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RECORDS:

1965/155

PRELIMINARY GEOLOGICAL INVESTIGATION OF NO. 1 DAMSITE, RAMU RIVER, UPPER RAMU HYDRO-ELECTRIC SCHEME, T.P.N.G.

by

J.P. MacGregor

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RECORD 1965/155

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SUMMARY

At the request of the Commonwealth Department of Works a brief investigation was carried out to determine the sediments present at the No. 1 damsite, on the Ramu River. Costeaning and drilling have revealed that the abutments consist of horizontally bedded, interbanded clay and conglomerate; the conglomerate has a sandy clay matrix. Between the base of the lake sediments, which is at a reduced level of 3,950 feet, and the river level at RL 3,990 feet there is a coarse conglomeratic band with a sandy matrix. Further investigation is required to determine the permeability of the conglomerate bands, especially those below river level.

INTRODUCTION

At the request of Mr. J.B. Fraser, Assistant Director-General (Investigation) of the Commonwealth Department of Works, Melbourne, a brief investigation was carried out, during early March, 1965, of the foundation conditions at the proposed No. 1 damsite on the Ramu River, about one mile upstream from the tunnel intake for the Upper Ramu Hydro-electric scheme (Plate 3). It was stressed by Mr. Fraser that results from this investigation must be available in Melbourne by the middle of March, 1965.

Two exploratory percussion bores, one on the right and one on the left abutment of the proposed damsite, were requested. They were to be drilled to bedrock, an estimated depth of about 200 feet. The holes were to be tested for permeability and samples from the holes were to be subjected to mechanical analysis.

In the immediate area of the damsite the geological succession consists of horizontally bedded, unconsolidated lake sediments, resting on a folded sequence of indurated siltstone and shale intruded by dolerite dykes. The lake sediments have, in the past, caused considerable difficulty in percussion drilling, and it was estimated that the percussion rig available would not be able to carry out the specified programme in time. As an alternative the diamond drilling rig at present working on the Upper Ramu investigation could have been used, but rotary drilling is not suited to permeability testing nor the complete recovery of unconsolidated sediments. It was therefore decided that the most accurate and rapid way to determine the succession in the area would be by surface investigation combined with one drill hole sunk in the bottom of the valley next to the river.

WORK CARRIED OUT

In the investigation a total of six costeans were dug, three on the left abutment and three on the right abutment, and the percussion hole RDS 1, situated on the right abutment beside the Ramu Bridge, was deepened by a diamond drill hole to bedrock (Plate 1A). Costeans and road cuttings in the area were geologically mapped and samples were taken of potentially permeable materials. The positions of the costeans and the levels of the various formation contacts were picked up by stadia survey. The samples taken were forwarded to the Commonwealth Department of Works Soils Laboratory in Port Moresby for mechanical analysis.

RESULTS OF INVESTIGATION

The position of the costeans, road cuttings and drill hole are shown in Plate 4. The succession as found in the investigation is indicated on Sections 1, 2, and 3, in Plate 5.

Section 1.

On the left abutment, costean 1 was excavated from a road cutting on the Highland's Highway to a bench at a reduced level of 4,115 feet. The combination of the road cutting and this costean gives a complete succession between RL 4,010 feet and RL 4,115 feet. In this section grey clay which weathers brown in colour is interbedded with conglomerate, which consists of rounded pebbles of igneous and metamorphic rocks up to ten inches in diameter in a matrix of sandy clay. Between RL 4,061 and RL 4,065 feet there is a band of fine brown sand with some clay; Sample 6 was taken from this level. The contacts between the various strata are roughly horizontal but there is an erosional disconformity at approximately RL 4,035 feet, where a thick band of conglomerate and some fine sand lenses have been deposited in wash-out channels in the underlying clay band (Plate 1A). Sample 4 was taken from the conglomerate in one of the channels above the disconformity. The lower part of the succession consists of conglomerate and minor clay bands; Sample 5 was taken from the conglomerate about ten feet below the disconformity. In this area considerable lensing was noted in the conglomerate (Plate 1B).

Section 2.

Section 2 has been compiled from exposures in the right abutment just upstream from the bridge and from information derived from the drill hole RDS 1. It gives an almost continuous succession from a level of RL 3,900 feet to RL 4,032 feet. The succession is again one of interbanded conglomerate and grey clay.

At about RL 4,024 feet there is an erosional disconformity similar to that found in Section 1, at the base of a layer of conglomerate with interbands of fine sand (Plate 1C); Sample 2 was taken from a sand lens. The sequence of deposition and erosion is clearly revealed in the road cutting (Plate 6).

Between the disconformity and river level conglomerate with sandy clay has been sampled in two places; Sample 1 is from RL 3,995 feet and Sample 5 from the lowest level exposed above the river (Plate 2B).

Below river level the succession encountered in the diamond drill is similar to that exposed at the surface (Plate 2C). Unfortunately most of the matrix in the conglomerate was lost owing to washing out by the drilling water. Sample 7 is taken from sand recovered in the barrel and Sample 8 from sludge recovered from the drilling water. The drill encountered bedrock, which consists of completely to highly weathered dolerite, at a depth of 58 feet 6 inches (RL 3,950 feet) and continued in the dolerite to RL 3,900 feet, where drilling was suspended.

Section 3.

Section 3 is compiled from costean No. 6, on the right abutment downstream of the bridge. A succession similar to those in Sections 1 and 2 is again exposed but because of the soft nature of the ground and minor slipping the contacts are not as clear as in other exposures. The succession exposed extends from RL 3,995 to RL 4,100 feet and is composed of clay, interbanded with conglomerate with a sandy clay matrix; the conglomerate content increases towards the base.

Laboratory Results

The samples taken were forwarded to the Soils Laboratory, Commonwealth Department of Works, Port Moresby, for mechanical analysis and the determination of plasticity index. The results of the tests are given in Appendix 1.

CONCLUSIONS

The evidence from the costeans shows that above river level the succession consists of conglomerate with sandy clay matrix, and clay in approximately equal amounts. The clay is impermeable, and the clay content apparent in hand specimens of conglomerate indicates that the conglomerate would not have a high permeability although in places seepage occurs at the lower contacts between gravel and clay. There are occasional lenses of fine sand which may be permeable, but they do not appear to be continuous across the damsite. The bedding is horizontal in general but disconformity, with overlying conglomerate, found in Sections 1 and 2 provides evidence of local erosion. This disconformity was found at a level of RL 4,035 feet on the left abutment and RL 4,025 feet on the right abutment. Below the disconformity the succession is similar on both banks of the river; above the disconformity the succession is obscured in Section 2. Section 3 cannot be readily correlated with the other two sections but many contacts in this section are obscure. The higher part of costean 6 had not been completed when the area was mapped and further investigation may prove the presence of minor banding in this zone.

In drill hole RDS 1 the first 31 feet was percussion-drilled in 1964. The samples from the first 15 feet were of sandy clay but an exposure in the river bank indicates that the sandy clay is, in fact, the matrix from a conglomerate. In the diamond drill hole only the larger stones were retained in the core barrel. The sludge recovered from this hole is a fine sandy silt which seems to be cuttings from the drilling of the boulders. Evidence from the other holes drilled through the lake sediments on the Upper Ramu scheme suggests that at the base of the lake sediments there is a coarse sandy layer. It is not known how much of this particular band has been washed by the drilling but Sample 7 indicates that the horizon is possibly permeable. The coarse conglomerate and sand at the base of the lake sediments is exposed in a cliff half a mile downstream from the damsite.

FURTHER WORK REQUIRED

In order to prove that the damsite would retain water it would be necessary to carry out further investigation to confirm the stratigraphic succession laterally and to measure the permeability of the zones of conglomerate and fine sand. It will also be necessary to investigate further the lithology and permeability of the zone between river level and bedrock. It is considered that the stratigraphic succession can be found much more easily by surface costeans than by drilling and that permeability testing can be done in percussion drill holes under careful supervision. A detailed soil mechanics investigation will be required over the area but, as a preliminary opinion, it seems that the clays present would be suitable for core material and that the conglomerate with sandy clay matrix could possibly be used as fill in an earth dam.

APPENDIX 1

RESULTS OF LABORATORY TESTS

ON SAMPLES FROM NO. 1 DAMSITE,

UPPER RAMU HYDRO-ELECTRIC SCHEME

(Carried out by Soils Laboratory, Commonwealth Department of Works, Port Moresby)

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT. RAMU DAMSITE INVESTIGATION

SAMPLE No. 655 154 (No. 1)

LOCATION Costean No. 4, Right Bank Ramu River (R.L.3995 feet)

CLASSIFICATION TEXTURE Clayey gravelly sand.
COLOUR Brown
U.S. ENG. S.C.

PASSING	2 INCH	%	
	1½ "	%	100
	1 "	%	85
	¾ "	%	82.5
	½ "	%	
	⅜ "	%	76.5
	¼ "	%	
	3/16 "	%	
	16		70

B.S.S. No.7	(2.41M.M.)%	64
14	(1.20M.M.)%	58
25	(.60M.M.)%	
36	(.42M.M.)%	47
52	(.29M.M.)%	43
100	(.15M.M.)%	35
200	(.076M.M.)%	27

0.05 M.M.	%	
0.02 M.M.	%	
0.005 M.M.	%	
0.002 M.M.	%	

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT	%	43
PLASTIC LIMIT	%	29.4
PLASTICITY INDEX	%	13.6
LINEAR SHRINKAGE	%	8.0

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT...RAMU DAMSITE INVESTIGATION.....

SAMPLE No. 655 155 (No. 2)

LOCATION Road cutting, right bank Ramu River (R.L.4022 feet)

CLASSIFICATION TEXTURE Clayey Sand
COLOUR Brown
U.S. ENG. SC

PASSING	2	INCH	%
	1½	"	%
	1	"	%
	¾	"	%
	½	"	%
	⅜	"	%
	¼	"	%
	16		

B.S.S. No.7	(2.41M.M.)%	100
14	(1.20M.M.)%	99.8
25	(.60M.M.)%	
36	(.42M.M.)%	83.3
52	(.29M.M.)%	59.5
100	(.15M.M.)%	31.0
200	(.076M.M.)%	21.8

0.05	M.M.	%
0.02	M.M.	%
0.005	M.M.	%
0.002	M.M.	%

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT	%	36.4
PLASTIC LIMIT	%	17.4
PLASTICITY INDEX	%	19.0
LINEAR SHRINKAGE	%	7.5

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT RAMU DAMSITE INVESTIGATION

SAMPLE No. 655 156 (No. 3)

LOCATION Costean No. 2, left bank Ramu River (R.L.4025 feet)

CLASSIFICATION TEXTURE Clayey Gravel
COLOUR Brown
U.S. ENG. GC

PASSING	2 INCH	%	100
	1½ "	%	90.4
	1 "	%	71.5
	¾ "	%	64.2
	½ "	%	
	⅜ "	%	45.3
	¼ "	%	
	3/16 "	%	
	16		34.0

B.S.S. No.	7 (2.41M.M.)	%	30.0
	14 (1.20M.M.)	%	26.8
	25 (.60M.M.)	%	
	36 (.42M.M.)	%	21.5
	52 (.29M.M.)	%	19.2
	100 (.15M.M.)	%	16.0
	200 (.076M.M.)	%	13.6

0.05 M.M.	%	
0.02 M.M.	%	
0.005 M.M.	%	
0.002 M.M.	%	

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT	%	76.6
PLASTIC LIMIT	%	22.3
PLASTICITY INDEX	%	54.3
LINEAR SHRINKAGE	%	19.0

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT. RAMU DAMSITE INVESTIGATION

SAMPLE No. 655 157 (No. 4)

LOCATION Road cutting left bank Ramu River (RL 4035 feet)

CLASSIFICATION TEXTURE Clayey gravel
COLOUR Brown
U.S. ENG. GC

PASSING	2 INCH	%	100
	1½ "	%	78
	1 "	%	66
	¾ "	%	60
	½ "	%	
	⅜ "	%	50
	¼ "	%	
	⅛ "	%	
	16		43

B.S.S. No.7	(2.41M.M.)%	41
14	(1.20M.M.)%	36
25	(.60M.M.)%	
36	(.42M.M.)%	27
52	(.29M.M.)%	23
100	(.15M.M.)%	18
200	(.076M.M.)%	13

0.05 M.M.	%	
0.02 M.M.	%	
0.005 M.M.	%	
0.002 M.M.	%	

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT	%	48.1
PLASTIC LIMIT		21.6
PLASTICITY INDEX	%	26.5
LINEAR SHRINKAGE	%	11.5

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

GENERAL TEST REPORT SHEET -- SOILS AND GRAVELS

PROJECT. RAMU DAM SITES INVESTIGATION

SAMPLE No. 655 158 (No. 5)

LOCATION Exposure, right bank Ramu River. (R.L. 3991 feet)

CLASSIFICATION TEXTURE Clayey Gravel
COLOUR
U.S. ENG. GC.

PASSING	2 INCH	%	
	1½ "	%	100
	1 "	%	94
	¾ "	%	80
	½ "	%	
	⅜ "	%	55
	¼ "	%	
	3/8 "	%	
	16		40

B.S.S. No.7	(2.41M.M.)%	33
14	(1.20M.M.)%	29
25	(.60M.M.)%	
36	(.42M.M.)%	23
52	(.29M.M.)%	20.5
100	(.15M.M.)%	16.5
200	(.076M.M.)%	13.5

0.05 M.M.	%	
0.02 M.M.	%	
0.005 M.M.	%	
0.002 M.M.	%	

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT	%	76.5
PLASTIC LIMIT	%	32.8
PLASTICITY INDEX	%	43.7
LINEAR SHRINKAGE	%	14.5

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT RAMU DAMSITE INVESTIGATION

SAMPLE No. 655 159 (No. 6)

LOCATION Costean No. 1, Left bank Ramu River. (R.L. 4065 feet)

CLASSIFICATION TEXTURE Silty Sand
COLOUR Brown
U.S. ENG. MH

PASSING	2	INCH	%
	1½	"	%
	1	"	%
	¾	"	%
	½	"	%
	⅜	"	%
	¼	"	%
	3/16	"	%

B.S.S. No. 7	(2.41M.M.)%	100
14	(1.20M.M.)%	99
25	(.60M.M.)%	
36	(.42M.M.)%	94
52	(.29M.M.)%	87
100	(.15M.M.)%	71
200	(.076M.M.)%	57

0.05 M.M.	%
0.02 M.M.	%
0.005 M.M.	%
0.002 M.M.	%

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT	%	64.7
PLASTIC LIMIT	%	35.1
PLASTICITY INDEX	%	29.6
LINEAR SHRINKAGE	%	12.5

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT. RAMU DAMSITE INVESTIGATION.....

SAMPLE No. 655 160 (No. 7)

LOCATION Sand sample from R.D.S.1 (R.L.3958 feet)

CLASSIFICATION TEXTURE
COLOUR
U.S. ENG.

PASSING	2 INCH	%	
	1½ "	%	100
	1 "	%	79
	¾ "	%	73
	½ "	%	
	⅜ "	%	50
	¼ "	%	
	3/16 "	%	48

B.S.S. No.7	(2.41M.M.)%	44
14	(1.20M.M.)%	36
25	(.60M.M.)%	
36	(.42M.M.)%	25
52	(.29M.M.)%	23
100	(.15M.M.)%	21
200	(.076M.M.)%	19

0.05 M.M.	%
0.02 M.M.	%
0.005 M.M.	%
0.002 M.M.	%

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT %

PLASTIC LIMIT %

PLASTICITY INDEX %

LINEAR SHRINKAGE %

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

NOTE: only 500gm sample supplied.

GENERAL TEST REPORT SHEET --- SOILS AND GRAVELS

PROJECT....RAMU DAMSITE INVESTIGATION.....

SAMPLE No. 655 161 (No. 8)

LOCATION Sludge Sample from R.D.S.I (R.L.3958-3977 feet)

CLASSIFICATION TEXTURE
COLOUR
U.S. ENG.

PASSING	2 INCH	%	
	1½ "	%	
	1 "	%	
	¾ "	%	
	½ "	%	
	⅜ "	%	
	¼ "	%	
	3/16 "	%	
			100

B.S.S. No.7	(2.41M.M.)%	99.5
14	(1.20M.M.)%	99
25	(.60M.M.)%	
36	(.42M.M.)%	95.6
52	(.29M.M.)%	89.1
100	(.15M.M.)%	60.9
200	(.076M.M.)%	33.7

0.05 M.M.	%
0.02 M.M.	%
0.005 M.M.	%
0.002 M.M.	%

PASSING No. 36 B.S.S. MATERIAL

LIQUID LIMIT %

PLASTIC LIMIT %

PLASTICITY INDEX %

LINEAR SHRINKAGE %

PASSING ¾" MATERIAL

SOLID DENSITY LB./CU.FT.

MODIFIED O.D.D. LB./CU.FT

" O.M.C. %

NOTE: Only 500gm sample supplied

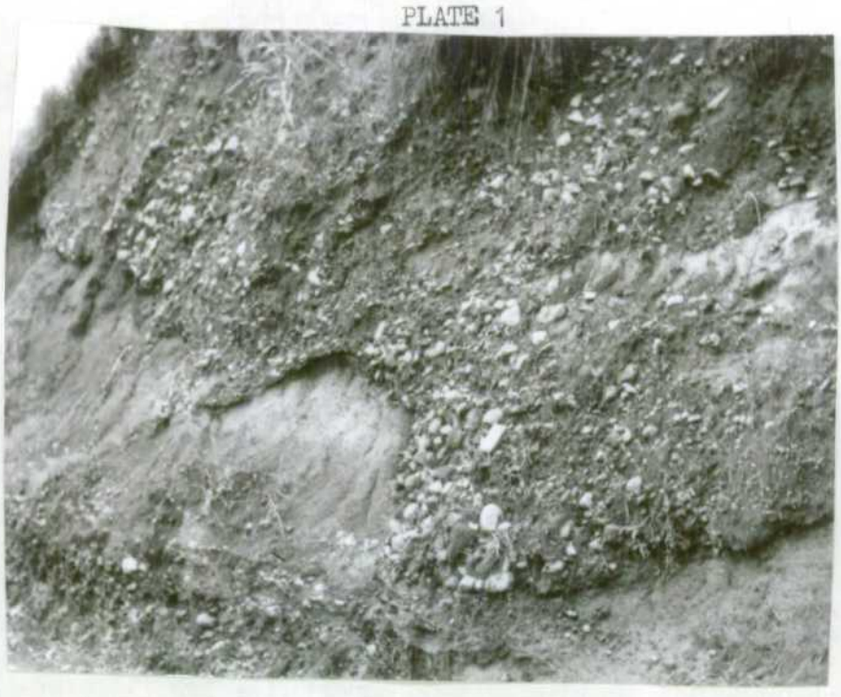
PLATE 1

A. Erosional disconformity between conglomerate and clay; road cutting, left abutment.

B. Erosional disconformity and lensing of conglomerate; road cutting, left abutment.

C. Detail of erosional disconformity of conglomerate on clay; road cutting, right abutment.

PLATE 1



A.

B

C.

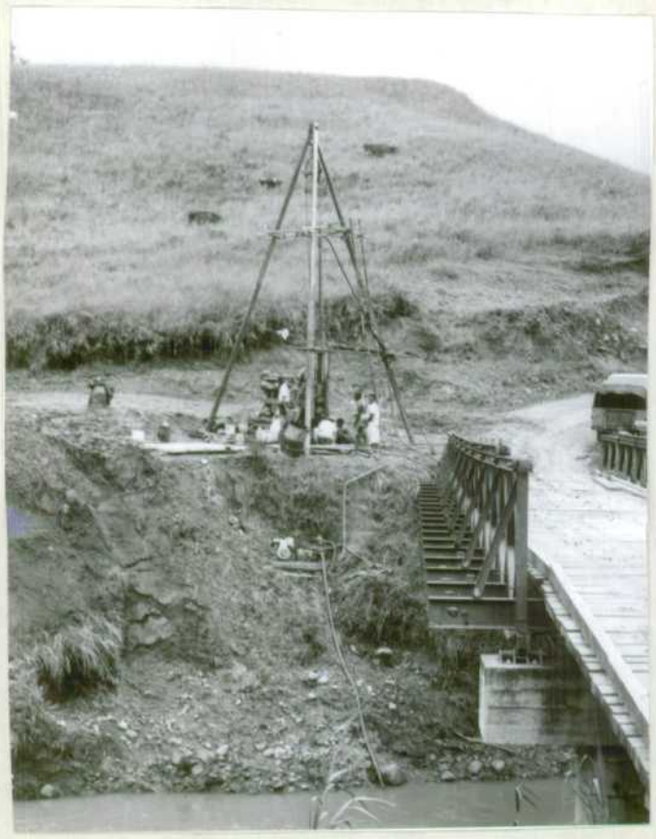
PLATE 2

A. Diamond drill on R.D.S.1, right abutment, downstream from Ramu Bridge.

B. Contact between conglomerate and clay just above river level, right abutment, upstream of Ramu Bridge.

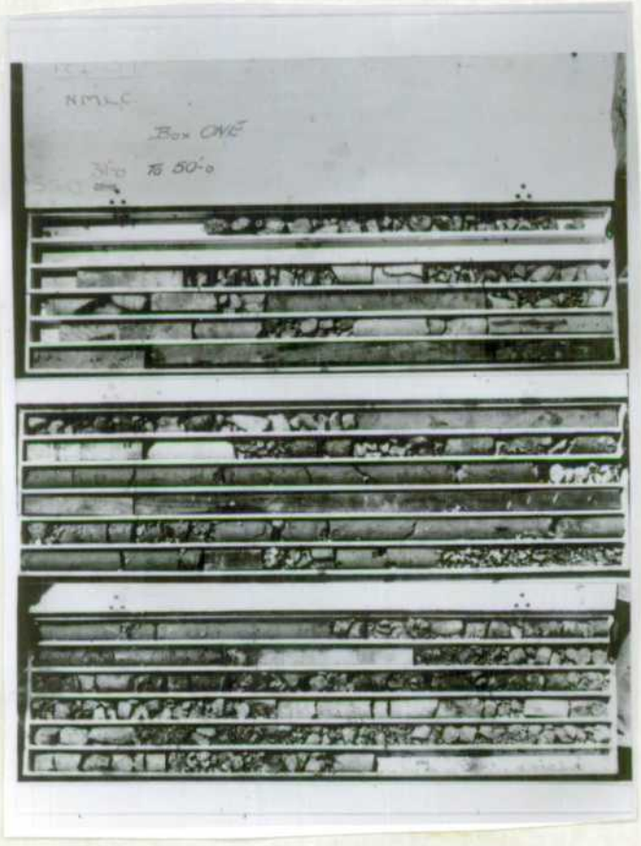
C. Core from R.D.S.1; Box 1, 31 feet-50 feet; Box 2, 50 feet-80 feet; Box 3, 80 feet - 108 feet. Base of lake sediments at 58 feet 6 inches.

PLATE 2.



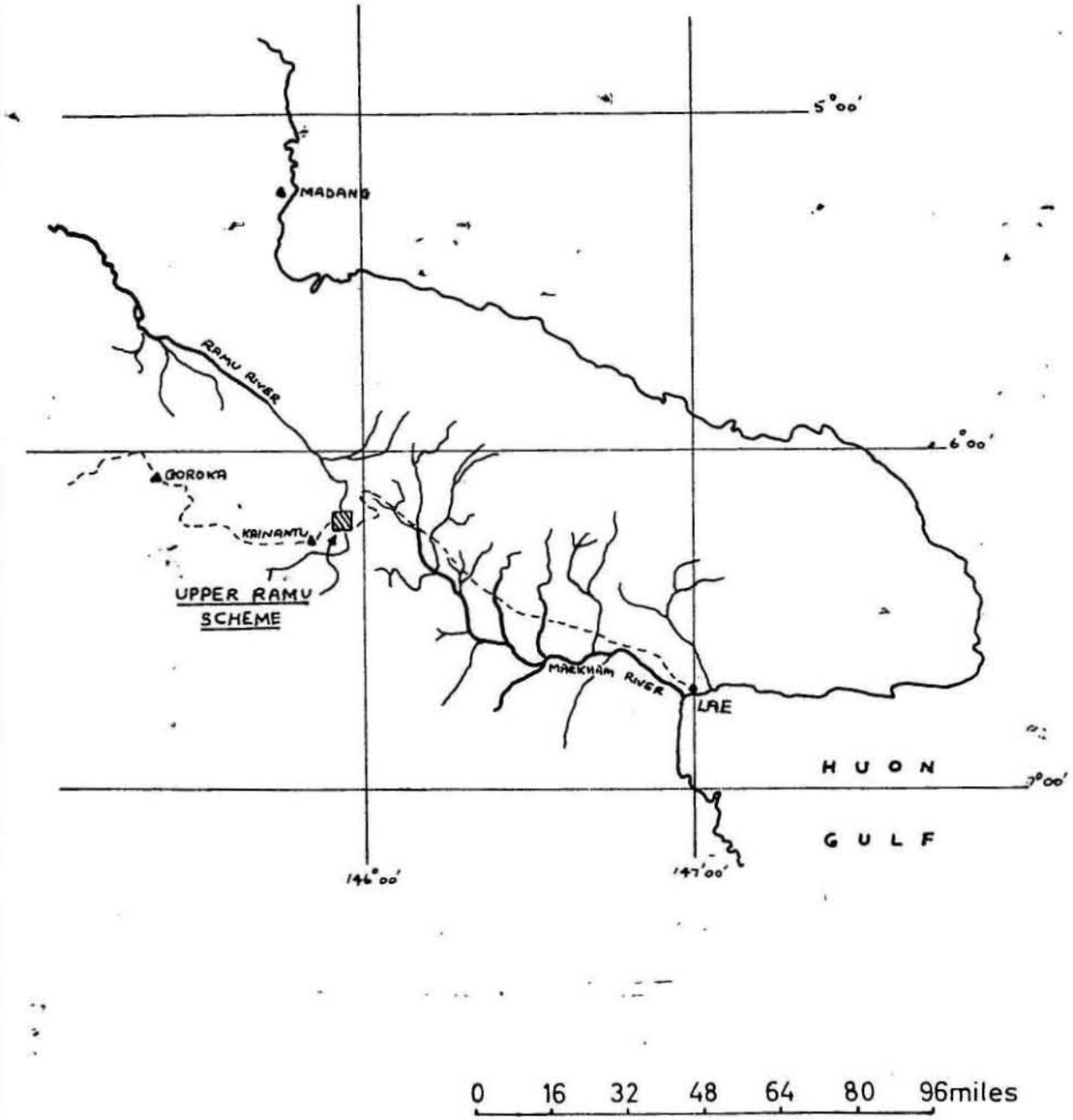
A.

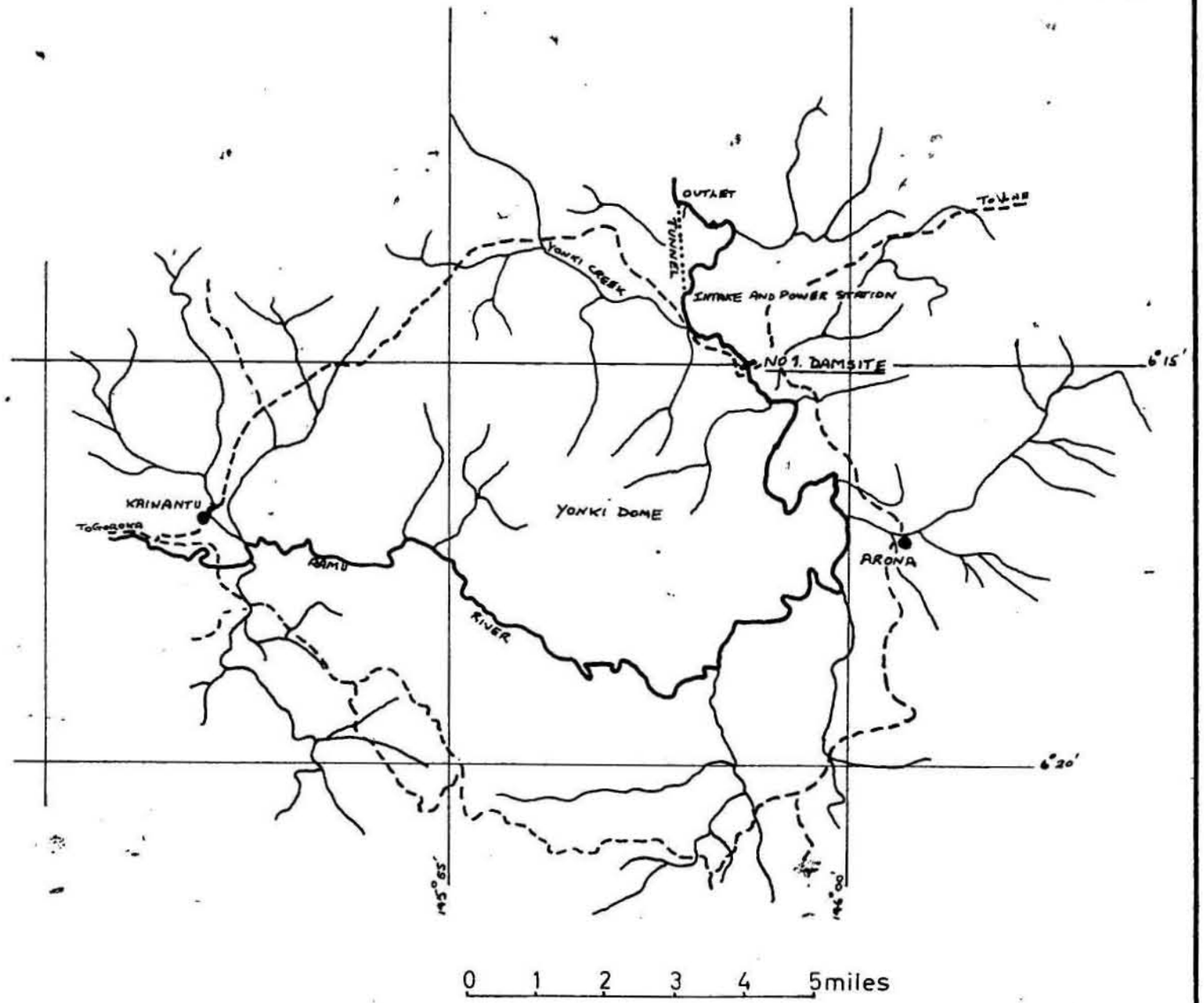
B.



C.

PLATE 3





UPPER RAMU HYDRO-ELECTRIC SCHEME

LOCATION OF NO.1 DAMSITE

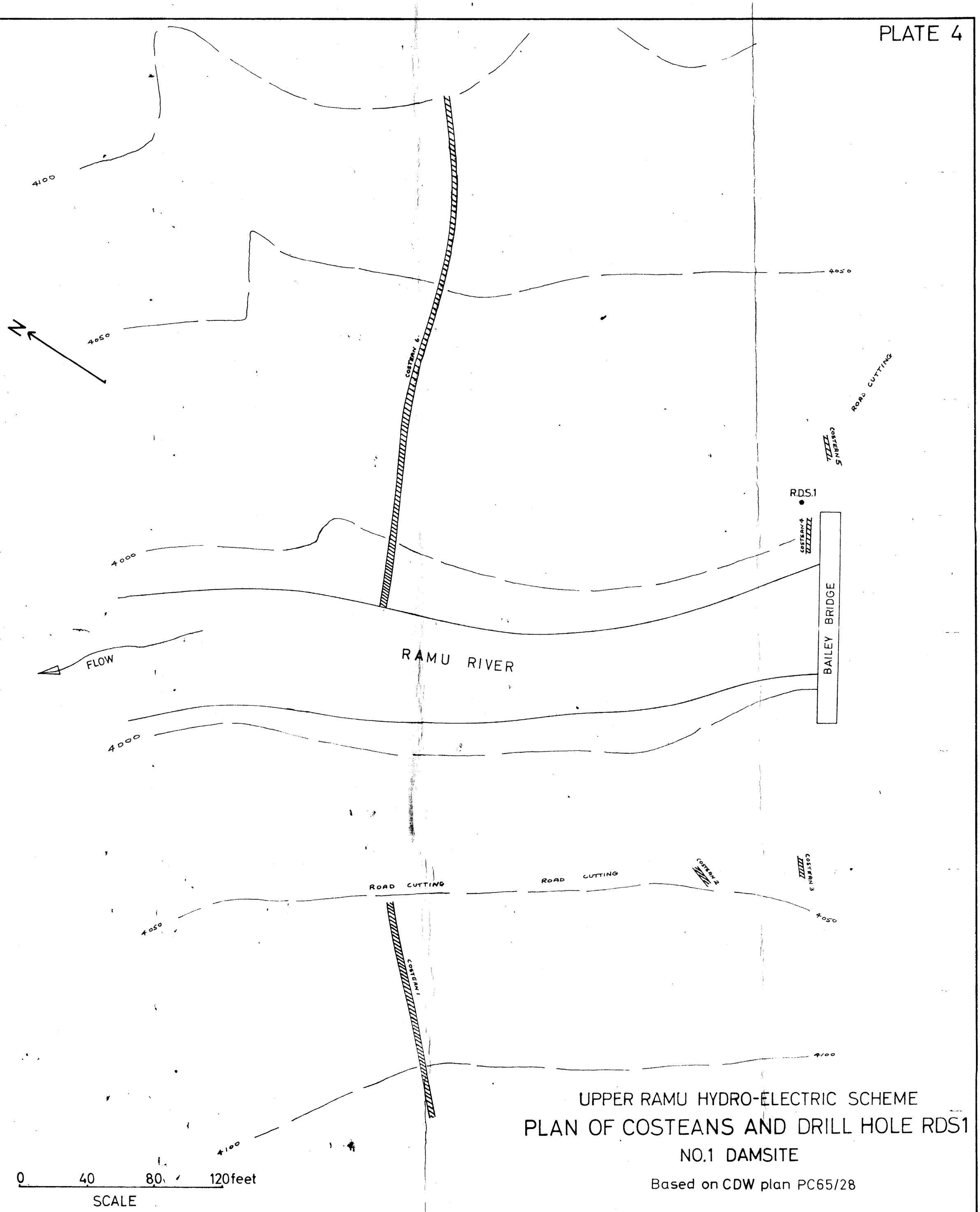
Based on CDW drawing HC63/94

Geological Office, Port Moresby J P MacGregor 15:7:65 To Accompany Record 1965/155

B55/A10/15

PNGB55-10-21

PLATE 4



UPPER RAMU HYDRO-ELECTRIC SCHEME

PLAN OF COSTEANS AND DRILL HOLE RDS1

NO.1 DAMSITE

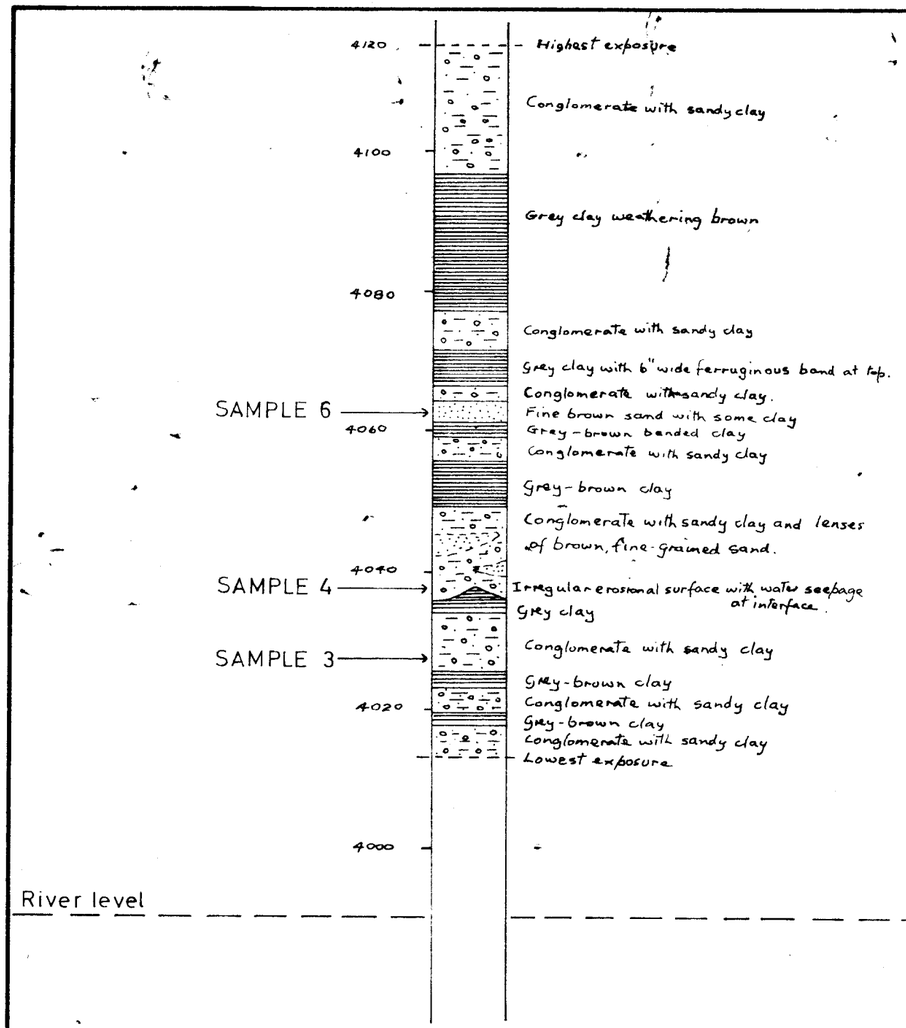
Based on CDW plan PC65/28

B55/A10/16

Geological Office, Port Moresby J.P. MacGregor 15:3:65 To Accompany Record 1965/155

PNGB55-10-18

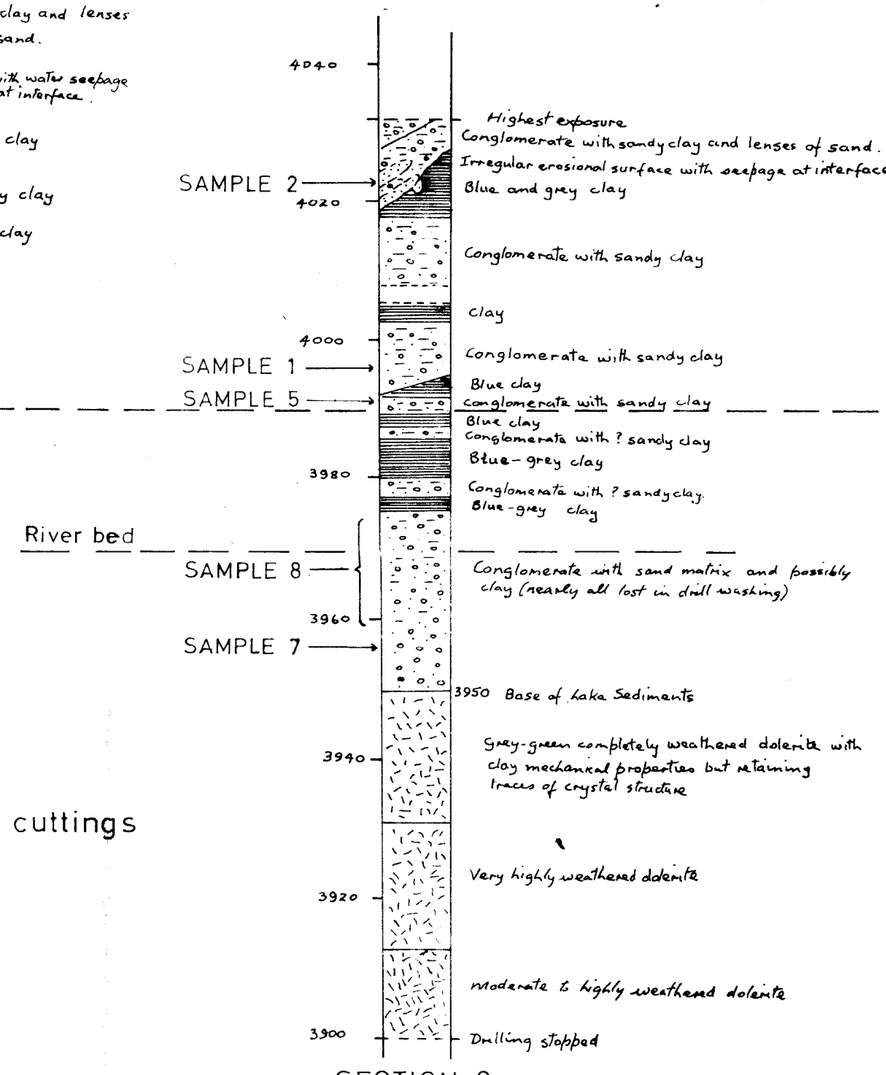
PLATE 5



SECTION 1
LEFT ABUTMENT

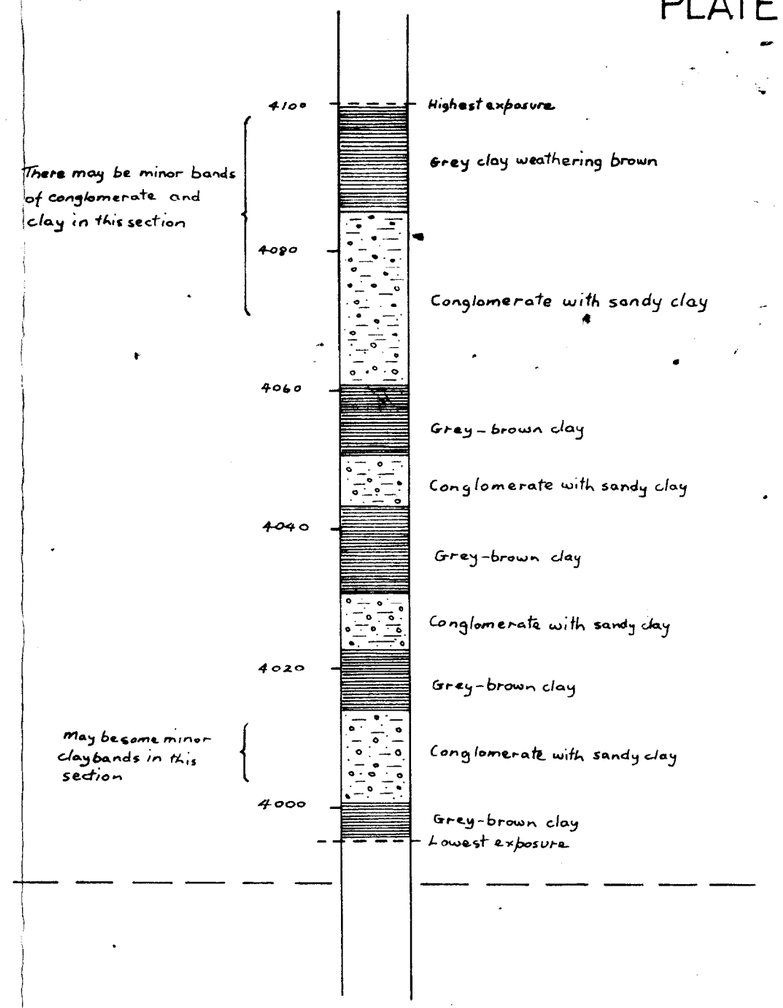
Compiled from Costeans 1,2,3 and road cuttings

Locations of costeans, drillhole and road cuttings shown on Plate 4



SECTION 2
RIGHT ABUTMENT

Compiled from Costeans 4,5, road cuttings and RDS 1



SECTION 3
RIGHT ABUTMENT

Compiled from Costean 6

UPPER RAMU HYDRO-ELECTRIC SCHEME

SECTIONS SHOWING GEOLOGICAL SUCCESSION IN ABUTMENTS

NO.1 DAMSITE

VERTICAL SCALE 1 inch = 20 feet

Geological Office, Port Moresby J.P. MacGregor 15:3:65 To Accompany Record 1965/155

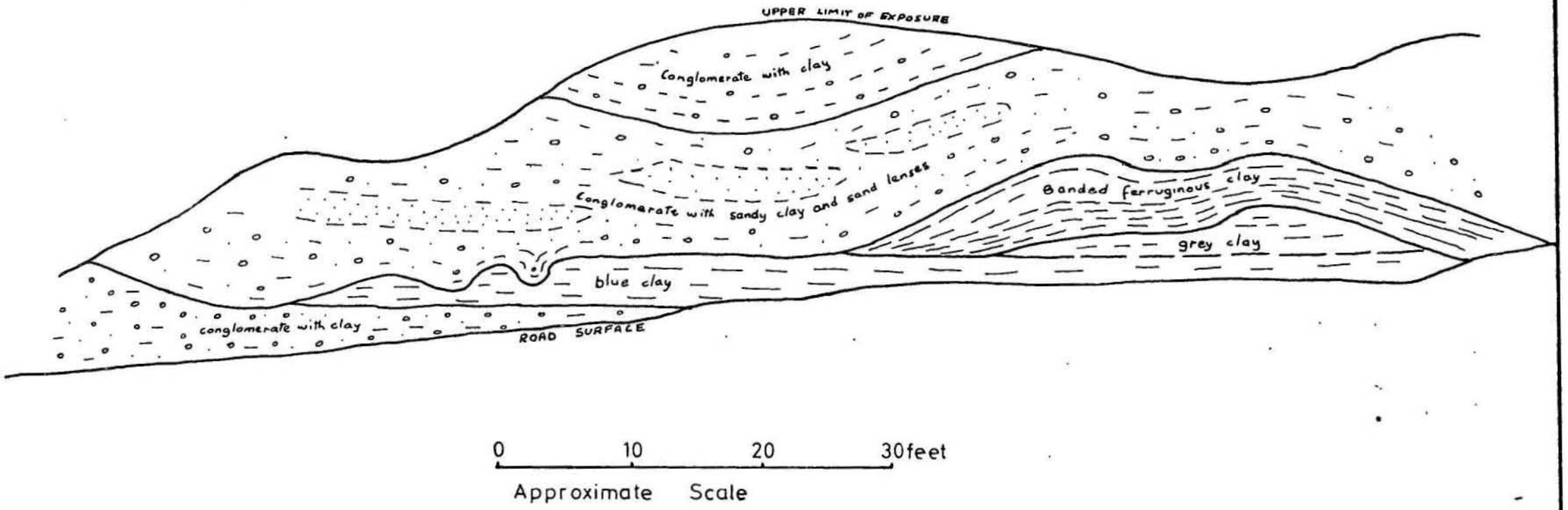
B55/A10/17
PNGB55-10-19

UPPER RAMU HYDRO-ELECTRIC SCHEME

PLATE 6

SKETCH SHOWING EROSIONAL DISCONFORMITY

IN ROAD CUTTING, RIGHT ABUTMENT NO 1 DAMSITE



B55/A10/18
PNGB55-10-20

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