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1960/57

GEOLOGICAL REPORT ON SIRINUMU DAM SITE NO. 2. UPPER LALOKI RIVER. CENTRAL DISTRICT, PAPUA.

by

H.L. Davies

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SUMMARY

The proposed Sirinumu Dam is a part of extensions to the Laloki Hydro-electric Scheme planned by the Commonwealth Department of Works. Dam site No. 2 is the second site investigated.

Rocks exposed in the area are volcanic agglomerate, with minor tuff beds and rare lava flows, belonging to a formation termed the Astrolabe Agglomerate. The formation is generally flat-lying, with dips of up to 8°, and covers an area measuring about 20 miles by 6. It is thought that the Agglomerate originated from the repeated explosive ejection of angular fragments of near-solid basalt and andesite from one or several vents.

The site is suitable for a rock-fill dam and has a quarry site nearby, above the left abutment. A saddle in the spur which forms the right abutment might be utilised as a spillway.

The Agglomerate is generally deeply weathered; this is due to the tropical climate and the chemical instability of the volcanic rocks. At Sirinumu local variation in the degree of weathering is very marked; e.g. rock is exposed at one end of the spillway saddle but is concealed by 80 feet of residual clay at the other. Localised deep weathering is attributed to movement of water in tension joints and permeable beds.

The investigation required 1,297 feet of diamond drilling, 60 auger holes, and two costeans.

** For abbreviations used see page 15.

INTRODUCTION.

Locality

Sirinumu dam site No. 2 is at the head of Sirinumu Gorge on the upper Laloki River, about twenty two miles east of Port Moresby. The site is only five miles south-east of Rouna Falls but is twenty miles distant by existing road; a more direct route has been surveyed. Access is by the Karakatana Road to a point 1½ miles beyond Eilogo Plantation, thence by bush track for a further 2½ miles. After rain sections of the bush track can only be traversed by four-wheel-drive vehicles.

Purpose of the investigation

The proposed Sirinumu Dam is a part of extensions to the Laloki Hydro-electric Scheme planned by the Commonwealth Department of Works. The dam will control the flow of the Laloki River and thereby ensure an adequate supply of water to the No. 2 Power Station (P.S.2 on Plate 1.) which is to be built at the foot of Rouna Falls.

Previous Work

Engineers from the Department of Works selected eight likely dam sites in the Sirinumu Gorge. These were numbered 1,2,3,4,5,5a,6, and 7, in order from the upstream to the downstream end of the gorge. In December, 1958, the dam sites were inspected by Messrs. L. C. Noakes and D. E. Gardner of the Bureau of Mineral Resources, Canberra. They selected sites Nos. 6 and 7 as the most likely, on the grounds of profile and degree of solid outcrop (Gardner and Noakes, 1959). Investigation of site No. 6 was begun in March, 1959, and completed on the 25th June (Davies, 1959).

Meanwhile attention had shifted to No. 2 site for the following reasons:

(i) A low saddle adjacent to the dam site appeared suitable for a spillway.

(ii) An accurate survey established a drop in base level of 25 feet between No. 2 and No. 6 sites - about double that suggested by the Adastra contour plan.

(iii) Little storage would be lost by using the upper site because between the two sites the river flows through a steep-sided gorge and has no major tributaries.

No. 2 site therefore offered almost the same storage with a dam 25 feet lower, though 100 feet wider than that required at No. 6 site.

The investigation of dam site No. 2 was begun in June, 1959, with the mapping of outcrop by the writer. Drilling commenced on the 21st July and was completed on the 10th November with a total footage of 1,297 feet. Ten holes, totalling 869 feet, were drilled on the spillway saddle, two holes (197 feet) were drilled on the dam site, and two holes (231 feet) were drilled on the quarry site. Little drilling was necessary on the dam site itself because a rockfill dam was planned. Drill core was photographed in black and white. The depth of overburden on dam site and spillway was investigated by auger holes and costeans.

The investigation was conducted in the field by the writer, who maintained close liaison with Messrs. J. D. Edwards, R. H. Gruber and J. R. Brett of C.D.W., Port Moresby, and Messrs. J. E. Thompson (Senior Resident Geologist, Port Moresby) and L. C. Noakes (Supervising Geologist, Engineering, Canberra) of the Bureau of Mineral Resources. The diamond drill was operated by Mr. J. Allis and a team of unskilled native labour.

Seepages on the Eilogo Creek side of the Laloki - Eilogo divide are currently under investigation and will be the subject of a later report.

REGIONAL GEOLOGY

The Astrolabe Agglomerate is a monotonous sequence of mainly fragmental volcanic rocks which covers an area 16 to 20 miles long on a north-westerly axis and 4 to 6 miles wide. It is 1000 to 1500 feet thick at Rouna and probably of the same order of thickness at Sirinumu. It is generally flat-lying and forms an undulating tableland known as the Sogeri Plateau. The upper Laloki River drains most of the plateau and flows generally north, north-west, and west.

At its western and southern margins the Agglomerate rests on folded and faulted Tertiary or Cretaceous sediments of the Eriama Series; at the eastern and northern margins the Agglomerate may be underlain by metamorphosed sediments of the Kemp Welch Formation (Mesozoic) or the Owen Stanley Metamorphics (Palaeozoic). None of these older rocks outcrop in the area considered in this report.

Description of the Agglomerate.

The Agglomerate is composed of angular and sub-angular boulders of basalt and andesite in a matrix of tuff, with minor beds of tuff. The strata have been compacted and cemented to form a competent rock. Rare boulders have a long axis of three to five feet but the normal size is from three to twelve inches. The tuff

ranges in grain-size from tuffaceous mudstone to coarse tuff which may grade into fine agglomerate.

Only two exposures of non-fragmental rock have been noted. One is an augite basalt lava flow exposed on the Jawarere Road, near the north-eastern margin of the Agglomerate (J. F. Ivanac, pers. comm.). The other is jointed and weathered porphyritic augite basalt outcropping through a vertical distance of 100 feet in a creek immediately east of Eilogo Plantation. Small lava flows are suggested by concentrations of dense basalt boulders at three other localities (see Locality Map, Plate 1.).

The agglomerate is generally quite well bedded in beds up to four and even six feet thick, but the bedding surfaces are rarely planar. Sorting of the boulders is very poor though some beds contain boulders approximating to the one size, particularly where the boulders are less than 3 inches in diameter. Graded bedding is common in the tuff beds and may be present in the tuff matrix of the agglomerate. Current bedding is in places developed around the larger boulders (2 to 3 feet in diameter) which occur sporadically in the tuff beds.

The boulders are augite basalt and, less commonly, horblende andesite (these are field names pending laboratory identification). As yet no pattern has been found in the distribution of the two types; both are commonly porphyritic with, in some cases, an alignment of phenocrysts. Fine-grained rocks may show a streaky banding caused by alteration of bands of finely vesicular and non-vesicular rock, and by variations in colour.

Vesicularity may be absent, minor or dominant but true scoria is rare; the more vesicular boulders weather rapidly.

A basal or near-basal conglomerate, several hundred feet in thickness, is exposed at the foot of Rouna Falls. This contains some rounded schist boulders, the only components of non-volcanic origin in the formation.

Calcite is seen in the outcrop of the conglomerate; elsewhere it is seen as a secondary vesicle filling in the drill cores of agglomerate. Zeolites also occur as vesicle fillings in the agglomerate.

Casts of twigs, branches and logs are found within the agglomerate.

Structure of the Agglomerate

The Agglomerate is generally flat-lying with local dips of up to 8°. A consistent north-easterly dip of about 8° on the south-western margin might be attributed to differential compaction or to tectonic

causes. Examples of stream capture suggest recent regional tilting with the south-western margin rising.

Tension joints striking between 20 and 50 degrees* are a feature of those areas which have been mapped in detail. These exercise some influence on the topography (see under). Shear joints striking between 50 and 60 degrees have been observed in places.

Weathering of the Agglomerate.

Weathering is very deep over most of the basin. Eighty feet of clay was penetrated at one point (DDH 2 S 10) and another drill hole revealed a depth of at least seventy feet of clay. The profile as revealed in pits and auger holes on the Eilogo Creek - Upper Laloki River Divide, is as follows :

0 to 6" or 1'	Dark humic soil with grass roots.
1' to 5'	Red homogeneous clay
5' to 8'	Clay, some of which shows rock fabric.
8' to 60' and probably deeper	Clay plainly showing the agglomerate fabric, and retaining some of the colours of the original rock.

Deep profiles of clay commonly show abrupt interfaces with tors of fresh solid rock. There is no obvious pattern in the distribution of these tors except that they are more common in the areas of higher relief. Depth of weathering is unpredictable (see sections of spillway saddle, Plate 3).

Costeaning and augering have shown beyond doubt the residual nature of the clay; thus the development of tors must be attributed solely to weathering. Presumably tension joints were locii of weathering and the erratic development of tors may be due to an erratic or discontinuous development of tension joints.

Patches of laterite occur over an area of low relief south-east of Sirinumu. The typical laterite consists of thin layers of hard limonite alternating with more porous limonite which may contain blebs of gibbsite.

Origin of the Agglomerate

It is thought that the agglomerate originated from the explosive ejection of solidified or near-solidified material from a vent (or vents) which was

* All bearings given in this report are referred to magnetic north.

fed by an extremely viscous magma. Such an original would explain the angularity of the bombs, streaky banding within the bombs, and the apparently lithic nature of the tuff (Williams, 1926).

DAM SITE GEOLOGY

Topography

The dam site is situated at the head of the Sirinumu Gorge, at a locality known to the natives as Kaindobu. Here the Laloki River is about 90 feet wide and flows to the north-west. The left abutment is part of a massive spur which rises sharply to more than 200 feet above river level. The proposed quarry site is situated on the upper part of this spur. The right abutment is a narrower, lower spur with a low saddle, 700 feet north-east of the dam site, which has been proposed as a spillway site.

Outcrop and depth of cover.

The upper part of the left abutment has steep rock faces which are split by vertical fractures in which soil and scree, up to fifteen feet deep, has accumulated. On the lower part of the left abutment there is generally a thin cover of soil and scree, and a few rock promontories near the river's edge. Immediately upstream, a tumbled boulder has caused a minor diversion of the river and river silt has accumulated downstream from it.

The right abutment contains three promontories of solid rock with near-vertical faces. These are separated by gullies, about 30 feet wide, filled with soil and scree up to 23 feet deep.

Continuous outcrop extends across the river-bed in places but is limited to only 25% of the river bed along the axis of the proposed dam.

On the north-eastern end of the spillway saddle there is no outcrop and drilling has revealed a depth of more than 80 feet of clay. The south-western end of the saddle shows some outcrop and boulders which have weathered out in situ. A steep rock face is continuous from this part of the saddle to the dam site. The saddle is flanked by two creeks in which weathered agglomerate is exposed.

Lithology

Typical basaltic volcanic agglomerate and tuff are exposed in the dam site. Drilling revealed clay-filling in fractures, vesicles and cavities in the matrix as deep as eighty feet below surface. Probably most of the clay originates from weathering

in situ. The soapy pale green banded clay intersected in DDH 2 S 5 may have developed from the alteration of a fine ash bed; although similar in appearance to bentonite the clay did not absorb water.

Lateral variation in grain-size within any one bed makes local correlation difficult. However one major tuff horizon, varying in thickness up to five feet, is exposed on the dam site and was probably intersected by drill holes on the saddle. On the right abutment it exhibits remarkable local variations in dip, probably caused by differential compaction.

In places the tuff is poorly cemented and shows a greater degree of weathering than does the adjacent rock, though elsewhere it is almost as competent as the agglomerate. In general it is more amenable to erosion than is the agglomerate and permits the formation of caves in the cliff faces.

Structure

A dip of 7 degrees in the direction 180-200 degrees can be measured in the cliffs of the left abutment. This agrees with the overall dip calculated from the levels of exposures of the principal tuff horizon on the dam site. However the 7 degree dip does not persist in the saddle area (Plate 3, Section DBC).

The most prominent structural feature is the system of near vertical fractures, probably tension joints, which strike at approximately 50 degrees. Laterally they do not persist very far, as is illustrated in Plate 2, since fractures a - a', a - a'', and b cannot be traced through outcrop in the riverbed. DDH 2 S 5 showed that there is no subsurface continuation of suspected fracture c. Most but not all tension joints become tight at shallow depth; for instance DDH 2 S 4 intersected a clay-filled fracture zone (d on Plate 2) at more than eighty feet below surface.

ENGINEERING GEOLOGY

The dam site, quarry, and spillway saddle were investigated by outcrop mapping, augering, costeaning, diamond drilling and water pressure testing of drill holes. The drill used was a Mindrill E-1000 with Triefus NMLC bits and stationary split inner tube core barrel. Core recovery was almost 100%. The pumps were Mindrill 750-1200s and the packers used in water pressure testing were single and double balloon types. Where possible water pressure testing was carried out at twenty foot intervals as the hole was deepened, using the single packer. Sections of particular interest were tested with the double packer which limits the test to 4'6" of drill hole. In each test a number of different water pressures was applied.

DAM SITE

If a section is drawn across the dam site through the major rock promontory on the right abutment the profile revealealed is quite narrow. However these promontories will be smoothed out before construction of a rock-fill dam commences to avoid differential compaction. It was therefore important to determine the bedrock profile in the gullies which separate the promontories. Depth of overburden, ranging from 2 to 23 feet, was determined from one costean and 28 auger holes (Plate 5).

Auger holes on the slope between the promontories and the river revealed that the bedrock surface is horizontally benched, as might be expected with horizontal strata, and that these benches are cut by shallow gullies which align roughly with the surface gullies.

Augering on the left abutment revealed shallow cover in most places. The deepest hole was in the gully of fracture "a" and went to 13 feet. Another hole at the upstream extremity of the site revealed 10 feet of black mud, probably river-borne sediment which has accumulated downstream from a large boulder.

The auger holes indicate only the minimum depth of overburden; it is very likely that some of the holes bottomed on scree boulders. Also the auger will not penetrate the zone of partly weathered rock which overlies fresh solid rock; drill holes indicate that this zone is generally about 5 feet thick.

Diamond Drilling

It is apparent from surface outcrop that the site is suitable for the construction of a rock-fill dam.

DDH 2 S 5 (114') was designed to seek the subsurface extension of fracture "c" and to investigate the strata below the riverbed. As noted above there was no evidence of fracture "c", and the rocks were normal agglomerate and tuff, except for two small sections of soapy clay. These two sections did not leak when water pressure tested. The overall leakage for the hole of 5.45 g.p.m. at 20 p.s.i. is unexplained.

The writer proposed that the second drill hole should be a low angle hole under the riverbed from the same site as 2 S 5. However the imminence of floods prevented the drilling of another hole from the outcrop in the riverbed.

DDH 2 S 6 (83') was designed to locate a possible fracture zone parallel to the river under the area of 'no-outcrop' on the right abutment, and to measure the depth of overburden. Again there was no subsurface confirmation of the suspected fracture. The only major leakage is attributed to near-surface weathering.

It appears that, as at dam site No. 6., none of the beds are significantly permeable, and fractures visible on the surface will not take much grout in depth.

SPILLWAY SADDLE

The spillway saddle is a remarkable example of tor development. South-west of peg 45 A the saddle is almost entirely solid with rock benches at RL 1745 and RL 1765, forming the top of the ridge, and with fresh rock at or near the surface on both flanks. North-east of peg 45A the weathered rock-fresh rock interface falls to below RL 1680, i.e. more than 100 feet below the surface, and there is no outcrop on either flank.

The saddle strikes at approximately 70 degrees but the underlying rock ridge strikes at between 50 and 60 degrees. In consequence rock crops out on the upstream flank at the south-western end of the saddle, and underlies the downstream flank at the north-eastern end.

In the vicinity of DDH 2 S 10 the spur consists mostly of clay, except for an off-centre ridge of weathered rock which rises to RL 1740 approximately.

Diamond Drilling and augering

Programme 869 feet of diamond drilling were carried out to test the spillway saddle. The holes are :-

2 S 1 (97'9"), a vertical hole near peg 45A, was designed to measure the depth of overburden and give information on lithology down to the base level of the dam, RL 1675.

2 S 2 (73'10") and 2 S 3 (76'1"), vertical holes on either side of 2 S 1, were designed to measure the depth of overburden and to test the tuff horizon at RL 1710 which had leaked badly in 2 S 1.

2 S 4 (171'2"), an inclined hole on the downstream flank of saddle, was designed to intersect suspected fractures striking probably at 50 degrees, and in particular the fracture which may have caused the leakage at RL 1710 in 2 S 1.

2 S 9 (30') and 2 S 10 (106'8"), vertical holes at the south-western and north-eastern ends of the saddle, were designed to measure the depth of overburden in the vicinity of the proposed spillway abutments.

2 S 11 (31'6") and 2 S 12 (25'4"), vertical holes on the downstream flank, were designed to measure the depth of overburden in the area of the spillway apron.

2 S 13 (141') and 2 S 14 (116'), inclined holes from the downstream and upstream flanks respectively, were designed to locate any off-centre tors in the vicinity of 2 S 10.

About twenty auger holes were sited in the area of the proposed spillway apron and at various points north-east of 2 S 10.

Results

Overburden Depth

The results of the measurement of overburden have been discussed under "Dam Site Geology". On the proposed spillway apron, auger holes indicated a rock bench at RL 1720 between the dry creek bed and the change in slope. Between 2 S 10 and an outcrop 450 feet to the north-east augering showed that there is no rock within at least 24 feet of the surface. Where sampled, the overburden consisted of a thin layer of dark humic soil, 5 to 10 feet of homogeneous red clay, and up to eighty feet of clay showing distinct rock fabric.

Water Pressure Testing

Water pressure testing revealed a number of major leakages which are attributed to the following causes :

(i) weathering and fissure development associated with near-vertical tension joints, e.g. at 150 feet in 2 S 4, and

(ii) weathering and loss of cementation of certain more susceptible beds where they lie at little depth below the weathered rock-fresh rock interface, e.g. at 14 feet in 2 S 12, at 16, 25 and 30 feet in 2 S 11, at 26 and 27 feet in 2 S 4, at 34 feet in 2 S 1, and at 45 feet in 2 S 2.

The leakage at RL 1710 (i.e., at 53 feet) in 2 S 1 falls into neither of these categories and it was at first thought that the tuff intersected here might be very permeable. However a similar bed was intersected in both 2 S 2 and 2 S 3 and proved impermeable in both cases. Perhaps the leakage was due to an adjacent tension joint but no such joint was intersected by 2 S 4.

There was little or no loss of drilling water in 2 S 10, either in the 80 feet of clay or in the underlying weathered rock. Testing showed the weathered rock to be relatively impermeable.

Conclusions.

It is proposed that the spillway should be 400 feet from one abutment to the other and should rise to RL 1752 approximately, at maximum height of the rock-fill dam.

Because of the unexpected depth of overburden north-east of peg 45A the spillway saddle is not as attractive as it first seemed. However the problem could be overcome by

siting the right abutment in the vicinity of peg 45A and excavating the rising ground to the south-west as far as peg 45C. Outcrop indicates that this would be mostly solid rock, at least up to RL 1765.

The spillway apron presents no problem. Rock surface has been quite well defined here by drilling and augering and there is nowhere any great depth of overburden. The bed of the creek, along which the overflow will escape, consists of weathered but solid rock and should not scour.

QUARRY

Approximately 100,000 cubic yards of rock-fill are required for construction of the dam. From examination of outcrop it is apparent that the quarry area contains at least double this amount. Two holes, 2 S 7 (130') and 2 S 8 (100'), were drilled chiefly to obtain samples of the rock for laboratory testing for rock-fill, aggregate and sand by Commonwealth Department of Works, Melbourne; results are not yet known.

Nearly all the component boulders of the agglomerate were quite fresh but the tuff matrix showed slight weathering. In both holes there was little or no variation in weathering throughout the length of the hole except at the tuff horizon, 6 to 7 feet thick, between RLs 1809 and 1819. This tuff is an unusual light brown colour and the few included boulders are entirely weathered or show weathered rims. Weathering here is probably assisted by the finely porous nature of the tuff which retains water (the water table is 30 to 40 feet below the tuff) and allows the water intimate contact with individual grains.

There is a belt of "no outcrop" between pegs S7, S12, and S1. This is co-linear with dam site fracture "c" and it is suspected that it is a zone of deeper weathering associated with the same tension joint.

SUMMARY OF RESULTS OF WATER PRESSURE TESTING

Only in cases of major leakage have corrections been applied to the water pressure testing results. These corrections are as follows :

(i) additional head due to column of water in pipes above packer or above standing water level, and

(ii) loss of head due to friction and turbulence in pipes at high rates of flow.

Correct results are denoted by (c), uncorrected results by (u).

DDH 2S1 Vertical

Testing was not begun until the hole had been drilled to 59'3". The overall leakage of section 24' - 59'3" is known but, owing to anomalous results, the leakage rates of some parts of this section are not. For instance

the leakage rate of section 41' - 59'3" is lower than that of section 52' - 59'3", so that it is not possible to subtract one result from the other to obtain the rate for section 41' - 52'.

Leakage was expected at 34' and 53' as drilling water circulation had been temporarily lost at these points. The section 52' - 59'3" leaked at the expected high rate. Testing of the section 31' - 36' was unavoidably delayed until the hole had been deepened to 97'9" and leakage may have been modified by the plugging effect of drill cuttings. This is suggested by the following results :

Initial test at 20 p.s.i. (uncorrected) :- leakage 0.8 g.p.m.

Final test at 20 p.s.i. (uncorrected) : - leakage 2.5 g.p.m.

The interpretation is that the plug of drill cuttings was washed out as the test progressed, permitting a higher leakage.

Leakage in section 31' - 36' is probably due to the 6" band of poorly cemented fine agglomerate at 34'. Similarly the leakage in section 52' - 59'3" is probably due to poorly cemented coarse tuff and fine agglomerate at 52'8" - 53'11". These two zones could account for most of the leakage in the overall section 24' - 59'3".

24' - 59'3"	16.0	g.p.m.	at	25	p.s.i.	(c)
31' - 36'	0.9	"	"	25	"	(c)
	2.97	"	"	40	"	(c)
41' - 59'3"	4.0	"	"	25	"	(c)
	10.6	"	"	40	"	(c)
52' - 59'3"	13.88	"	"	40	"	(c)
	14.6	"	"	50	"	(c)
58'9" - 68'6"	0.18	"	"	60	"	(u)
69' - 97'9"	0.61	"	"	60	"	(u)

DDH 2 S 2 Vertical

The one significant leakage is probably due to badly broken fine agglomerate at 45'2" - 45'4" and/or weathered friable tuff at 48'9" - 49'2"

36' - 54'4"	4.8	g.p.m.	at	55	p.s.i.	(c)
54' - 73'10"	0.43	"	"	60	"	(u)

DDH 2 S 3 Vertical

27' - 46'4"	0.3	g.p.m.	at	30	p.s.i.	(u)
46' - 61'	0.07	"	"	50	"	(u)
61' - 76'1"	0.01	"	"	50	"	(u)

DDH 2 S 4 — Inclined 30 degrees

Leakage in the section 26' - 46'10" might be due to broken weathered fine agglomerate at 26' and 27', or to poorly cemented broken medium agglomerate at 43' - 43'4". Leakage at 112' - 131'11" might be due to poorly cemented fine-medium agglomerate at 125'10" - 126'6". Leakage at 132' - 151'11" is almost certainly due to the clay-filled fracture at 148'3" - 150'4" and associated fractures.

26' - 46'10"	2.55 g.p.m.	at	40 p.s.i.	(c)
46'10" - 66'10"	0.76 "	"	40 "	(u)
66'10" - 86'10"	0.4 "	"	40 "	(u)
86'10" - 112'	0.81 "	"	40 "	(u)
112' - 131'11"	3.53 "	"	70 "	(c)
132' - 151'11"	17.7 "	"	45 "	(c)

DDH 2 S 5. — Inclined 30 degrees.

This hole was tested after drilling was completed. The overall leakage was measured and suspected leakage zones tested with the double packer.

34' - 114'2"	5.45 g.p.m.	at	20 p.s.i.	(c)
73'2" - 77'8"	nil	"	40 "	(u)
102'6" - 107'6"	0.02 "	"	50 "	(u)

DDH 2 S 6 — Inclined 15 degrees

The one significant leakage might be due to weathered and poorly cemented broken agglomerate at 29'6" - 30'1".

27'9" - 47'11"	5.78 g.p.m.	at	50 p.s.i.	(c)
47'11" - 67'8"	0.02 "	"	40 "	(u)
67'8" - 82'8"	0.41 "	"	40 "	(u)

DDHs 2 S 7 and 2 S 8 — Both vertical

Not tested as the purpose of these holes was merely to test a quarry site.

DDH 2 S 9 — Vertical

18' - 30'	0.22 g.p.m.	at	20 p.s.i.	(u)

DDH 2 S 10. Vertical

87'8"	- 106'8"	0.42 g.p.m.	at	40 p.s.i.	(u)

DDH 2 S 11. Vertical

The deduced major leakage in section 15' - 29'6" is probably due to broken agglomerate at 16'7" - 16'8" and at 24'11". The leakage between 29'6" and 31'6" is through broken agglomerate at 30'8" - 30'10".

15'	- 31'6"	16.0 g.p.m.	at	19.7 p.s.i.	(c)
29'6"	- 31'6"	8.87 "	"	20 "	(c)
		10.7 "	"	30 "	(c)

Deduced:

15'	- 29'6"	7. " approx.	"	20 "	(c)

DDH 2 S 12. Vertical

The major leakage between 13' and 18' is through a zone of badly weathered and broken agglomerate at 13'5" - 14'5".

13'	- 25'4"	14.1 g.p.m.	at	18.2 p.s.i.	(c)
18'	- 25'4"	0.18 "	"	30.1 "	(c)

Deduced:

13'	- 18'	14. " approx.	"	18.2. "	(c)

DDHs 2 S 13 and 2 S 14. Both inclined 15°

Not tested as (i) little solid rock was encountered, and (ii) there would have been considerable risk of losing the packer in low angle holes in such material.

REFERENCES.

DAVIES, H. L., 1959 - Geological report on Sirinumu dam site No. 6. Bur. Min. Resour. Aust. Rec. 1960/7 (unpub.).

GARDNER, D.E., and NOAKES, L. C., 1959 - Geological reconaissance of the Laloki River hydro-electric projects - Port Moresby. Ibid., 1959/21 (unpub.).

WILLIAMS, Howell., 1926 - Notes on the characters and classification of pyroclastic rocks. Proc. Lpool. geol. Soc., 45, 223-249

GEOLOGICAL LOGS OF DIAMOND DRILL HOLES.

All cores were logged by H.L. Davies. The following
** abbreviations are employed:-

Volc.	Volcanic
Agglom.	agglomerate
cpts.	components, the angular fragments which, with finer material, comprise the agglomerate.
ves.	vesicular
porph	porphyritic
bldr.	boulder
fracs.	fractures
gdd bdg.	graded bedding
bdd	bedded
fllg	filling
rgh.	rough, i.e. not smooth
irreg.	irregular, i.e. not planar
frags.	fragments (of core)
wtd.	weathered
deg.	degrees (of arc)
med.	medium - grained
sec ctg.	secondary coating
mod.	moderate

GEOLOGICAL LOGS OF DIAMOND DRILLING

DDH 2 S 1

Location : Spillway saddle, near peg 45A
Reduced level : 1765.1 feet
Angle : Vertical
Length : 97'9"
Standing water level : 49' at 1030 hrs, 11.8.59
Objective : (i) Depth of weathering
(ii) Lithology to base level (RL 1675')
Commenced : 23/7/59.
Completed : 5/8/59.

From	To	Core Description
00	4'5	No core; in situ clay and weathered rock.
4'5	18'1	Weathered fine-med volc agglom; matrix soft and friable and core broken and partly lost at 4'5-5'9, 9'3-12'9, 14'1-14'10 and 17'0-18'1.
18'1	32'3	Fine-med agglom with some 6" cpts; slightly wtd with some fracs around bldrs; rounded fragments from caving at top of each pull originate from 17' or 12'.
32'3	32'5	Fine tuff and tuffaceous mudstone.
32'5	34'0	Fine-med agglom, slightly wtd.
34'0	34'6	Fine agglom broken into ½" frags due weak matrix, not badly wtd or soft. Lost circulation.
34'6	47'6	Fine-med agglom with rare 6"-9" bldrs; slightly wtd (matrix brown, some basalt bldrs red); several irreg fracs.
47'6	48'2	Coarse tuff, one bed.
48'2	49'5	Coarse tuff with increasing proportion of ½"-2" cpts.
49'5	52'8	Med agglom one 12" cpt bldr; slightly wtd.
52'8	53'11	Coarse tuff and fine agglom broken ½"-2" frags; driller reports temporary complete loss of circulation; weathering little or no greater than higher and lower core, probably permeable.
53'11	60'5	Coarse agglom some 9" bldrs; slightly wtd; calcite in vesicles at 59'.
60'5	61'6	Tuff, fine and coarse, with irreg bdg, contains one 8" bldr; irreg frac 60'8 and 61'5; this tuff bed retains moisture.

DDH 2 S 1

From	To	Core Description
61'6	64'10	Fine-med agglom with proportion of matrix (tuff) increasing with depth to grade into coarse tuff.
64'10	65'2	Probable position of 4"/ lost core since bounded by coarse friable tuff.
65'2	65'6	Fine-med agglom broken into ½" frags; no water loss.
65'6	67'0	Fine-med agglom; irreg frac at 65'9.
67'0	68'6	Med agglom with high proportion matrix (tuff) approx 60-70%.
68'6	76'11	Med agglom with some 4"-6" cpts; slightly wtd, tuff matrix brown and some basalt bldrs red; 74'4-74'7 coarser tuff matrix weakly cemented but not broken.
76'11	77'9	Tuff with one fine agglom bed and several thin beds of fine mudstone; not broken; not friable but softer than normal agglom matrix, cut by knife. Retains moisture.
77'9	86'7	Med-coarse agglom, cpts up to 8"; slightly wtd; five fractures around bldrs, widely-spaced, sec ctg.
86'7	91'3	Fine agglom (½"-1" cpts) with rare 3" cpts; slightly wtd; one frac in weakly cemented material at 89'6.
91'3	92'9	Tuff, coarse and fine; well compacted.
92'9	94'9	Coarse agglom; bldr fractured at 93'6.
94'9	97'9	Fine-med agglom; one frac.

END OF HOLE

DDH 2 S 2

Location : Spillway saddle, near peg 45A2.
Reduced level : 1773.7 feet.
Angle : Vertical
Length : 73'10".
Standing water level:- 70' at 1030 hrs, 15.10.59.
Objective : (i) Depth of weathering
(ii) Test tuff at RL 1710' approx.
Commenced : 7/8/59.
Completed : 13/8/59.

From	To	Core Description
00	29'1	Soil, clay and very wtd rock,-- casing set.
29'1	30'7	Fine-med agglom, ½"-2" cpts; slightly wtd; one irreg frac.
30'7	33'7	Broken fine-med agglom; some cpts fresh, all matrix very wtd and friable.
33'7	39'9	Fine to coarse agglom; slightly wtd; several irreg fracs.
39'9	41'1	Med agglom; some cpts wtd to yellow, matrix wtd to lt. brown, cpts and matrix cheesy; matrix tuff partly replaced by soapy clay.
41'1	44'4	Med agglom, slightly wtd.
44'4	46'11	Fine agglom, slightly wtd, cavities from removal of matrix partly filled by clay; 45'2 - 45'4 badly broken.
46'11	48'9	Med agglom, slightly wtd.
48'9	49'2	Fine tuff, wtd and friable.
49'2	59'2	Med and coarse agglom, slightly wtd but fresher than above core.
59'2	60'0	Tuff, compact, hard.
60'0	67'4	Tuff and fine agglom grade into med and coarse agglom; 60% tuff matrix; wtd soft friable tuff at 60'7 - 60'9; all matrix wtd brown.
67'4	69'8	One bldr fine porphyritic basalt i.e. 28" dia.
69'8	72'8	Med agglom with high propn tuff (60% approx); some bldrs wtd red, matrix wtd brown.
72'8	73'4	Fine agglom, friable and badly broken 72'8 - 73'0.
73'4	73'10	Med agglom, slightly wtd.

END OF HOLE.

DDH 2 S 3

Location : Spillway saddle, near peg 45 A3
Reduced Level : 1770.3 feet
Angle : Vertical
Length : 76'1"
Standing water level : 41' at 1000 hrs 15.10.59.
Objective (i) Depth of weathering
(ii) Test tuff at RL 1710' approx.
Commenced : 18/8/59.
Completed : 22/8/59.

From	To	Core Description
00	18'6	Clay and wtd agglom, several fresh bldrs, -- no continuous corings.
18'6	25'5	Med-coarse agglom, wtd and friable but improving with depth, some cpts fresh, others wtd or with wtd rims (e.g. 22'), some 6" lengths.
25'5	26'8	Fine agglom, wtd but not broken.
26'8	27'9	Med-coarse agglom, tuff matrix and rims of bldrs wtd.
27'9	29'0	Tuff grades into fine agglom, some matrix removed, part replaced by clay; wtd.
29'0	31'3	Fine to coarse agglom with 1" tuff at 29'7, some clay slightly wtd, few fracs.
31'3	33'10	Med agglom; slightly wtd (tuff brown); broken at 32'3
33'10	34'0	Tuff.
34'0	45'4	Mostly fine agglom (½"-1" cpts), some med and rare 6"-9" bldr; slightly wtd, few fracs, small amt matrix removed.
45'4	45'5	Coarse tuff, slightly friable.
45'5	53'0	Fine-med agglom, rare fracs, some matrix removed and clay fllg at 52'.
53'0	54'11	One bldr slightly porph ol or augite basalt with several coated fracs.
54'11	59'6	Med agglom, slightly wtd; thin tuff bed at 57'0; some matrix removed (here a very fine tuff) and partly replaced by clay at 58'3 - 59'6.
59'6	61'10	One bldr, sim to that at 53'.
61'10	63'8	Tuff with minor ¼"-1" cpts; compact, not friable.
63'8	66'1	Above with proportion of fine agglom inc easing to about 50%; compact and not friable. 61'10 - 66'1 is prob same tuff horizon which leaked badly in Ddh 2S1 and which forms caves at the dam-site; RL 1710' approx.

DDH 2 S 3

From	To	Core Description
66'1	69'4	Med and coarse agglom, slightly wtd as is all core; sec ctg in the few fracs; 12" bldr at 67' appears to contain 2" xenoliths of similar rock (a fine-grained mod vesicular basalt) --- may merely be wtrg effect.
69'4	74'2	Fine-med agglom, ¼"-2" cpts; few fracs.
74'2	76'1	Med-coarse agglom; 4"-6" bldrs in tuff matrix which is bedded in places.

END OF HOLE

DDH 2 S 4

Location : Spillway saddle, down stream flank
Reduced Level : 1754.0 feet
Angle : 30 degrees
Direction : 106°30' T.B.
Length : 171'2"
Objective : Locate any vertical fractures
Commenced 26/8/59
Completed 4/9/59

From	To	Core Description
00 00	22'2	Soil and wtd rock; no recovery; casing.
22'2	35'2	Wtd fine and med agglom; core broken (1" frags approx) at 22', 26', 27'; friable tuff matrix at 32'6; some matrix removed and cavities part-fild by clay at 29'5, and 33'6 - 34'3.
35'2	39'6	Slightly wtd fine agglom; fracs rare.
39'6	47'2	Slightly wtd med-coarse agglom; some matrix removed between 42'6 and 45'0, resulting in broken core at 43'0 - 43'4; other fracs rare.
47'2	51'4	Fine-med agglom, solid.
51'4	58'4	Med-coarse agglom, one 27" bldr fine moderately vesicular basalt, matrix

DDH 2 S 4

From	To	Core Description
51'4	58'4	of coarse tuff with some thin irreg beds of fine mudstone; 51'6 and 50'4 70 deg fracs in basalt bldr, sec ctg; other fracs around bldrs.
58'4	63'6	Fine-med agglom with one 10" bldr; rgh 70 deg frac at 62'8, sec ctg.
63'6	64'10	Tuff, fine and muddy to coarse with some ½"-4" cpts, coarse tuff appears porous; some 2" - 3" cpts of previously consolidated coarse tuff in fine tuff matrix.
64'10	66'10	Fine agglom.
66'10	69'8	Tuff predominantly (75% approx) with some ½" - 4" cpts.
69'8	79'7	Fine and med agglom.
79'7	80'5	Bldr vesicular porph ol or aug basalt; 70 deg frac at 80'0, sec ctg.
80'5	90'0	Fine and med agglom, a little matrix removed; as in preceding rock fracs are rare, and are irreg; three irreg fracs.
90'0	91'7	One bldr porph ol or aug basalt; 70 deg frac at 90'9, sec ctg.
91'7	112'0	Consistent fine and med agglom (½" - 4" cpts); one bldr at 111'2 shows marked elongation of vesicles; fracs rare. Casts of twigs at 108'1 - 108'7 total carbon: thin coating 1" x ⅛" approx.
112'0	120'5	Solid med agglom with in places high propn of matrix.
120'5	121'11	Fine agglom, some matrix removed, slightly friable.
121'11	125'7	Med agglom, similar to 112'-120' rock
125'7	126'11	Fine-med agglom with some matrix removed; 125'10-126'6 is broken, matrix friable, not wtd.
126'11	142'00	Fine and med agglom, solid with few fracs around bldrs size of cpts is up to 4"; a little friable coarse tuff at 138'6. Weathering 112' to 142' is slight, matrix dark brown, most cpts fresh though a few red (possibly original colour) and yellow.
142'00	142'11	Fine agglom with some matrix removed (indicates greater friability).
142'11	148'3	Solid med agglom; weathering increases from 147'10 to 148'3 but no fracs.

DDH 2 S 4

From	To	Core Description
148'3	148'5	Soft yellow-brown clay with small clay polyhedra and small rock frag-ments, may be highly wtd agglom; 30-40 deg frac marks end of solid rock, irreg surface with smooth coating of soft soapy material; the polyhedra suggest that clay may pseudomorph crystals, one piece appears to be octahedral.
148'5	150'3	No core; from the driller's report it appears that this section too was clay --- removed by circulating water.
150'3	150'4	Clay with some agglom frags.
150'4	15[illegible]'4	Broken wtd agglom (some cpt bldrs fresh); soapy material on 60 deg frac at 150'6.
151'4	152'6	Solid wtd fine-med agglom.
152'6	153'00	Broken wtd agglom with a little clay.
153'00	153'10	Solid wtd agglom.
153'10	154'2	Broken agglom (wtd) and clay frac at 154'2 strikes between 020 and 060 degrees (prob 040 deg) and dips steeply to S-E; oriented by bdg at 160'.
154'2	160'3	Wtd fine-med agglom, mostly solid; 154'8 - 154'11 irreg fracs with a little clay; 60 deg frac at 156'10 with black sec ctg; similar frac at 158'7; 158'9 - 159'3 is more wtd, cpts yellow except for augite (?) phenocrysts.
160'3	161'2	Fine tuff and mudstone, bdd, solid.
161'2	163'9	Med agglom, less wtd; two irreg fracs with a little clay.
163'9	163'11	Broken agglom, slightly more wtd and matrix more friable.
163'11	165'11	Med agglom with increasing proportion of matrix
165'11	166'3	Broken fresh tuff and mudstone.
166'3	167'1	Coarser tuff, solid.
167'1	169'1	Med agglom, solid.
169'1	170'10	A series of graded beds, tuffaceous mudstone grades into fine (½") agglom, one bed 6" thick.
170'10	171'2	Med agglom.

END OF HOLE

DDH 2 S 5

Location : Dam site, on river bed outcrop
Reduced Level : 1674.8 feet
Angle : 30 degrees
Direction : 131 degrees T.B.
Length : 114'2"
Objective : Test downward extension of tension joints.
Commenced : 9/9/59
Completed : 12/9/59.

From	To	Core Description
000'00	1'2	Slightly wtd med agglom, 3" frags, iron-stained fracs.
1'2	5'0	Fine-med (½" - 2 cpts) agglom, three irreg fracs.
5'0	8'7	Med-coarse agglc with coarse tuff matrix, 3 irreg fracs
8'7	11'3	Fine agglom, indefinite bdg at 11'1.
11'3	11'7	Broken, frags up to 2", med agglom with gdd bdg in matrix.
11'7	12'6	Med agglom.
12'6	15'1	Fine and med agglom, few fracs with sec ctg.
15'1	16'0	Fine agglom with 70% tuff, solid.
16'0	20'7	Med agglom, 4" cpts, 50% tuff.
20'7	21'7	Coarse tuff with rough bdg, rough core indicates friability but not broken.
21'7	38'3	Med and coarse agglom with high propn tuff matrix, 50-60%, tuff shows some gdd bdg from coarse tuff to fine mudstone; broken at 21'7, a few other fracs; some cpt bldrs up to 12", bldrs generally slightly fractured with sec ctg.
38'3	41'0	Fine-med agglom, some matrix removed, one frac.
41'0	42'11	Three larger bldrs (4" - 10") in the f-med agglom
42'11	49'1	Fine-med agglom, a little matrix removed.
49'1	50'8	Graded beds of mudstone, tuff and fine agglom.
50'8	54'11	Med-coarse agglom with high propn of matrix (coarse tuff)
54'11	58'10	Fine agglom, cpts up to 1"; change from slightly wtd to fresh rock at 57'5 (matrix becomes grey-black, loses brown tint).
58'10	63'2	Med-coarse agglom, most bldrs vesicular with a thin skin of green mineral (weathers grey) in vesicles; a little matrix lost; one irreg frac.

DDH 2 S 5

From	To	Core Description
63'2	63'6	Coarse tuff, slightly friable, one frac.
63'6	68'6	Fine-med agglom with high propn of tuff (coarse) in places.
68'6	70'7	Coarse agglom (up to 18"), streaky flow lineation in one bldr.
70'7	73'2	Med agglom.
73'2	75'2	One bldr of finely porph aug basalt; frac 45 deg at 74'2 has powder-blue ctg; at 74'3 rgh vug with calcite (?) nodules; 74'4 - 75'3 frac through bldr and some adjacent fine agglom sub-parallel to core a little tuff matrix but most matrix is soft (H = 2) brittle banded pale-green soapstone primary or secondary deposit. At least part of the banding is at 30 deg to the core, may be horizontal.
75'2	75'3	Soapstone with a few inclusions of ½" basalt frags.
75'3	75'5	Fine agglom and tuff with yellow soapstone in interstices. Specimen removed from 75'3 for lab. examination.
75'5	80'11	Med and coarse agglom with coarse tuff matrix, powder-blue films in vesicles; 75'5 - 76'11 one bldr fine porph aug basalt with flowage streaks; four irreg fracs.
80'11	89'2	Fine and med agglom, few fracs, very low propn of matrix in parts (10% approx.)
89'2	104'10	Fine and med agglom, cpts up to 6", solid and fresh.
104'10		¼" band of yellow soapy clay enclosing small (up to ⅛") tuff frags; band may be thicker since some material may have been washed out during drilling.
104'10	108'7	Fine and med agglom, slightly wtd from 104'10 to 106'6 one frac.
108'7	109'2	Fresh fine agglom broken into ½" - 3" frags; breakage probably caused by drilling as this section dropped from the core barrel and was recovered by lowering the tools and drilling it again, dry.
109'2	110'6	Med agglom solid.

DDH 2 S 5

From	To	Core Description
112'7	114'2	Fine and med agglom, solid.
END OF HOLE		Owing to precarious position of drill in rivercourse water-testing was not carried out while drilling; circulation while drilling appeared to be 100%.

DDH 2 S 6

Location : - Dam site, right abutment
Reduced Level : 1688.3
Angle : 15 degrees
Direction : 44° T.B.
Length : 82'8"
Objective : Locate any fractures parallel to river under area of no outcrop.
Commenced 19/9/59
Completed 23/9/59

From	To	Core Description
00'00	13'4	No core, casing set.
13'4	22'2	Very wtd volc agglom; friable and mostly broken but with some 4" - 8" lengths; some cpt bldrs fresher.
22'2	24'1	Wtd agglom, less wtd than preceding, broken into 4" lengths, some fresh bldrs.
24'1	29'6	Fine and med agglom, some matrix removed 28'9 - 29'6; wtd but not friable, no fracs.
29'6	30'1	Broken agglom (due to loss of matrix), ½" frags, wtd.
30'1	50'4	Fine and med agglom, proportion of tuff matrix increases with depth, 12" bldr slightly ves basalt at 36'; slightly wtd but not friable. only 6 fracs in 20 feet.

DDH 2 S 6

From	To	Core Description
50'4	55'10	Tuff, fine and coarse, containing some fine agglom, bdg (some gdd) varies from horizontal on small scale.
55'10	61'7	Fine agglom, slightly wtd, solid.
61'7	61'9	Broken agglom and agglom wtd to clay; bounded by one irreg frac 90 deg, and one 30 deg frac.
61'9	65'0	Med agglom with up to 80% matrix; wtd irreg frac at 62'5.
65'0	82'8	Med and coarse agglom, bldrs up to 10"; slightly wtd but solid, 12 irreg fracs.

END OF HOLE

DDH 2 S 7

Location : Quarry, western limit
Reduced level : 1891.6 feet
Angle : Vertical
Length : 130'5"
Standing water level : 127' at 1100 hrs 15/10/59
Objective : Sample quarry rock
Commenced : 1/10/59.
Completed : 7/10/59.

From	To	Core Description
00'00	7'1	Clay and wtd agglom, soft --- casing set
7'1	9'6	Wtd agglom, some cpts fresh but matrix soft and friable broken.
9'6	22'10	Fine and med agglom, ½" to 4" cpts, 50% matrix; matrix slightly wtd, brown; core solid, few fracs.
22'10	34'6	Med agglom, most cpts 3", finer bed (½" cpts) 30' - 31', one 15" bldr; wtrg as above; fracs around bldrs with thin sec ctg. 30 - 40% matrix.
34'6	35'3	Tuffaceous mudstone and fine tuff with few 1" cpts; wtd, soft, friable.
35'3	40'3	Fine and med agglom, 40% matrix; slightly wtd, matrix brown; 6" frags.
40'3	40'7	Tuff with some 1" cpts; wtd soft friable.
40'7	49'4	Med agglom with a few tuff beds: at 41'1 (2" thick), at 44'8 (2 x ¼"), some matrix removed and part replaced by clay at 45', some matrix removed 48'4 - 48'10; wtrg slight, matrix brown; few fracs around bldrs with thin sec ctg. Matrix 30 - 40%.
49'4	52'5	Fine agglom, ½" - 1" cpts; solid; wtrg as above.
52'5	53'7	Med agglom 3" cpts; as above.
53'7	54'6	Fine agglom, ¼" - ½" cpts.
54'6	55'2	Med agglom, 50% tuff.
55'2	56'1	Tuff with some fine agglom; wtrg slight, as above.
56'1	58'3	Fine and some med agglom, 50% matrix (coarse tuff), some matrix removed; fresh, matrix grey; few fracs.
58'3	62'2	Med agglom with one 7" bldr; 40 - 50% matrix (fine tuff); matrix slightly wtd. brown; few fracs.

DDH 2 S 7

From	To	Core Description
62'2	62'3	**Tuff**, brown.
62'3	66'5	Fine agglom, 30% matrix (coarse tuff), some matrix removed; fresh, matrix grey; few fracs.
66'5	68'6	Fine and med agglom, 30% matrix; slightly wtd, matrix brown; solid.
68'6	72'5	Fine and med agglom, one 6" bldr, 50 - 60% tuff matrix slightly wtd; solid.
72'5	73'9	Fine agglom, becoming finer at depth, graded tuff beds at 72'5 (2") and 72'[illegible] (3"); very slightly wtd, solid.
73'9	78'10	Uniform med tuff, competent, hard (softer when wet?) slightly wtd, light brown; 25 deg frac at 74'6, mostly solid.
78'10	79'7	Above tuff with some 1" cpts, most of which show reaction rims (⅛"); solid.
79'7	80'2	Similar above but cpts coarser, one 5" bldr. Reaction rims and unusual colour of the tuff might indicate that this bed is an aquifer.
80'2	89'5	Fine and fine-med agglom, 20-30% matrix, a little matrix removed, part replaced at 88' by white talc (?) slightly wtd, matrix dark brown-grey; few fracs.
89'5	91'2	Med agglom with 40-50% matrix (coarse tuff); wtrg as above; few fracs.
91'2	97'1	Fine and a little med agglom, 20-30% matrix; matrix very slightly wtd; few fracs.
97'1	108'3	Fine and med agglom with 30 to 50% matrix (80% in places), clay in ex-matrix cavities at 97'1 to 98', and elsewhere in vesicles; wtrg slight, similar to most of preceding core.
108'3	109'6	Bldr slightly vesic[illegible] basalt.
109'6	10[illegible]	Tuff, mudstone.
109'10	110'9	Med agglom.
110'9	111'3	Med tuff.
111'3	113'3	Med agglom with one 1" mudstone bed.
113'3	113'10	Fine tuff and tuffaceous mudstone.
113'10	118'11	Med agglom, 40% matrix.
118'11	119'5	[illegible]rse tuff.

DDH 2 S 7

From	To	Core Description
119'5	130'5	Med and a little coarse agglom, with fine agglom 127' to end, matrix approx 40%; wtrg slight, unchanged; fracs rare.

END OF HOLE

DDH 2 S 8

Location : Quarry, near peg S 10
Reduced level : 1860.6 feet
Angle : Vertical
Length : 100'2"
Standing water level : 82' at 1130 hrs, 15/10/59.
Objective : Sample quarry rock.
Commenced : 9/10/59
Completed : 13/10/59

From	To	Core Description
000'00	6'5	Soil and weathered rock --- casing set.
6'5	10'2	Fine and med agglom, 40% matrix; slightly wtd; in 6"-9" pieces.
10'2	10'9	Tuff; friable, wtd; broken 1" frags, soapy clay in fracs.
10'9	15'4	Fine and med agglom with few coarser cpts, 30% matrix; slightly wtd; few fracs, one parallel core [illegible]
15'4	15'9	Coarse tuff; friable; broken 2" frags with soapy ctg.
15'9	20'9	Med agglom, some matrix friable; slightly wtd; few fracs. 40% matrix
20'9	21'6	Tuff, fine and coarse, not friable; slightly wtd; no fracs.
21'6	40'5	Fine and med agglom with one 9" and one 15" cpts, matrix varies from nil to 80% overall about 40%; all slightly wtd, a little matrix lost where friable; few fracs

DDH 2 S 8

From	To	Core Description
21'6	40'5	with yellow soapy ctg and white powdery ctg. Weathering in following core is slight (matrix brown, not grey as when fresh) unless otherwise noted.
40'5	40'10	Med agglom; broken 1" frags with thin sec ctg.
40'10	41'9	Med agglom, solid.
41'9	42'1	Coarse tuff, friable, broken ½ and 1" frags.
42'1	45'6	Fine agglom with few 4" cpts. 70% under ¼"; 4 fracs
45'6	45'9	Same fine agglom more wtd and friable; broken into 1" frags.
45'9	53'6	Tuff well lithified not friable, mostly fine some coarse with a few ¼"-1" cpts at 51'6; wtrg colour changes from normal dark brown to light brown at 48', fresh larger (1"-3") cpts at 49'5-50'8, cpts at 51'6 are completely wtd (cf. those with reaction rims in 2S7 at 80').
53'6	55'10	One bldr porph aug basalt with some vesicles; fresh in centre but slightly wtd and phenocrysts very wtd at margins --- prob an inclusion within the tuff bed.
55'7	55'10	Tuff as above, light brown.
55'10	57'6	Fine-med agglom 1" cpts; few fracs, some yellow clay.
57'6	61'3	Fine-med agglom with very friable matrix; slightly wtd as is rest of core; broken into 1" to 6" frags and into ¼" frags at 60'10-61'3. 40-50% under ¼".
61'3	77'6	Fine and med agglom with few 6" cpts, propn of matrix varies from nil to 60%, averages about 35%. Matrix at 67'3 is wtd red; a little white powdery filling where matrix removed, f[illegible]
77'6	77'9	Core broken into ½" and 1" frags around 20 degree frac; wtd.
77'9	81'3	Fine-med agglom, 40% matrix; 79'3 irreg 30 degree frac and broken agglom, with white powdery filling.
81'3	81'11	Tuff; grey, friable, broken into 2" frags.

DDH 2 S 8

From	To	Core Description
81'11	90'11	Fine and med agglom; badly wtd 88'10 - 89'7 light brown friable tuff; fracs irreg with clay and white powdery ctg at 82'3, 83'9, 85'8, 87'3, 88', 88'1, 88'5 and between 88'10 and 89'7. Matrix 40%.
90'11	91'6	Bed of coarse tuff, solid.
91'6	94'3	Fine agglom grades downwards into tuff; solid 75% under ¼".
94'3	97'3	Med agglom with 30% matrix; fracs with sec ctg at 95'-95'3.
97'3	98'2	Tuff with few ½" cpts; solid.
98'2	99'2	Med agglom with irreg fracs with soapy clay ctg.
99'2	100'2	Fine agglom grades downwards into tuff; solid.

END OF HOLE

DDH 2 S 9

Location : Spillway saddle, south-western end
Reduced level : 1782 feet
Angle : Vertical
Length : 30'0"
Objective : Depth of weathering
Commenced : 16/10/59
Completed : 17/10/59.

From	To	Core Description
00	9'9	Clay and soft wtd rock with few fresh bldrs; not cored.
9'9	12'3	Med agglom; soft, wtd, with one fresh bldr fine basalt 11'0-11'6; broken into ½"-2" frags.
12'3	13'1	Med agglom; soft, wtd matrix, some bldrs fresh; 2 frags.
13'1	13'4	Fine agglom, some matrix removed; mostly soft, wtd; broken ½" frags.

DDH 2 S 9

From	To	Core Description
13'4	16'0	Med agglom with one 12" bldr, some matrix removed at 15'; matrix soft wtd, becoming fresher; 6 frags.
16'0	30'0	Fine and med agglom, some matrix lost at 16'6 and at 26'3-27' and at 27'6; matrix only slightly wtd and bldrs fresh, slight increase in wtrg at 28'8 to end of core -- distinct 45 degree boundary at 28'8 in solid core; mostly solid but broken into 1"-3" lengths where matrix lost.

END OF HOLE

DDH 2 S 10

Location : Spillway saddle, north-eastern end.
Reduced level : 1786.5 feet
Angle : Vertical
Length : 106'8"
Standing water level
Objective : Depth of weathering
Commenced : 19/10/59
Completed : 22/10/59

From	To	Core Description
00	54'6	Not cored; clay and soft weathered rock, probably all residual.
54'6	55'0	Brown clay containing small fragments of clay which show basalt texture; material may originally have had rock fabric which was destroyed by drilling - (split inner tube core barrel not used)
55'0	81'9	Not cored; clay and soft weathered rock.

DDH 2 S 10

From	To	Core Description
81'9	82'6	Med agglom; boulders and matrix weathered and soft; 4" lengths.
82'6	83'1	Tuff, porous; weathered soft.
83'1	85'3	Med agglom; matrix and bldrs wtd soft; 3" - 9" lengths.
85'3	85'8	Med agglom; matrix and bldrs wtd soft; broken ½" frags.
85'8	86'3	Tuff; soft wtd; solid.
86'3	86'8	Med agglom; all wtd soft; broken ½" frags.
86'8	87'1	Tuff; soft wtd; 3" frags.
87'1	91'6	Med agglom; all wtd soft; mostly 4"-12" lengths.
91'6	91'8	Tuff; soft wtd; solid.
91'8	92'6	Med agglom; all soft wtd; 2" frags.
92'6	93'9	Coarse and fine tuff; soft wtd; solid.
93'9	102'5	Med agglom with a few 6" bldrs; matrix all soft wtd, all bldrs wtd 93'9 - 95'0, from 95' onward some bldrs are completely wtd, some show wtrg rims, and some are fresh; 2", 4", and 15" lengths.
102'5	103'5	Med agglom, some matrix removed and part replaced by clay which shows lamination pink, yellow, white; all matrix wtd, some bldrs fresh; 3 frags.
103'5	106'8	Med agglom with one 10" bldr; all matrix and some bldrs wtd soft; 5 frags.

END OF HOLE

DDH 2 S 11

Location : Spillway saddle, downstream flank.
Reduced level : 1762.7 feet
Angle : Vertical
Length : 31'6"
Objective : Depth of weathering
Commenced : 23/10/59
Completed : 24/10/59.

From	To	Core Description
00	7'9	Not cored; soil and soft wtd rock.
7'9	10'8	Med agglom; soft and wtd except for a few fresh bldrs; badly broken.
10'8	13'4	One bldr (32") fine slightly vesicular basalt; fresh; split by near-vertical fracture. iron stained.
13'4	16'7	Med agglom; wtd soft 13'4-13'6, remainder only slightly wtd; solid except for frac around boulder at 16'3.
16'7	16'8	Agglom broken into ½" frags.
16'8	30'8	Fine and med agglom with one 9" bldr of coarsely porphyritic (¼" phenocrysts) augite basalt, mudstone matrix at 22'8 shows irreg bdg around bldrs; slightly wtd; only 9 fracs, one due to friable matrix at 24'11.
30'8	30'10	Agglom with friable matrix; a little more wtd; broken into ½" frags.
30'10	31'6	Med agglom; slightly wtd; solid.

END OF HOLE

DDH 2 S 12

Location : Spillway saddle, downstream flank.
Reduced level : 1757.7 feet
Angle : Vertical
Length : 25'4"
Objective : Depth of weathering
Commenced : 26/10/59
Completed : 27/10/59

From	To	Core Description
00	1'2	Not cored; soil and soft wtd rock.
1'2	1'4	Agglom; matrix soft wtd, bldrs fresh; broken ½" frags.
1'4	4'7	Fine-med agglom, 1" cpts; slightly wtd; frags; 3", 2", 1", 10", 10", 3", ½", 7".
4'7	5'6	Fine agglom; slightly wtd; broken into ½" and 1" frags with blue-coated surfaces.
5'6	7'6	Fine-med agglom; slightly wtd; only 3 fracs.
7'6	8'5	Fine agglom; all very wtd, soft; broken into small frags.
8'5	13'5	Med and fine agglom; slightly wtd, 8'6 wtd rim on bldr; only 2 fracs, a little clay in that at 13'1.
13'5	14'0	Not recovered; probably very wtd soft agglom.
14'0	14'5	Fine-med agglom; very wtd, soft; broken small frags.
14'5	16'3	Fine and med agglom; slightly wtd; solid.
16'3	16'6	Fine-med agglom, most matrix lost; 16'3 to 16'10 a little more wtd; broken into ½" and 1" frags.
16'6	21'2	Med and coarse agglom, one 12" bldr, a little matrix removed at 17'7; slightly wtd; only 2 fracs.
21'2	21'5	Tuff shows graded bdg.
21'5	22'5	Med agglom, some matrix lost, replaced by clay; slightly wtd: one frac.
22'5	24'6	Fine-med agglom, high propn matrix in places, matrix more friable; slightly wtd; 3 fracs.
24'6	25'4	Fine-med agglom, some matrix lost replaced by clay; a little more wtd; one frac.

END OF HOLE

DDH 2 S 13

Location : Spillway saddle, at foot of downstream slope
Reduced level : 1742 feet approx.
Angle : 15 degrees
Direction : 136 degrees T.B.
Length : 141'0"
Objective : Locate any solid rock (tors) above RL 1680 feet
Commenced : 29/10/59
Completed : 4/11/59

From	To	Core Description
00	37'6	Not cored; clay and soft weathered rock, probably mostly residual.
37'6	55'5	Fine, med and coarse agglom, basalt boulders up to 15"; matrix and smaller bldrs very wtd, soft, larger bldrs fresh, 2'7" of core washed out in section 40'11 - 45'11; badly broken except for a few 6"-18" lengths.
55'5	92'3	Fine-med agglom mostly, two 27" bldrs between 76' and 87', 4" of tuff at 63'6; all matrix wtd to light brown colour but not as poorly cemented as in preceding section, most bldrs fresh but a few very wtd; generally solid in 6" to 36" lengths but badly broken at 60'-60'2, 63'6 (tuff), and moderately broken 74'3-74'9.
92'3	97'3	Med agglom; matrix all very wtd, some bldrs fresh; broken into ½"-3" frags between 92'3 and 94'9, 6" lengths between 94'9 and 97'3.
97'3	102'9	Tuff mostly coarse, with a few 2"-4" cpts; soft, wtd; readily broken.
102'9	113'0	Med agglom; very wtd and soft with few fresh bldrs; mostly broken with few 6"-12" lengths.
113'0	115'0	Tuff; very wtd, soft; broken.
115'0	116'0	One bldr moderately vesicular basalt; very wtd, soft; broken.
116'0	118'4	Washed out, no core.
118'4	141'0	Med and coarse agglom with few 18" bldrs; all matrix very wtd soft, most bldrs wtd soft but a few fresh, 10" core lost in section 131'-136'; mostly broken but some 4" and 6" lengths.

END OF HOLE

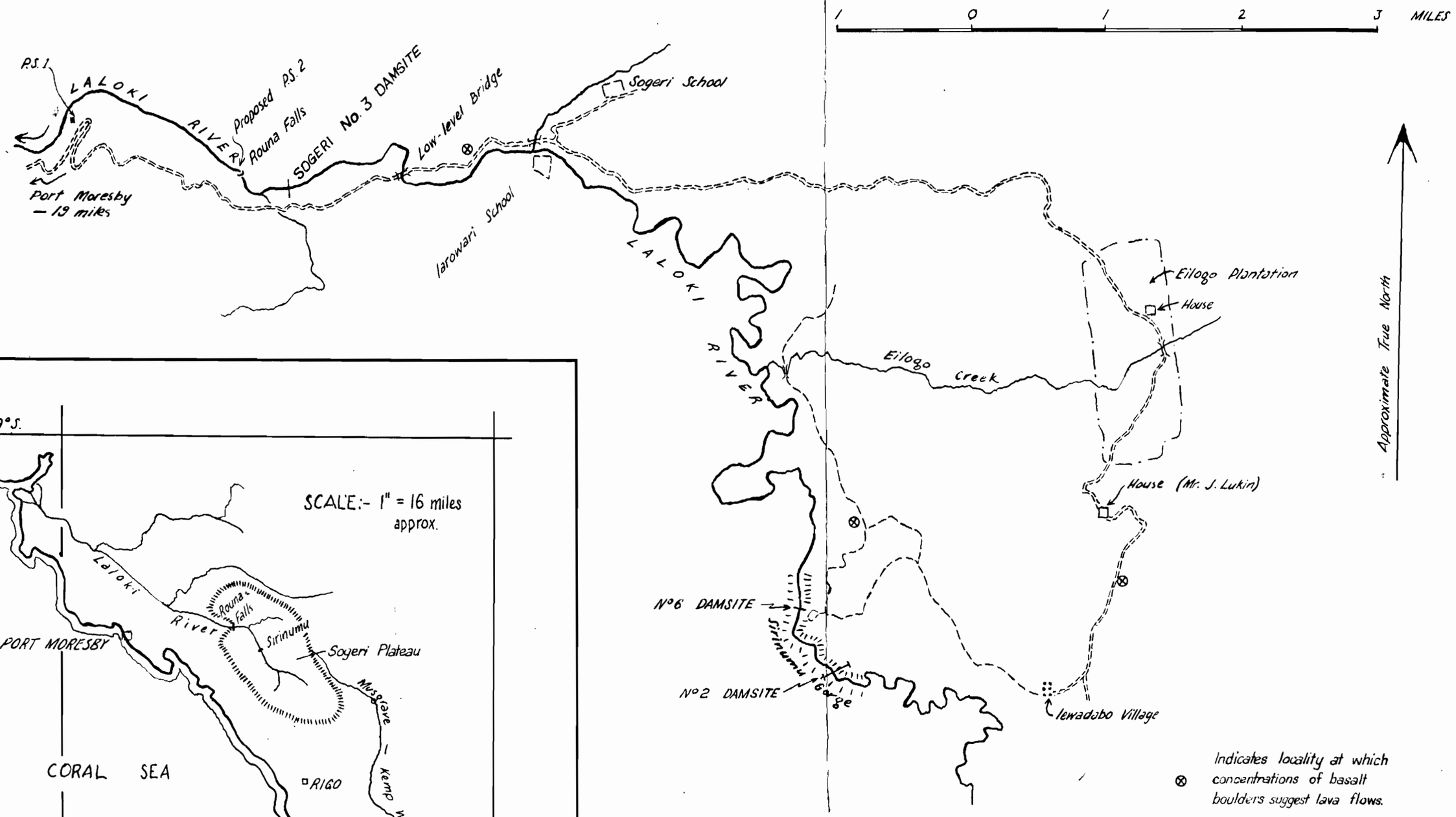
DDH 2 S 14

Location : Spillway saddle, at foot of upstream slope
Reduced level :
Angle : 15 degrees
Direction : 355 degrees T.B.
Length :- 116'0"
Objective : Locate any solid rock (tors) above R.L. 1680'.
Commenced : 6/11/59
Completed : 10/11/59.

From	To	Core Description
71'	84'6	Med agglom broken with some 3" to 9" lengths.
84'6	88'6	Tuff and fine agglom, most badly broken, section 86'-87' washed out.
88'6	96'	Med agglom broken with some 3"-6" lengths; core washed out:
96'	115'	Med agglom, broken where disturbed, some 12" to 14" lengths.
115'	115'9	Tuff
115'9	116	Med agglom

END OF HOLE

LOCALITY MAP — SIRINUMU AREA
TRACED FROM AERIAL PHOTOGRAPHS
UBERI RUNS 3A. AND 4.



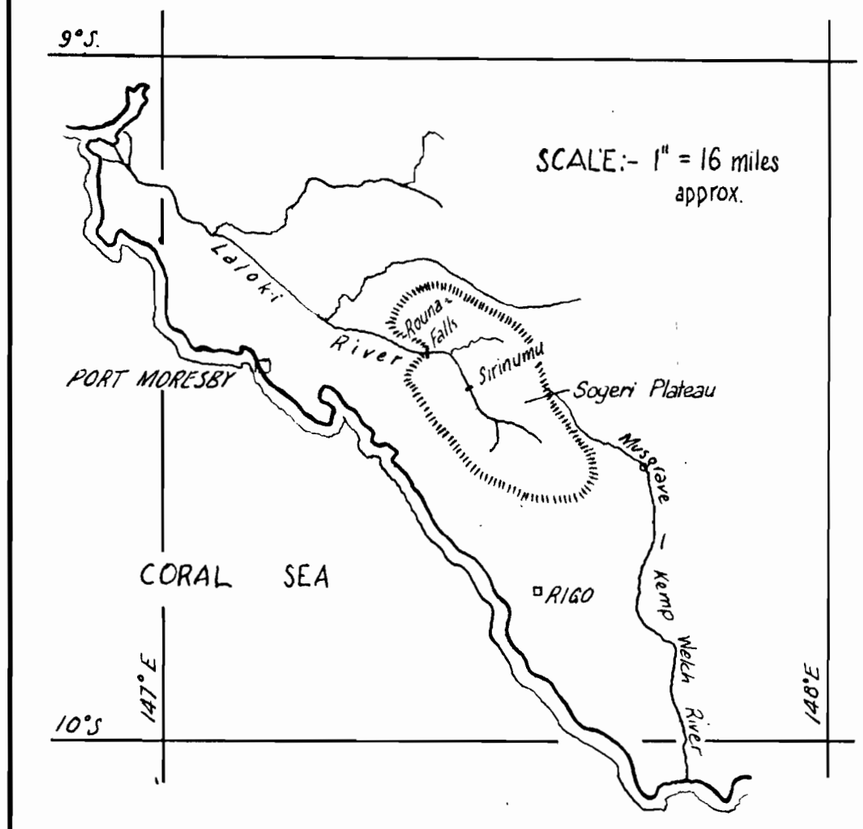


Plate 1

PLATE 2.

PORT MORESBY HYDRO-ELECTRIC PROJECT

SIRINUMU DAM SITE 2

OUTCROP MAP OF DAM SITE, QUARRY AND SPILLWAY SADDLE

Scale

40 0 40 80 120 160 200 Feet

Contour plan based on surveys by: J.Morris, D.Thiedecke, and G.Kolarov.

Geology by H.L.Davies, based on plane table survey.

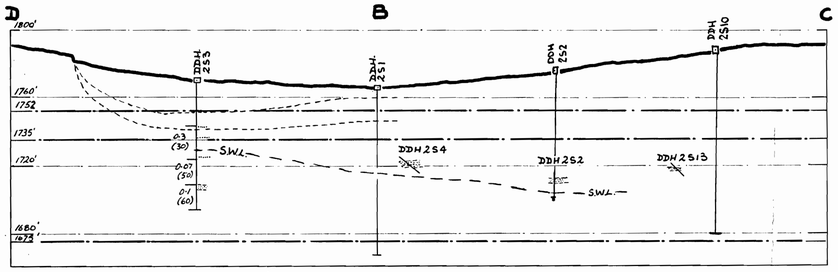
Map adapted from Commonwealth Department of Works Drawing No. PH 59/155 A - P, December, 1959.

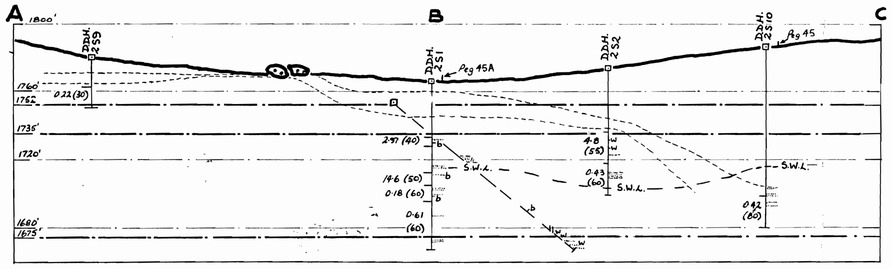
True bearing $\Delta^1 - \Delta^2$: 283°30' approx.

Bureau of Mineral Resources, Geology & Geophysics. A.C.T. July, 1960.

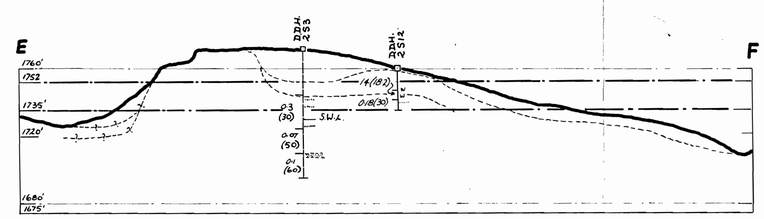
PNG 8C-11

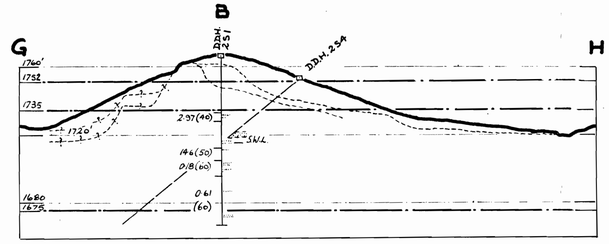
PLATE 3

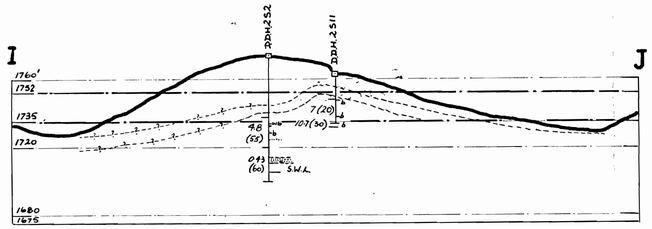


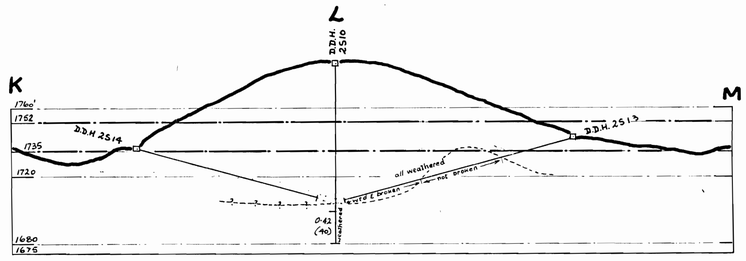


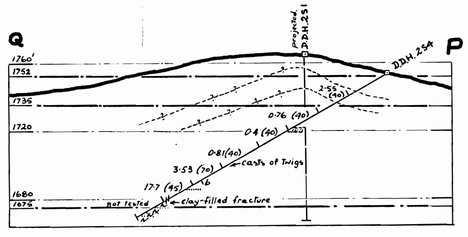
LONGITUDINAL SECTIONS.



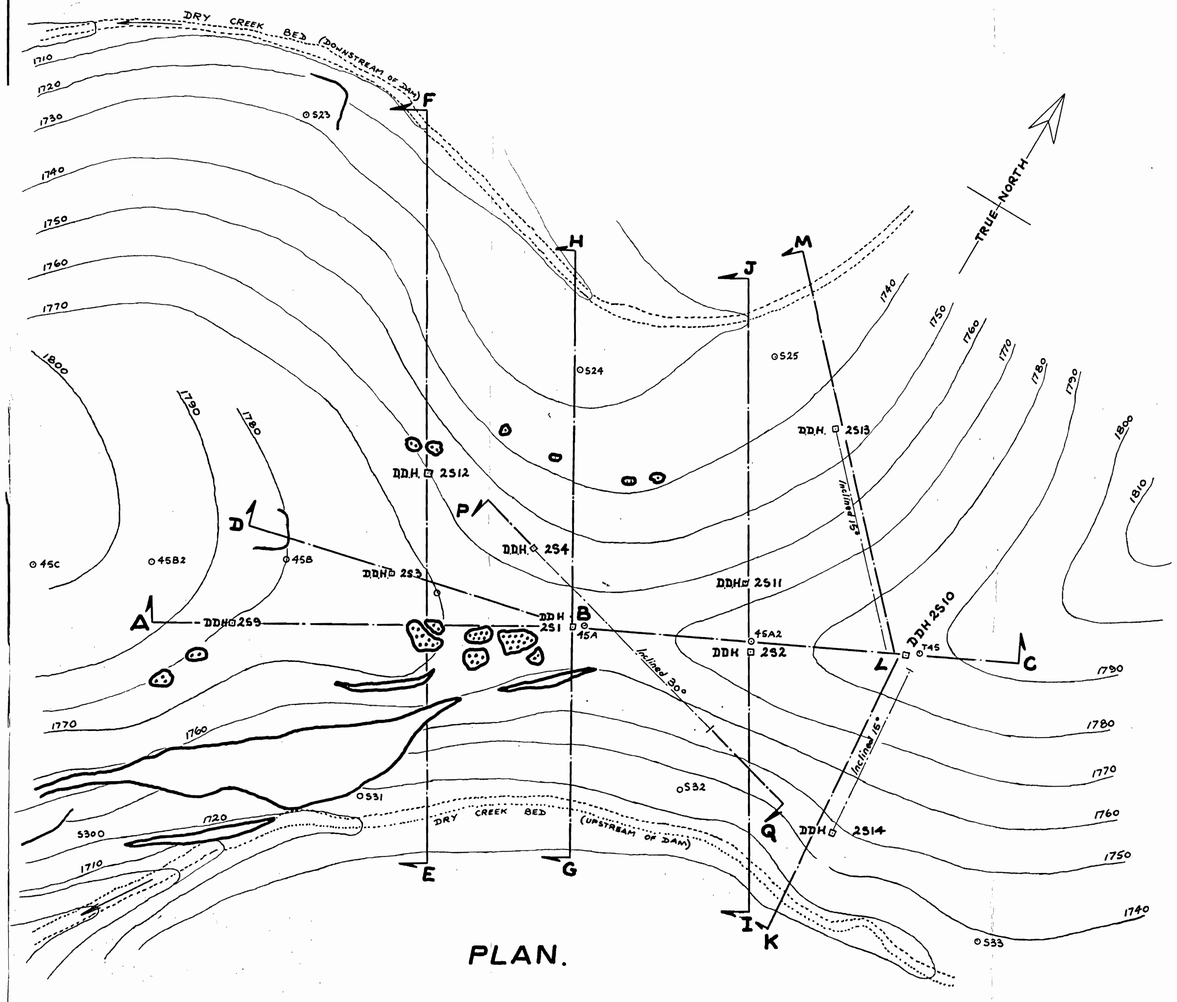








CROSS SECTIONS.



PLAN.

LEGEND.

D.D.H. 2510	:	Diamond drill hole, (i.e. the tenth drilled on N°2 Damsite).
2·47 (40)	:	Water pressure testing result, (i.e. a leakage of 2·47 G.P.M. at 40 P.S.I)
w	:	Weathered.
b	:	Broken.
	:	Tuff beds, Thick and thin.
	:	Boundary between soft rock and soil, and partly weathered and broken rock.
	:	Boundary between partly weathered and broken rock, and relatively solid rock.
1752	:	Top Water Level, stage 2.
1735	:	Top Water Level, stage 1.
1675	:	Dam base level.

ORIGINAL OF THIS PLAN PREPARED BY GEOLOGIST H.L.DAVIES, BUREAU OF MINERAL RESOURCES. FROM SURVEYS & DRILLING INFORMATION.

Stable Survey to be used for Instrument in Preparation

COMMONWEALTH OF AUSTRALIA
DEPT. OF WORKS
PAPUA AND NEW GUINEA BRANCH

PORT MORESBY HYDRO ELECTRIC.
SIRINUMU DAM SITE 2 —
SPILLWAY GEOLOGICAL SECTIONS.

AMDT No.	DESCRIPTION	DATE	INIT.	DRG. No.	SUBJECT

AMENDMENTS — ASSOCIATED DRAWINGS

J. D. Edwards 18/12/59
SUPERVISING HYDR. ENG.

PRINCIPAL ENGINEER.

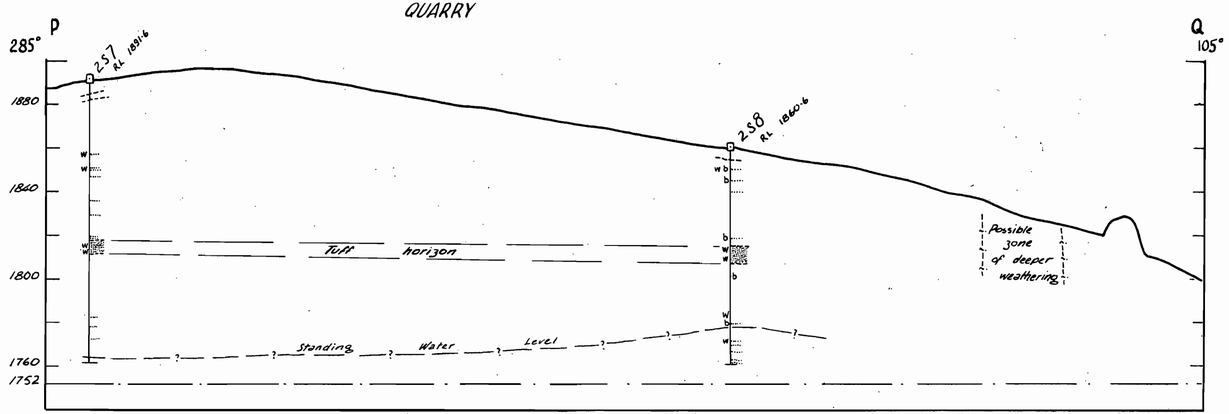
DIRECTOR OF WORKS

SCALE: 40' to 1"
DATE: 8·12·59
FILE 56/728

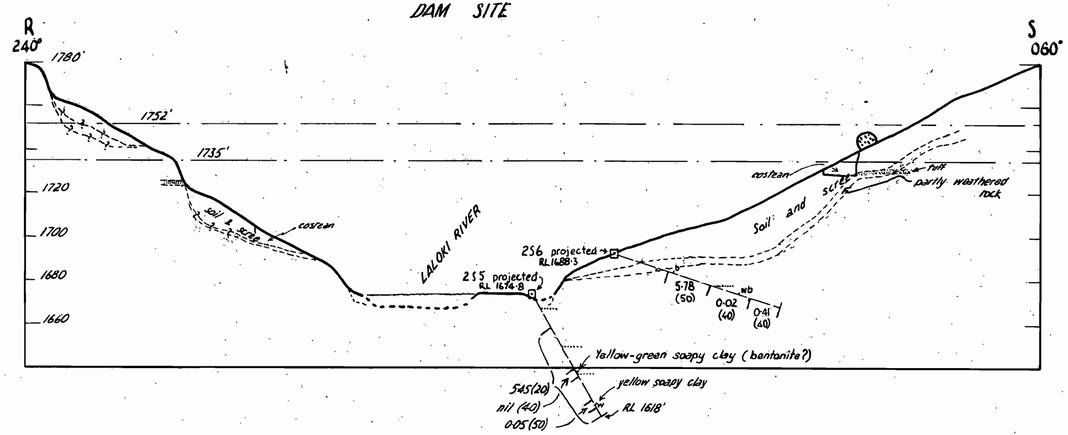
DRAWN H.L.D
TRACED K.A.P.
CHECKED J.R.B

DRAWING No. PH59/154 B P

QUARRY



DAM SITE



Both Sections natural scale — 40' = 1"

REFERENCE:-

255	Diamond drill hole No. 255
-------	Interface — soil, scree + clay / partly weathered rock
- - - - -	Interface — partly weathered rock / mostly fresh rock.
w w	Weathered
b	Broken
5·78(50	Water pressure testing result ie. leakage of 5·78 g.p.m. at 50 p.s.i
WWW	Beds of tuff, thick and thin.
1752	Top water level, Stage 2.
1735	Top water level, Stage 1.

SIRINUMU No. 2 DAM SITE & QUARRY SECTIONS

PLATE 4

SIRINUMU N° 2 DAM SITE.

showing outcrop, auger holes, costeans & drill holes

REFERENCE:–

Boulder

Vertical Cliff

Steep Rock Face

Λ2 Surveyor's Instrument Station

5° Strike and dip of bedding where not horizontal

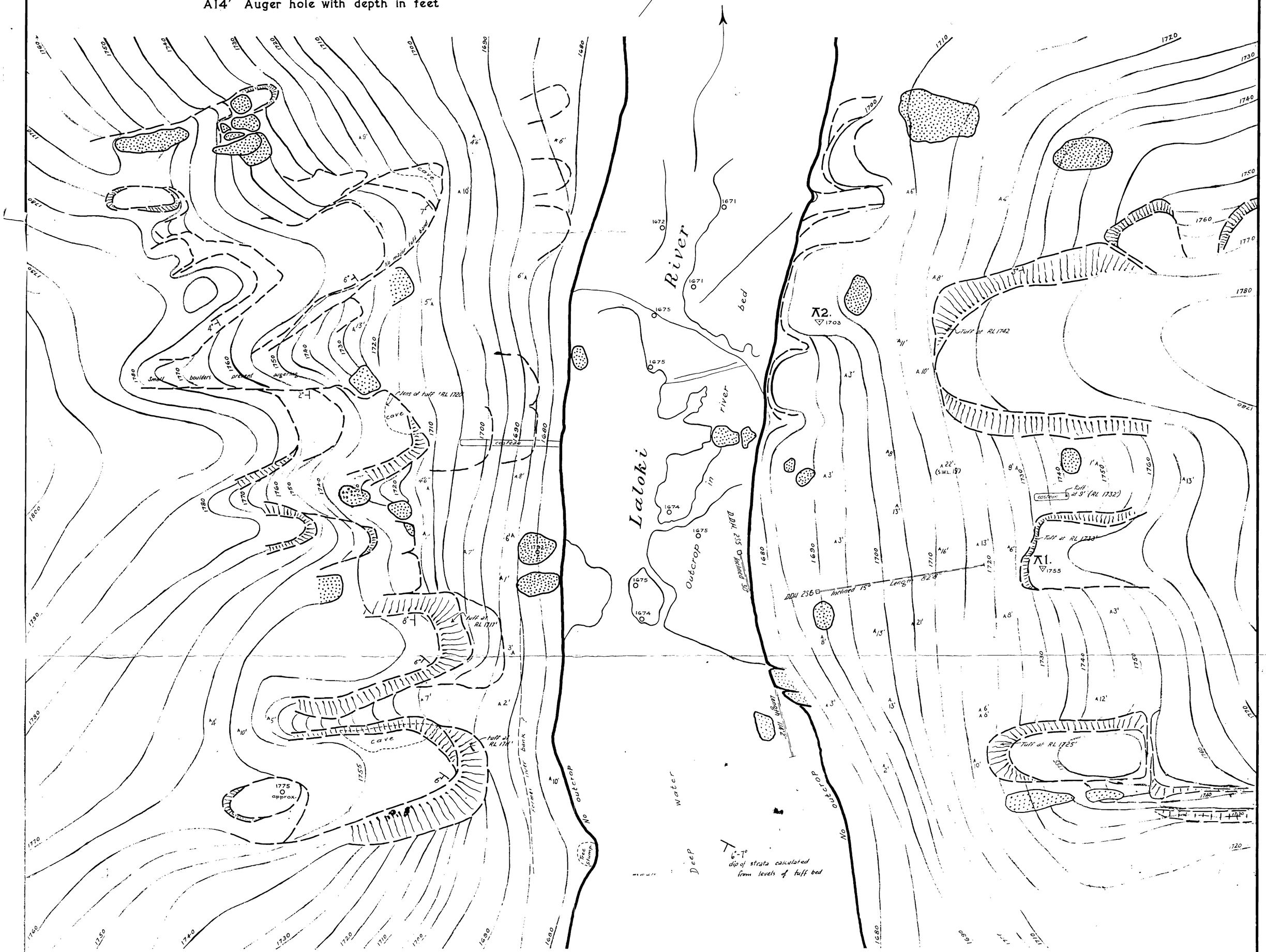
A14' Auger hole with depth in feet

True North 6½°

Magnetic North

DIAMOND DRILL HOLES.

	Azimuth	Inclination	Length
2S5	131°T	30°	114 ' 2''
2S6	040°T	15°	82' 8''



Planetable Survey by H.L.DAVIES

Scale 20' - 1"

PLATE 5

SIRINUMU Nº 2 DAM SITE

BED-ROCK CONTOUR PLAN

SCALE 20' = 1"

INTERPRETIVE

True North
Magnetic North

o1693' Auger-hole and R.L. of bedrock or scree boulder on which it bottomed.

In areas of no outcrop these contours are only approximate as some of the auger holes have probably bottomed on scree boulders.

Drilling indicates that fresh solid rock generally lies about five feet below the surface of partly weathered rock which is contoured here.

RIVER

not contoured

LALLOKI

not contoured

costean

costean

△R2

△R1

PLATE 6