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SIRINUMU DAM, LALOKI RIVER, Territory of Papua and New Guinea Stage 2 Geological Investigations, 1967 - 1968

by

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SUMMARY

It is required that the Sininumu Dam be raised to increase storage of water for hydro-electric power stations supplying Port Moresby. The existing main dam is a rockfill structure 80 feet high, in a gorge of the Laloki River. On the north side of the reservoir, there are five earthfill saddle dams. Topography limits the raising of the storage level to 22 feet.

The site of the main dam is entirely of well-cemented volcanic agglomerate with thin beds of tuff. The sites of the saddle dams are of stiff red clay overlying completely weathered agglomerate. The depth of weathering is 100-200 feet.

The investigation was carried out in 1967 and 1968. Methods of investigation included geological mapping, diamond drilling, water pressure tests in drillholes, geophysical investigation and soil testing.

It is concluded that the dam and spillway sites are suitable for the proposed construction. Special treatment is required for a few deeply weathered joints and measures should be taken to record possible leakage through the deep red clay east of the spillway. Excavation of the spillway should provide sufficient satisfactory rockfill for raising the main dam, but some enlargement of the stilling basin may be necessary, particularly if rip-rap is to be obtained from the site.

On the north sides of the saddle dams, springs are cutting back into saddles. Studies, as discussed with the design engineers, should be maintained to give information on the behaviour of the springs as the reservoir level rises.

The risk of major earthquakes in the area is not high.

INTRODUCTION

General

At the request of the Director-General, Commonwealth Department of Works, Melbourne, an investigation was carried out at Sirinumu Dam to determine foundation conditions for raising the dam and constructing a new spillway.

The investigation included geological mapping of the spillway and main dam areas, excavation of costeans, spillway site, geophysical survey and soils investigation. The work was done in two phasea: between July, 1967 and February, 1968; and in August, 1968.

Outline of the Scheme

The Sirinumu Dam was constructed in 1962 to regulate the flow in the Laloki River particularly to Rouna No.2 Power Station which was completed in 1968. In 1962, the designers of the dam foresaw that the storage at Sirinumu would have to be increased at a future date. However, the growth in demand for electric energy in Port Moresby has increased faster than was forecast and the dam must be raised by 1970.

The dam is a rockfill embankment 80 feet high and 375 feet long at the crest, which is at R.L. 1752 feet. On the upstream face, a welded steel plate acts as an impermeable membrane. The present full supply level is R.L. 1730. The emergency spillway is a 200 feet wide channel cut through rock; the spillway crest is at R.L. 1742. Along the north side of the reservoir, there is the narrow watershed between the Laloki River and the catchment of Eilogo Creek which joins the Laloki River $2\frac{1}{4}$ miles downstream from the dam. In five saddles on the watershed, earth embankments have been built up to R.L. 1752.

The hydro-electric development of the Laloki River is described by Fraser (1968).

It is proposed that the storage level should be raised to R.L.1764. This is considered to be the highest practicable level determined by the topography of the area. The crests of the main and saddle dams would be raised to R.L. 1776. The new spillway would have a crest level at R.L. 1764 and a concrete-lined chute, 100 feet wide, with a "ski-jump" deflector discharging to a stilling basin. Overflow from the stilling basin would pass along an unlined channel to the Laloki River.

Location and Access

Sirinumu Dam is situated on the Laloki River $20\frac{1}{2}$ miles due east of Port Moresby (Plate 1). The distance by the Rouna and Eilogo roads is 32 miles. Eight miles of road were constructed for access to the main dam. The saddle dams A, B, C, and D are accessible for four-wheel drive vehicles from the Eilogo public road at Ninoa Estate. Saddle dam E, farther west, is reached by a rough track from the Sirinumu Dam access road.

Topography

The dam is at the upstream end of a gorge in which the Laloki River flows north-westwards. The existing dam is 80 feet high and its crest is at 1752 feet above sea level. The reservoir lies south-east and east of the dam.

The terrain above the dam is a clay plateau at 1800 feet with tors of agglomerate rising to 1900 feet above sea level. There is a marked flattening of gradients at 1750 - 1800 feet and the lower parts of valleys are steep. The vegetation is grass with eucalypts on the higher ground and thick forest in the valleys. Around most of the reservoir, the cultivation of widely scattered native gardens is the only land used. There are rubber plantations in the north-eastern part and timber is being cut along the eastern shore.

Previous Investigations

Engineers of the Commonwealth Department of Works selected eight possible sites for a dam. Of these, two sites (Nos. 6 and 7) were examined geologically by Gardner and Noakes (1959). No.6 site, 1500 yards downstream from the dam, was mapped in more detail and drilled (Davies 1960a). Meanwhile, a ground survey showed the river to fall more steeply than was determined photogrammetry and attention was turned to No.2 site. This was investigated by Davies (1960b) and finally chosen as the site of the dam. Further geological investigations for design purposes was carried out by Thompson (1960).

Mapping

Geological mapping has been done by Davies (1960b) and Thompson (1960) and tied to beacons set up by surveyors of the Commonwealth Department of Works.

Nearly all of the beacons were destroyed during the Stage 1 construction. The construction areas were mapped by contract surveyors in 1967. The maps refer to a grid which is not the same as that used in Stage 1. Reduced levels refer to the same datum, approximately mean sea level, throughout. The correlation of other data from different surveys is inexact.

Geological mapping of the Stage 2 investigation was done with tape, compass, Abney level and plane table and tied to survey beacons set up in 1967 (Plate 2).

Diamond Drilling

The diamond drilling programme was carried out by the drilling section of the Department of Lands, Surveys and Mines ofthe Territory of Papua and New Guinea, for the Commonwealth Department of Works. A Mindrill F30 KT machine was used for the work by indigenous operators. All holes were drilled at NX size with NMS double tube core-barrels with stationary split inner tubes.

In all, 1075 feet were drilled in 18 holes. One hole, SDD23, is on the left abutment; one, SDS27 in the right abutment; five, SDS18-22 for the spillway crest and chute; six, SDS23, SDS24, SDS28-31, for the stilling basin; two SDS32 and SDS33 for the discharge channel; and three, SDS34-36 in the ridge east of the spillway. SDS25 and SDS26 were for an alternative design of the discharge channel and were not drilled.

Geological logs of core from the drillholes are included in Appendix 2. The locations of drillholes are shown in Plate 2.

Water Pressure Testing

Tests were carried out in all holes except SDS18 and SDS36. Water was pumped into the holes through N rods and a hydraulic sleeve packer with the ram pump used to circulate drilling water. Damage to the only packer available prevented the systematic testing in sections of 10 or 20-foot lengths.

Gauge pressures of the tests were corrected for hydrostatic and friction heads to determine the effective water pressure in the section under test. The joint permeabilities in feet per year were determined with the formula devised by Chapple for the Snowy Mountains Hydro-Electric Authority and quoted by Hill (1964). The results of the tests are tabulated in Appendix 3.

Costeans

Five costeans were excavated, the total length being 686 feet. Costeans 1 and 2 are on the north side of the creek north of the spillway; 3 is on the right bank of the Laloki River; 4 in the right abutment and 5 is in the left abutment of the main dam (Plates 2 and 3). The costeans were excavated by the Commonwealth Department of Works to a maximum depth of 15 feet.

Geophysical Survey

Seismic traverses to determine depth and condition of bedrock were carried out by the Commonwealth Department of Works. In all, eight traverses of total length 2000 feet, were shot: traverses A and B on the ridge east of the spillway; C, D, F, G, across the creek north of the spillway channel; E and H on the right bank of the Laloki River downstream from the main dam (Plate 2).

Soils Investigation

An extensive soils investigation was carried out by the Commonwealth Department of Works for the foundations of the saddle dams and in the borrow areas for the construction. A few holes were sunk

in the ridge east of the spillway. The work is described by McDevitt (1968). Soils and water testing carried out by the Division of Soil Mechanics, C.S.I.R.O. are described in a separate report.

GEOLOGY

REGIONAL

The catchment of the Laloki River above the Rouna Falls occupies almost all of the Sogeri Plateau. It is in Astrolabe Agglomerate, a succession of coarse basaltic agglomerate with subordinate tuff. Lava flows are rare; one, of porphyritic augite basalt, was found by Davies (1960b) immediately east of Eilogo Plantation. The bottom of the agglomerate has not been found in the vicinity of Sirinumu Dam. The deepest drillhole, SDD8, was stopped in agglomerate at R.L. 1529 (Thompson, 1960). Thus the thickness exceeds 400 feet.

The agglomerate is composed of angular to sub-rounded fragments of basalt and andesite up to 5 feet across, set in a tuffaceous matrix. The greater part of the agglomerate is unsorted. Well-sorted agglomerate generally occurs in lenticular masses.

The matrix particles range in size from clay to sand; in some beds the matrix is fairly uniformly sandy. The pelitic matrix is far more strongly cemented than the arenitic matrix which, in places, is so weakly cemented that it is friable.

Tuff occurs throughout the succession in irregular, lenticular beds of thicknesses up to about 15 feet. Tuff beds a few inches thick commonly occur as partings between thicker beds of agglomerate. Particle sizes in the tuff range from clay to sand size. Many features of deposition in water, such as graded bedding, current-bedding, slump-bedding and scour-and-fill, can be observed. Pelitic tuffs, where fresh, are strongly cemented; many of the arenitic tuffs are very weakly cemented.

Fossils of vegetable matter, commonly prostrate tree trunks and the stems of reeds or grass, occur. They are mostly very poorly preserved although some silicified wood is found. Moulds of tree trunks up to 18 inches in diameter can be seen in the north face of the right abutment.

The Astrolabe Agglomerate is not greatly disturbed. Locally, dips of up to about 7° occur.

Faults and zones of shearing have been observed but their displacements are not known owing to the absence of stratigraphic markers within the succession. Joints are well developed, and in cliff faces many have become wide, steep-walled fissures filled with clay.

Although resistant to subaerial weathering, the agglomerate is readily degraded by chemical weathering along the joints to at least 100 feet depth; tuff is more readily weathered than agglomerate. The ultimate product of chemical weathering is a firm to stiff red clay. The landscape of the Sogeri Plateau is of rounded clay ridges with scattered tors of agglomerate. In the tors, the joints are widely spaced so that large masses of rock have been preserved from chemical weathering.

DAM SITE

LEFT ABUTMENT

Topography

The left abutment is in a cliff of agglomerate rising steeply to R.L. 1780. Above R.L. 1780, there is a gently rising slope of clay and scattered outcrops culminating in a tor at R.L. 1900 about 400 feet south-west of the abutment. To build the road to the valve house, a cutting was made in the left abutment in the direction 274°, or 36° to the axis of the dam. The rock of the abutment above R.L. 1752 is now a sharp spur. At the end of the existing crest, there is a steep-sided gully running in the direction 210°M. (magnetic) from R.L. 1755 - 1785.

Stratigraphy

Drillhole SDD23 proved moderately weathered agglomerate with thin beds of tuff at R.L. 1766, 1760, 1758 and 1754. Similar strata are exposed in the road cutting where the tuff beds are seen to be impersistent.

Structure

The bedding is almost horizontal and no faults have been detected. Steeply dipping joints exposed in the road cutting have strikes of Magnetic North, 025° and 040°M. and dip at 50° east to vertical. The steep joints with strike 040°M. appear to be strongly developed throughout the area and control many erosional features such as the sides of many of the tors, the creek north of the spillway and the south side of the gully of the left abutment. The most prominent joint of shallow dip is exposed in the cutting near the bend in the road at 200 feet downstream from the crest. This joint strikes 315°M. and dips 30° west. There is clay filling in it up to 2 feet thick.

Costean 5 was excavated for 50 feet bearing 238°M. (grid west) from SDD23 to determine the bedrock profile under red clay (Plate 3). The surface of the moderately weathered agglomerate was found to slope towards the middle of the costean where the bottom is in completely weathered agglomerate at R.L. 1775. This indicates a deeply weathered joint which can be correlated with the shallow-dipping joint described above. It is possible that the weathering may be along a steep joint with a strike of about 140°M. In SDD23 eight steep joints were intersected between R.L. 1734 and R.L. 1721.

A number of cracks can be seen in the rock mass of the abutment, above the roadway. They were apparently formed during stage 1 construction.

RIGHT ABUTMENT

Topography

The right abutment is a tor with almost vertical sides and three pinnacles on the side facing the river. The abutment is on the south side of the north pinnacle which, on the downstream side of the existing crest, projects 60 feet towards the river. The present access road leaves the crest at right angles and passes around the south side of the tor. The rock face of the cut for the road and abutment rises to R.L. 1760-1775, and is highest near the end of the crest. The central pinnacle carries the shore end of the existing intake bridge.

Stratigraphy

The rock of the right abutment down to R.L. 1740 is sound agglomerate. At R.L. 1735-1740 there is an irregular bed of tuff which can be seen in the north face. The tuff was intersected in drillhole SDS27 of the present investigation and SDD12 (Thompson, 1960).

The agglomerate underlying the tuff is a more permeable kind, and was weathered more easily, than the agglomerate above. This is shown in the formation of shallow caves along the north face and in SDS27. The thickness of the more permeable agglomerate is not definitely known. Drillhole SDS27 passed into well-cemented rock at R.L. 1707 but this depth is considered to be deeper than normal owing to the presence of a deeply weathered joint close by.

Structure

The dip of the bedding is less than 7° south-south-west. The joint system consists of a set of joints of strike 035-050°M. and another set of strike 145°M. Both sets have steep to vertical dips. Weathering along these joints produced the buttressed form of the outcrops.

The joints of the 035-050°M. set have only a white coating on the surfaces but should not be considered to be tight above R.L. 1740.

The only joint of 140°M. strike in the right abutment is located 60 feet east of the end of the existing crest. Drillhole SDS27 passed through the weathered zone of the joint at R.L. 1723-1712; the horizontal width of completely weathered agglomerate is 4 feet (Plate 3). Costean 4 exposed the joint at R.L. 1772 where weathering is 6 feet wide. Other indications of the joint are a clay-filled fissure on the north face of the abutment and an open fissure 2 feet wide in the pinnacle of rock south of the intake bridge. The joint is considered to persist right through the abutment and to be filled with weathered material down to R.L. 1700 or deeper. The joint passes between drillholes SDD12 and SDD13 (Thompson, 1960).

DAM FOUNDATION

Rockfill of the raised dam will occupy additional ground in the river bed downstream of the existing dam. In this area, bedrock is covered with red clay and spoil. Rock level is expected to be at R.L. 1670-1675. A flow of water (about 6,000 gallons per hour) emerges from the toe of the rockfill slope at about 20 feet west of the Valve House.

The old course of the river under the dam is straight and bears 140°M., this is parallel to the weathered joint in the right abutment. Thompson (1960, Plate 2) draws attention to possible steep fractures in his section along the upstream toe of the dam.

SPILLWAY SITE

SPILLING CREST AND CHUTE

Topography

The new spilling crest and chute are to be constructed on the site of the existing spillway channel. The last-named is a flat-bottomed channel 200 feet wide; its centre line is 285 feet east of the eastern end of the existing dam crest and bears 315°M. The floor of the channel is at R.L. 1742-1738. Above R.L. 1750 the west wall is cut back 30 feet.

Stratigraphy

The west wall is of agglomerate with a bed of tuff up to 3 feet 6 inches thick; the top of the tuff is at R.L. 1742 at the south end and at R.L. 1750 at the north end of the rock wall. The agglomerate overlying the tuff is mostly well-cemented but has some thin beds with a weakly cemented arenitic matrix. Below the tuff the agglomerate is mainly of arenitic matrix with lenses of pelitic material as shown in drillholes SDS18-22. Much of the arenitic agglomerate is well-cemented, with narrow beds of friable rock.

The east wall is of agglomerate with a thin bed of tuff up to 1 foot thick at R.L. 1760-1763.

Structure

Few joints occur in the agglomerate agglomerate above R.L. 1750. Three occur in the west wall and one in the east wall. All are steeply dipping with strikes of 035-050°M. The joint surfaces have a thin coating of white or yellow clay. Below the floor of the channel, one open joint was found in SDS20 and is an extension of a joint seen in the west wall. Very few joints were intersected by the other drillholes. Inspection of the floor of the channel did not reveal any joints in the exposed rock. About 80% of the floor is covered with spoil.

STILLING BASIN AND DISCHARGE CHANNEL

Topography

The site of the stilling basin is across a small creek flowing west to the Laloki River. There is a small perennial flow at the site. The present bed of the creek is at R.L. 1695-1700.

The discharge channel from the stilling basin to the Laloki River is to be on the right bank of the creek.

Stratigraphy

The sides of the creek are of red clay and agglomerate boulders, some of which are more than 20 feet long. During the Stage 1 construction, spoil was deposited along the left bank and on the right bank near the Laloki River.

The interface of rock (moderately weathered agglomerate) with the overlying completely weathered agglomerate or tuff or red clay is shown to be irregular by drillholes SDS7, SDS10-14, SDS23, SDS28-31, costeans 1 and 2, and in outcrops (Plate 4). The costeans and outcrops suggest that there is a buried cliff of agglomerate running 245°M., almost parallel to the centre line of the discharge channel and about 40 feet north of it. The top of the cliff is at R.L. 1720-1730 and the bottom is estimated to be at R.L. 1690-1700.

Above the cliff, the bedrock profile rises at about 25° to the horizontal. In the southern part of the stilling basin, the top of the moderately weathered agglomerate slopes westwards from R.L. 1720-1670. There is expected to be much weathering along joints. The drillholes in the stilling basin area yielded cores of moderately weathered to fresh agglomerate which is well-cemented. Drillholes SDS32 and SDS33 in the discharge channel yielded cores in which well-cemented agglomerate are interbedded with thin bands of weaker material.

Structure

Drillholes SDS23, SDS24 and SDS28-31 passed through numerous joints, many of which are highly weathered. There are no outcrops of rock near the drillholes. It is inferred that the dominant strike of these joints is 030-050°M. and that the spacing of them is 10 feet or less.

RIDGE EAST OF THE SPILLWAY

Topography

For 310 feet east of the existing spillway channel, the ridge has a flat top at R.L. 1765-1773; rock is exposed immediately east of the channel. Farther east, the ridge rises above R.L. 1800 as clay slopes where no outcrops of rock occur. The north and south sides of the ridge are the valleys of two roughly parallel creeks. The narrowest part of the ridge is at grid line 1640E where the distance between the creek beds is 310 feet and the creek beds are both at R.L. 1720. The upper reaches of both creeks are dry for most of the year. The lower part of the southern creek is flooded by the reservoir. There is a small perennial flow in the northern creek from a spring concealed by spoil deposited on the southern slope.

Stratigraphy

In the three investigations, a total of 18 drillholes were put down to determine the strata and subsurface contours of sound rock. Drillholes 2S1-2S4, 2S10-2S14 proved the occurrence of agglomerate with impersistent beds of tuff and weakly cemented, broken agglomerate and that the subsurface of the sound rock plunges steeply eastwards (Davies, 1960b) at about grid line 1650E. The drillholes SDS3, SDS5, SDS5, SDS8 and SDS15-17 enabled Thompson (1960) to estimate more closely the sound rock subsurface. Drillholes SDS34, SDS35 and SDS36 of the present investigation confirmed the earlier interpretations.

In the eastern part of the ridge, highly and completely weathered agglomerate overlain by red clay occur to depths exceeding 100 feet. Construction spoil was deposited in considerable quantities on both the north and south sides of the ridge.

Geological sections through the ridge are shown in Plate 5.

Structure

Existing rock exposures afford little evidence of the joint system in the ridge. It is inferred that the north and south sides are determined by weathering along joints of strike 040° of which one only is to be seen in the east wall of the spillway channel. A cliff in this direction is shown to occur in the side of the southern creek by both Davies and Thompson; it is now buried. Joints of strike 140°, if present, would readily explain the abrupt termination of high bedrock under the east part of the ridge.

SADDLE DAMS

Topography

On the northern boundary of the reservoir basin there are at present five earth dams in saddles on the divide between the catchment of the Laloki River above the dam and that of Eilogo Creek. Eilogo Creek joins the Laloki 2.2 miles bearing 351° from the main dam; the confluence is at about R.L. 1540. Many of the tributaries of the Eilogo are fed by perennial springs at R.L. 1615-1655. The springs are eroding the heads of the creeks by causing slips in the banks above them. Springs have been located downhill from saddle dams E, A, B, and C.

Vegetation at saddle dam A is grass with scattered trees; at saddle dams A, B, C, and D, rubber has been cultivated since before Stage 1 construction.

Stratigraphy

Boreholes have been sunk by the Commonwealth Department of Works to investigate the stratigraphy in the saddle dam and borrow areas. These show that red clay overlies completely weathered agglomerate and tuff. Moderately weathered agglomerate bedrock occurs at 100-200 feet depth. Below the spring line in the Eilogo tributaries highly weathered agglomerate containing unweathered pebbles of lava occurs. The only outcrop of moderately weathered to fresh agglomerate forms a high tor north-east of saddle dam D.

Structure

There is very little evidence of the joint pattern in the area of the saddle dams. One of the springs at 720 feet bearing 298°, from saddle dam B flows up through a steep fissure which is insufficiently exposed for its strike to be determined.

Groundwater

A topographical survey made before Stage 1 construction recorded several springs in the Eilogo catchment north of saddle dams A, B, and C. Recent work revealed that similar springs occur north of saddle dam E. The springs issue at the contact of highly weathered agglomerate with overlying completely weathered agglomerate and tuff.

The water table between saddle dams B and C and nearby springs was investigated in June-August, 1961 before the reservoir filled and in September-October, 1968 when the reservoir water level was at R.L. 1732 (Plate 6).

In the 1961 investigation water levels were measured in four boreholes on the crest of the saddle north of saddle dam C. The levels fluctuated irregularly with local rainfall and relative to each other. The greatest range of level was in borehole D2, R.L. 1668-1724. On one day boreholes D4 and D5 were overflowing at R.L. 1733.

In 1968, it was noted during excavation of test pit TP2 that seepage from the bottom occurred when the pit was 5 feet deep and flow from the sides below 12 feet depth. At this level, weathered tuff occurs.

Landslips

In the vicinity of the springs, slips have occurred as a result of erosion of completely weathered agglomerate and tuff. Near saddle dam E there is a slip scar, 10 feet high and of 25-foot radius, centred on a spring. Elsewhere recently slumped masses of up to 5 cubic yards can be seen north of saddle dam A; rubber trees have been damaged. North of saddle dam B, slopes are irregular and shallow scars occur but there has been no displacement of trees. In this locality, auger holes AH1, AH2 and AH3 were sampled with a driven tube to see if deep slips could be detected by the presence of slickensides or layers of soft or organic material. In AH2, the normal succession of red clay overlying completely weathered agglomerate was found to be duplicated at 7 feet 6 inches depth but there is no softening of soil or other indication of a slip.

ENGINEERING GEOLOGY

ENGINEERING PROPERTIES OF ROCKS AND SOILS

Agglomerate

The strength and resistance to weathering of agglomerate depends on the proportion and particle size distribution of the tuffaceous matrix. Agglomerate consisting of fresh lava pebbles closely packed in a pelitic matrix is strong, practically impermeable and very

resistant to weathering. The weakest agglomerate consists of scattered lava pebbles in a weakly cemented matrix of uniform sandsize particles.

Tuff

Fresh pelitic tuff is a moderately strong brittle rock. Arenitic tuff is commonly weakly cemented, of low strength and permeable. In the thicker beds of tuff, the pelitic and arenitic types commonly occur in alternate bands. Tuff is less competent than agglomerate and joints have developed within the thicker beds of tuff. As a result, tuff is more readily weathered than agglomerate.

Products of Weathering

Slightly and moderately weathered agglomerate and tuff are substantially similar in their engineering properties to the fresh rocks and, although the matrix has been weakened, they cannot be excavated with hand tools.

Highly weathered agglomerate has properties intermediate between rock and soil. It forms a cracked or exfoliated layer between moderately and completely weathered rock, consequently groundwater readily passes through it.

Completely weathered agglomerate and tuff are firm to hard silty clays or dense clayey silts in which joints commonly remain open and increase the permeability of the soil mass. Vertical faces in these soils stand up for a considerable time.

The red clay forms a mantle over nearly all of the Sogeri plateau. It is much less permeable than the completely weathered agglomerate and tuff which it overlies. The red clay is considered to be an important factor contributing to the watertightness of the reservoir.

EXCAVATION

Excavation of soil

For temporary excavations in soil, steep batters can be cut. Permanent batters of $\frac{1}{2}$ to 1 (horizontal to vertical) in completely weathered agglomerate, and 1 to 1 in red clay would be stable. However, experience has shown that cuts in soil, and soil embankments, in the area are slow to revegetate, consequently they would erode before stabilization by naturally-propogated plants could take place.

Excavation of rock

Steeply dipping joints are rare in the sites of the main dam and spillway chute therefore the fragmentation of rock will be by the explosive alone and much energy may be lost through the escape of explosion gases along horizontal partings. As rock from the spillway chute excavation can be used for rock fill in the main dam, careful judgment will be required to break out material of the desired size. Further, as the agglomerate is brittle, care will be needed to minimize undesirable cracking of the walls and floors of excavations made by explosives. Experience gained during Stage 1 and Rouna construction should provide a useful guide. In any places where undamaged rock is required in the walls of excavations line drilling, or even hand mining, may be necessary.

MAIN DAM

Left abutment

It may be necessary to extend the upper part of the steel membrane farther west in order to lengthen the leakage path in rock on the downstream side of the concrete cutoff. The weathered joint exposed in Costean 5 should be excavated deeper and upstream to determine its attitude and extent.

Right abutment

The weathering in the joint located in drillhole SDS27 and Costean 4 is at least 80 feet deep. The water pressure test in drillhole SDS27 indicates a permeability of 200 feet/year in the tested section at 35'6" - 92'9" depth. If it is assumed that the leakage occurred only in the highly and completely weathered rock at 42' - 83' depth, then the permeability is about 300 feet/year. Inspection of the vicinity upstream and downstream of the abutment found no sign of leakage to surface after the test. Although the measured permeability is low, it is very likely to increase owing to chemical change in the joint filling. The chemical factors are:

(a) The joint filling of weathered agglomerate and tuff contains oxides of iron and aluminium which are soluble in acid water.

(b) The water in the deeper parts of the reservoir is acid because of dissolved hydrogen sulphide. This condition has been brought about by the rotting of vegetation in the reservoir.

It is therefore desirable that the weathered material be replaced with concrete as much as possible and grouted in depth by stages. Weathered material should be removed by jetting in the grout holes before injecting neat cement grout.

Dam Foundation

The cause of leakage through or under the existing dam may be found by examining the bedrock for joints. For this purpose the rock should be thoroughly cleaned by sluicing or other effective means.

SPILLWAY

Spillway Crest and Chute

In the first two feet below the existing spillway floor, the rock is extensively broken. The foundations for the crest and non-spill walls should be on sound rock at 5 feet depth(about R.L. 1734) and continued at this level across the rock bench on the west side of the channel. The rock of the bench is shattered.

Excavation for the chute is expected to be in sound rock with few joints on the west side and probably more joints and more weathered rock on the east side.

Permeability indicated by water pressure tests is low or practically nil. . Water levels in drill holes stood at R.L. 1735-1737. The grout curtain of the spillway crest and walls would be most effectively formed through holes drilled to intersect specific joints located by inspection.

Stilling Basin and Discharge Channel

In the stilling basin, the top of bedrock is expected to be at R.L. 1680-1690 except on the north side where it rises abruptly to R.L. 1730 and higher. Numerous weathered joints occur in the bottom of the basin. The dominant strike is expected to be parallel to the north wall of the stilling basin. The proposed slope of 1 horizontal to 2 vertical is expected to be stable but allowance should be made in the contract for rock bolting.

Measured permeabilities are generally low, the maximum is 400 feet/year. Standing water levels measured in drillholes are at R.L. 1690-1710 therefore artesian conditions will prevail.

Ridge East of the Spillway

The problem presented here is the leakage of water through the ridge. In the high mass of moderately weathered to fresh agglomerate adjacent to the spillway channel, Davies (1960b) found a narrow zone of high permeability at R.L. 1708 in drillhole 2S1 (Plate 5). In drillhole 2S11 the high permeability of 8,000 feet/year was found near the top of the rock. In this locality, the bedrock subsurface begins to plunge steeply eastwards and joints with wide zones of weathering can be expected. It is highly probable that leakage through the highly weathered mantle of the tor will be

significant. The permeability of the completely weathered agglomerate farther east has not been determined. It is expected to be similar to that of the same kind of material tested at saddle dams B and C.

SADDLE DAMS

From available evidence, the water table in the divide between the reservoir and the basin of Eilogo Creek has not changed substantially since the reservoir filled. The reservoir has a natural impermeable lining of red clay overlying the more permeable completely weathered agglomerate and tuff. It is suggested that leakage of water to the ground is mainly where rock crops out or where the clay cover has been removed. It is desirable that borrow pits within the reservoir should not be excavated to the full depth of red clay.

The springs feeding the tributaries of Eilogo Creek have existed since the drainage was incised below the water table. Erosion by the springs, and by runoff on the slopes above them, causes the sites of the springs to move southwards. The stability of the slopes on the north side of the saddles is endangered thereby. It is necessary to prevent erosion by containing the springs in suitable filter drains and controlling runoff by constructing drains on the slopes above the springs.

In the saddles of saddle dams B and C, the test pits and auger holes show that the groundwater below the red clay cover rises to the surface.

The existing saddle dam E is a low bank about 300 feet north-west of the proposed site for the new dam. There is a considerable area of swampy ground on the reservoir side of the existing dam. At present the drainage is towards the reservoir. Drainage will be necessary.

CONSTRUCTION MATERIALS

The rock-fill of the main dam is to be fresh or slightly weathered, well-cemented agglomerate. This rock can be identified by the dark blue-grey or purplish-brown colour of the matrix; the matrix is only slightly bruised by a normal blow from a 2 lb. hammer.

The fracture logs of drillhole cores indicate that much of the agglomerate will break into large fragments because of the rarity of natural partings and joints. Most of the weakly cemented agglomerate and thinly bedded tuff will break to a small size during blasting but it is desirable that material proposed for rock-fill should be inspected before it is placed in the embankment.

About 72,000 cubic yards of rock-fill is required for raising the main dam. Suitable rock can be obtained from the excavation for the spillway chute and stilling basin. Rock from the discharge channel is considered to be generally unsuitable. The volume of suitable rock, in place, is estimated at 79,000 cubic yards. After allowing for 20% wastage in breaking the rock and a bulking factor of 40%, the volume of rockfill material from this source becomes 88,000 cubic yards.

The yield of material suitable for rock fill will depend largely upon the blasting technique.

If the spillway and stilling basin excavation does not yield sufficient material, additional rock can be obtained by enlarging the stilling basin, which is to be unlined.

The spillway and stilling basin can also provide coarse aggregate for making concrete. Agglomerate containing abundant coarse pebbles and boulders is most suitable for crushing because the lava fragments are broken out of the tuffaceous matrix to yield an aggregate of crushed basalt. Raw material containing much tuff should be rejected. Tests for potential alkali reactivity should be carried out on coarse aggregate.

Material for the riprap in the upstream faces of the saddle dams is obtainable from the high tor north of saddle dam D.

There are no local deposits of sand suitable for concrete making. The nearest commercial deposits are at Brown River, a road distance of about 40 miles from Sirinumu.

WATER

Analyses of surface water from Sirinumu reservoir and from the springs near saddle dam B are given in Appendix 4. Both waters are chemically suitable for making concrete and are innocuous in prolonged contact with concrete structures; further they are not likely to cause clogging of filter drains.

The water discharged through the dam to the Laloki River is drawn from the bottom of the reservoir. It contains dissolved hydrogen sulphide and, after aeration, colloidal ferric hydroxide is precipitated from it to form a rusty slime. This water should not be used in construction work.

The effect of the bottom water on concrete is not known and it is advisable to inspect existing submerged structures for deterioration.

From the evidence of drillholes, it is expected that the completed excavations for the spillway chute and stilling basins will be below the water table at heads of up to 60 feet. The inflow of groundwater to the stilling basin is roughly estimated at 20,000 gallons per day but this could be greatly exceeded if open joints occur.

SEISMICITY

The recorded history of earthquakes felt in the Sogeri plateau is short and only shocks of low intensity have been felt. According to Brooks (1965) the strongest shock to be felt in 100 years, statistically would not be expected to exceed intensity VI on the Modified Mercalli Scale. Such a shock would cause a ground acceleration of about 1 foot/second^2 (0.03g) and would not affect a well-designed and well-constructed structure. However, a shock of felt intensity VI on a rock foundation will be felt at a higher intensity when the shock passes into thick deposits of soil. Thus the effects of earthquakes are not significant in the design of the main dam and spillway which have rock foundations but they should be considered in respect of the saddle dams which will stand on a thick layer of residual soils derived from volcanic rocks.

CONCLUSIONS

1. The foundation and abutments of the main dam are of moderately weathered to fresh agglomerate. Beds of tuff in the left abutment are thin and impersistent; in the right abutment, there is a bed of tuff up to 3'6" thick at about R.L. 1740.

2. Joints are rare in the dam site. Strikes are 000°, 025°, 040° and 145° magnetic for steeply dipping joints; a flat joint has a strike of 315°M., and dips 30 - 35° west. Weathered zones, along joints, up to 5 feet wide have been observed.

3. In the left abutment, one deeply weathered joint of 315°M. strike and 30° - 35° west dip occurs and is considered not to be of great significance to the design of the dam.

4. In the right abutment, a nearly vertical joint strikes 145°M., at right angles to the axis of the dam. Drilling found the width of complete weathering to be 4 feet at R.L. 1714. The joint filling is of low permeability but there is a risk of deterioration due to the acidity of the bottom water of the reservoir.

5. An unrecorded joint of strike 145°M., or alternatively the joint along the face of the right abutment to the existing dam, may be the cause of leakage under the existing dam.

6. The spillway crest and chute will be founded on moderately weathered to fresh agglomerate with very little tuff below R.L. 1740. A bed of tuff up to 3'6" thick occurs at R.L.1740-1752 in the west side of the existing channel. Joints are rare in the agglomerate but common in the tuff bed.

7. The stilling basin and discharge channel are to be excavated in the bed of a creek below which the agglomerate is weathered along numerous joints.

8. Artesian groundwater conditions will prevail in the stilling basin.

9. In the ridge running eastwards from the spillway the bedrock plunges steeply at about 300 feet from the spillway to depths greater than 100 feet. Completely weathered agglomerate was found in drill holes to R.L. 1680.

10. Narrow zones of high permeability occur in the bedrock of the ridge and leakage is expected in the cracked and weathered rock enveloping the bedrock. Consequently, if the clay blanket on the ridge does not prevent entry of water into the rock of the ridge, leakage from the reservoir through the ridge may occur.

11. The sites of the saddle dams are on red clay overlying completely weathered bedrock and tuff to depths of 100 - 200 feet.

12. The water table in the divide between the Laloki River and Eilogo Creek basin rises to the bottom of the saddles at R.L. 1730, (saddle dams B and C) in holes or pits penetrating the red clay cover. This occurred in both Stage 1 and Stage 2 investigations.

13. Tributaries of Eilogo Creek have cut their beds below the water table and a spring line occurs in the basin at R.L.1615 - 1655 at the contact of completely weathered agglomerate on the highly weathered rock beneath.

14. Erosion by the springs has aided, and continues to aid, the cutting back of the Eilogo Creek tributaries into the saddles.

15. The reservoir is not contributing much water to the springs because the reservoir basin is floored for the greater part by impermeable red clay.

16. Agglomerate from the excavation of the spilway chute and stilling basin should provide sufficient suitable material for the rock-fill of the main dam. Alternative sources of material for rock-fill and coarse aggregate for concrete are the high outcrops west of the dam and north of the spillway.

17. Riprap for the saddle dams can be won from the high tor north of saddle dam D.

18. Estimates of earthquake risk are that a shock of intensity no higher than VI can be expected once in 100 years. Seismic loads need not be taken into account in the design of the main dam and spillway which have rock foundations. In the sites of the saddle dams, the same shock could have a higher intensity in the thick layer of completely weathered material.

RECOMMENDATIONS

1. The weathered joint in the left abutment should be excavated deeper and upstream to determine the attitude of the joint.

2. The steep weathered joint in the right abutment should be made watertight by thorough grouting; a concrete grout cap may be needed where the joint is exposed below top water level.

3. For the foundation of the rock-fill, all clay and completely weathered rock and all loose rock should be removed. All joints should be inspected and pockets of clay should be removed. The contractor should report all seepages and flows of water when they are discovered.

4. The concrete cut-off and anchor of the steel membrane should be 3 feet wide and 3 feet deep in sound rock, in accordance with the design of Stage 1.

5. Foundations for the spilling crest and adjoining walls should be at R.L. 1734 over the entire width of the existing spillway channel (230 feet).

6. The foundations of the spillway chute, deflector bucket and associated training walls are expected to be in sound rock of low permeability. No special requirements of design are foreseen.

7. The grout curtain of the spillway crest and main dam to 30 feet depth into rock should be formed by injection through holes drilled to meet specific joints and fractures in addition to primary holes drilled at 10 feet spacing.

8. Rock bolts, with expanding shell or similar type of anchors, and grouted anchor bars can be satisfactorily used in moderately weathered to fresh, well-cemented agglomerate provided that normal good practice is followed. Tuff, weakly cemented agglomerate and the proximity of weathered joints should be avoided in choosing positions for rock bolts and anchor bars.

9. The leakage through the ridge east of the spillway should be studied further. The spring in the creek north of the ridge should be located, after removing debris from the creek bottom, and the discharge measured. Piezometers should be installed along the ridge to observe groundwater movement. The watertightness of the ridge can probably be improved by placing a rolled clay blanket on its south side between the bed of the creek and top water level.

10. The sensiitivity of clay to be used in the saddle dams should be determined. Design of the embankments will be affected by the seismic response of the clay, but, in any case, owing to the thickness of clay in the foundations allowance should be made in the design of the embankment for seismic acceleration.

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APPENDIX 1

DEFINITIONS OF SEMI-QUANTITATIVE DESCRIPTIVE TERMS

The following terms have been used in this report:-

Grade Scale

Coarse-grained	$\frac{1}{2}$ m.m. to 1 m.m. in diameter
Medium-grained	$\frac{1}{4}$ m.m. to $\frac{1}{2}$ m.m. in diameter
Fine-grained	less than $\frac{1}{4}$ m.m. in diameter

Weathering

Fresh	Rock shows no discolouration, loss of strength nor any other defect due to weathering.
Slightly weathered	Rock is slightly discoloured but not noticeably lower in strength than fresh rock.
Moderately weathered	Rock is discoloured and weakened to an extent that the tuffaceous component can be readily broken. Lava fragments are still fresh.
Highly weathered	Rock is cracked and much discoloured with iron-staining, tuffaceous components completely altered and only fragments of dense lava remain unweathered.
Completely weathered	The rock is changed entirely to a soil with the original fabric preserved.

APPENDIX 2

Geological Logs of Diamond Drill Holes

Note Drillholes SDS25 and SDS26 were not drilled

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2

LOCATION W. side of existing spillway

ANGLE FROM HORIZONTAL -90° DIRECTION -

COORDINATES 1194 E 531 N R.L. 1740·0

HOLE NO SDS18

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CORE LOSS	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE LOSS	CORE LOSS
Gravel	Crushed agglomerate		NMS								
Agglomerate moderate to slight weathering	Pelitic, brownish-grey matrix, some pebbles weathered										
	Arenitic, brownish to dark grey matrix friable 8'-16' 20'-21' 23'9"-25'		10				0° 12" clay and alteration				
	Pelitic tuff 23'2"-23'3"		20				60° ½" clay				
			27'6								

DRILL TYPE Mindrill P50HT

FEED Hydraulic

CORE BARREL TYPE NMS

5' capacity

DRILLER M. Larivite

COMMENCED 12·9·67

COMPLETED 14·9·67

LOGGED BY I.S. Cumming

VERTICAL SCALE 1" = 10'

NOTES

FRACTURE LOG Number of fractures per foot of core. Zones of core loss are blacked in.

BEDDING AND JOINT PLANES – Angles are measured relative to a plane normal to the core axis.

Single tube corebarrel, 1' long used to 5' depth.

WATER PRESSURE TESTS

PACKER TYPE

SUPPLY LINE

VERTICAL SCALE

Pressures given are gauge pressures. Test sections are indicated graphically by blacked in strips.

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Centre of existing spillway

ANGLE FROM HORIZONTAL: -90° DIRECTION: —

COORDINATES: 1268E 559N R.L. 1740·6

HOLE NO. SDS 19

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO: CORE BOX	PHOTO REF NO: CORE BARREL
Agglomerate moderate to slight weathering	Matrix mainly arenitic, friable at 3'-6' 18'-18'3", 19'-19'3" Tuff 8'1"-8'2"		NMS 10 20 27'6"				45°, coated		0·025 0·050 10 15 20 15 10 10 15 20 15 10		

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 27·9·67
COMPLETED: 28·9·67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 50'

NOTES

FRACTURE LOG.- Number of fractures per foot of core. Zones of core loss are blacked in.
BEDDING AND JOINT PLANES -- Angles are measured relative to a plane normal to the core axis.

Single tube corebarrel, 1' long, used to 5' depth.

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rod
VERTICAL SCALE: 1" = 50 psi.
Figures given are gauge pressures.
Test sections are indicated graphically, by blacked in strips.

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE:
COLOUR:

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GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: W. side of existing spillway

ANGLE FROM HORIZONTAL: -90° DIRECTION: —

COORDINATES: 1176E 584N R.L. 1739.0

HOLE NO. SDS 20

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO. CORE BOX	PHOTO REF NO. CORE LARGE
Gravel	Crushed agglomerate				Not cored		2'-7', drilling water escape to ground level along joint				
Agglomerate. slight to moderate weathering	Pelitic brownish-grey matrix, some weathered pebbles. Boulders up to 12" size.		NMS				70°		0.025 0.050		
			10				45° 60° 65° All joints are coated with buff-coloured chalky material Some clay and alteration of walls.		No seal with packer		
	Tuff 15'7" – 15'10"						85° 60° 40°		15 25 35 25 15		
			20				45°				
			29								

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 20.9.67
COMPLETED: 22.9.67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blacked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis.

Single tube core-barrel, 1' long, used to 5' depth.

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rod
VERTICAL SCALE: 1" = 50 p.s.i.
Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE:
COLOUR:

C55/A7/44 (3 of 23)

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GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Centre of existing spillway

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 1257 E 644 N R.L. 1739.7

HOLE NO. SDS 21

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX REF. NO.	CORE BARREL NO.
Agglomerate moderate to slight weathering	Pelitic brownish-grey matrix; pebbles up to 4" size		NMS				No joints occur		0 0·05 0·1		
	Pelitic tuff 9'3½" – 9'4"										
	Arenitic matrix with friable rock at 10'6" – 12' 16'9" – 19'3"		10						10 15 20 15 10		
			20						10 15 20 15 10		
			27								

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Lasivita
COMMENCED: 25·9·67
COMPLETED: 27·9·67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

Single tube corebarrel, 1' long, used to 5' depth.

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods.
VERTICAL SCALE: 1" = 50psi.
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

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GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2

LOCATION N.W. Corner of existing spillway

ANGLE FROM HORIZONTAL -90° DIRECTION -

COORDINATES 1125E 733N R.L. 1740

HOLE NO. SDS 22

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX	PHOTO REF. NO. CORE NO. RANGE
Clay	Firm to stiff red clay with stones				Not cored						
Agglomerate completely weathered	Hard silty clay; red, yellow and brown mottling with boulders of agglomerate		NMS 10								
Agglomerate moderately weathered	Pelitic brownish grey matrix; many cobbles of vesicular lava		20						0·01 0·02		
Agglomerate slightly weathered	Arenitic matrix; beds of small pebbles and of boulders up to 18" size; friable matrix at 22'4" - 24'4" 34'4" - 35' 49' - 50' Tuff 37'7" - 38'		30 40 50								

DRILL TYPE Mindrill F30KT

FEED Hydraulic

CORE BARREL TYPE NMS 5' capacity

DRILLER M. Larivita

COMMENCED 29·9·67

COMPLETED 2·10·67

LOGGED BY I.S. Comming

VERTICAL SCALE 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blacked in

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE Hydraulic sleeve

SUPPLY LINE N rods

VERTICAL SCALE 1" = 50p.s.i.

Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

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GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Left abutment of main dam.

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 529 E 604 N R.L. 1784

HOLE NO. SDD 23

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
Red clay											
Agglomerate, mainly tuffaceous with beds of tuff, moderate weathering	Matrix light brown, mainly arenitic, with well cemented pelitic bands		NMS		Not cored		75° coated		0·002 0·004		
			10				60° coated				
	Arenitic tuff, pelitic at base 17'-18'3"						75°				
			20						5 10 15		
	Pelitic tuff 23'-23'9" 24'9"-25'4"										
			30				70°		13'6"-73'5"		
							70° coated				
	Agglomerate with small pebbles 36'-52'		40						10 20 30 20 10		
			50				65° coated				
	Badly broken core at 52'-53'						70° "				
							80° "				
							80° "				
							60° "				
							80° "				
			60				70° "				
							50°				
							75°		11·1·68		
	Pebbles closely packed below 63'6"										
			70				80° coated & broken				
			73'5"				70° coated		33'6"-73'5"		

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 3·11·67
COMPLETED: 8·11·67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.

BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50psi.

Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE:

COLOUR:

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: S. side of creek; 193ft bearing 035° Mag. from Valve House.

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 1047E 843N R.L. 1722

HOLE NO. SDS 23

SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
Clay with boulders	Soft to firm clay with crushed rock and loose boulders 0-15'				Not cored						
			10								
			NMS					5·10·67			
	Boulder of slightly weathered agglomerate		20					10·10·67			
								14·10·67			
Agglomerate completely weathered	Stiff to hard red, brown and yellow silty clay		30								
Agglomerate and tuff, slight to moderate weathering	Pelitic brownish-grey matrix; lava cobbles up to 6" size, well cemented		40						0·0005 0·0010		
			50								
	Tuff at 56'10"-57'2" 57'4"-57'10" 59'5"-60'2"										
Agglomerate, fresh with local alteration	As above but with grey matrix Toff at 63'5"-63'6"		60						0·002 0·004		
	Matrix of buff-coloured material 68'3"-68'8"		70				- 60°				
Agglomerate and tuff, complete to moderate weathering with clay	Brown clay with coated lava pebbles 71'9"-75' Toff at 75'-76'9" C.W. agglomerate at 76'9"-79'6"						- 45° coated - 20° " - 45° " - 90° "		71'6"-85'		
			80								

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 3·10·67
COMPLETED: 9·10·67
LOGGED BY: I.S. Comming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50 p.s.i.
Figures given are gauge pressures
Test sections are indicated graphically by blacked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE:
COLOUR:

C 55/A7/44 (7 of 23)

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: S. side of creek; 193 ft bearing 035° Magnetic from Valve House

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 1047E 843N R.L. 1722

HOLE NO. SDS23

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
Agglomerate and tuff; complete to moderate weathering, and clay	Broken M.W. agglomerate 79'6" - 87'6" C.W. tuff at 81'-81'6", 82'-82'3", 83'2"-83'4" 84'4"-84'6", 87'6"-88'.		80 NMS 90				60° coated 70° 80° 75° coated 70°, 45° coated 65° coated 70° 45° coated		0.002 0.004 30 40 50 40 30 71'6" - 100'		
Agglomerate, slight weathering	Pelitic grey and brownish-grey matrix		100								

DRILL TYPE: Mindvill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 3.10.67
COMPLETED: 9.10.67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core Zones of core loss are blacked in

BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50 p.s.i.
Figures given are gauge pressures
Test sections are indicated graphically by blacked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Creek bottom; 192ft bearing 005° Magnetic from Valve House

ANGLE FROM HORIZONTAL: -44° DIRECTION: 137°M.

COORDINATES: 982E 920N R.L. 1687

HOLE NO. SDS 24

SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BURNED
Clay	Yellow, red and brown silty clay with boulders of agglomerate		NMS		Not cored						
	Boulder, slightly weathered		10								
Agglomerate and tuff: slightly weathered to fresh	Pelitic matrix, dark grey colour		20								
	Sandy layer dip 45° 24'3" – 24'5"										
			30				45° coated				
							30° "				
	Lapilli tuff 35'-35'11" dip 40°										
	Firm grey silty clay with fresh lapilli – swelling 35'11"-36'1" and 37'-39'3"		40				Drill water shut off				
							30° coated		0·005 0·010		
							40°				
							60°				
							45°				
			50				80° ½" white clay				
							60° coated				
							45° "				
							45° "				
	Tuff 60'6" – 61'		60				30° "				
							45° "				
							60° "				
			70								
			80								

DRILL TYPE: Mindrill F30RT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 11·10·67
COMPLETED: 20·10·67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blacked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50psi
Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

C55/A7/44 (9 of 23)

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2

LOCATION Creek bottom; 192ft bearing 005° Magnetic from Valve House

ANGLE FROM HORIZONTAL -44° DIRECTION 137° M

COORDINATES 982E 920N R.L. 1687

HOLE NO. SDS 24

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO. CORE BOX	PHOTO REF NO. CORE BARREL
Agglomerate moderately weathered to fresh	Pelitic matrix with some weathered pebbles		80				45° 65° coated 25° " 60° "		0.005 0.010		
			NMS				60°		30 40		
	Moderately weathered agglomerate 89'-97½"		90				10° coated		50 40		
							75° " 20° "		30		
							30° " 45° "		20		
			100						7½" - 100'		

DRILL TYPE Mikdrill R30RT
FEED Hydraulic
CORE BARREL TYPE NMS 5' capacity
DRILLER M. Larivita
COMMENCED 11·10·67
COMPLETED 20·10·67
LOGGED BY I.S. Cumming
VERTICAL SCALE 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in

BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE Hydraulic sleeve
SUPPLY LINE N rods
VERTICAL SCALE 1" = 50psi.
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Right abutment of main dam

ANGLE FROM HORIZONTAL: -60° DIRECTION: 065°M.

COORDINATES: 1000E 652N R.L. 1778

HOLE NO. SDS 27

SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF. NO. CORE BOX	PHOTO REF. NO. CORE & SHARDS
Topsoil	Red silty clay				NIL						
Agglomerate moderate to slight weathering	Pelitic matrix		NMS								
	Arenitic matrix with friable beds at 25'-26', 30'-30'3" and 32'9"-33'		10								
	Abundant pebbles of vesicular lava		20				30° 1" yellow clay				
	Lapilli bed at 26' dip 20°						75° coated				
			30				60° "				
	Pelitic matrix with arenitic bed at 38'-38'9"								0·10 0·20		
			40				45° " 30° 1" yellow clay				
Tuff moderately weathered	Light brown pelitic tuff; sandy layer near base						60° Mn staining 45° 60°				
Agglomerate highly weathered	Arenitic red-brown matrix, most pebbles weathered on surface		50					31·10·67 9·1·68	5 10 15 20 25 30 25 20 15 10 5		
	Friable at 46'5"-47' 47'9"-48'2" 50'-50'6" 55'5"-56'6" 59'4"-59'8" 61'-68'6"		60				45°, 30°, 70°				
							70° 70°				
Agglomerate completely weathered	Multicoloured silty clay with lava fragments		70								
Agglomerate highly weathered	Pelitic matrix, easily crushed.		80						Water pressure test 35'6"-92'9"		

DRILL TYPE: Mindrill F30KT

FEED: Hydraulic

CORE BARREL TYPE: NMS 5' capacity

DRILLER: M. Larivita

COMMENCED: 26·10·67

COMPLETED: 30·10·67

LOGGED BY: I.S. Cumming

VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.

BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

1. Single tube corebarrel used to 3' depth
2. Drill water did not fully return below 40' depth

WATER PRESSURE TESTS

PACKER TYPE: Hydraulic

SUPPLY LINE: N yods

VERTICAL SCALE: 1" = 50psi

Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2

LOCATION Right abutment of main dam.

ANGLE FROM HORIZONTAL -60° DIRECTION 065°M.

COORDINATES 1000E 652N R.L. 1778

HOLE NO. SDS27

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX	PHOTO REF. NO. CORE BARREL
Agglomerate highly weathered			80								
Agglomerate moderately weathered	Pelitic matrix, well cemented		NMS 90 92'9"								

DRILL TYPE Miadrill F.BOKT

FEED Hydraulic

CORE BARREL TYPE NMS 5' capacity

DRILLER M. Larivita

COMMENCED 26·10·67

COMPLETED 30·10·67

LOGGED BY I.S. Cumming

VERTICAL SCALE 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blacked in.

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE Hydraulic sleeve

SUPPLY LINE N rods

VERTICAL SCALE

Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: N. end of existing spillway channel; centre line of proposed spillway.

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 1136E 801N R.L. 1735

HOLE NO. SDS28

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE SAMPLE
Overburden - spoil, clay and boulders	Dark brown plastic clay with agglomerate pebbles and boulders		NMS								
Agglomerate completely weathered	Orange-grey silty clay with agglomerate texture apparent Easily crumbled between fingers; some pebbles crushing with a single hammer blow		10				Joints dip at 10°, 30° and 70°	16.11.67 24.11.67			
Agglomerate highly weathered	Angular to elongate pebbles up to 1" size in tuffaceous matrix Completely weathered at 25'9" - 28'		20								
Agglomerate moderately weathered	Vesicular lava fragments up to 5" size Grey tuff 38'10" - 39'2" Tuff 44' - 45'		30				Joints nearly horizontal	15.11.67			
			40				42'-42'7" Crushed 43'2"-43'10" clay filled				
Tuff, slightly weathered	Grey finegrained arenitic		50				0° bedding 40° thin white clay filling		0.005 0.010		
Agglomerate moderately weathered	Vesicular lava fragments up to 4" size		60				85° clay coated 60'-60'6" Crushed 61'-61'5" clay filled 61'6"-62'3" Branching fractures, clay filled		20 30 40 Increase in leakage 40 30 20		
Agglomerate slightly weathered to fresh	Grey brown with vesicular lava fragments up to 4" size Grey vesicular lava with swirled structure at top 70-72' Baked clay at 72', ¼" thick Vesicular lava fragments up to 6" size		70								
			80						51' - 82'3"		
			82'3"								

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 13.11.67
COMPLETED: 15.11.67
LOGGED BY: J.C. Braybrooke
VERTICAL SCALE: 1" = 10'

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50psi.
Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: N. end of existing spillway; centre line of proposed spillway

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 1128E 834N R.L. 1733

HOLE NO. SDS 29

SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX NO.	CORE BARREL NO.
Spoil clay and boulders	Brown clay with boulders and broken fragments of agglomerate; some pieces of wood		NMS		Not cored						
			10								
								28·11·67			
			20								
Agglomerate slightly weathered	Grey and red vesicular lava and grey tuff fragments up to 8" size in tuffaceous matrix						Joints dip 45°-55°				
			30					23·11·67	0·20 0·40		
Agglomerate completely weathered	Iron-stained soft matrix pebbles easily crushed						Joints dip 0°-20°				
							33'1"-33'11" Crush zone				
Agglomerate moderate to high weathering	Grey & brown moderately hard and strong						Joints dip 15°.30°.50°		20 30 20 10		
	Yellow, brown, weak 37'5"-38'5" Vesicular lava at 39'1"-40',		40				40'10"-41'7" cream clay between lava fragments				
Agglomerate slightly weathered	Lava fragments up to 3" size						45'-47'2" very vuggy		31'-54'		
	Grey tuff 51'10"-52'9"		50				Joints dip 0°-10° with irregular surfaces, some dip 50°				
							54'9"-55'8" irregular joint dip 80° with soft infilling of cream vitreous material				
			60				58'6" uneven 75° joint with thin white and black filling		30 40 50 40 30		
	Fine grained tuff 64'5"-66'6"						64'6" clean 70° joint				
	Grey fine grained vesicular lava, irregular upper surface, lower surface dips 10° and coated with smoky white vitreous material 66'8"-67'8"		70				72'10"-73'1" Highly weathered zone		46'6"-92		
	As above with upper surface dipping 20° and lower surface horizontal 69'3"-70'						-30° ¼" clay filling				
							76'-76'6" broken				
			80								

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS
5' capacity
DRILLER: M. Larivita
COMMENCED: 21·11·67
COMPLETED: 24·11·67
LOGGED BY: J.C. Braybrooke
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N Yads
VERTICAL SCALE: 1" = 50psi
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: N. end of existing spillway; centre line of proposed spillway

ANGLE FROM HORIZONTAL: -90° DIRECTION: —

COORDINATES: 1128E 834N R.L. 1733

HOLE NO. SDS 29

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
Agglomerate slightly weathered			80				81'5" 1" broken with brown silty clay				
			NMS								
			83'8"								
No recovery	Returning water creamy brown colour with particles of cream vitreous material										
			87'6"								
Agglomerate moderate to slight weathering			90				-45°				
			92				90'5"-90'9" broken				

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 21.11.67
COMPLETED: 24.11.67
LOGGED BY: J.C. Braybrooke
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core Zones of core loss are blacked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N yods
VERTICAL SCALE: 1" = 50psi
Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: N. bank of creek; centre line of proposed stilling basin-foundation.

ANGLE FROM HORIZONTAL: -45° DIRECTION: 134° Mag.

COORDINATES: 1107E 929N R.L. 1703

HOLE NO. SDS30

SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX REF.	PHOTO REF. NO. CORE/ PAPER
Clay and boulders	Plastic chocolate clay with boulders of agglomerate	Q			Not cored						
	Boulder of moderately weathered agglomerate 8'-10'11"		NMS 10				30.11.67 1.12.67				
Agglomerate slightly weathered	Moderate to high weathering at 14'-15'4". Fragments of fine-grained tuff and vesicular lava up to 6" size		NMS 20				Irregular joints		0.01 0.02		
	24'4"-25'6" Fine grained tuff or lava top dips 50° bottom 15° in same direction		30				40° Irregular surfaces 60° coated with soft grey green clay		15 25 35 25 15		
							1/10" soft white infilling 25° between fragments				
			40								
	45'5"-45'11" Soft, weak grey green greasy clay with occasional pebbles of agglomerate						45° 1/10" soft grey green infilling				
	46'11"-46'7" No recovery		50				40° joints, opposing dips 40°		30 40 50 40 30		
							53'9"-55'8" finely crushed zone				
			60				57'-58" broken				
			70				45° joints strike at 90° 40° to each other 50° coated				
							45° joints strike at 45° 90° to each other 45°				
							77'5"-77'9" crush zone Horizontal joint, 1" H.W. sandy clay				

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Lacivita
COMMENCED: 27.11.67
COMPLETED: 1.12.67
LOGGED BY: J.C. Braybrooke
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis.

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50 psi.
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE:
COLOUR:

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: N. bank of creek; centre line of proposed stilling basin - founaation

ANGLE FROM HORIZONTAL: -45° DIRECTION: 134° Mag.

COORDINATES: 1107E 929N R.L. 1703

HOLE NO. SDS 30

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE REF. ROLL NO. CORE BARREL
Agglomerate slightly weathered	95'1"-95'11" Fine grained grey tuff top dips 60° bottom 40°		80 NMS 90 96				85'1"-85'6" Broken zone with vitreous sandy clay 45° Irregular joint 93'9"-93'11" broken 30°		0·10 0·20 30 40 50 40 30 72'-96'.	

DRILL TYPE: Mindrill F30RT
FEED: Hydraulic
CORE BARREL TYPE: NMS
5' Capacity
DRILLER: M. Larivita
COMMENCED: 27·11·67
COMPLETED: 1·12·67
LOGGED BY: J.C. Braybrooke
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core Zones of core loss are blacked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50 p.s.i.
Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE:
COLOUR:

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: N. bank of creek; centre line of proposed stilling basin - N. wall.

ANGLE FROM HORIZONTAL: -80° DIRECTION: 314° Mag.

COORDINATES: 1107E 929N R.L. 1703

HOLE NO. SDS 31

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BARREL
Clay with boulders	Chocolate soft to firm silty clay with boulders of agglomerate		NMS 10		Not cored			7·12·67 6·12·67 11·12·67 5·1·68		
Agglomerate moderately weathered	Grey brown moderately strong agglomerate 16'-16'5" vesicular lava		20				clean irregular joints dip 15°, 25°, 35° broken zone		0·005 0·010	
	25'7"-26' Finegrained grey lava top is flat, bottom dips 45°						25'-25'4" broken zone highly weathered with brown sandy clay		10 20 30 20 10	
Agglomerate moderately to slightly weathered	Grey strong agglomerate		30				E 40°-45° Joints rough surfaces, thin filling of brown vitreous material			
	47'-48'3" grey vesicular lava, bottom dips 60°		40				broken zone			
	51'8"-52'9" grey vesicular lava, bottom dips 35°		50						20 30 40 30 20	
Clay	No core recovered Return water brown colour									
Agglomerate							90° 80° broken zone			
Clay	No core recovered		60							
Agglomerate										
Clay	No core recovered Return water brown colour		70		Nil					
Agglomerate moderately to slightly weathered	Strong hard grey brown agglomerate		79							

DRILL TYPE: Mindrill F30KT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED: 4·12·67
COMPLETED: 7·12·67
LOGGED BY: J.C. Braybrooke
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50psi
Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE
COLOUR

C55/A7/44 (18 of 23)

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Discharge Channel

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 917E 951N R.L. 1695

HOLE NO. SDS32

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF. NO. CORE BOX	PHOTO REF. NO. CORE BARREL
Clay					Not cored						
Agglomerate moderate to slight weathering	Grey brown, hard, strong agglomerate with thin zones of soft, weak, highly weathered agglomerate at 4'6"-5', 24'-24'3", 30'3"-30'5", 32'10"-33'		10				10° 45° broken, coated 50° conjugate, clay filled 15·12·67 4·1·68 13'8"-14' broken 10° ½" weathering 65° uneven, weathered 45° weathered 65° conjugate		0·10 0·20		
			20				5° 0° 45° weathered		5 10 15		
			30				29'7"-29'9" broken 30'3"-30'5" " 32'10"-33' "				

DRILL TYPE: Mindrill F30KT

FEED: Hydraulic

CORE BARREL TYPE: NMS 5' capacity

DRILLER: M. Larivita

COMMENCED:

COMPLETED: 15·12·67

LOGGED BY: J.C. Braybrooke

VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.

BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE: Hydraulic sleeve

SUPPLY LINE: N rods

VERTICAL SCALE: 1" = 50 psi.

Figures given are gauge pressures

Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE:

COLOUR:

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: SIRINUMU DAM STAGE 2

LOCATION: Discharge Channel
111ft bearing 301½° Mag. from Station 17.

ANGLE FROM HORIZONTAL: -90° DIRECTION: -

COORDINATES: 860E 910N R.L. 1688

HOLE NO. SDS 33

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF CORE BOX	PHOTO REF NO CORE BOXES
Spoil with gravel over red clay	Excavation spoil at least to 3' depth underlain by red clay				Not cored			3·1·68			
			10 11'2"								
Tuffaceous agglomerate moderate weathering	Arenitic brownish-grey matrix with lava boulders up to 24" size, mainly vesicular. Matrix exceeds 50% of rock. White chalky material replaces matrix at 15'-15'2"		20				30° weathered 25° white coating 40° 60° 70° white coating		0·1 0·2 10 15 20 15 10 5		
	33'6"-34' highly weathered		30 34				45° 1" clay 0°				

DRILL TYPE: Mindrill F30RT
FEED: Hydraulic
CORE BARREL TYPE: NMS 5' capacity
DRILLER: M. Larivita
COMMENCED:
COMPLETED: 15·12·67
LOGGED BY: I.S. Cumming
VERTICAL SCALE: 1" = 10'

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE: Hydraulic sleeve
SUPPLY LINE: N rods
VERTICAL SCALE: 1" = 50 psi
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE:
COLOUR:

C 55/A7/44 (20 of 23)

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2

LOCATION On saddle 170ft E. of Spillway Channel, R.H. Wall.

ANGLE FROM HORIZONTAL -90° DIRECTION —

COORDINATES 1535E 590N R.L. 1767

HOLE NO. SD534

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE LOST	PHOTO REF. NO. CORE BARREL
Spoil and red clay	Agglomerate pebbles, concrete and red clay		NMS		Not Cored						
Tuffaceous agglomerate moderate weathering	Brown arenitic matrix lava fragments up to 9" size, mainly fresh		10				30° tight		0.025 0.050		
Tuffaceous agglomerate high to complete weathering	Red-brown matrix 50% of pebbles weathered						0° Top and bottom contacts gradational	22-1	5 10 7.5 5 2.5		
Agglomerate moderate to slight weathering	Matrix arenitic down to 24' and pelitic 24'–33'3" A few cobbles of weathered scoriaceous lava		20				0"	23-1	0.001 0.002		
			30						5 10 15 10 5		
			33'3"								

DRILL TYPE Mindrill F30KT

FEED Hydraulic

CORE BARREL TYPE NMS 5' capacity

DRILLER M. Larivita

COMMENCED 19·1·68

COMPLETED 22·1·68

LOGGED BY I.S. Cumming

VERTICAL SCALE 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE Hydraulic sleeve

SUPPLY LINE N rods

VERTICAL SCALE 1" = 50psi.

Figures given are gauge pressures

Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

C 55/A7/44 (21 of 23)

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2

LOCATION On saddle 305ft E. of Spillway Channel, R.H.wall.

ANGLE FROM HORIZONTAL -71° DIRECTION 058° M.

COORDINATES 1673E 591N R.L. 1770

HOLE NO. SDS 35

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE SAMPLE
Red clay	Firm to stiff silty red clay										
Agglomerate completely weathered	Red and brown clay with pebbles altered to ochre. Matrix washed away		10 NMS								
	Matrix of brown hard clay, all pebbles are weathered		20 30								
	Brown and grey clay matrix below 43'.		40 50					22·2·68			
Agglomerate highly weathered with bands of completely weathered agglomerate and tuff	Brown arenitic matrix with fresh pebbles and boulders up to 18" size. Matrix forms 60% of rock. 55'9" – 57'6" clay 61'3" – 62'9" " 63'3" – 64'6" " 67'3" – 67'6" tuff 72'9" – 73'4" " 76'3" – 77'3" " Bedding dips 20°		60 70 80						0·025 0·050 10 20 30 40 30 20 10		

Not cored

DRILL TYPE Mindrill E30KT

FEED Hydraulic

CORE BARREL TYPE NMS 5' capacity

DRILLER M. Larivita

COMMENCED 26·1·68

COMPLETED 1·2·68

LOGGED BY I.S. Cumming

VERTICAL SCALE 1" = 10'

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE Hydraulic sleeve

SUPPLY LINE N rods

VERTICAL SCALE 1" = 50psi.

Figures given are gauge pressures

Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

C 55/A7/44 (22 of 23)

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT SIRINUMU DAM STAGE 2.

LOCATION On ridge 220' E. of spillway channel R.H. Wall.

ANGLE FROM HORIZONTAL -90° DIRECTION -

COORDINATES 158SE 590N R.L. 1768

HOLE NO. SDS36

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX	PHOTO REF NO. CORE BARREL
Gravel	Crushed agglomerate		NMS 2'0"		Not cored						
Red clay											
Agglomerate completely weathered	Red & brown mottled clay		10				45° tight				
Agglomerate moderately weathered	Matrix grey-brown aremitic with a few weathered pebbles 17'-17'10" Light brown aremitic tuff		20				45° tight				
			24'3"								

DRILL TYPE Mindrill P30RT

FEED Hydraulic

CORE BARREL TYPE NMS 5' capacity.

DRILLER M. Larivita

COMMENCED 5.2.68

COMPLETED 5.2.68

LOGGED BY I.S. Cumming

VERTICAL SCALE 1"=10'

NOTES

FRACTURE LOG - Number of fractures per foot of core. Zones of core loss are blacked in.

BEDDING AND JOINT PLANES - Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS

PACKER TYPE

SUPPLY LINE

VERTICAL SCALE

Figures given are gauge pressures
Test sections are indicated graphically by blacked-in strips

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE

COLOUR

C 55/A7/44 (23 of 23)

APPENDIX 3

Water Pressure Test Computation Sheets

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE LEFT ABUTMENT

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION - R.L. OF COLLAR 1784 ' SIZE OF HOLE NX

LOCATION 529E 604N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDD23

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1968	a	b	c	d	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
11.1	33.5	73.4	5	10	21.90	22.05	0.15	0.03	39.9	1.1	63.3	2	35	15.6	0	0	25.6	0.0008	Good seal
			5		2.05	2.25	0.20						N rod						Water from dam
			5		2.25	2.40	0.15												Ram pump 750g.p.h.
			5	20	23.00	23.30	0.30	0.06							0	0	35.6	0.0016	
			5		3.30	3.55	0.25												
			5		3.55	3.85	0.30												
			5	30	24.25	24.70	0.45	0.10							0	0	45.6	0.0028	Joint permeability
			5		4.70	5.20	0.50												2ft per year
			5		5.20	5.70	0.50												
			5	20	26.20	26.70	0.50	0.10							0	0	35.6	0.0028	
			5		6.70	7.25	0.55												
			5		7.25	7.75	0.50												
			5	10	27.75	27.95	0.20	0.05							0	0	25.6	0.0014	
			5		7.95	8.20	0.25												
			5		8.20	8.45	0.25												
11.1	13.5	73.4	5	5	39.10	40.10	1.00	0.18	59.9	1.2	63.3	2	15	6.8	0	0	11.8	0.0036	Good seal
			5		40.10	1.00	0.90						N rod						
			5		1.00	1.80	0.80												
			5	10	42.10	43.15	1.05	0.20							0	0	16.8	0.0040	Joint permeability
			5		3.15	4.15	1.00												8ft per year
			5		4.15	5.10	0.95												
			5	15	45.75	47.00	1.25	0.25							0	0	21.8	0.0050	
			5		7.00	8.30	1.30												
			5		8.30	9.50	1.20												Seal failed at 20 psi.

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0.44. sin θ. (ℓ + m); if ℓ > a, p = 0.44. sin θ. n.

FILE No. C55/A7/45 (5 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMO DAM STAGE 2 FEATURE SPILLWAY

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION — R.L. OF COLLAR 1740·6 SIZE OF HOLE NX

LOCATION 1268E 559N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF

HOLE NO. SDS19

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.) *	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	g/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
28·9	8·75	17·75	5	10	11·35	12·85	1·50	0·30	9·0	0·9	4·0	2·0	10·0	2·6	0	0	12·6	0·030	Good seal.
			5		2·85	4·35	1·50						N rod						Ram pump
			5		4·35	5·80	1·45												750g.p.h.
			5	15	6·45	8·75	2·30	0·45							0	0	17·6	0·045	Water from dam.
			5		8·75	21·00	2·25												
			5		21·00	3·20	2·20												
			5	20	3·75	6·55	2·80	0·54							0	0	22·6	0·054	Joint permeability
			5		6·55	9·25	2·70												90ft per year.
			5		9·25	31·95	2·70												
			5	15	32·10	4·30	2·20	0·42							0	0	17·6	0·041	
			5		4·30	6·40	2·10												
			5		6·40	8·50	2·10												
			5	10	8·60	9·55	0·95	0·19							0	0	12·6	0·018	
			5		9·55	40·45	0·95												
			5		40·45	1·40	0·95												
28·9	17·75	27·50	5	10	46·80	47·75	0·95	0·19	9·75	0·9	4·0	2·0	20·0	2·6	0	0	12·6	0·018	Good seal.
			5		7·75	8·70	0·95						N rod						
			5		8·70	9·65	0·95												
			5	15	50·10	51·45	1·35	0·27							0	0	17·6	0·025	Joint permeability
			5		51·45	2·80	1·35												45ft per year.
			5	20	3·15	4·85	1·70	0·34							0	0	22·6	0·032	
			5		4·85	6·50	1·65												
			5	15	6·50	7·60	1·10	0·22							0	0	17·6	0·021	
			5		7·60	8·70	1·10												
			5	10	8·60	9·15	0·55	0·11							0	0	12·6	0·010	
			5		9·15	9·70	0·55												
			5		9·70	60·25	0·55												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. C55/A7/45 (1 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SPILLWAY

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION — R.L. OF COLLAR 1739.0 ' SIZE OF HOLE NX

LOCATION 1176E 584N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS 20

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	g/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
21·9	9·0	19·0	—															—	No seal due to joint in W. side open to surface
25·9	19·0	29·0	5	15	01·05	01·75	0·70	0·12	10·0	0·9	2·0	2·0	20	1·7	0	0	16·7	0·010	Good seal
			5		1·75	2·35	0·60						N yods						Ram pump
			5		2·35	2·95	0·60												750g.p.h.
			5	25	3·85	5·80	1·95	0·39							0	0	26·7	0·036	Water from dam
			5		5·80	7·75	1·95												
			5	35	11·05	14·00	2·95	0·56							0	0	36·7	0·050	
			5		4·00	6·80	2·80												Joint permeability
			5		6·80	8·60	2·80												Soft per year.
			5	25	20·40	22·40	2·00	0·40							0	0	26·7	0·036	
			5		22·40	24·40	2·00												
			5	15	5·50	6·45	0·95	0·14							0	0	16·7	0·013	
			5		6·45	7·15	0·70												
			5		7·15	7·85	0·70												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SPILLWAY

ANGLE FROM HORIZONTAL (θ) −90° DIRECTION — R.L. OF COLLAR ' SIZE OF HOLE NX

LOCATION 1257E 644N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF

HOLE NO. SDS 21

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≈ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f−e=g	9/c=h	b−a=i	k*	ℓ	m	n	p+	q*	r*	d+p−q−r	k x h/i	
26·9	7·0	17·0	5	10	30·85	32·70	1·85	0·40	10·0	0·9	4·0	2·0	10	2·6	0	0	12·6	0·036	Good seal
			5		2·70	4·70	2·00						N rod						Ram pump
			5		4·70	6·70	2·00												750 g.p.h.
			5	15	42·40	45·90	3·50	0·70							0	0	17·6	0·063	Water from dam.
			5		5·90	9·40	3·50												
			5	20	54·95	59·60	4·65	0·93							0	0	22·6	0·084	Joint permeability
			5		9·60	4·25	4·65												120ft per year
			5	15	65·65	69·05	3·40	0·68							0	0	17·6	0·061	
			5		69·05	72·45	3·40												
			5	10	74·35	76·20	1·85	0·37							0	0	12·6	0·033	
			5		6·20	8·05	1·85												
27·9	17·0	27·0	5	10	82·45	82·60	0·15	0·03	10·0	0·9	4·0	2·0	20	2·6	0	0	12·6	0·003	Good seal
			5		2·60	2·75	0·15						N rod						
			5	15	3·45	3·95	0·50	0·10							0	0	17·6	0·009	
			5		3·95	4·45	0·50												
			5	20	5·10	6·00	0·90	0·18							0	0	22·6	0·016	Joint permeability
			5		6·00	6·90	0·90												25ft per year
			5	15	7·00	7·55	0·55	0·11							0	0	27·6	0·010	
			5		7·55	8·10	0·55												
			5	10	8·15	8·45	0·30	0·06							0	0	12·6	0·005	
			5		8·45	8·80	0·35												
			5		8·80	9·10	0·30												

* Values are read from appropriate correction graphs.

+ If $\ell \leq a$, $p = 0{\cdot}44 \sin\theta\,(\ell + m)$; if $\ell > a$, $p = 0{\cdot}44 \sin\theta\, n$.

FILE No C55/A7/45 (3 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SPILLWAY

ANGLE FROM HORIZONTAL (θ) −90° DIRECTION — R.L. OF COLLAR 1740 ' SIZE OF HOLE NX

LOCATION 1125E 733N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS22 SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≈ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f−e=g	g/c=h	b−a=i	k*	ℓ	m	n	p+	q*	r*	d+p−q−r	k x h/i	
30·9	15·3	28·3	5	10	61·85	62·05	0·20	0·03	13·0	0·9	4·0	2·0	20	2·6	0	0	12·6	0·002	Good seal
			5		2·05	2·15	0·10						N rod.						Ram pump 750g.p.h
			5		2·15	2·30	0·15												Water from dam.
			5	15	3·40	4·05	0·65	0·13							0	0	17·6	0·009	
			5		4·05	4·70	0·65												
			5	20	6·70	8·05	1·35	0·26							0	0	22·6	0·018	Joint permeability
			5		8·05	9·35	1·30												25 ft per year.
			5		69·35	70·60	1·25												
			5	15	71·85	2·60	0·75	0·15							0	0	17·6	0·010	
			5		2·60	3·35	0·75												
			5	10	4·00	4·10	0·10	0·02							0	0	12·6	0·001	
			5		4·10	4·20	0·10												
30·9	28·3	40·0	5	15	76·45	77·15	0·70	0·13	11·7	0·9	4·0	2·0	30	2·6	0	0	17·6	0·010	Good seal
			5		7·15	7·75	0·60						N rod.						
			5		7·75	8·40	0·65												
			5	20	8·60	9·25	0·65	0·14							0	0	22·6	0·010	
			5		79·25	80·00	0·75												
			5		80·00	0·70	0·70												
			5	25	1·00	1·70	0·70	0·14							0	0	27·6	0·010	Joint permeability
			5		1·70	2·40	0·70												11ft per year
			5	20	3·45	4·00	0·55	0·11							0	0	22·6	0·008	
			5		4·00	4·55	0·55												
			5	15	5·35	5·75	0·40	0·08							0	0	17·6	0·006	
			5		5·75	6·15	0·40												
2·10	40·0	50·0	5	15	92·20	92·40	0·20	0·04	10·0	0·9	4·0	2·0	40	2·6	0	0	17·6	0·004	Good seal
			5		2·40	2·60	0·20						N rod						
			5	25	3·25	3·50	0·25	0·04							0	0	27·6	0·004	
			5		3·50	3·70	0·20												
			5		3·70	3·90	0·20												
			5	35	4·10	4·35	0·25	0·05							0	0	37·6	0·005	Joint permeability
					4·35	4·55	0·20												5ft per year.
					4·55	4·85	0·30												
			5	25	4·80	4·95	0·15	0·03							0	0	27·6	0·003	
			5		4·95	5·10	0·15												
			5	15	5·20	5·25	0·05	0·01							0	0	17·6	0·001	
			5		5·25	5·30	0·05												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ+m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. C55/A7/45(4of17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SPILLWAY

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION — R.L. OF COLLAR ' SIZE OF HOLE NX

LOCATION PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF

HOLE NO. SDS 23

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (a 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	g/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
5·10	37·5	62·5	5	30	98·15	98·25	0·10	0·01	25·0	1·0	13·5	2·0	40	6·8	0	0	36·8	0·0004	Good seal
			5		8·25	8·30	0·05						N rod						Ram pump 750g.p.h.
			5		8·30	8·35	0·05												Water from dam.
			5	40	699·95	700·05	0·10	0·02							0	0	46·8	0·0008	
			5		700·05	0·15	0·10												
			5	50	0·25	0·40	0·20	0·03							0	0	56·8	0·0012	Joint permeability
			5		0·40	0·55	0·15												0·7 ft per year
			15	40	0·65	0·75	0·10	0·007							0	0	46·8	0·0003	
			20	30	0·75	0·85	0·10	0·005							0	0	36·8	0·0002	
6·10	71·5	85·0	15	30	22·90	22·95	0·05	0·003	13·5	0·9	13·5	2·0	70	6·8	0	0	36·8	0·0002	Good seal
			10	40	3·25	3·35	0·10	0·01					N rod		0	0	46·8	0·0007	
			10		3·35	3·45	0·10												
			5	50	3·60	3·90	0·30	0·06							0	0	56·8	0·0042	Joint permeability
			5		3·90	4·20	0·30												2·5 ft per year
			5		4·20	4·50	0·30												
			5	40	4·60	4·85	0·25	0·05							0	0	46·8	0·0035	
			5		4·85	5·10	0·25												
			5		5·10	5·35	0·25												
			5	30	5·50	5·75	0·25	0·04							0	0	36·8	0·0028	
			5		5·75	5·95	0·20												
			5		5·95	6·15	0·20												
14·10	71·5	100·0	5	30	64·35	64·65	0·30	0·06	28·5	1·0	29·0	2·0	70	13·6	0	0	43·6	0·0021	Good seal
			5		4·65	4·95	0·30						N rod						
			5	40	5·15	5·50	0·35	0·06							0	0	53·6	0·0021	
			5		5·50	5·80	0·30												
			5		5·80	6·10	0·30												
			5	50	6·70	7·10	0·40	0·08							0	0	63·6	0·0028	Joint permeability
			5		7·10	7·50	0·40												1·5 ft per year.
			5		7·50	7·90	0·40												
			10	40	8·15	8·65	0·50	0·045							0	0	53·6	0·0017	
			10		8·65	9·05	0·40												
			10	30	9·15	9·50	0·35	0·035							0	0	43·6	0·0012	
			10		9·50	9·85	0·35												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No C55/A7/45 (6 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE Bottom of creek, N. of spillway

ANGLE FROM HORIZONTAL (θ) -44° DIRECTION 137°M. R.L. OF COLLAR 1687 ' SIZE OF HOLE NX

LOCATION 982E 920N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS 24 SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
17·10	42·5	57·0	5	20	87·45	87·80	0·35	0·07	14·5	1·0	2·0	2·8	40	1·5	0	0	21·5	0·0050	Good seal.
			5		7·80	8·15	0·35						N rod						Ram pump 750 g.p.h
			5	25	8·75	9·15	0·40	0·08							0	0	26·5	0·0055	Pond water
			5		89·15	9·55	0·40												
			5	30	89·70	90·15	0·45	0·09							0	0	31·5	0·0062	Joint permeability 8ft per year
			5		90·15	0·65	0·50												
			5		0·65	1·05	0·40												
			5	25	1·45	1·70	0·25	0·05							0	0	26·5	0·0034	
			5		1·70	1·95	0·25												
			5	20	2·15	2·30	0·15	0·03							0	0	21·5	0·0021	
			5		2·30	2·45	0·15												
19·10	57·0	91·0	—																No seal obtained
19·10	63·0	91·0	5	30	86·80	90·90	4·10	0·84	28·0	1·1	2·0	2·8	65	1·5	0	0	31·5	0·033	Good seal
			5		90·90	5·10	4·20						N rod						
			5		5·10	9·30	4·20												
			5	35	07·20	12·70	5·50	1·10							0	0	36·5	0·043	Joint permeability 40ft per year
			5		12·70	18·20	5·50												
			5		18·20	23·65	5·45												
			5	40	28·65	36·00	7·35												Water rising in hole
23·10	71·7	100·0	5	30	07·40	07·80	0·40	0·08	28·3	1·1	2·0	2·8	70	1·5	0	0	31·5	0·0031	Good seal
			5		7·80	8·25	0·45						N rod						
			5		8·25	8·65	0·40												
			5	40	8·75	9·25	0·50	0·09							0	0	41·5	0·0035	Joint permeability 5ft per year
			5		9·25	9·70	0·45												
			5		9·70	10·15	0·45												
			5	50	10·40	11·25	0·85	0·19							0	0	51·5	0·0074	Water rising in hole
			5		1·25	2·25	1·00												
			5		2·25	3·20	0·95												
			5	40	4·55	5·35	0·80	0·16							0	0	41·5	0·0062	No water rising
			5		5·35	6·15	0·80												
			5	30	6·95	7·60	0·65	0·13							0	0	31·5	0·0051	" " "
			5		7·60	8·25	0·65												
			5	20	8·75	9·20	0·45	0·09							0	0	21·5	0·0035	" " "
			5		9·20	9·65	0·45												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No C55/A7/45 (7 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE RIGHT ABUTMENT OF MAIN DAM
ANGLE FROM HORIZONTAL (θ) -60° DIRECTION 065°M. R.L. OF COLLAR 1778 ' SIZE OF HOLE NX
LOCATION 1000E 642N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS27
SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1968	a	b	c	d	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
9·1	35·5	92·8	5	5	3945·4	3974·4	29·0	5·81	57·3	1·2	54·5	2·3	35	13·3	0·3	0·4	17·6	0·122	Good seal
			5		74·4	4004·0	29·6						N rod						Water from dam
			5		4004·4	32·6	28·6												Ram pump 750g.p.h.
			5	10	45·3	78·2	32·9	6·45							0·4	0·5	22·4	0·134	
			5		78·2	110·0	31·8												
			5		110·0	42·0	32·0												
			5	15	56·4	92·5	36·1	7·02							0·5	0·6	27·2	0·147	
			5		92·5	227·0	34·5												
			5		227·0	61·7	34·7												
			5	20	76·4	314·8	38·4	7·53							0·6	0·7	32·0	0·158	
			5		314·8	51·8	37·0												
			5		51·8	89·8	37·5												
			5	25	404·9	446·2	41·3	8·30							0·7	0·9	36·7	0·174	
			5		46·2	87·7	41·5												
			5		87·7	529·4	41·7												
			5	30	546·9	91·9	45·0	9·06							0·9	1·0	41·4	0·189	
			5		91·9	637·5	45·6												Limit of water supply
			5	25	672·1	714·7	42·6	8·41							0·7	0·9	36·7	0·175	
			5		714·7	56·3	41·6												
			5		56·3	98·2	41·9												
			5	20	813·1	851·1	38·0	7·38							0·6	0·7	32·0	0·154	
			5		51·1	88·0	36·9												
			5		88·0	924·8	36·8												
			5	15	944·5	77·5	33·0	6·60							0·4	0·5	27·4	0·138	
			5		77·5	5010·5	33·0												
			5	10	5021·9	50·4	28·5	5·69							0·3	0·4	22·6	0·119	
			5		50·4	79·1	28·7												
			5		79·1	107·2	28·1												Joint permeability
			5	5	117·0	41·0	24·0	4·76							0·3	0·3	17·7	0·100	200ft per year
			5		41·0	64·8	23·8												
			5		64·8	88·4	23·6												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. C55/A7/45(8 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SPILLWAY
ANGLE FROM HORIZONTAL (θ) -90° DIRECTION - R.L. OF COLLAR 1735 ' SIZE OF HOLE NX
LOCATION 1136E 801N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS28
SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≈ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	g/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
20.11	51	82.3	5	30	280.80	280.90	0.10	0.020	31.3	1.1	22	2	50	10.6	0	0	40.6	0.0007	Good seal
			5		0.90	1.00	0.10						N rod						Water from pond
			5		1.00	1.10	0.10												Ram pump 750gph
			5	40	81.40	81.55	0.15	0.040							0	0	50.6	0.0014	
			5		1.55	1.80	0.25												
			5		1.80	2.00	0.20												
			5		2.00	2.20	0.20												
			5	50	82.90	83.20	0.30	0.060							0	0	60.6	0.0021	Joint permeability 1ft per year
			5		3.20	3.50	0.30												
			5		3.50	3.70	0.20												
			5		3.70	3.75	0.05												
			5		3.75	3.85	0.10												
			5		3.85	3.90	0.05												
			5		3.90	5.70	1.80	0.266							0	0	60.6	0.0093	Increased take of water — packer continued to keep a good seal
			5		5.70	7.20	1.50												
			5		7.20	8.50	1.30												
			5		8.50	9.70	1.20												
			5		89.70	90.70	1.00												
			5		90.70	92.00	1.30												
			5		2.00	3.20	1.20												Joint permeability 5ft per year.
			5	40	93.10	94.50	1.40	0.270							0	0	50.6	0.0095	
			5		4.50	5.80	1.30												
			5		5.80	7.20	1.40												
			5		7.20	8.50	1.30												
			5	30	300.10	301.00	0.90	0.145							0	0	40.6	0.0051	
			5		1.00	1.80	0.80												
			5		1.80	2.40	0.60												
			5		2.40	3.00	0.60												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0.44. sin θ. (ℓ + m); if ℓ > a, p = 0.44. sin θ. n.

FILE No. C55/A7/45 (9 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SPILLWAY

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION — R.L. OF COLLAR 1733 ' SIZE OF HOLE NX

LOCATION 1128E 834N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS29

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
23.11	31	54	5	20	1437.0	1485.0	48.0	9.80	23	1.0	30.5	2	30	14.3	0.8	1.2	32.3	0.427	Good seal
			5		85.0	1534.0	49.0						N rod.						Water from pond
			5		1534.0	83.0	49.0												Ram pump 750 gph
			5	30	1727.0	1788.5	61.5	12.10							1.2	1.9	41.2	0.525	
			5		88.5	1849.0	60.5												
			5		1849.0	1909.5	60.5												
			5	20	1989.0	2036.0	47.0	9.45							0.7	1.1	32.5	0.410	Joint permeability
			5		2036.0	88.0	48.0												400ft per year.
			5		88.0	2133.0	45.0												
			5		2133.0	2182.0	49.0												
			5	10	2232.5	2270.0	37.5	7.50							0.5	0.7	23.1	0.325	
					70.0	2307.5	37.5												
					2307.5	2345.0	37.5												
24.11	46.5	92	5	30	2390.7	2401.2	10.5	1.98	45.5	1.1	16	2	45	7.9	0	0	37.9	0.048	
			5		401.2	11.0	9.8						N rod						
			5		11.0	20.8	9.8												
			5		20.8	30.2	9.4												
			5	40	501.2	515.3	14.1	2.84							0.1	0.1	47.7	0.069	
			5		15.3	29.6	14.3												
			5		29.6	43.8	14.2												
			5	50	589.0	610.8	21.8	4.53							0.3	0.2	57.4	0.110	Joint permeability
			5		610.8	32.4	21.6												40ft per year.
			5		32.4	53.9	21.5												
			5	40	733.0	747.6	14.6	2.55							0.1	0.1	47.7	0.064	
			5		47.6	59.6	12.0												
			5		59.6	71.3	11.7												
			5	30	788.2	797.2	9.0	1.80							0	0	37.9	0.044	
			5		97.2	806.4	9.2												
			5		806.4	15.2	8.8												

* Values are read from appropriate correction graphs.

+ If $\ell \leq a$, $p = 0.44 \sin\theta\ (\ell + m)$; if $\ell > a$, $p = 0.44 \sin\theta\ n$.

FILE No C55/A7/45 (10 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE STILLING BASIN
ANGLE FROM HORIZONTAL (θ) -45° DIRECTION 134° M. R.L. OF COLLAR 1703 SIZE OF HOLE NX
LOCATION 1107E 929N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS30
SHEET 1 OF 2

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (a 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	q/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
29.11	24	42	5	15	851.95	852.45	0.50	0.100	18	1.0	8.5	2.8	25	3.5	0	0	18.5	0.0056	Good seal
			5		2.45	2.90	0.45						N rod						Water from pond
			5		2.90	3.45	0.55												Rain pump 750gph
			5	25	54.00	54.55	0.55	0.117							0	0	28.5	0.0065	
			5		4.55	5.20	0.65												
			10		5.20	6.35	1.15												
			5	35	56.95	57.45	0.50	0.090							0	0	38.5	0.0050	
			5		7.45	7.90	0.45												
			5		7.90	8.35	0.45												
			5		8.35	8.75	0.40												Joint permeability
			5	25	59.10	59.60	0.50	0.090							0	0	28.5	0.0050	10ft per year
			5		9.60	60.00	0.40												
			5		60.00	0.45	0.45												
			5		0.45	0.90	0.45												
			5	15	61.10	61.60	0.50	0.100							0	0	18.5	0.0056	
			5		1.60	2.10	0.50												
			5		2.10	2.60	0.50												
30.11	42	72	5	30	91.00	92.55	1.55	0.285	30	1.1	8.5	2.8	45	3.5	0	0	33.5	0.0104	Good seal
			5		2.55	3.85	1.30						N rod						
			5		3.85	5.30	1.45												
			5		5.30	6.50	1.20												
			5	40	899.80	901.30	1.50	0.320							0	0	43.5	0.0117	
			5		901.30	2.90	1.60												
			5		2.90	4.60	1.70												
			5	50	8.55	11.10	2.55	0.470							0	0	53.5	0.0173	Joint permeability
			5		11.10	3.25	2.15												10ft per year.
			5		3.25	5.80	2.55												
			5		5.80	7.95	2.15												
			5	40	18.30	19.45	1.15	0.237							0	0	43.5	0.0087	
			5		9.45	20.65	1.20												
			5		20.65	1.85	1.20												
			5	30	23.60	24.50	0.90	0.165							0	0	33.5	0.0060	
					4.50	5.35	0.85												
					5.35	6.10	0.75												
					6.10	6.90	0.80												

* Values are read from appropriate correction graphs.

+ If $\ell \leq a$, $p = 0.44 \sin\theta\ (\ell + m)$; if $\ell > a$, $p = 0.44 \sin\theta\ n$.

FILE No. C55/A7/45 (11 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE STILLING BASIN

ANGLE FROM HORIZONTAL (θ) -45° DIRECTION 134°M. R.L. OF COLLAR 1703 ' SIZE OF HOLE NX

LOCATION 1107E 929N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS30

SHEET 2 OF 2

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≈ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
1·12	72	96	5	30	2964·4	2971·6	7·2	1·32	24	1·0	9·5	2·8	75'	3·8	0	0	33·8	0·055	Good seal
			5		71·6	78·4	6·8						N rods						Water from pond
			5		78·4	85·1	6·7												Ram pump 750gph.
			5		85·1	90·5	5·4												
			5		90·5	97·5	7·0												
			5	40	3027·5	3042·4	14·9	3·09							0·2	0·1	43·5	0·128	
			5		42·4	58·2	15·8												
			5		58·2	73·5	15·3												
			5		73·5	89·2	15·7												Joint permeability
			5	50	3105·6	3136·3	30·7	6·10							0·8	0·5	52·5	0·255	100ft per year.
			5		36·3	66·3	30·0												
			5		66·3	97·1	30·8												
			5	40	3219·6	3137·2	17·6	3·50							0·3	0·1	43·4	0·146	
			5		37·2	54·6	17·4												
			5		54·6	72·1	17·5												
			5	30	3267·3	3276·2	8·9	2·04							0·1	0	33·7	0·085	
			5		76·2	86·6	10·4												
			5		86·6	94·4	7·8												
			5		94·4	305·3	10·9												
			5		305·3	17·4	12·1												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. C55/A7/45 (12 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE STILLING BASIN

ANGLE FROM HORIZONTAL (θ) -80° DIRECTION 314°M. R.L. OF COLLAR 1703 ' SIZE OF HOLE NX

LOCATION 1107E 929N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF

HOLE NO. SDS31 SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1967	a	b	c	d	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
6·12	25	39	5	10	24·60	24·95	0·35	0·060	14	0·9	11	2	25	5·6	0	0	15·6	0·0038	Good seal
			5		4·95	5·20	0·25						N rod						Water from pond
			5		5·20	5·50	0·30												Ram pump 750 g.p.h.
			5	20	27·75	28·20	0·45	0·107							0	0	25·6	0·0069	
			5		8·20	8·90	0·70												
			5		8·90	9·40	0·50												
			5		9·40	9·90	0·50												
			5	30	31·10	32·00	0·90	0·193							0	0	35·6	0·0124	
			5		2·00	3·10	1·10												
			5		3·10	4·00	0·90												Joint permeability
			5	20	34·00	34·40	0·40	0·100							0	0	25·6	0·0064	10 ft per year
			5		4·40	5·00	0·60												
			5		5·00	5·50	0·50												
			5	10	35·20	35·30	0·10	0·020							0	0	15·6	0·0013	
			5		5·30	5·40	0·10												
			5		5·40	5·50	0·10												
1968																			
5·1	39	79	5	20	796·90	797·05	0·15	0·033	40	1·1	14	2	40	6·9	0	0	26·9	0·0009	Good seal
			5		7·05	7·20	0·15						N rod						
			5		7·20	7·40	0·20												
			5		7·40	7·55	0·15												
			5	30	97·95	98·20	0·25	0·040							0	0	36·9	0·0011	
			5		8·20	8·40	0·20												
			5		8·40	8·55	0·15												Joint permeability
			5	40	99·55	99·95	0·40	0·077							0	0	46·9	0·0021	1·5 ft per year
			5		9·95	800·35	0·40												
			5		800·35	0·70	0·35												
			5	30	00·75	1·05	0·30	0·063							0	0	36·9	0·0017	Water rising inside
			5		1·05	1·40	0·35												casing.
			5		1·40	1·70	0·30												
			5	20	1·75	2·05	0·30	0·050							0	0	26·9	0·0014	
			5		2·05	2·25	0·20												
			5		2·25	2·50	0·25												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. C55/A7/45 (13 of 17)

M(Pt) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE DISCHARGE CHANNEL

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION — R.L. OF COLLAR 1695 ' SIZE OF HOLE NX

LOCATION 917E 95N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS32

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1968	a	b	c	d	e	f	f-e=g	%c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
4·1	24·5	35	5	5	694·90	697·20	2·30	0·32	10·5	0·9	10·5	2	25	5·5	0	0	10·5	0·027	Good seal
			5		7·20	9·20	2·00						N rod						Water from pond
			5		9·20	700·80	1·60												Ram pump 750 gph.
			5		700·80	2·40	1·60												
			5	10	8·70	13·40	4·70	0·91							0	0	15·5	0·077	
			5		13·40	7·70	4·30												
			5		7·70	22·30	4·60												
			5	15	30·60	41·20	10·60	1·91							0	0	20·5	0·180	Joint permeability 200 ft per year.
			5		41·20	50·60	9·40												
			5		50·60	9·30	8·70												Pump could not maintain required pressure. Test abandoned

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No C55/A7/45 (14 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE DISCHARGE CHANNEL

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION — R.L. OF COLLAR 1688 SIZE OF HOLE NX

LOCATION 860 910N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS 33

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
1968	a	b	c	d	e	f	f-e=g	g/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x √i	
3·1	14·5	34	5	10	81·40	90·50	9·10	1·68	19·5	1·0	5·5	2	15	3·3	0	0	13·3	0·086	Good seal
			5		90·50	99·10	8·60						N rod						Water from pond
			5		399·10	407·60	8·50												Ram pump 750gph
			5	15	15·40	29·10	13·70	2·95							0	0·1	18·2	0·152	
			5		29·10	42·40	13·30												
			5		42·40	56·60	14·20												
			5	20	70·50	95·10	24·60	5·15							0·1	0·3	22·9	0·263	
			5		495·10	521·00	25·90												Joint permeability
			5		21·00	47·60	26·60												270ft per year
			5	15	55·50	72·80	17·30	3·55							0	0·1	18·2	0·182	
			5		72·80	90·70	17·90												
			5		590·70	608·80	18·10												
			5	10	14·30	26·10	11·80	2·35							0	0·1	13·2	0·120	
			5		26·10	38·10	12·00												
			5		38·10	49·60	11·50												
			5	5	50·30	56·80	6·50	1·58							0	0	8·3	0·082	
			5		56·80	63·10	6·30												
			5		63·10	70·10	7·00												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No C55/A7/45 (15 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SADDLE E. of SPILLWAY

ANGLE FROM HORIZONTAL (θ) -90° DIRECTION - R.L OF COLLAR 1767 ' SIZE OF HOLE NX

LOCATION 1535E 590N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF.

HOLE NO. SDS34

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (a 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1968	a	b	c	d,	e	f	f-e=g	9/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
22·1	10·5	20·0	5	5	62·50	64·30	1·80	0·38	9·5	0·9	16	2	10	5·5	0	0	10·5	0·036	Good seal
			5		4·30	6·30	2·00						N rod						Water from dam
			5		6·30	8·20	1·90												Ram pump 750gph.
			5	10	69·00	71·30	2·30	0·46							0	0	15·5	0·044	
			5		71·30	3·60	2·30												
			5		3·60	6·00	2·40												
			5	7·5	77·30	79·35	2·05	0·39							0	0	13·0	0·037	
			6		9·35	81·30	1·95												
			5		1·30	3·30	2·00												Joint permeability
			5	5	83·80	85·55	1·75	0·36							0	0	10·5	0·034	100ft per year
			5		5·55	7·45	1·90												
			5		7·45	9·15	1·70												
			5	2·5	89·60	90·90	1·30	0·24							0	0	8·0	0·023	
			5		0·90	2·20	1·20												
			5		2·20	3·40	1·20												
23·1	20·0	33·3	5	5	97·45	97·50	0·05	0·010	13·3	0·9	18·5	2	20	9·0	0	0	14·0	0·00067	Good seal
			5		7·50	7·55	0·05						N rod						
			5		7·55	7·60	0·05												
			15	10	97·60	97·80	0·20	0·013							0	0	19·0	0·0009	Joint permeability
			15	15	97·80	98·10	0·30	0·020							0	0	24·0	0·0013	1·5ft per year.
			15	10	98·10	98·30	0·20	0·013							0	0	19·0	0·0009	
			15	5	98·30	98·45	0·15	0·010							0	0	14·0	0·00067	

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No C55/A7/45 (16 of 17)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT SIRINUMU DAM STAGE 2 FEATURE SADDLE E. of SPILLWAY

ANGLE FROM HORIZONTAL (θ) -71° DIRECTION 058°M. R.L. OF COLLAR 1770 SIZE OF HOLE NX

LOCATION 1673E 591N PACKER TYPE HYDRAULIC SLEEVE DRILL LOG REF

HOLE NO. SDS35

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
1968	a	b	c	d	e	f	f-e=g	g/c=h	b-a=i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
2·2	67·5	80	5	10	12·85	14·85	2·00	0·40	12·5	0·9	43	2	70	18·7	0	0	28·7	0·028	Good seal
			5		4·85	6·80	1·95						N rod						Water from dam
			5		6·80	8·85	2·05												Ram pump 750gph.
			5	20	20·40	22·60	2·20	0·44									38·7	0·032	
			5		2·60	4·80	2·20												
			5		4·80	7·00	2·20												
			5	30	28·55	31·40	2·85	0·59									48·7	0·042	
			5		1·40	3·95	2·80												
			5		3·95	8·10	2·90												
			5	40	39·35	42·80	3·45	0·73									58·7	0·053	
			5		2·80	6·40	3·60												Joint permeability
			5		6·40	9·90	3·50												30 ft per year.
			5	30	52·00	54·85	2·85	0·59									48·7	0·042	
			5		4·85	7·70	2·85												
			5		7·70	60·50	2·80												
			5	20	62·05	64·35	2·30	0·46									38·7	0·033	
			5		4·35	6·70	2·35			70									
			5	10	67·10	68·70	1·60	0·32									28·7	0·026	
			5		8·70	70·25	1·55												

* Values are read from appropriate correction graphs.

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No C55/A7/45 (17 of 17)

M(Pf) 107

APPENDIX 4

CHEMICAL ANALYSES OF WATER

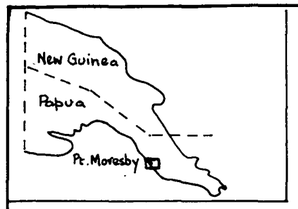
Sample A is of surface water in the Sirinumu reservoir.

Sample B is of water from a spring north of Saddle Dam B.

Both samples were analysed in the laboratory of the Department of Agriculture, Stock and Fisheries, Konedobu, Papua.

	A	B
pH	7.3	7.3
Total soluble salts (by conductivity)	40 ppm	140 ppm
Calcium	3	13
Magnesium	3	17
Potassium	1	6
Bicarbonate	18	85
Carbonate	Nil	Nil
Chloride	Nil	Nil
Sulphate	Nil	Nil

PLATE 1



T. N.

LALOKI RIVER

GOLDIE R.

Rouna Road

Rigo Road

PORT MORESBY

CORAL SEA

600M
400M
200M

ROUNA No1 P.S.

Rouna Falls

ROUNA No2 P.S.

LALOKI RIVER

Eworogo Creek

SOGERI

Eilogo Road

Eilogo Creek

600M

SADDLE DAMS

A B C D E

SIRINUMU DAM

800M

ASTROLABE RANGE

1000M

800M

600M

400M

200M

1000M

600M

REFERENCE

200M — Contours, vertical interval 200 metres (656 feet)

Roads

Town area

SCALE

0 1 2 3 4 5 miles

PORT MORESBY HYDRO-ELECTRIC PROJECT

LOCALITY PLAN

To accompany Record 1969/1
Geological Office Port Moresby

C55/A7/39
PNG C55-7-21

PLATE 2

MN

Grid North = 328° Magnetic

LALOKI RIVER

Costean 1
Costean 2
Costean 3
Costean 4
Costean 5

usually dry
creek usually dry
pond
small perennial flow
Stilling Basin
Channel
Unlined
pond
Spillway
Northern limit of moderately weathered agglomerate in spillway floor
Rock floor of spillway is uneven and covered with spoil 0-2ft thick
Dam embankment
Road
Road
Cottage
Valve house
Flow from rock fill approx. 6,000 gph
Intake
Bridge
Proposed crest of enlarged dam
Existing crest of dam
Steel plate
Reservoir

SDS32 1695
SDS24 1687
SDS33 1688
SDS23 1722
SDS29 1733
SDS28 1735
SDS30 1703
SDS31 1703
SDS13 1718·9
SDS22 1740
SDS21 1739·7
SDS19 1740·6
SDS20 1739·0
SDS18 1740·0
SDS27 1778
SDD23 1784
SDS35 1770
SDS36 1768
SDS34 1767

1 1782·2
2 1685·2
3 1694·7
4 1688·7
5 1739·6
6 1753·6
7 1772·2
8 1755·1
9 1728·8
10 1752·0
11 1752·0
12 1694·8
13 1706·9
14 1739·0
15 1724·5
16 1734·4
17 1752·8
18 1789·4
19 1794·5
20 1797·
21 1772·
22 1761·
23 1739·
24 1732·
25 1753·5
26 1840·
27 1855·
28 1828·

REFERENCE

- Steep face of rock
- Boulder
- Slope in spoil
- 67 Inclined joint with angle of dip
- Vertical joint
- Spring, flow in gallons/hour
- SDS35 1770 71° Inclined drillhole, angle below horizontal and elevation of collar
- SDS34 Vertical drillhole
- Seismic traverse
- Costean
- 7 △1772·2 Survey mark and elevation
- ·1772 Spot level
- 1760 Surface contour
- Agglomerate
- Tuff
- Outline of structure (including Dam embankment) } position approx.
- Limit of cut or fill

0 40 80 120 160 feet

PORT MORESBY HYDRO-ELECTRIC PROJECT

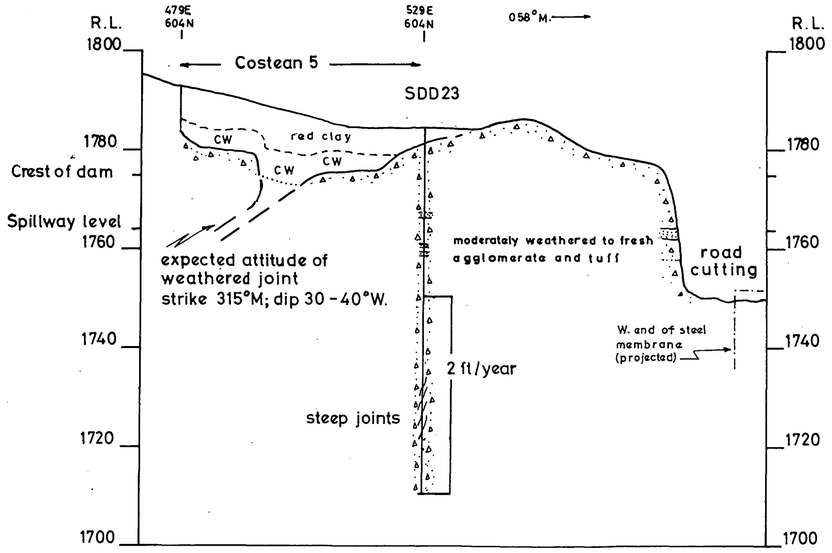
SIRINUMU DAM & SPILLWAY

GEOLOGICAL PLAN

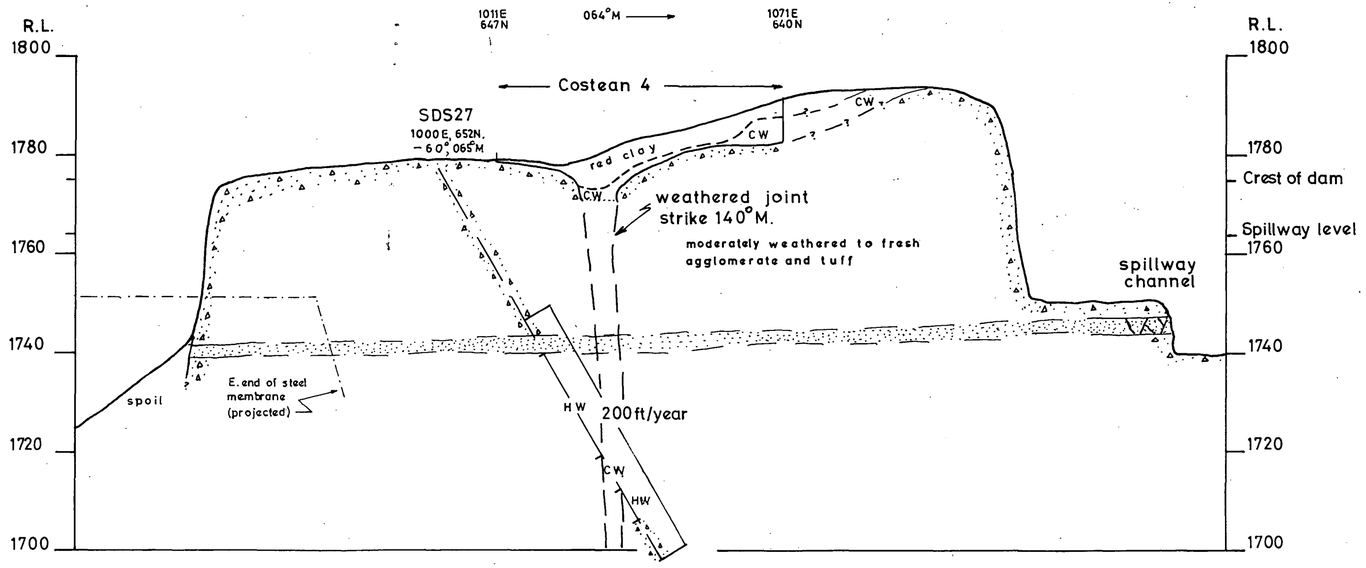
To accompany Bureau of Mineral Resources Record No. 1969/1

Geological Office, Port Moresby. C 55/A7/37 PNG.C55-7-16

LEFT ABUTMENT (looking downstream)



RIGHT ABUTMENT (looking downstream)



REFERENCE

SDD 23 — Drillhole in plane of section, full line
" off " " " broken line

Water pressure test section and joint permeability
2ft/year

Agglomerate, moderately weathered to fresh.

Tuff, moderately weathered to fresh.

HW — Highly weathered rock

CW — Completely weathered rock

SCALE

0 20 40 60ft

PORT MORESBY HYDRO-ELECTRIC PROJECT

SIRINUMU MAIN DAM ABUTMENTS

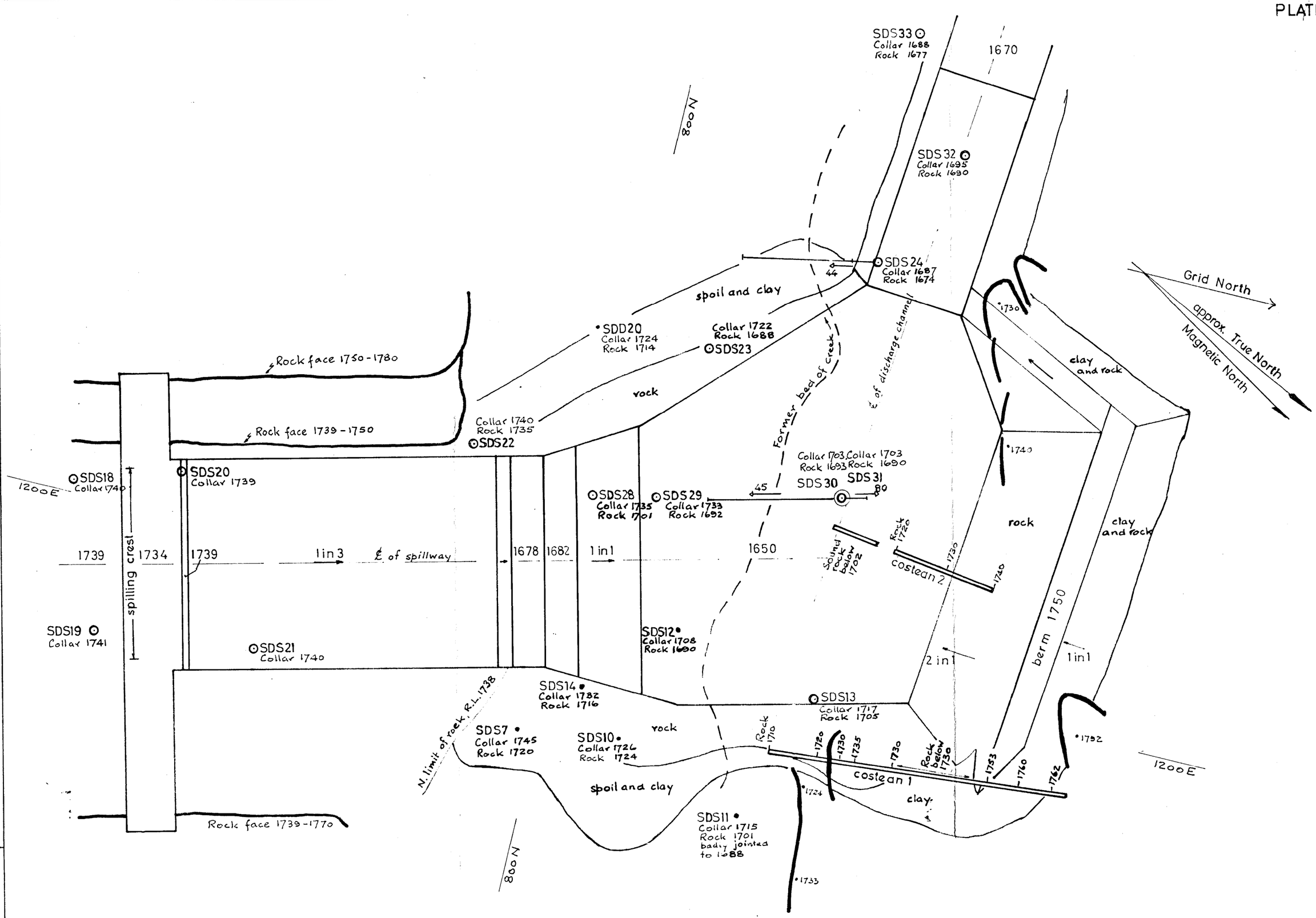
INTERPRETATIVE GEOLOGICAL SECTIONS

To accompany Record No. 1969/1

Geological Office Port Moresby

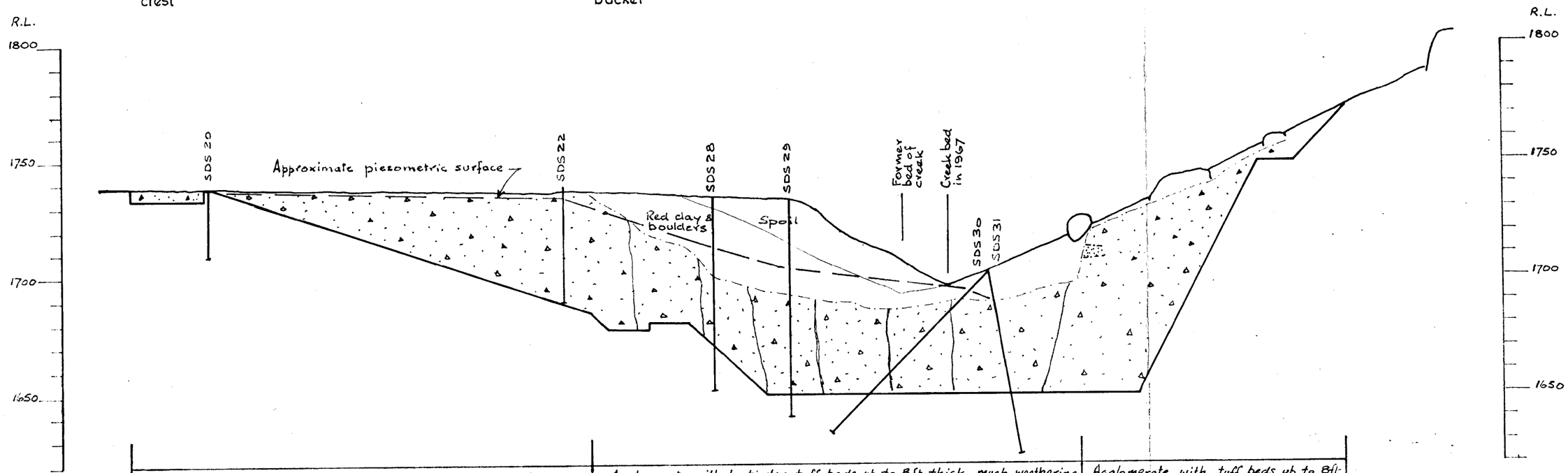
C55/A7/40
PNG C55-7-24

PLATE 4



PLAN OF SPILLWAY

Spilling crest → Chute → Deflector bucket ← Stilling basin and discharge channel →



Agglomerate moderately weathered to fresh; tuff beds thin. Joints are rare; strike 035-045°, dips 75°N to vertical, joint intersected in SDS20 is open down to R.L. 1720. Rock and bedding plane permeabilities are low, <120ft/year	Agglomerate with lenticular tuff beds up to 8ft thick, much weathering along joints. Commonest strike of joints is expected to be 030-050°. Joints are clay filled, becoming tighter in depth. Flow of water along joints will increase as clay filling weathers.	Agglomerate with tuff beds up to 8ft thick. Few joints expected.

SECTION ON CENTRE-LINE OF SPILLWAY

REFERENCE

- ·1740 — Steep rock face, spot height on top
- 1734 — Proposed excavation level
- 1 in 3 — Gradient, vertical component first
- 1720 / 1730 — Costean, rock elevations shown
- SDS19 ⊙ — Vertical drillhole position certain
- SDS12 • — " " " approx.
- 44 — Inclined " angle below horizontal

Agglomerate Tuff

0 20 40 60 80 100

SCALE IN FEET

PORT MORESBY HYDROELECTRIC PROJECT

SIRINUMU DAM - PROPOSED SPILLWAY INTERPRETATIVE GEOLOGICAL PLAN AND SECTION

Based on C.D.W. drawings HC 68/32&33/B

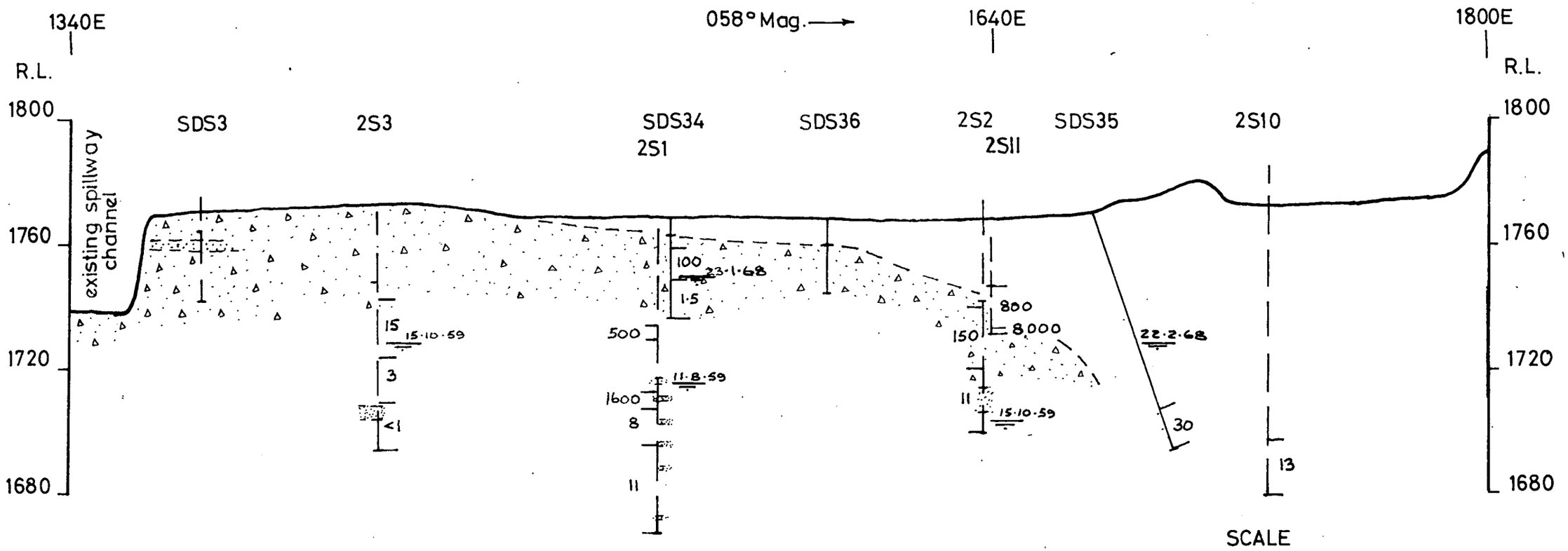
To accompany Record 1969/1

Geological Office Port Moresby

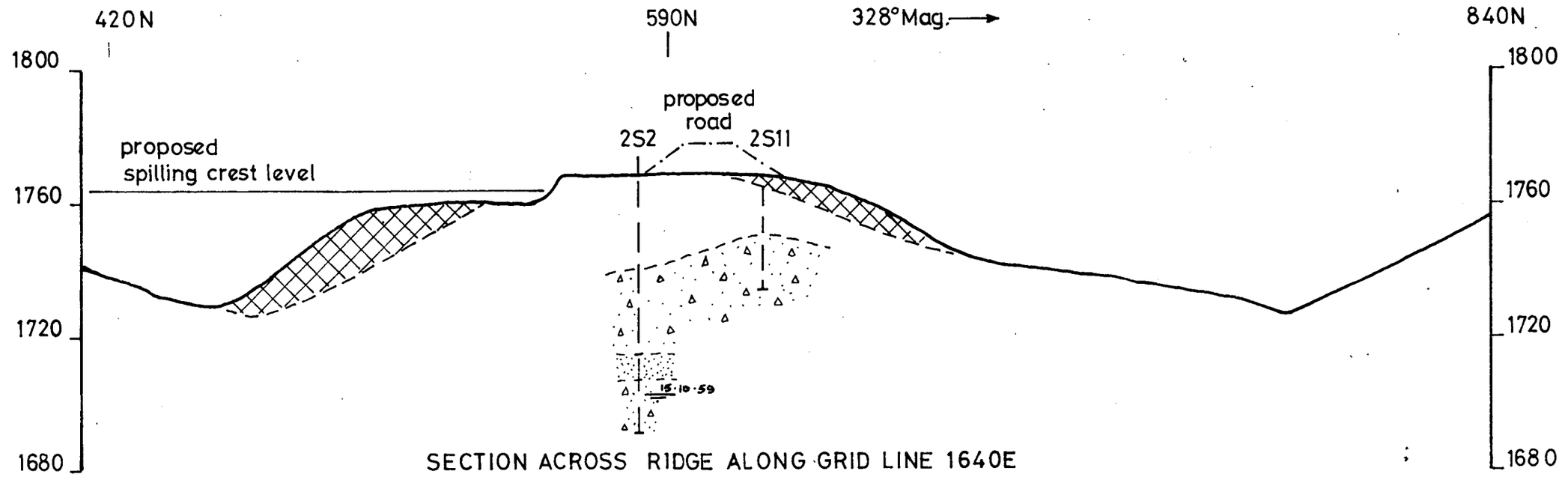
P.N.G. C55-7-19

C55/A7/41

PLATE 5



SECTION ALONG RIDGE ALONG GRID LINE 590N



SECTION ACROSS RIDGE ALONG GRID LINE 1640E

REFERENCE

Drillhole, full line - position known
broken line - position approximate

100
1·5
water pressure test sections, joint permeabilities in feet per year

15-10-59
Standing water level & date

Spoil

Red clay, completely or highly weathered agglomerate

Agglomerate, moderately weathered to fresh

Tuff

PORT MORESBY HYDRO-ELECTRIC PROJECT

SIRINUMU DAM
GEOLOGICAL SECTIONS THROUGH RIDGE EAST OF SPILLWAY

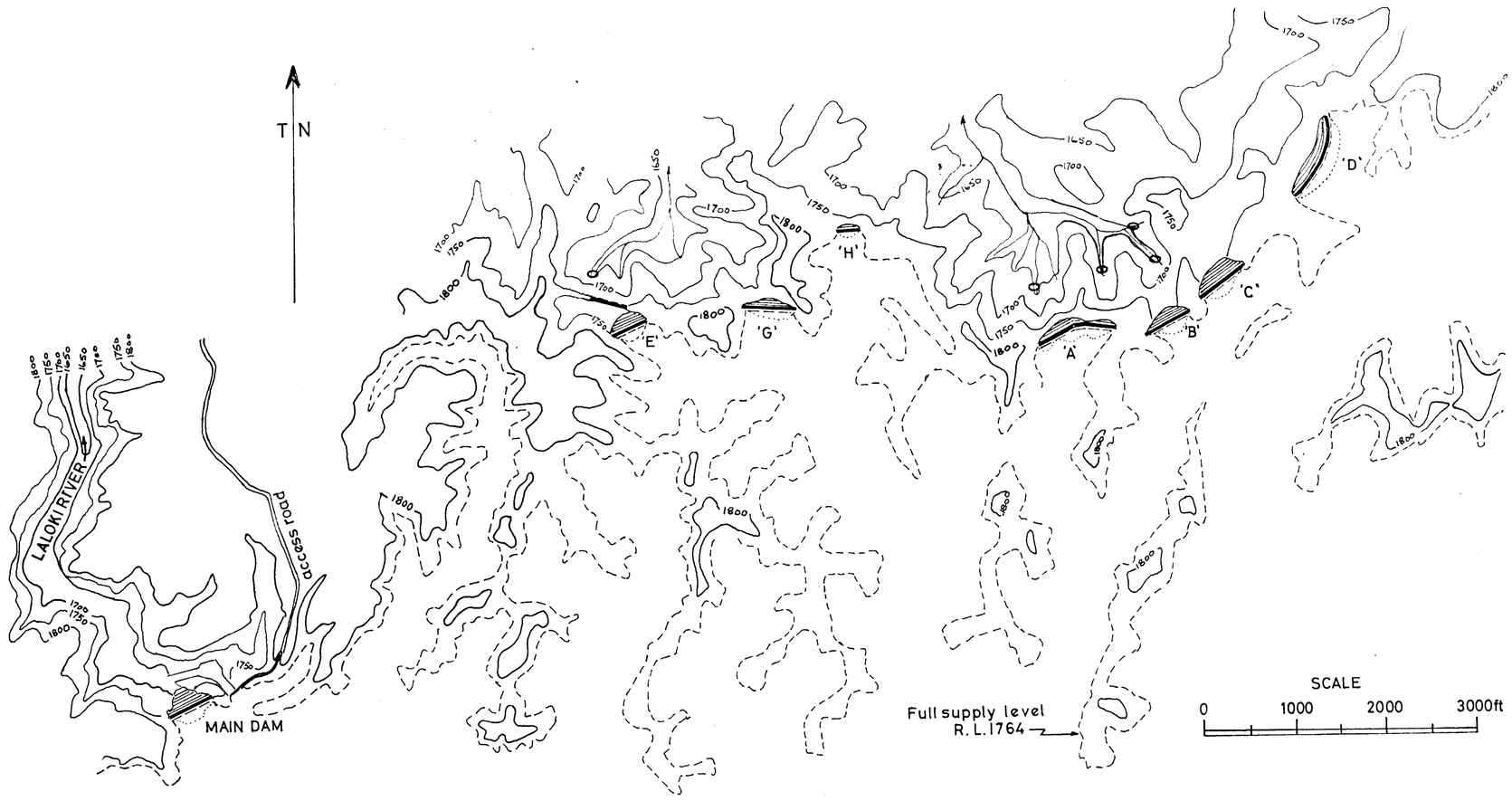
To accompany Record No. 1969/1

Geological Office Port Moresby

C55/A7/42
PNG C55-7-22

SIRINUMU DAM STAGE 2 SADDLE DAMS

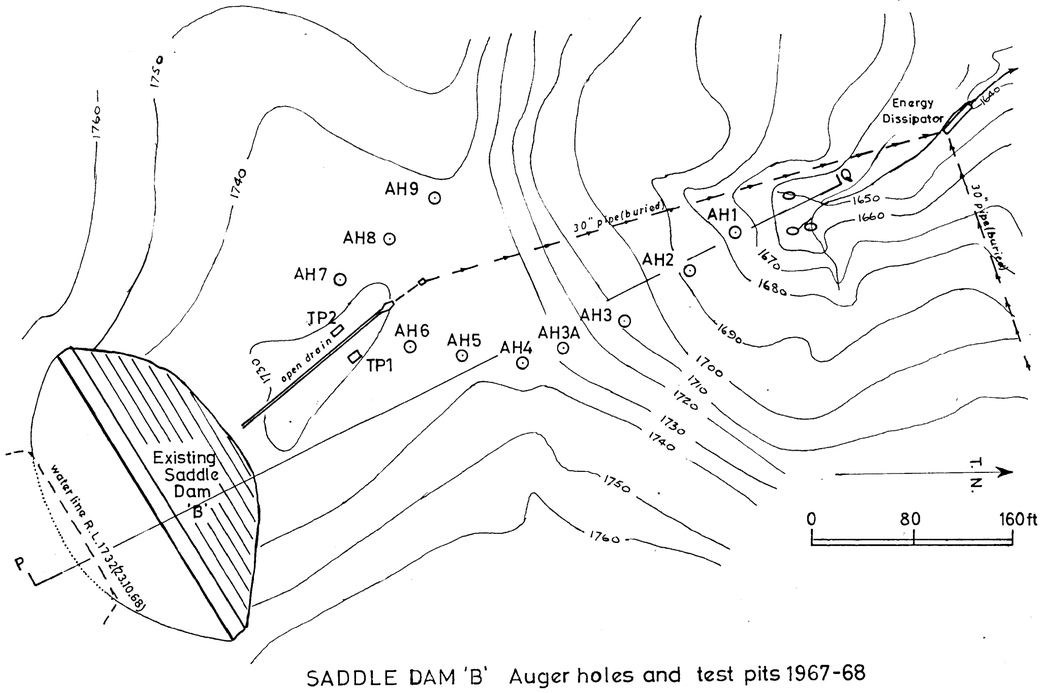
PLATE 6



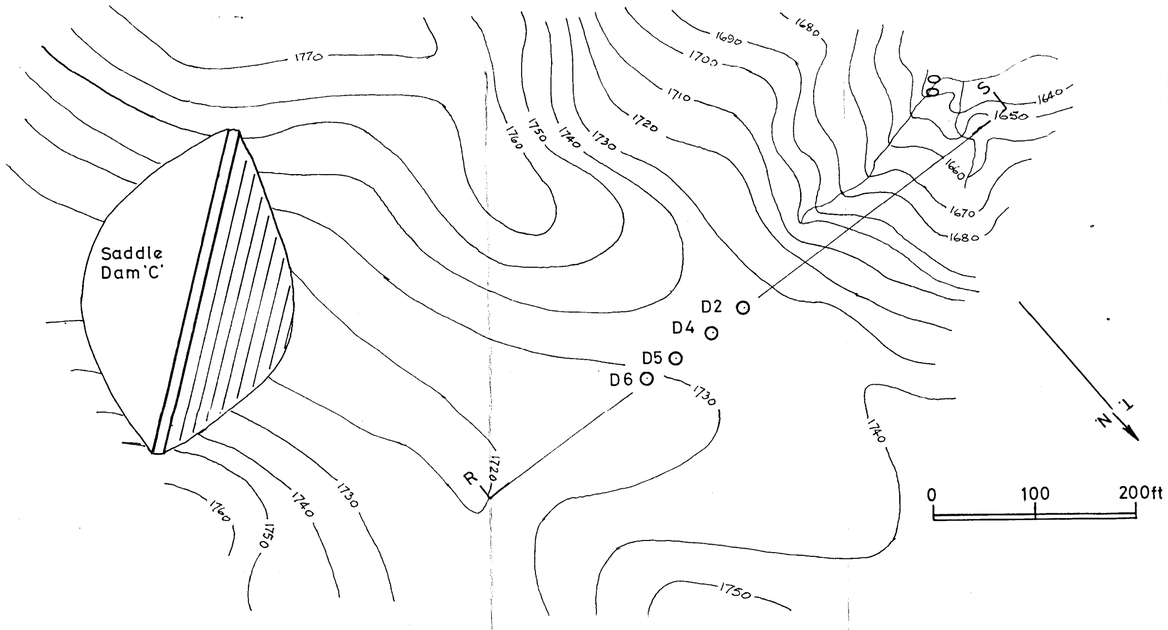
REFERENCE

- Dam, shading on dry side; A,B,C,D,E saddles have dams in Stage 1
- Spring
- AH — Auger holes sunk 1968
- D — Boreholes sunk 1960-61
- TP — Test pit
- P Q — Section line
- Surface contour; those above 1800ft are omitted
- Water line

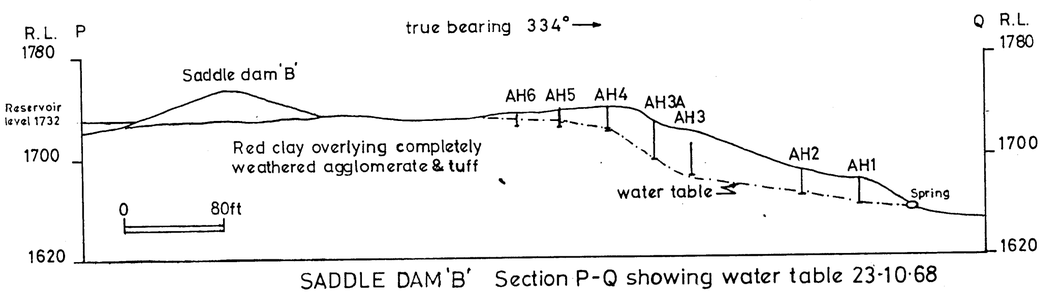
LOCATION OF SADDLE DAMS OF STAGE 2 AND SPRINGS



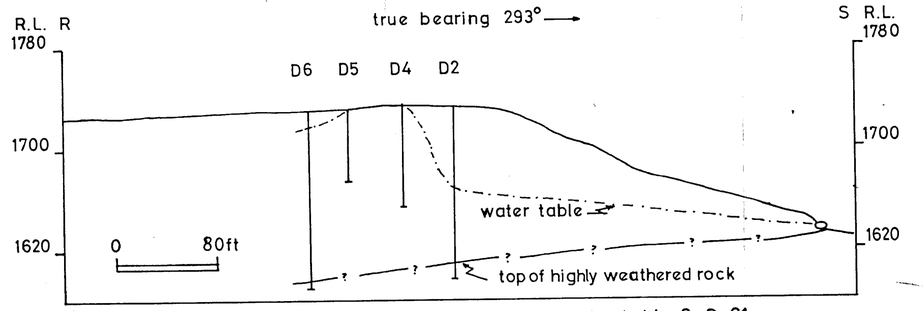
SADDLE DAM 'B' Auger holes and test pits 1967-68



SADDLE DAM 'C' Boreholes 1961 (before filling of reservoir)



SADDLE DAM 'B' Section P-Q showing water table 23-10-68



SADDLE DAM 'C' Section R-S showing water table 2·8·61
(from C.D.W. Drawing PH 61/167 B)

Geological Office, Port Moresby

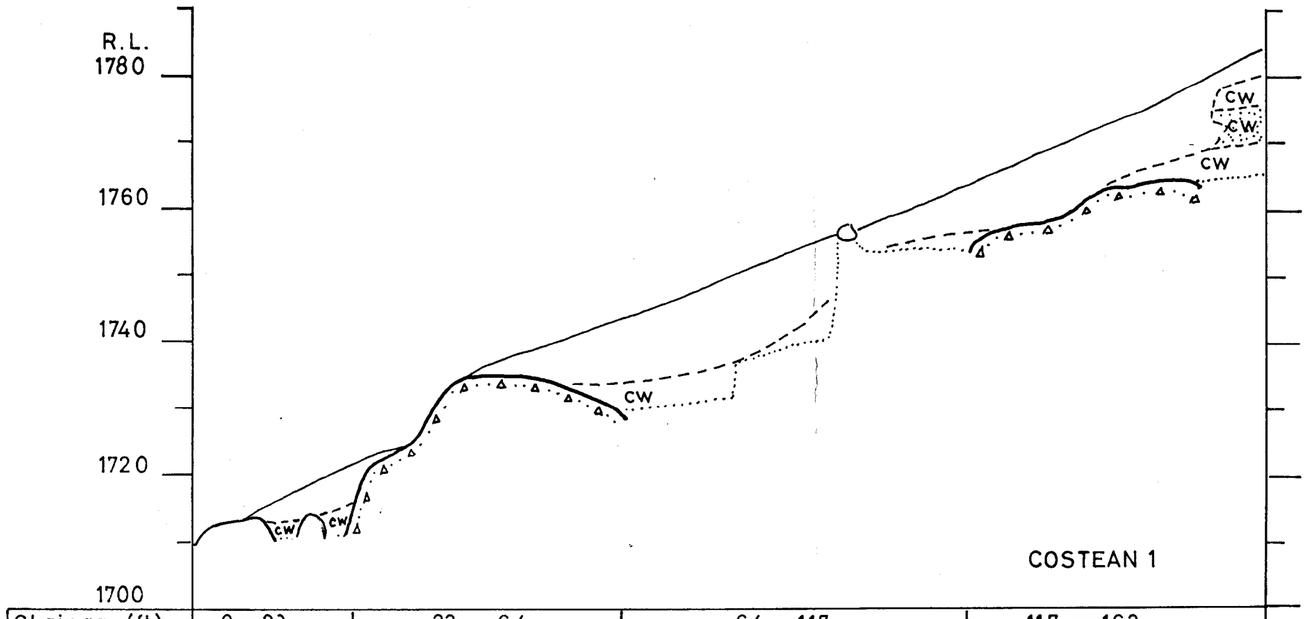
PNGC 55-7-23

C 55/A7/43

To accompany Record 1969/1

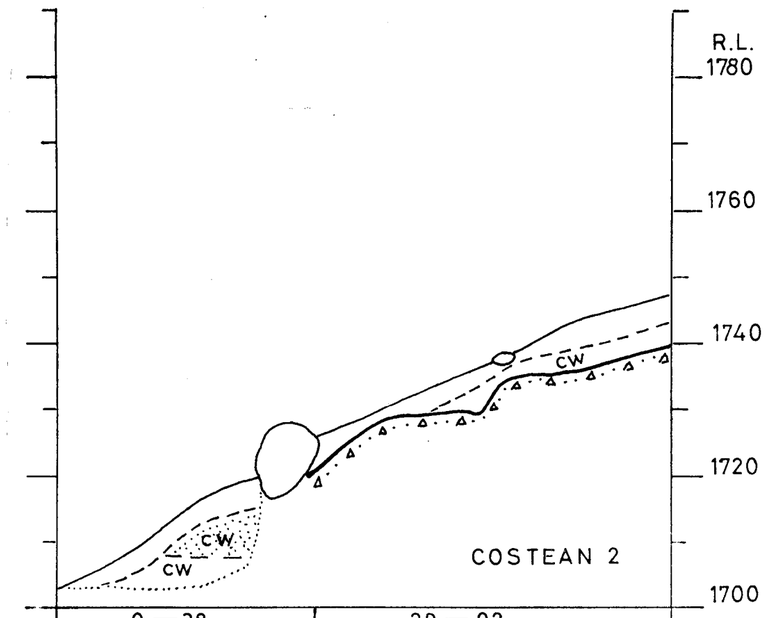
PLATE 7

Coordinates 1245E, 922N — Bearing 324°M. → — 1229E, 1082N



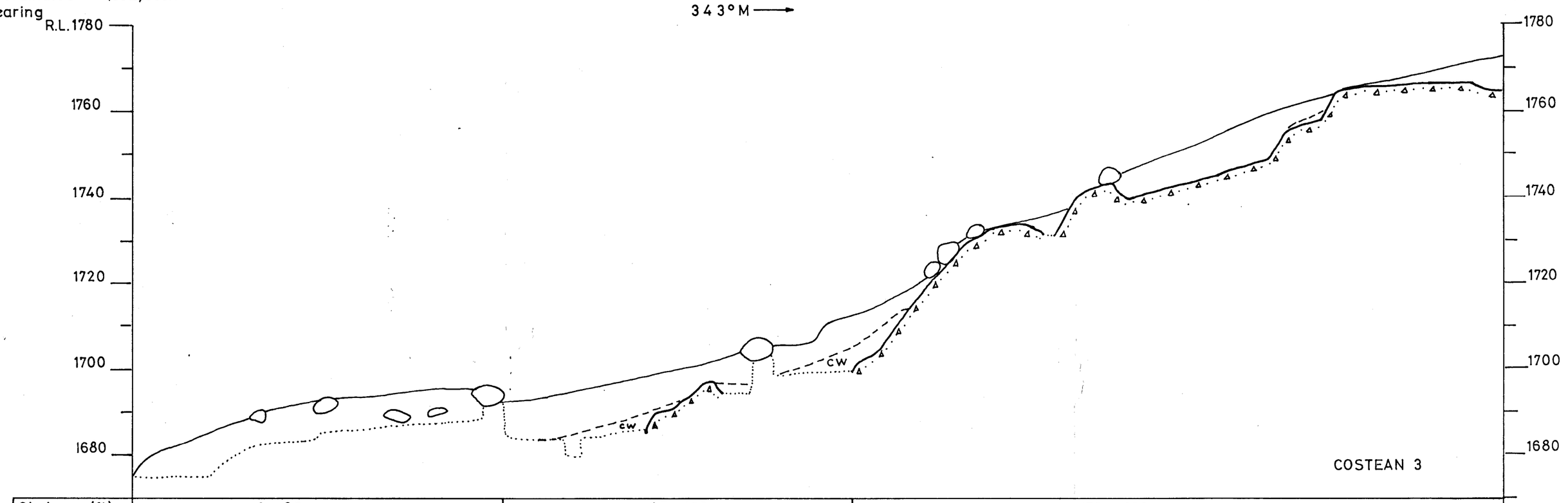
Chainage (ft)	0 – 23	23 – 64	64 – 117	117 – 163
Soils	Red clay 0-12ft thick; completely weathered agglomerate & tuff 0-15ft proved thickness			
Bedrock	not proved	M.W. aggl. R.L. 1710-1735	not proved	M.W. aggl. 1753-1764 n.p.

Coordinates 1122E, 928N — Bearing 336°M. → — 1136E, 1020N



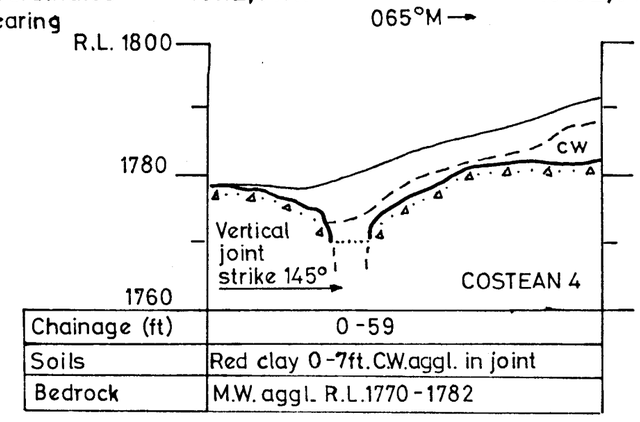
0 – 38	38 – 92
Red clay 2-4ft; C.W. aggl. & tuff 0-10 ft proved	
not proved	M.W. agglomerate R.L. 1720-1740

Coordinates 788E, 900N — Bearing 343°M → — 866E, 1212N



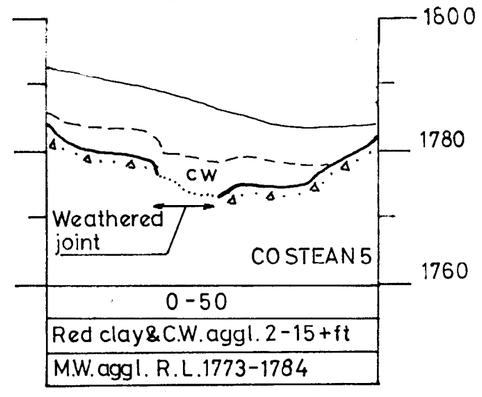
Chainage (ft)	0 – 87	87 – 170	170 – 323
Soils	Uncompacted spoil on soft to firm brown clay	Firm to stiff red clay 0-10 ft thick; completely weathered agglomerate 0-5ft proved thickness	
Bedrock	not proved	M.W. aggl. at 121-139, R.L. 1685-1697	Moderately weathered agglomerate R.L. 1699-1766

Coordinates 1011E, 647N — Bearing 065°M → — 1070E, 640N



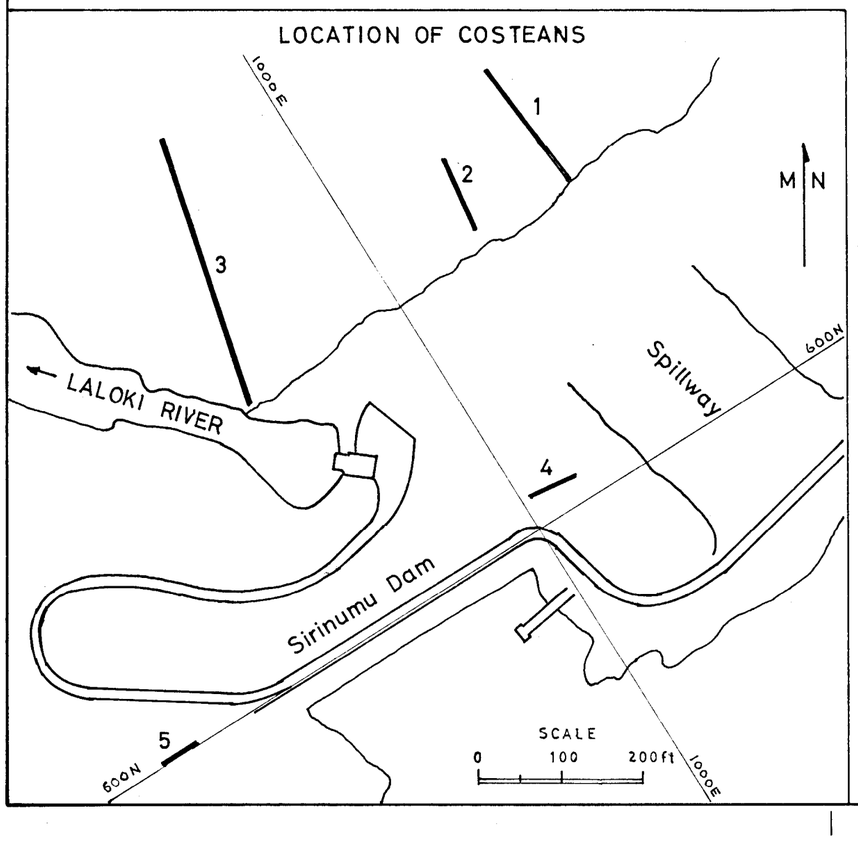
Chainage (ft)	0-59
Soils	Red clay 0-7ft. C.W. aggl. in joint
Bedrock	M.W. aggl. R.L. 1770-1782

Coordinates 479E, 604N — Bearing 058°M → — 529E, 604N

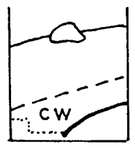


0-50
Red clay & C.W. aggl. 2-15+ft
M.W. aggl. R.L. 1773-1784

LOCATION OF COSTEANS



REFERENCE



Ground level with boulder
Red clay, spoil
Completely weathered rock
Bottom of costean; heavy line - moderately weathered rock; dotted line - soil

Agglomerate

Tuff

SCALE
0 20 40ft

To accompany Record 1969/1

PORT MORESBY HYDRO-ELECTRIC PROJECT

SIRINUMU DAM & SPILLWAY

GEOLOGICAL LOGS OF COSTEANS

Geological Office Port Moresby

C55/A7/38
PNG C55-7-17A