 12.8	Weathered and weak shale from 35 to corner. 6 ft. cuts stable. Rocks dip steeply north.	30-40
(37) 13.0	Weathered gabbro. Slips in overburden but no high slopes above road.	25-35

Station & Mileage	Description	Side-slope (Degrees)
(38) 13.9	End of gabbro at 13.7. Weathered volcanic rocks - ash, tuff, lava. Deeply weathered in gullies and slipping on all cuts above 15 feet.	25-35
(39) 14.6	30 ft high slip showing weathered volcanic bedrock at 4-5 ft. Deep gully.	45-50
(40) 14.7	150 ft high slip, deep, may be into bedrock of completely weathered volcanics. Overburden of up to 15 feet on side of steep gully.	35
(41) 15.0	70 ft high slip through 10 feet overburden and into bedrock. Into steep gully.	40
(42) 15.3	Fill on side of road unstable. Tension cracks in pavement. 20 ft high slip above road. Possibility of losing pavement in next rain. At 15.4 cut in weathered rock on side of steep gully. Likely slip area.	45
(43) 16.0	From 15.5 to 43 road on top or close to top of ridge with low side slopes. At 43 three 25 ft high slips into one steep gully.	5-20
(44) 16.3	Two slips into very deep gully. Difficult to stabilise this section or re-align road.	40-45
(45) 16.5	Three 20 ft slips into steep gully	40
(46) 17.1	Top of Daulo Pass. Several small slips on road between 45 and 46. Side slopes lower near top of ridge.	20-30
(47) 17.2	50 ft high slip on side of gully in weathered volcanics; erosion removing pavement built on fill. 3-4 ft of overburden.	35-40
(48) 17.9	Between 47 and 48 side slopes low as road is near top of spur but just before 48 road outs into high slope of 400-500 ft of weathered volcanics. 150 ft high slip in this slope in 5-15 feet of overburden. Slip surface on contact with moderately weathered rock. Slope below road is 25-30° but erosion is removing road based on slipped material. Additional major slipping above road likely.	40

Station & Mileage	Description	Side-slope (Degrees)
(49) 18.2	Small creek with 15 ft high cuttings in fresh volcanic rock. Outside of road on fill which is being eroded.	25
(50) 18.3	Bridge. Faulted contact between volcanics and black and brown shale. Rock sheared and slickensided. Moderately weathered shale stands in batters of 10 ft.	35
(51) 18.6	Well-cleaved purple shale dipping to the east at 35° parallel to the slope of the hill. Minor slipping in the 2-4 ft of overburden. Slips along bedding occur in very small cuttings. Bedrock moderately weathered with some sandstone bands.	40
(52) 18.9	PEG 1125. From 18.8 to 18.9 deeply weathered igneous dyke which is stable in small cuts but slipping occurs in 4-6 ft of overburden on steep slopes. Purple shale at 18.9.	35-40
(53) 19.1	Weathered porphyry cuts purple shale. Overburden 6-8 ft. Shale dips parallel to hill slope. Slips 30-50 ft high with signs of more instability above. Road based on fill and is steadily being eroded.	30
(54) 19.2	Large area of slip, of overburden over bedrock, on moderate slopes. Slip extends 900 ft above road and is 300 ft wide.	25-30
(55) 19.3	Road cut in moderately to highly weathered shale with little overburden. Rock falls along bedding and joint planes.	40
(56) 19.5	From 55 cuttings in weathered shale with 3-5 ft of overburden. Minor slipping in overburden and rock falls along bedding and jointing.	30
(57) 19.8	Ridge with porphyry dyke which is well jointed and deeply weathered. Flanked by weathered shale and siltstone.	
(58) 20.1	Box cut in deeply weathered spur composed mainly of slipped material. Cut is over 20 feet deep and no sign of fresh rock.	25

Station & Mileage	Description	Side-slope (Degrees)
(59) 20.3	Large slip in old slipped area from 150 ft above road. Slips are found in valleys between spurs formed by weathered porphyry dykes. Rock type is weathered shale and mudstone with 20-30 feet of overburden in slip area.	20
(60) 20.7	From 59 road crosses side-slopes in weathered shale dipping at 25° to the south-east, parallel to the hillside. There are minor slips which could develop into major landslides in 5-8 ft of overburden.	25-30
(61) 20.8	At bridge 10-15 ft of overburden underlain by completely weathered mudstone. 30 ft high slip above road which is based on fill. Several slips into creek above bridge.	25-30
(62) 21.1	Spur of deeply weathered porphyry. Just past 62 many small slips on steep slope with 3-4 feet of overburden on weathered bedrock.	35-40
(63) 21.3	End of porphyry. Bedrock is weathered shale.	
(64) 21.7	From 63 cuttings in weathered shale with occasional porphyry and dolerite dykes. Strongly jointed. Only small cuts as near top of spur.	5-15
(65) 22.1	At bridge. Weathered shale and mudstone at 20° to the north-east covered by 15-20 feet of stony overburden which is stable in most places.	20
(66) 22.2	40 ft high slip in overburden with road constructed on fill from slip. Cuts in this area are 25 feet high with little slipping.	
(67) 22.4	Shale and mudstone with 2-5 ft of clayey overburden. Minor slipping but most cuts are less than 10 ft.	35-40
(68) 23.1	Road from 67 on moderate side-slopes with small cuts in stony overburden over weathered shale and mudstone. One or two thin igneous dykes.	10-20

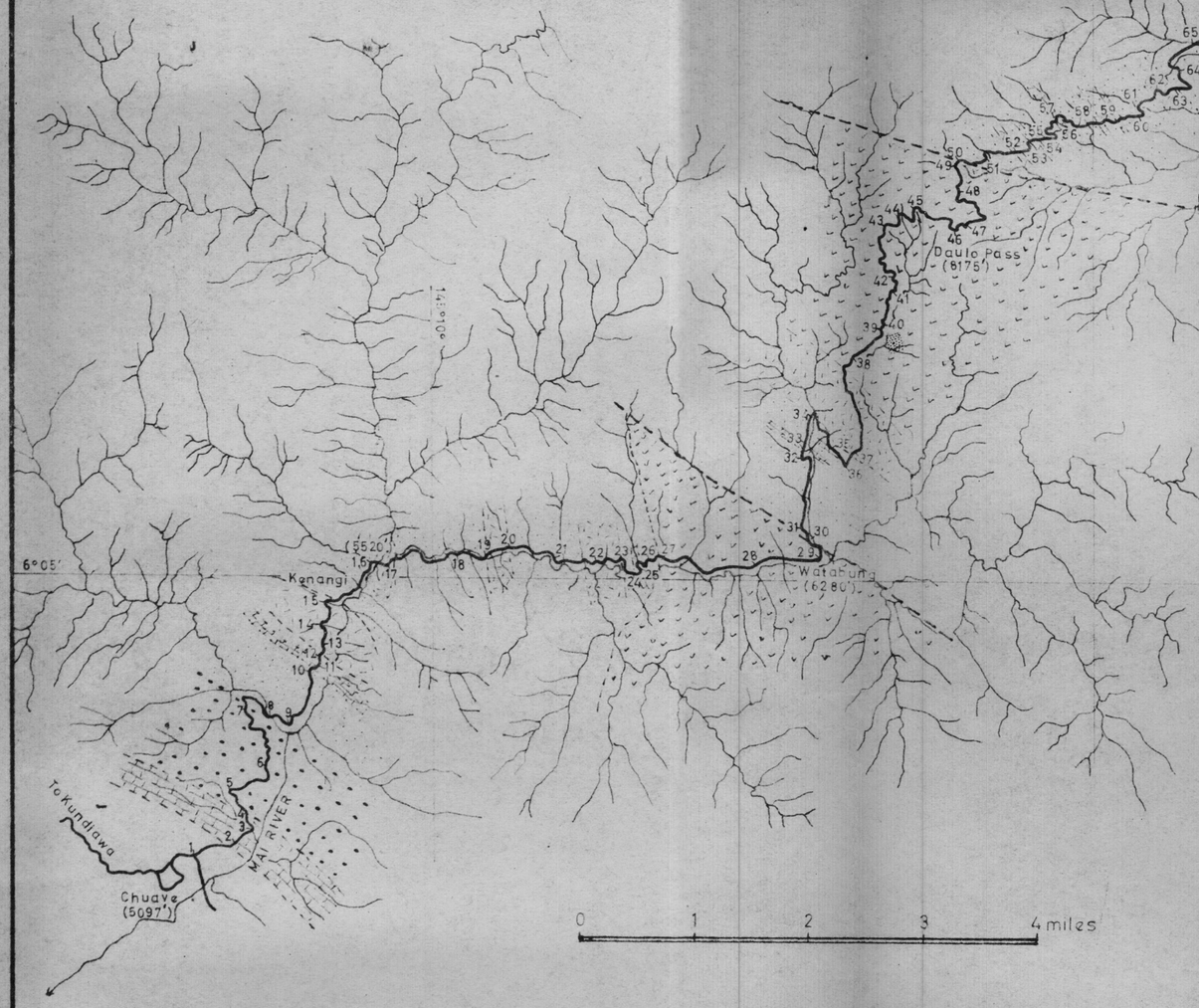
Station & Mileage	Description	Side-slope (Degrees)
(69) 23.8	From 68 road on red-brown clayey soil overlying shale and mudstone. Slopes negligible. At 69 small creek with 10 ft high cuts at approaches.	0-10
(70) 24.0	From 69 shallow cuts in weathered shale. At 70 fault zone has produced talc-rich sheared rock from shale. No instability problem.	5-10
(71) 24.2	Start of straight section of road. Built on red clay overlying horizontal lake sediments.	
(72) 25.5	End of straight section of road. On lake sediments.	
(73) 25.7	Descent through upper layers of lake sediments. Red clay overlying blue clays.	20
(74) 26.2	Descent through clay and gravel in lake sediments; slopes are relatively stable. After bridge, bedrock is shale.	10-20
(75) 26.4	Ascent of ridge. Weathered and fresh indurated shale with 10-20 ft high cuts and little slipping. Overburden 3-4 ft.	10-25
(76) 27.0	Descent of ridge through weathered shale with two to three feet of overburden.	5-20
(77) 27.5	Asaro cross roads - on horizontal lake sediments.	
(78) 27.8	Next bridge on tributary of Asaro - horizontal lake sediments.	
(79) 30.2	River. Horizontally bedded lake sediments - mostly gravel with some clay.	
(80) 32.6	Bridge before Kabiufa College. Lake sediments with up to 10 feet of red soil. Some slumping on banks of creek.	0-10
(81) 35.1	Bridge over stream. 10 ft of red soil and clay which forms stable fill. Below are gravels.	0-10
(82) 36.2	Bridge at big river. 10 ft of red soil on top of gravel and clay.	0-15

Station & Mileage	Description	Side-slope (Degrees)
(83) 37.5	Small creek. Thin covering of red soil over lake sediments.	
(84) 38.2	Creek before town. Horizontal lake sediments.	0-10
(85) 39.3	District Office, Goroka.	

PLATE 1

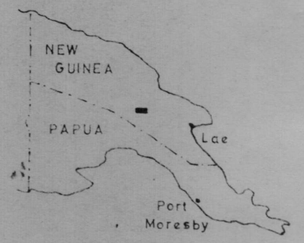
GEOLOGICAL INVESTIGATION

GOROKA-DAULO PASS-CHUAVE ROAD



REFERENCE

- Gravel, silt and clay - Goroka Beds
- Shale, mudstone, siltstone and sandstone
- Lava, agglomerate and tuff - Daulo volcanics
  Hornblende-feldspar porphyry
- Pebble conglomerate
- Limestone
- Diorite, gabbro, porphyry - Intrusives
- Geological boundary
- Inferred fault
- -20 Traverse station
- Road



Locality Map

Geological Office Port Moresby J.P. MacGregor 12:10:66

To accompany record 1967/25

PNGB55-9-7