# 7. CORRESPONDENCE REGARDING THE DEMOLITION OF TEC'S OFFICE

# (1) FROM EU FIJI OFFICE TO TUVALU



EUROPEAN UNION DELEGATION OF THE EUROPEAN COMMISSION FOR THE PACIFIC Head of Delogation

TRANSMISSION BY TELEFAX (688.20.210)

005 AAL **5** 

Mr Seve Paenlu Permanent Secretary and National Authorising Officer Ministry of Finance & Economic Planning Private Mail Bag Funafuti TUVALU

#### Dear Mr Paeniu,

Subject: Request to demolish the EU funded Electricity Corporation Administration Building

We have been informed by Ms Pasemeta, that it is cheaper to demolish the above building and build a new one, rather than to refurbish it. We understand that JICA is assisting the government of Tuvalu in this matter and would need our permission in writing, to proceed.

Infrastructure built with EDF funding becomes the property of the beneficiary country, at the end of the project. Thus the building in question is the property of the government of Tuvalu and therefore it is up to the government to decide on this matter and our permission is not necessary.

We are nevertheless surprised that a building that is about 8 years old costs more to renovate than to demolish and build anew. We would like to have further information on this issue, in particular we would like to know what has been done in terms of basic maintenance since the building was built.

Yours s	sincerely,
	Z FOR THE OF PACIFIC
	J. RALHA
	Mr Araki, JICA Fiji Office (fax:3302.452) Mr James Conway, (fax:688.20.200) Ms Pasemeta Talaapa
Atten	tion : Mr Laasai
Fax	# 688 20207

Ath Floor, Development Bank Centre, Private Mali Bag, GPO, Suva, Fill

# (2) FROM TUVALU TO EU FIJI OFFICE



# **GOVERNMENT OF TUVALU MINISTRY OF WORKS AND ENERGY** G.P.O. VAIAKU, FUNAFUTI, TUVALU

Tel: (688) 20060 / 20055 Fax: (688) 20207 Email: minwe@tuvalu.tv

Date: 21 January 2005 ref. WE : /

Ms Maria J, RALHA Head of Operations Delegation of the EU Commission for the Pacific 4<sup>th</sup> Floor Development Bank Centre SUVA, Republic of Fiji

Dear Ms Ralha,

# Subj/Re: Demolition of the Tuvalu Electricity Corporation Admin Bldg

Thank you for sending me a copy of your letter to Mr. Paeniu regarding the above matter.

We can understand your reservations about the matter and feel obliged to offer the following reasons to really clarify the situation here:

- 1. The Cabinet has approved plans to construct a new power plant in the area of the existing powerhouse under grant aid from the Government of Japan.
- 2. The existing area reserved for the TEC is too small to construct the new powerhouse without relocating the existing fuel oil tanks, if the existing TEC office is left as it is.
- 3. The existing powerhouse will need to be running continuously while the project is on, therefore it is impossible to relocate the fuel oil tanks without causing inconvenience and great disruptions to normal services.
- 4. Also if the existing office is not removed, it will create great difficulties in implementing the project, as heavy equipment and machineries will need wide open access to the area behind the office for the construction of the new powerhouse.
- 5. The Cabinet has ruled out relocating the new powerhouse to a different site, considering the scarcity of land and the insurmountable difficulties associated with land tenure in Tuvalu (private landowners are being drilled in human right laws and have little qualms about threatening all sorts of eviction possibilities to people leasing lands).
- 6. We believe that it is more cost effective and environmentally friendly in the long term to rebuild the office than relocating the new powerhouse.

Given the above considerations I believe that you are now in a better position to appreciate our dilemma in this vital development.

Also, given the capacity and quality of our existing powerhouse, we cannot afford to delay this project by going through tedious negotiations with landowners, nor can we afford readily the costs of preparing a new site for the project.

Yours sincerely,

[Pusinelli Laafai] Acting Secretary for Works and Energy

cc: .Mr. Hayashi Hiryuki, JICA Tokyo Mr. Araki, JICA Fiji Mr. Mitsuhisa Nishikawa, Yachiyo Engineering Co. Ltd, Tokyo

# (3) FROM JICA TO EU FIJI OFFICE



For a better tomorrow for all. Japan International Cooperation Agency

Ms. Maria J. RALHA Head of Operations Delegation of the EU Commission for the Pacific 4<sup>th</sup> Floor Development Bank Center Suva, Republic of Fiji

Dear Ms. Ralha,

Re: Submission of Draft Basic Design Report on the Project for Upgrading of Electric Power Supply in Funafuti Atoll, TUVALU

Through the communications with Ms. Pasemeta Talaapa, Mr. Seve Paeniu and Mr. Pusinelli Laafai, you were informed that the Government of Tuvalu requested the Government of Japan to provide a grant aid for the titled project. Upon the request from the Government of Tuvalu, We, Japan International Cooperation Agency (JICA) are conducting a Basic Design Study to evaluate the necessity and urgency of the request and to formulate the scope and components of the Project. Now we are going to complete the study and prepare a draft basic design report.

It is our great pleasure to submit you a copy of the draft report as attached. we will briefly explain the summary of the report and inform you of an important issue which we request your kind understanding.

The main components of the Project are as follows;

1. Construction of a new power house where new diesel engine generators to be provided under the Project are installed

2. Procurement and installation of three (3) sets of diesel engine generators with output capacity of 600 kW each and their mechanical and electrical auxiliaries.

3. Upgrading of 11kV distribution cables and substation equipment such as Ring Main Units and Distribution Transformers including procurement of equipment and materials and installation work

Through the Basic Design Study, we recognized that the request from the Government of Tuvalu has high necessity and urgency if current power supply shortage and unreliable distribution network of Tuvalu are taken into consideration. We also recognized that the Government of Tuvalu is facing a difficulty to secure enough land to construct the new power house under limited land availability in Tuvalu. The Cabinet of Tuvalu ruled out relocating the new power house to a different site, considering the scarcity of land and the insurmountable difficulties associated with land tenure in Tuvalu. Since land acquisition for the new power house is difficult as described above, there is no alternative other than utilizing the existing power station area.

Through the field survey, it turned out that it is possible to construct the new power house inside the existing power station area if either the existing fuel tanks or TEC office is removed. We concluded that we had better to remove TEC office rather than the existing fuel oil tanks because of the following reasons:



For a better tomorrow for all. Japan International Cooperation Agency

1. The existing generating units will need to be running continuously while the Project is implemented. Therefore, the existing fuel oil tanks which supply fuel to the existing generating units are indispensable for continuous power supply and it is impossible to remove them. Relocation of the fuel tanks is also impossible, considering the land availability and power supply disruption during the relocation work.

2. If the existing office is not removed, it will create great difficulties in implementing the Project, as heavy construction equipment and machines will need wide open access to the area behind the office for the construction of the new power house.

We respects EU's assistance to the construction of TEC office building which has provided convenient and comfortable working environment to TEC officials for the past nine years and we believe that the assistance contributed to improve power supply service in Tuvalu. However, power supply shortage in Tuvalu is getting worse and worse, a land for new power plants is much more important for the people of Tuvalu. Through discussions with officials of Tuvalu and the field survey, we concluded that demolition of the TEC office is inevitable.

We understand that reliable power supply system is a crucial infrastructure for economic development and improvement of living standards in developing countries.

Your understanding and consideration to the Project would be highly appreciated.

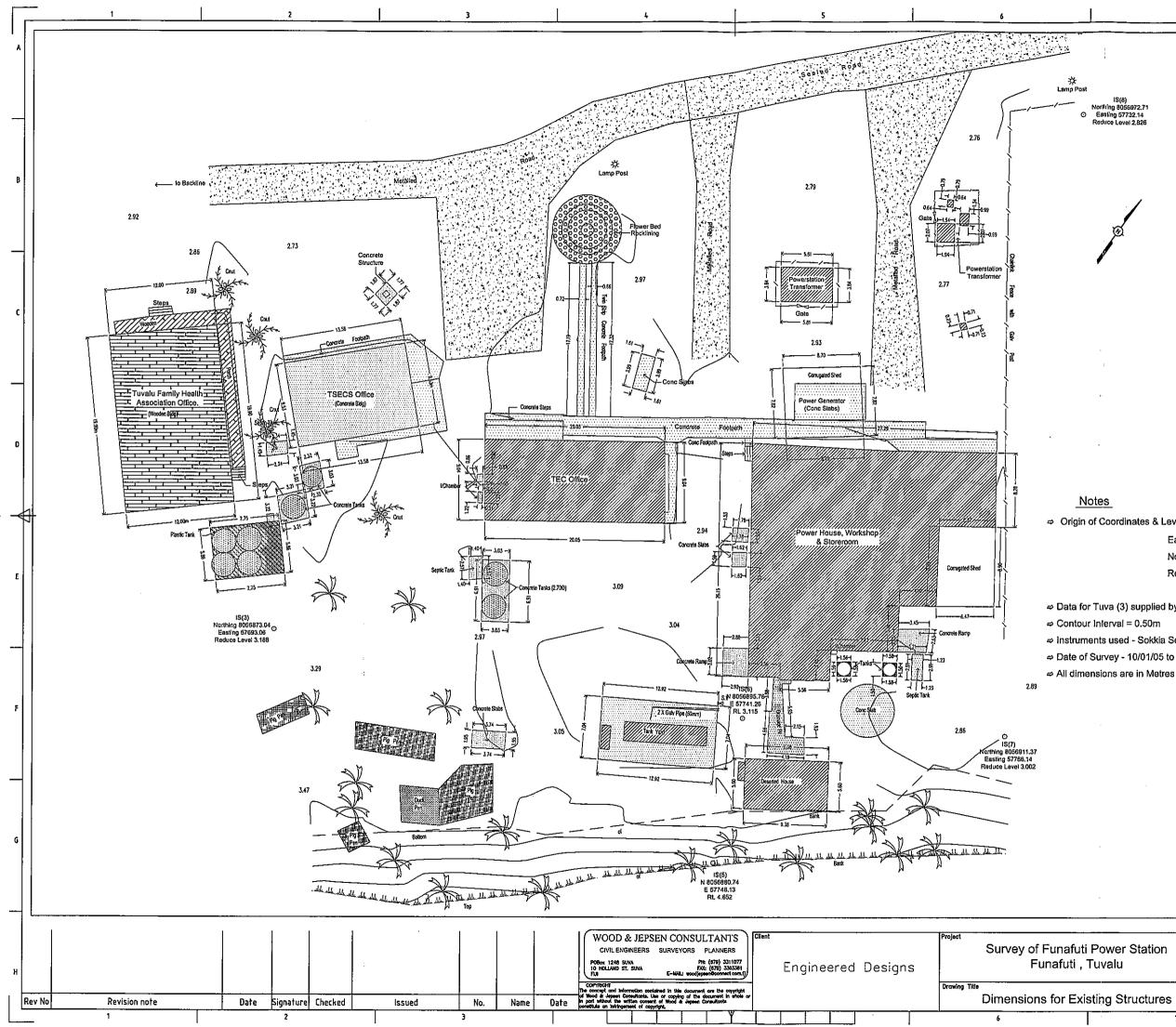
Yours sincerely,

3-Z

Hayashi Hiroyuki Traffic Infrastructure Team Project Management Group II Japan International Cooperation Agency

# 8. TOPOGRAPHIC SURVEY AND SOIL EXPLORATIONS

(1) TOPOGRAPHIC SURVEY



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Easting 57366.48 Northing 8057002.15 Reduce Level 3.96

⇒ Data for Tuva (3) supplied by Tuvalu Lands & Survey Dept ⇒ Date of Survey - 10/01/05 to 13/01/05

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# REPORT

YACHIYO ENGINEERING CO. LTD

Proposed Funafuti Power Station Re-development Geotechnical Investigation

**Report prepared for:** YACHIYO ENGINEERING CO. LTD

Report prepared by:

TONKIN & TAYLOR INTERNATIONAL LTD

**Distribution:** 

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YACHIYO ENGINEERING CO. LTD	3 copies
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#### February 2005

Job no: 750468

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7 Applicability 4	6	6.1 Introduction	3
	7	Applicability	4

Appendix A:Drawing No. 1: Trial Pit Locations,Drawing No. 2a: Dynamic Cone Penetrometer test locations, Set B1Drawing No. 2b: Dynamic Cone Penetrometer test Locations, Set B2

Appendix B: Site Photos

Appendix C: Laboratory Test Results

## 1 Introduction

This report presents the results of the geotechnical investigation for the proposed extensions of the existing power station, at Funafuti in the Tuvalu islands.

Tonkin & Taylor International (T&TI) in association with Engineered Designs (E-D) were engaged by Yachiyo Engineering Co. Ltd to carry out a geotechnical investigation of the site for the proposed extensions.

# 2 Objectives and scope

The objective of the investigation was to assess the subsurface conditions and determine allowable bearing capacities for foundation design, based upon field-testing and laboratory test results.

The scope of the field investigation undertaken by E-D comprised dynamic cone penetrometer tests (Scala), trial pits excavated by digger, and recovery of bulk samples.

The laboratory testing included determinations of water content, particle size analyses and solid densities.

The interpretation of the investigation results, assessment of subsurface conditions and determination of foundation design parameters has been undertaken by T&TI.

## 3 Field Investigation

The technicians from E-D carried out the geotechnical investigation of the site in January 2005, liaising with T&TI to ensure quality assurance during the investigations.

The first stage of work, involved 33 dynamic cone penetrometer tests carried out at the locations indicated on drawing no. 2a and 2b in Appendix A. Twenty-three tests were carried out in the area marked "Set B1" (drawing no. 2a), and 10 in the area marked "Set B2" (drawing no. 2b). All tests were carried out to "refusal", ranging between depths of 100 – 600 mm.

Following consultations with T&TI, E-D undertook a second stage of work which comprised putting down 3 trial pits excavated by a 12-tonne digger at the locations indicated on drawing no. 1, in Appendix A. All of the trial pits reached "refusal" at shallow depths, and the ground was too hard to reach the target depth of 5 m. Trial pits B1, B2 and B2A reached "refusal" at 0.20 m, 0.25 m, and 0.60 m depth respectively.

Site photos taken by E-D are contained within Appendix B.

## 4 Laboratory testing

Laboratory testing to determine the water content of the samples retrieved from trial pits B1 and B2 was carried out by E-D. T&TI have carried out determinations of solid density and particle size analyses on bulk samples retrieved from all three trial pits. Table 1 presents a summary of the water content results. Full test results are available in Appendix C.

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## **Table 1: Water content results**

	A	T	EST NUMBE	R	
TEST LOCATION	Depth	1	2	3	AVERAGE
B1	100 mm	20.92 %	26.24 %	25.84 %	24.34 %
B2	100 mm	20.64 %	20.44 %	21.36 %	20.81 %
B2	200 mm	22.15 %	21.68 %	17.77 %	20.53 %

## **Table 2: Solid Density results**

TEST LOCATION	Sample No.	Depth (m)	Solid Density (t/m³)
B1	1	0.1	2.62
B2	1	0.1	2.48
B2	2	0.2	2.47
B2A	1	0.2	2.62

# 5 Site Conditions

## 5.1 Geology of Tuvalu

The islands of Tuvalu are atolls with low lying coral sand covering modern reef, built upon older volcanic seamounts<sup>1</sup>. The islands are geologically young, having been formed during the last 3000 years<sup>1</sup>

## 5.2 Subsurface conditions

The results of the field investigation show that the two main units underlie the site:

- Weathered residual soil
- Coral rock formation

A summary of the respective characteristics of these units is as follows:

<sup>1</sup>SOPAC Preliminary Report 38 (1991). Mapping survey and baseline study of coastal erosion on the islands of Tuvalu.

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(2) SOIL EXPLORATIONS

#### 5.2.1 Weathered residual soil

The investigations identified between 100 and 200 mm of weathered residual soil overlying the coral rock formation, comprising very fine-grained black silty sand, with occasional organics, including rootlets, wood, leaves and coral fragments greater than 100mm in diameter.

#### 5.2.2 Coral rock formation

Cemented limestone coral rock formation was recorded at depths of 0.1, 0.2, and 0.2 m in trial pits B1, B2, and B2A respectively. The coral is vesicular, and visual inspections of the surface of the coral estimate the voids to be minor and in the order of 5%.

# 6 Geotechnical recommendations

## 6.1 Introduction

The opinions and recommendations presented in this section are based upon subsurface information obtained from the dynamic cone penetrometer tests and the 3 trial pit excavations, as well as our existing geotechnical database. The nature and continuity of the subsoil away from the tests locations is inferred, so it must be appreciated that actual conditions may vary from the assumed model.

## 6.2 Foundation Options

Shallow footings are considered suitable for the building development, and a geotechnical ultimate bearing capacity of 1MPa can be assumed for footings founded on the coral rock. This corresponds to an Ultimate Limit State (FOS=2) and Working Load bearing capacity (FOS=3) values of 500 and 300 kPa respectively, in accordance with NZS.4203:1992<sup>2</sup>.

The above geotechnical ultimate capacities have been assessed using previous laboratory test results, and our knowledge of these materials.

Coral rock formations are susceptible to solution cavities and it will be essential to carry out proof drilling of the rock during construction to confirm the integrity of the foundation materials. We recommend a minimum depth of drilling of "2B" (B=footing width) be used to determine the minimum drilling depth.

<sup>2</sup> NZS.4203:1992, Code of practice for general structural design and design loadings for buildings.

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# 7 Applicability

This report has been prepared for the benefit of Yachiyo Engineering Co. Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

#### TONKIN & TAYLOR INTERNATIONAL LTD

Environmental and Engineering Consultants

Report prepared by:

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Steven Drury

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Authorised for Tonkin & Taylor by:

Chris Freer PROJECT CO-ORDINATOR

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# Appendix A:

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# Site Plans and Test Locations

Test Pit Logs and Dynamic Cone Penetrometer Results

# **TEST PIT LOGS**

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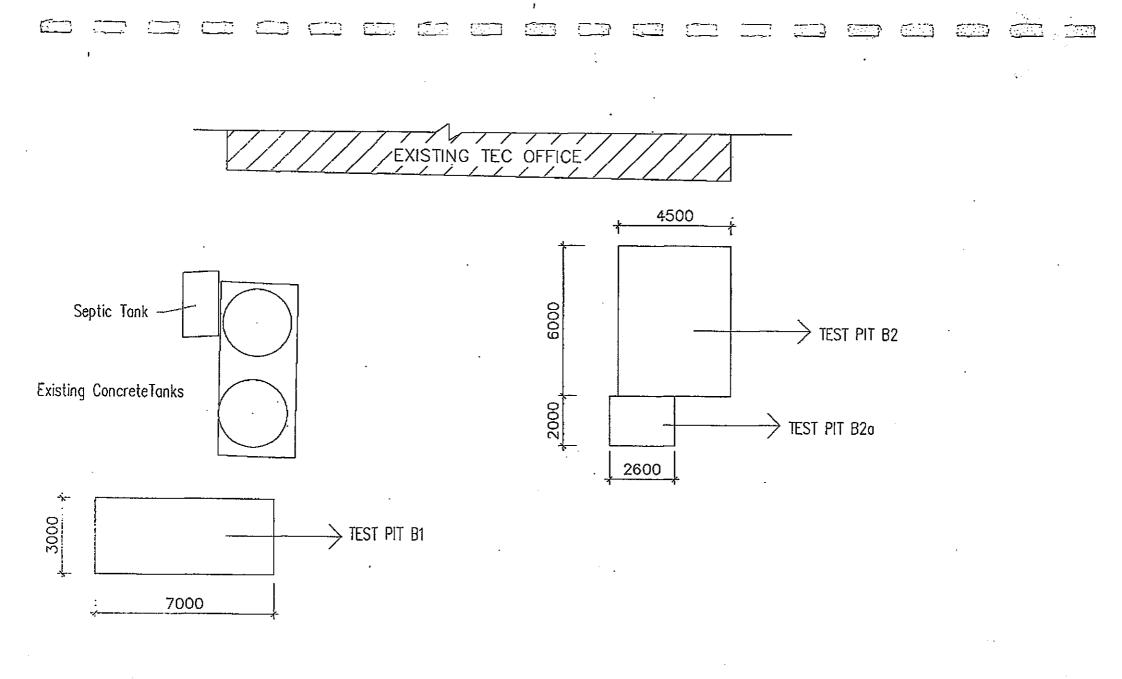
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100 [21]	Engineered Designs		TEST PIT NUMBER:B1	
	PROJECT: Funafuti Power Project.	LOCATION: Funafuti, Tuyalu.	JOB NUMBER 170/04	
	EXPOSURE TYPE: Trial Pit EQUIPMENT: 12 Tonne Digger Dimension: 7.0 x 3.0(M)	HOLE STARTED: 13/01/2005 HOLE FINISHED: 13/01/2005	Logged BY: SVC Checked BY: V.K	
	GEOLOGICAL GEOLOGICAL UNIT,		ENGINEERING DESCRIPTION SOIL DESCRIPTION	
	GENERIC NAME, ORIGIN, MUNERAL COMPOSITION TEST	R.L. (m) DEPTH (m) GRAPICALLOS	AlMA minor components, strength, colour, structure, weathering. ROCK DESCRIPTION SUBSTANCE: Rock Type, Particle size, Colour, minor compone DEFECTS: Type, Inclination, thickness, roughness, fitting	
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臼	WEATHERED RESIDUAL SOIL?	SM M L	SILTYSAND, Very fine grained, black with occasional orga fragments; rootlets, wood, leaves.	1
			Coral rock(formation),comented,creamy white,Vesicular(< Surface) with some shell fossils)	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
[]	CORAL ROCK FORMATION			
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		2.00		
		3.00		
			END OF TEST PIT at 0,20m. Unable to penetrate further.(Coral Rock Formation)	
		4.00		
		6.00		

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- 1 - 1 - 1	Engineered Designs Grading Codd Structure Structure		TEST PIT NUMBER: B2	• F
	PROJECT: Funafuti Power Project.	LOCATION: Funafuti, Tuvakı.	JOB NUMBER 170/04	]
	EXPOSURE TYPE: Trial Pit EQUIPMENT: 12 Tonne Digger Dimension: 6.0 x 4.5(M)	HOLE STARTED: 13/01/2005 HOLE FINISHED: 13/01/2005	Logged By: SVC Checked By: V.K	
Ϊ.J	GEOLOGICAL GEOLOGICAL UNIT,		ENGINEERING DESCRIPTION	4
	GENERIC NAME, ORIGIN, MINERAL COMPOSITION TES		MAIN minor components,strength,colour,structure,weathering. ROCK DESCRIPTION SUBSTANCE: Rock Type,Particle size,Colour, minor components DEFECTS: Type,inclination,thickness,roughness,filling	
	WATER	R.L. (m) DEPTH (m) GRAPHCAL L4 GLASSIFICAL L4 MCMSTURE/V		-
	WEATHERED RESIDUAL SOIL?		SILTYSAND, Vory fine grained black with occasional rootiets and coral fragments < 50mm dia, sub angular to angular, hard.	
	CORAL ROCK FORMATION		200- grades brownish with coral fragments > 100mm diameter, subangular to angular, hard.	
{ }			250- Coral rock(formation),cemented,creamy white,Vesicular(< 5% Surface) with some shell fossils.A dark orange stain was noted on few of the fragments.	_
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[-]	<del>ज्</del> रम7.	3.00		
			END OF TEST PIT at 0.25m. Unable to penetrate further.(Coral Rock Formation)	
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	Engineered D	esigns							TE	ST PIT NUMBER: B2A	
R I	ROJECT: Funafuti Po	wer Pro	ject.	LOCATION	l:Funafu	Ü,Tuvalu			JOE	NUMBER 170/04	<b>1</b>
E	XPOSURE TYPE: Tri QUIPMENT: 12 Ton Imension: 2.60 x 2.0	al Pit ne Diggo		Hole Sta Hole Fini						Ged BY: SVC Ecked BY: V.K	
Ē	GEOLOGICAL	<u></u>			<u> </u>			1	EN	DINEERING DESCRIPTION	
G C C	Seneric Name, Drigin, Mineral Composition		test		GRAPICAL LOG CLASSIFICATION SYMBOL	MOISTURE/ WEATHERING	U DENSITY		lan (mr	MAINI minor components, strength, colour, structure, weathering. ROCK DESCRIPTION SUBSTANCE: Rock Type, Particle size, Colour, minor components DEFECTS; Type, Inclination, thickness, roughness, filling	
		water		R.L. (m) DÉPTH (m)	CLASSIFICATIO	KOISTURE	STRENGTH		DEFECT		
	WEATHERED RESIDUAL SOIL?									SILTYSAND, Very fine grained, black with occasional rootlets and coral fragments < 50mm dia, sub angular to angular, hard.	
lo	CORAL ROCK					$\uparrow$				100- grades grey with coral fragments > 100mm diameter,subangular to angular,hard.	
				1.00					/	600- Coral rock(formation),cemented,creamy white,Vesicular(< 5% Surface) with some shell fossils).	
				2.00						· · ·	
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										END OF TEST PIT at 0.60m. Unable to penetrate further.(Coral Rock Formation)	
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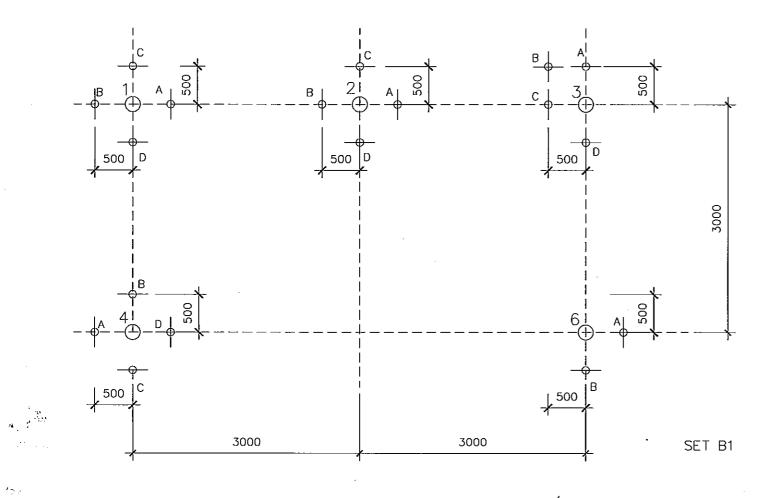
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# DYNAMIC CONE PENETROMETER RESULTS FOR SET B1

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Existing ConcreteTanks



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Site: Funafuti, Tuvalu.     Page 1       Job Name: Runafuti Power Project.     Job No: 170/0:       TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer     Job No: 170/0:       Depth from ground surface to commencement of penetration: 0.00m     SOIL DESCRIPTION       MAIN\ minor components, strength, colour     REFER TO TEST PIT LOGS       structure, weathering.     DYNAMIC CONE PENETROMETER SCALA     REMARKS       TEST 1     Blows/S0mm
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Pentetrometer         Depth from ground surface to commencement of penetration: 0.00m         SOIL DESCRIPTION         MAIN/ minor components,strength,colour       REFER TO TEST PIT LOGS         Vertical       Number of blows       DYNAMIC CONE PENETROMETER SCALA       REMARKS         TEST 1       Blows/50mm
Depth from ground surface to commencement of penetration: 0.00m SOIL DESCRIPTION MAIN, minor components, strength, colour structure, weathering. Vertical Number Distance of driven blows (mm) DYNAMIC CONE PENETROMETER SCALA REMARKS TEST 1 50 1 100 3 150 20 200 >300 250 350 TEST 1A 50 4 100
SOIL DESCRIPTION MAIN, minor components, strength, colour structure, weathering.         REFER TO TEST PIT LOGS           Vertical driven (mm)         Number blows         DYNAMIC CONE PENETROMETER SCALA         REMARKS           TEST 1         Blows/50mm
MAIN\ minor components,strength,colour structure,weathering.         REFER TO TEST PIT LOGS           Vertical driven (mm)         Number of blows         O         A         REMARKS           TEST 1         DYNAMIC CONE PENETROMETER SCALA         REMARKS           100         3         O         2         4         6         10         12         14         16         18         20           200         >300         50         1         0         2         4         6         10         12         14         16         18         20           300         150         20         50         100         100         100         100         100         100         150         100
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TEOT (D
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PO Box 117 Telephone: [ Fax: [679] 3 Email: edesi Tuvalu. afuti Power 1 DD USED: N round surfact ION mponents,str ering. Der	679] 3383788 370354 gns@connect.com.fj Page 2	2 o:170/05
PO Box 117 Telephone: [ Fax: [679] 3 Email: edesi Tuvalu. afuti Power 1 DD USED: N round surfact ION mponents,str ering. Der	Suva Fiji 879 3383788 870954 gns@connect.com.fj Project. Job No IZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer te to commencement of penetration: 0.00m	
PO Box 117 Telephone: [ Fax: [679] 3 Email: edesi Tuvalu. afuti Power 1 DD USED: N round surfact ION mponents,str ering. Der	Suva Fiji 879 3383788 870954 gns@connect.com.fj Project. Job No IZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer te to commencement of penetration: 0.00m	
Tuvalu. Ifuti Power 1 DD USED: N round surfac ION mponents,str ering. per	Page 2 Project. Job No IZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer se to commencement of penetration: 0.00m	
Ifuti Power DD USED: N round surfact ION mponents,str ering.	Project. Job No IZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer te to commencement of penetration: 0.00m	
round surfac ION mponents,str ering. per	ZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer te to commencement of penetration: 0.00m	
round surfac ION mponents,str ering. per	e to commencement of penetration: 0.00m	
ION mponents,str ering.		
	AMIC CONE PENETROMETER SCALA	iks
	Biows/50mm	
0		
100		
Ĕ <sup>200</sup>		
<sup>16</sup> 300		
400		
	Blows/50mm	
	0 0.5 1 1.5 2	
10		
(j 20		
06 bpth		
40		
50		
	0 100 (iii) 200 the 300 400 500 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	$ \begin{array}{c}             0 \\             2 \\           $

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Engin	eered Designs Civi & Structural Engineers	Suite A10 - A12 PO Box 117 Suva Telephone: [679] Fax: [679] 33703 Email: edesigns@	Fiji 3383788 54					2	
Site: Fu	nafuti,Tuv	alu.						Page 3	1 St 17
Job Nam	e:Funafuti	Power Pro	ject.					Job No:170/	/05
TEST M	IETHOD U	JSED: NZS	4402:198	38 Test 6.5.	2 Dynamic	Cone l	Penetromete	er	
Depth f	rom grour	nd surface (	o commend	cement of pe	enetration: (	0.00m			
MAIN\ mi structure,	weathering	nents,streng	yth,colour		REFER T	O TEST	PIT LOGS		
Vertical Distance driven (mm)	Number of blows	DYNAI	MIC CON	E PENET	ROMETE	ER	- SCALA	REMARKS	
TES	ST 2								
50	4				ws/50mm				
100	>30	0	0.5	1 1.5	2 2.5	3	3.5 4		
150									
200		<u></u> 50 −						-	
250		E,							
300 350		Depth (mm)							
400		- 100							
450									
500		150 上							
			500000000000000000000000000000000000000						
	T 2A			Blo	ws/50mm			-	
50 100	4 >30	0	0.5	1 1.5	2 2.5	3	3.5 4		
150	200	°							
200									
250		Ê 50							
300		Depth (mm)							-
350		ā 100							
400									
450 500		150			1				
500									
TES	Т 2В								
50	2	0	0.5	Blov I 1.5	w <b>s/50mm</b> 2 2.5	3	3.5 4		
100	>30	° 📉					1		
150		10							
200		Ê 20							
300		÷							
350		B 30							
400		40							
450		50							
500							2		

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		PO Box 117 Suva Fiji Talaphona:(679) 33837 Fax:(879) 3370354 Email: edesigns@con:	iect.com.f)			· · · · · · · · · · · · · · · · · · ·	·
Site: Funat lob Name:		ower Project.				Page 4 Job No:170/05	
			: 1988 Test 6.5.2 Dy	namic Cone I	enetrometer		
Depth fro	m ground s	surface to comme	ncement of penetratio	n: 0.00m			
SOIL DES MAIN\ mii structure,	tor compo	nents,strength	,colour	REFER	to test pit logs		
Vertical				<u>}</u>		······	
Distance driven (mm)	of blows	DYNAM	IC CONE PENE	TROMET	ER SCALA	REMARKS	
TES	r 2C			<u></u>		· · · · ·	
50	1	0 2		ws/50mm 10 12	14 16 18 20	· · · · · · · · · · · · · · · · · · ·	
100	>30	° † †		······································			
150 200		N I					
250		E					
300	`	(EL) 25				·····	
350		å					
400 450						· · · · · · · · · · · · · · · · · · ·	
500		50	<u></u>				
				· · · · · · · · ·			
TES			Bio	ws/50mm			
50 100	2 >30	0	1	2	3 4 -		
150		°					$\neg$
200							
250		E 20					
300 350		ي الله 20 الله 30 م					
400	••••	40	-+				-1
450		50					
500			·····			,	
		•					
···· -							
<b>ESTED BY:</b>	CVC		DATE: 11/01/05		AUTHORISED BY: VK		

Oites Ener	futi,Tuvalu.	Calephone,1876) 3383788 Fax:[878] 3370354 Email: edesigns@connect.com.f]		<sup>, , , ,</sup>
	•		Page 5	
		wer Project.	Job No:170/05	
		ED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer		
Depth fro	om ground s	urface to commencement of penetration: 0.00m		
	CRIPTION			
	nor compo weathering	nents,strength,colour REFER TO TEST PIT LOGS		
	Number	·	· · · · · · · · · · · · · · · · · · ·	
Distance	of			
driven	blows	DYNAMIC CONE PENETROMETER SCALA		
(mm)			REMARKS	
TES	ST 3			-
50	7	Blows/50mm		
. 100	9		·····	
150	13			_
200	>30	≥ 50		
250 300			·····,·····	_
350				
400				
450				
500				
TES		Blows/50mm	•	
	8 10	0 4 8 12 16		
150	10		<u> </u>	$\dashv$
200	>30	25		
250		fill         50           75         75           fill         100		
300				
350				
400	· · · · · · · · ·			_
450 500				
~~~	l,			-
TES	т зв			
50	10	Blows/50mm 0 2.5 5 7.5 10 12,5 15 17.5 20		
100	13			
150	18			
200	>30	£ 50		
250 300	]			
350				-
400	——-			-
450		150	·······	-1
500				
				7
<b>TESTED BY:</b>	\$¥C	DATE: 11/01/05 AUTHORISED BY: VK		1

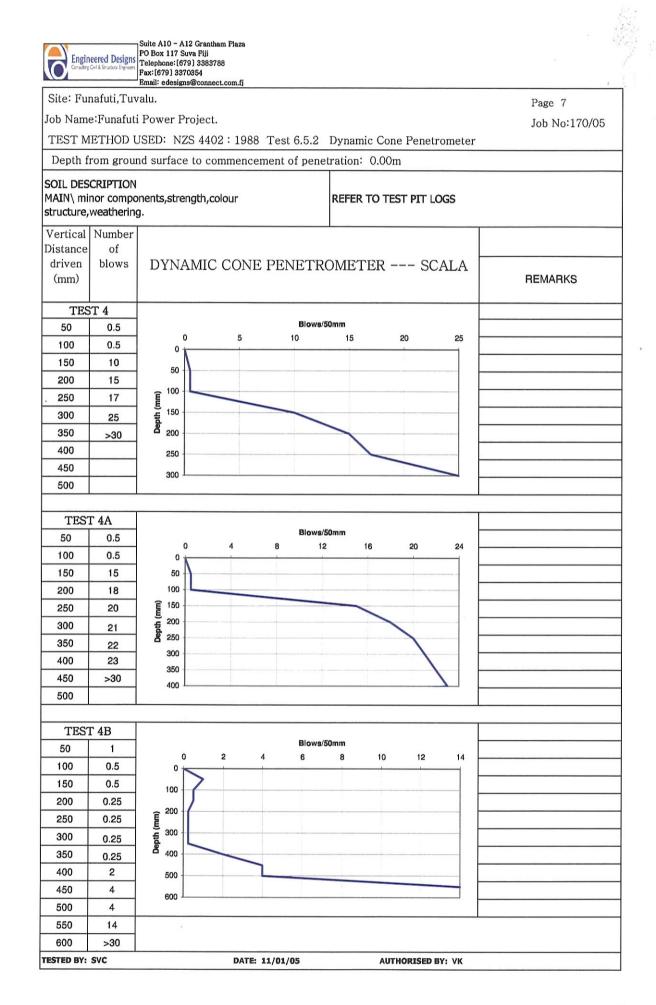
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Engineered Designs	Suite A10 - A12 Grantham Plaza 20 Box 117 Suva Fiji Felophone:[879] 3383788 ax:[879] 3370354		
Site: Funafuti, Tuvalu. Job Name: Funafuti Po	wer Project.	<u> </u>	Page 6 Job No:170/05
	ED: NZS 4402 : 1988 Test 6.5.2 D urface to commencement of penetration	· · · · · · · · · · · · · · · · · · ·	<u></u>
SOIL DESCRIPTION MAIN\ minor compo structure,weathering	nents,strength,colour	REFER TO TEST PIT LOGS	
Vertical Number Distance of driven blows (mm)	DYNAMIC CONE PENI	ETROMETER SCALA	REMARKS
TEST 3C	B		
30         11           100         15           150         18           200         >30			
200 230 250 300 350	\$0 \$0 \$100 \$100 \$100		
400 450 500	150		
TEST 3D		······································	
50         15           100         >30           150		ows/50mm 8 12 16	
200 250 300	10 (IIII) 20 Http: 30		· · · · · · · · · · · · · · · · · · ·
350 400 450	40		· · ·
500			
·			
TESTED BY: SVC	DATE: 11/01/05	AUTHORISED BY; YK	

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Convingen	i i in chailegran   F	O Box 117 Suva Fiji Telephono:(676) 338378 Tax:(676) 3370354 Email: edesigne@conne	c.com.[]			
ite: Funaf	nti,Tuvalu.			·	<u></u>	Pago 8
b Name:H	'unafuti Po	wer Project.				Job No:170/05
EST ME	THOD US	ED: NZS 4402 :	1988 Test 6.5.2 Dynar	nio Cone Penetrometer		
Depth from	n ground s	urface to common	cement of penetration: (	).00m		
AIN\ mir	CRIPTION for compo veathering	nents,strength,	colour	REFER TO TEST PIT LO	GS	
/ertical	Number		··· ··· -		·····	, <u> </u>
istance	of				.	
driven (mm)	blows	DYNAMI	C CONE PENETI	ROMETER SCAL	A	REMARKS
TES1 50	4C 3		Blows	50mm		
100	4		1.5 1 1.5 2	2.5 3 3.5	4	
150	>30	° † – –				
200						······
250	•	Ē				
300		[imi] 50	<u> </u>			
350		ă				· · · · · · · · · · · · · · · · · · ·
400						
450 500		100	4 E L		_>>	<del>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</del>
					<b>_</b>	
TES	4D					
50	4	0	Blows 2 4 6 8	/50mm 10 12 14 16	18	
100	17	۰ 📉		<u></u>		
150	>30	20	<u> </u>			
200 250		Ē 40				<u></u>
300		54				· · · · · ·
350		t 60				
400		80				· · · · · · · · · · · · · · · · · · ·
450		100			·····	<u>,</u>
500						
	SVC		DATE: 11/01/05	AUTHORISED E		····

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Engineered Desi Constry Constraintly	Suito A10 PO Box 117 Talephone Fax: [679] 3	18791 3383788				
te: Funafuti, Tuv	Entall: oder	signs@connect.com	<u>0                                    </u>			
						Page 9
b Name:Funafut		-				Job No:170/05
			Test 6.5.2 Dyna		trometer	
epth from grou	nd surface to	o commenceme	nt of penetration:	0.00m	· · · · · · · · · · · · · · · · · · ·	
IL DESCRIPTI				Grev mott	ed with light black	SAND with medium to coarse
AIN\ minor com		strength,colous	r			ubangular to subrounded.
ucture, weathe						
ertical Numb stance of	IOL.					
stance of inven blow	s n		ONE PENET	ROMETER		<u> </u>
(mm)			أيسا الالسة المستعيب			REMARKS
TEST 6			Blarra	/50mm		
50 4		0 0.5		2 2.5	3 3.5 4	
100 >30		0			1 1	
200	_	HE				
250 .		25				
300	Depth (mm)	50				
350						
400	7	/5			+	
450		»				
500						
TEST 6A			Blow	s/50mm		
50 4		0 0.5	1 1.5	2 2.5	3 3.5 4	
		<u>.</u>				1
100 >30		° +		1 1	1 1	· · · · · · · · · · · · · · · · · · ·
150		25				
150 200		25				· · · · · · · · · · · · · · · · · · ·
150 200 250		25				
150 200		25				
150 200 250 300		25				
150           200           250           300           350	11 11 11 11 11	25				
150       200       250       300       350       400	11 11 11 11 11	25				
150       200       250       300       350       400       450       500	11 11 11 11 11	25				
150 200 250 300 350 400 450 500 TEST 6B	11 11 11 11 11	25	Biow			
150       200       250       300       350       400       450       500		25	Blow 1 1.5	s/50mm 2 2.5	3 3.5 4	
150       200       250       300       350       400       450       500         TEST 6B       50     4       100     >30		25		s/50mm	3 3.5 4	
150       200       250       300       350       400       450       500         TEST 6B       50       4       100       >30				s/50mm	3 3,5 4	
150       200       250       300       350       400       450       500       TEST 6B       50     4       100     >30       150     200				s/50mm	3 3.5 4	
150       200       250       300       350       400       450       500         TEST 6B       50       4       100       >300       150       200       250				s/50mm	3 3.5 4	
150 200 250 300 350 400 450 500 TEST 6B 50 4 100 >300 150 200 250 300				s/50mm	3 3.5 4	
150       200       250       300       350       400       450       500       TEST 6B       50       4       100       200       200       200       200       200       250       300       350				s/50mm	3 3.5 4	
150 200 250 300 350 400 450 500 TEST 6B 50 4 100 >300 150 200 250 300				s/50mm	3 3.5 4	
150       200       250       300       350       400       450       500       TEST 6B       50     4       100     >30       150     4       200     250       300     350       400     400				s/50mm	3 3.5 4	
150 200 250 300 350 400 450 500 TEST 6B 50 4 100 >300 150 200 250 300 350 400 450				s/50mm	3 3.5 4	
150 200 250 300 350 400 450 500 TEST 6B 50 4 100 >300 150 200 250 300 350 400 450				s/50mm		

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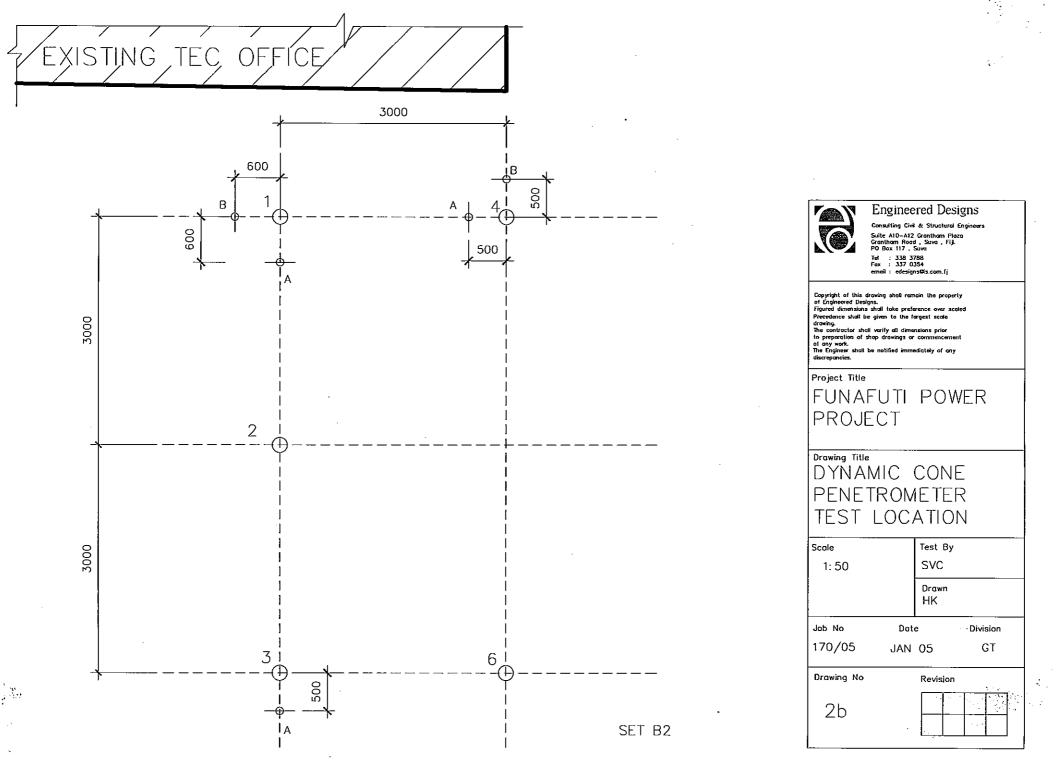
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## DYNAMIC CONE PENETROMETER RESULTS FOR SET B2

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Consting Constrained Designs	Sulte A10 - A12 Grantham Pieza PO Box 117 Suva Fiji Talophone:(878) 3383768 Frail: of a 370354 Email: odasigns@connect.com/)	
Site: Funafuti, Tuvalu		Page 1
Job Name:Funafuti P	ower Project.	Job No:170/05
TEST METHOD US	ED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer	
Depth from ground	surface to commencement of penetration: 0.00m	
SOIL DESCRIPTION MAIN\ minor comp structure,weatherin	onents, strength, colour REFER TO TEST PIT LOGS	
Vertical Number Distance of		
driven blows (mm)	DYNAMIC CONE PENETROMETER SCALA	REMARKS
TEST 1		
50 1	Blows/50mm 0 0.25 0.5 0.75 1	
100 >30		
150	25	,,,,
250		
300	figure 50	
350	75	
400		
500	100 J	
TEST 1A 50 1	Biows/50mm	
100 1		
150 1	50	
200 1		
250 1 300 1		
350 1		
400 >30	250	
450	300	
	I	
TEST 1B	Blows/50mm	······································
50 1	Biowspomm 0 0.5 1 1.5 2 2.5 3 3.5 4	
100 1 150 1		
200 1		
250 1		
300 1		
350 >30 400		
400	250	
500		
-		
TESTED BY: SVC	DATE: 11/01/05 AUTHORISED BY: VK	

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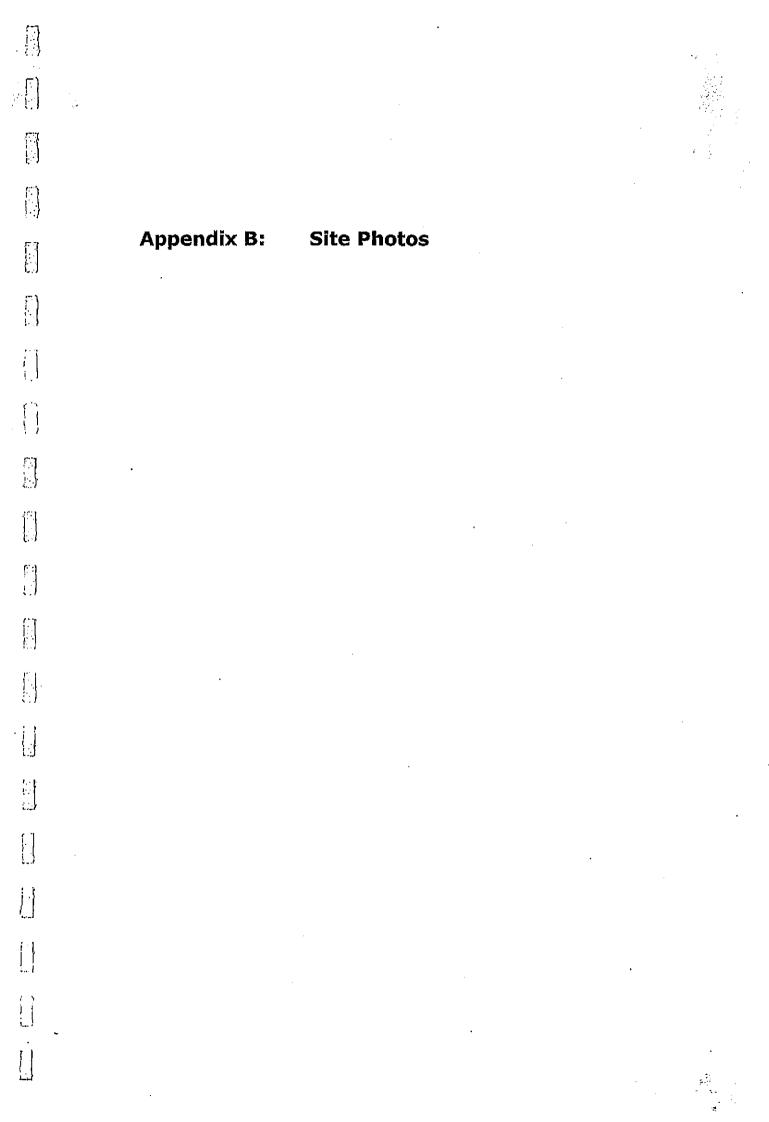
6	0 Box 117 Suva Fiji elophone:[879] 3383788 ax:[879] 3370354 mail: edeelgne@connect.com.fj	· · · · · · · · · · · · · · · · · · ·	<u></u>
Site: Funafuti, Tuvalu.			Page 2
Job Name:Funafuti Pov	wer Project. ED: NZS 4402 : 1988 Test 6.5.2 L	Xmamic Cone Penetrometer	Job No:170/0
and the second division of the second divisio	urface to commencement of penetrati		
SOIL DESCRIPTION MAIN\ minor compo	nents,strength,colour	REFER TO TEST PIT LOGS	
structure,weathering	•		
Distance of driven blows (mm)	DYNAMIC CONE PEN	ETROMETER SCALA	REMARKS
TEST 2			
50 1 100 1	0 0.25	lows/50mm 0.5 0.75 1	
150 1	0		·····
200 2 250 >30	25 Ê		
300	50		·····
350 400	75		
450	100		·
500			
,,,,			· ·
. <u> </u>		· · · · · · · · · · · · · · · · · · ·	<u> </u>
TESTED BY: SVC	DATE: 11/01/0	5 AUTHORISED BY: VK	

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Site: Funafuti, Tuvalu	Email: edesigns@connocl.com.fj	Page 3
Job Name:Funafuti Pe	ower Project.	Job No:170/05
	ED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer	<u>.</u>
Depth from ground	surface to commencement of penetration: 0.00m	
SOIL DESCRIPTION MAIN\ minor comp structure,weatherin	onents, strength, colour REFER TO TEST PIT LOGS	
Vertical Number Distance of		
driven blows (mm)	DYNAMIC CONE PENETROMETER SCALA	REMARKS
TEST 3	Blows/50mm	
50 1 100 1	0 2 4 6 8 10	
150 1		·····
200 1		
250 2 300 9		
350 >30		
400 450	250	· · · ·
500	300	
TEST 3A	······································	
50 1	Blows/50mm	
100 1		
150 1		
250 1		
300 1 350 >30		
400	250	
450 500		
	<u> </u>	
	•	
TESTED BY: SVC	DATE: 11/01/05 AUTHORISED BY: VK	

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Engineered Designs	Suite A10 – A12 Grantham Plaza PO Box 117 Suva Piti Pelephone:[679] 3383788 rax:[679] 3370354 zaxii: doi:no:2000.000000000000000000000000000000000		
Site: Funafuti,Tuv	Email: edesigns@connect.com.fj		Dama C
ob Name:Funafuti			Page 6
			Job No:170/05
	SED: NZS 4402: 1988 Test 6.5.		
Depth from groun	d surface to commencement of pe	enetration: 0.00m	
OIL DESCRIPTION IAIN\ minor compor tructure,weathering	nents,strength,colour	REFER TO TEST PIT LOGS	
ertical Number			
istance of driven blows (mm)	DYNAMIC CONE PENET	TROMETER SCALA	REMARKS
TEST 6	Blo	ws/50mm	
100 1	0 2 4 6 8	10 12 14 16 18 20 -	1
150 8	50		
200 8	100		
250 9			
300 10	150 + 200 + 250		
350 17			
400 18	300		
450 >30	350		
500			
STED BY: SVC	DATE: 11/01/05	AUTHORISED BY: VK	

Corabiy Col	Eu	c:[679] 3370354 all: edosigns@conne	et.com.fj					
Site: Funafu		an Desigat						Page 4
Job Name:Fi		D: NZS 4402 :	1088 Test 6 4	Dunami	o Cone Per	atromater		Job No:170/05
w		rface to commer						
SOIL DESC								<b></b> .
	or compon	ents,strength,	colour		REFER TO	D TEST PI	LOGS	
Vertical N								
Distance driven	of blows	DYNAM		PENETR	OMETE	R SC		,
(mm)								REMARKS
TEST					···			· · ·
50	0.5	O	1	Blows/5 2	VITUUI	3	4	
100 150	0.5 2	°						
200	3	50	ל				-	
250	4	Ê 100						· · · · · · · · · · · · · · · · · · ·
300 350	4 4	€ 100 150 € 200						
400	4 >30	250						
450		300					[	· · · · · · · · · · · · · · · · · · ·
500								
TEST	4A		······································					
50	1	D	2	Blows/5 4	aran0 6	8	10	· · · · · · · · · · · · · · · · · · ·
100 150	1 2	° 📉						
200	4	50 -						
250	8							·····
300 350	9	(IIII) 150						
400	>30	250						
450		300						
500					, ,			
TEST	4B						T	·····
50	4	0 2	2 4 6	Blows/5 8 10		14 16	18 20	· · · · · · · · · · · · · · · · · · ·
100	8	°					┽╌┨┡	
150 200	12 15	50						
250	15	100 Ē 150						
300	15	(正) 150				┝┓	╡╾╍╾┥	
350	18	2000				<b> </b> <del> </del>	┼┈┤╞	
400 450	>30	300			•   			<u></u>
500		350	<u>,                                  </u>					
·	E				•			
TESTED BY: :			DATE: 11			AUTHORIS		<u></u>



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## **Appendix B: Site Photos**



Photo(1): Area B2 (Dynamic Cone penetrometer test locations)



Photo(2): Area B1(Dynamic Cone penetrometer test locations)



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Photo(3)



Photo(4): Coral Formation



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Photo(5): Test Pit B1 / Coral Formation



Photo(6): Test Pits B1, B2 and B2A



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Photo(7): Test Pit B2A / Coral rock

Appendix C:

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**Laboratory Test Results** 

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Site: Funafuti, Tuvalu.		Page: 1	e Eliter Alto de la com	
Job Name: Funafuti Power Pro	oject.	Job Number: 170/2004		
Test Method Used:	NZS 4402 : 1986 T	est 2.1 Determina	tion of Water Content	•
(delete non-applicable)	NZS 4407 : 1991-T	est-3.1 Water-Con	itent of Aggregate	
	NZS 3111 : Aggreg	ate-Moisture Cent	tent	
· · · · · · · · · · · · · · · · · · ·	WATER CO	NTENT		
Date in oven	20-Jan-05	20-Jan-05	20-Jan-05	Average moisture
Sample No.	B1	B1	B1	content
Depth(mm)	100	100	100	
Tin No.	B02	B04	B05	
Tin mass M1 (g)	120.28	118.76	119.32	
Tin + wet mass M2 (g)	228.54	204.87	202.10	
Tin + dry mass M3 (g)	209.81	186.97	185.10	
Water content ω (%)	20.92	26.24	25.84	24.34
Date in oven	20-Jan-05	20-Jan-05	20-Jan-05	Average moisture
Sample No.	B2 ·	B2	B2	content
Depth(mm)	100	100	100	
Tin No.	A01	A03	A05	
Tin mass M1 (g)	96.33	93.98	94.57	
Tin + wet mass M2 (g)	176.06	160.09	169.80	
Tin + dry mass M3 (g)	162.42	148.87	156.56	
Water content ω (%)	20.64	20.44	21.36	20.81
Date in oven	20-Jan-05	20-Jan-05	20-Jan-05	Average moisture
Sample No.	B2	B2	B2	content
Depth(mm)	200	200	200	
Tin No.	A07	A08	A09	
Tin mass M1 (g)	96.59	96.25	104.57	
Tin + wet mass M2 (g)	169.72	201.16	179.72	
Tin + dry mass M3 (g)	156.46	182.47	168.38	
Water content ω (%)	22.15	21.68	17.77	20.53
TESTED BY: S	VC		DATE: 20/01/05	

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## GEOTECHNICS LTD 23 MORGAN ST. NEWMARKET, AUCKLAND TELEPHONE (09) 3556020 FAX (09) 3070265

Plate No.:

Site : Funafuti Power Station, Funafuti, Tuvalu Islands

Page of

Job No.: 750468

Test Method Used: NZS 4402:1986 Test 2.7.1 Determination of Solid Density

SOLID DENSITY TEST RESULTS

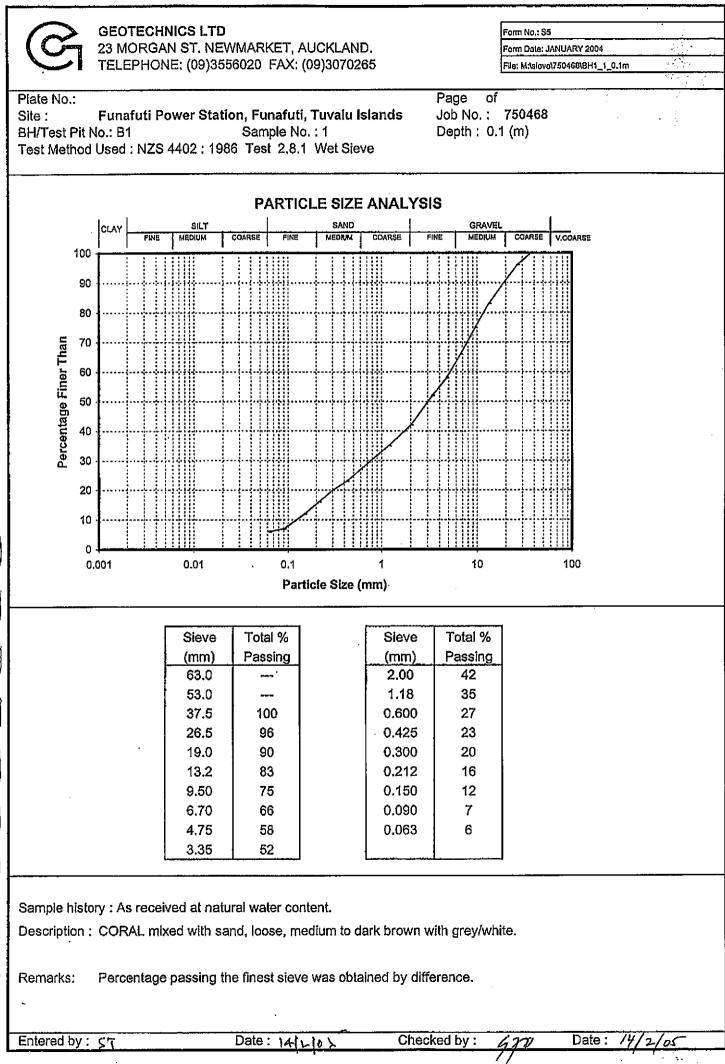
Table 1: Solid Density

BH/Pit No.		B1	B2	B2	B2A
Sample No.		1	1	2	1
Depth	(m)	0.1	0.1	0.2	0.2
Solid Density	(t/m³)	2.62	2.48	2.47	2.62

Tested by: 57

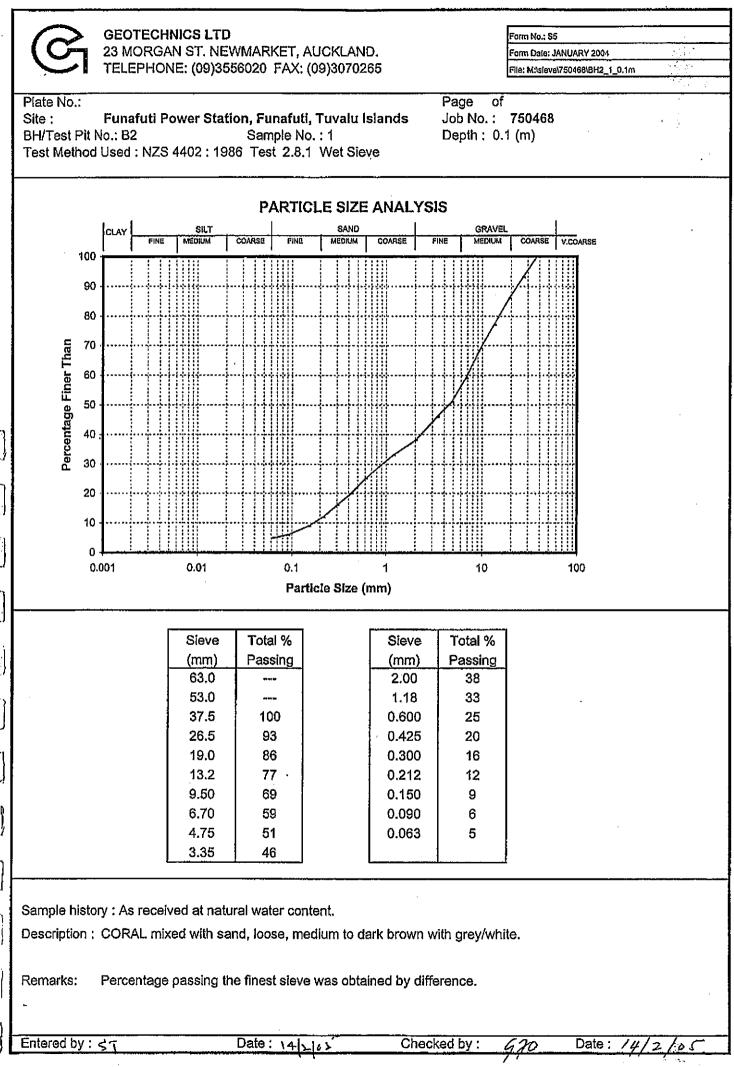
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