資料－８　事業事前計画表

事業事前計画表 (基本設計時)

1．案件名

ツバル国　フナフチ環礁電力供給施設整備計画

2．要請の背景（協力の必要性・位置付け）

(1) ツバル国（以下「ツ」国と称す）では、国家開発戦略である「VISION 2015（1998～2015 年)」において、①人材育成、②公共セクター改革、③民間セクター開発、④離島の開発、⑤基礎的インフラ整備、の 5 分野を重点活動計画として取り上げている。これらの重点活動計画の中で、電力は「基礎的インフラ整備」を実現するための重要なインフラと位置付けられている。

(2) 「ツ」国電力セクターは、主に旧宗主国である英国および EU の支援により首都フナフチの電力供給設備を整備してきたが、これらの設備は設置後 20 年近く経過して老朽化しているばかりか、電力需要の増加により過負荷状態となっている。このため発電設備、配電設備等の事故が頻発し、安定した電力供給に支障を来たしている。特に、1993 年から 2003 年までの過去 10 年間で、最大需用電力は年平均 7.46%の高い伸び率を記録し、最大電力は約 2 倍となっているが、供給力の増加が需要の伸びに追いつかず、近年は供給制限を実施せざるを得ない状況にある。

(3) 上記(2)の様な脆弱な電力供給体制は、首都フナフチに在る「ツ」国の政治、経済等の中枢機能に支障を及ぼしているとともに、保健、衛生、教育といった行政サービスや市民生活にも重大な影響を与えている。このため、「ツ」国電力セクターは「発電設備の新設による供給力の確保」、「配電設備の更新による供給信頼性の確保」を喫緊の課題としているが、財政難のため課題の達成は困難な状況にある。

(4) 本計画は上記の電力セクターの課題を達成するため、首都フナフチに信頼度が高く安定した電力を供給し、計画目標年次までの電力需要の増加に対応できる電力供給力を確保することを目的とし、フォガファレ発電所への発電設備の増設、並びに 11kV 配電設備・配電ケーブルの更新等を行うものである。

3．プロジェクト全体計画概要

(1) プロジェクト全体計画の目標（裨益対象の範囲及び規模）

「ツ」国フナフチにおいて安定した電力供給が確保される。

《裨益対象の範囲及び規模》
フナフチの住民約 4,500 人。

(2) プロジェクト全体計画の成果

1) フナフチにおいて発電・配電設備の調達・据付が行われる。
2) フナフチの既設発電・配電設備の更新・修理が行われる。

(3) プロジェクト全体計画の主要活動

1) 発電設備の調達、据付を行う。
2) 既設発電設備の更新・修理を行う。
3) 配電設備の調達、据付を行う。
4) 既設配電設備の更新・修理を行う。

5) 上記の発電・配電設備を使用して電力供給を行う。

(4) 投入（インプット）

1) 日本側：無償資金協力 9.26 億円

2) 相手国側

a) 施設建設用地
b) 運転・維持管理要員
c) 調達された設備の運転・維持管理費用
d) 既設発電・配電設備の更新・修理費用

(5) 実施体制

1) 主管官庁： 公共事業・エネルギー省（MWE）

2) 実施機関： ツバル電力公社（TEC）

4．無償資金協力案件の内容

(1) サイト
「ツ」国フナフチ環礁、フォガファレ島

(2) 概要
「ツ」国フナフチにおける発電設備（600kW x 3 台）の調達・据付、発電所建屋の建設、及び配電用変電所の改修ならびに 11kV 配電ケーブルの敷設

(3) 相手国側負担事項
既設 TEC 事務所の撤去、発電所建設用地の整地及び不要物の撤去

(4) 概算事業費
9.30 億円（無償資金協力 9.26 億円、ツバル国側負担 0.04 億円）

(5) 工期
詳細設計・入札期間を含め約 18 ヶ月（予定）

(6) 貧困、ジェンダー、環境及び社会面の配慮
発電所からの騒音・排気ガス対策など、環境面に配慮した設計とした。また、事業の実施に係る周辺住民への事前通知（案件概要の公示）を行った。

5．外部要因リスク

特になし

6．過去の類似案件からの教訓の活用

特になし

7．プロジェクト全体計画の事後評価に係る提案

(1) プロジェクト全体計画の目標達成を示す成果指標

項　目	現状（2003 年）	計画後（2007 年）
発電設備容量 （供給予備力）	820kW （0kW）	2,550kW （612kW）
配電設備事故による停電回数	63 回/年	0 回/年

(2) その他の成果指標
特になし

(3) 評価のタイミング

2007 年以降

資料－９　既設 TEC 事務所撤去に係るレター

（１）　EU フィジー事務所からツバル国宛

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

TRANSMISSION BY TELEFAX (688.20.210)

005

05 JAN 2005

Mr Seve Paeniu
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 sincerely,

DELEGATION OF THE EUROPEAN COMMISSION FOR THE PACIFIC

MARIA J. RALHA
Head of Operations

cc: Mr Araki, JICA Fiji Office (fax:3302.452)
Mr James Conway, (fax:688.20.200)
Ms Pasemeta Talaapa

Attention : Mr Laasai
Fax # : 688 20207

4th Floor, Development Bank Centre, Private Mail Bag, GPO, Suva, Fiji
Telephone: (679) 331 3633 – Telefax (679) 330 0370 E-mail: delegation-fiji@ec.europa.eu

（２）　ツバル国からEUフィジー事務所宛

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
4th 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）　JICA から EU フィジー事務所宛

Ms. Maria J. RALHA
Head of Operations
Delegation of the EU Commission for the Pacific
4th 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:

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.

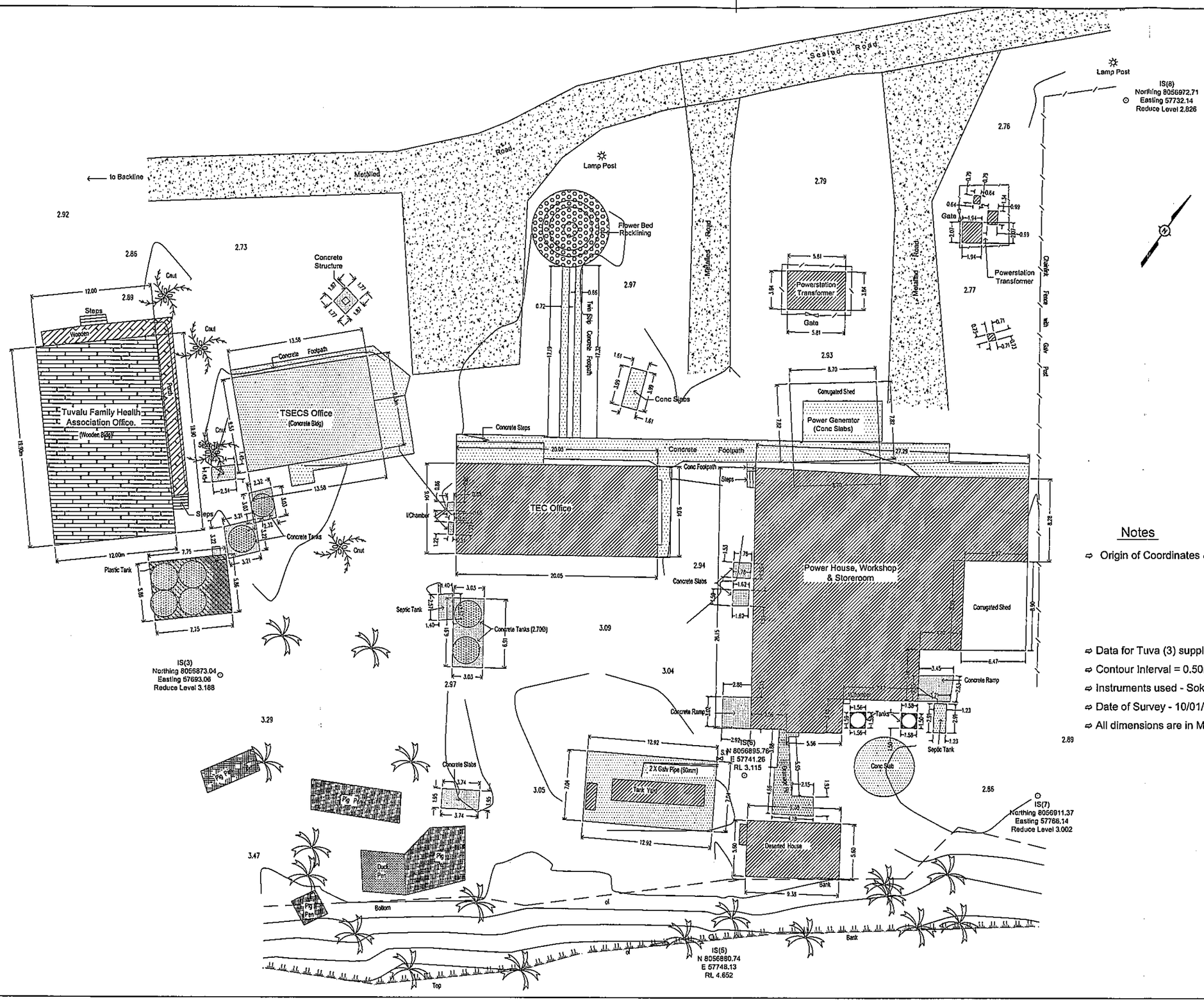
Your understanding and consideration to the Project would be highly appreciated.

Yours sincerely,

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

資料－１０　自然条件調査の結果

（１）　地形測量結果



Notes

- ⇨ Origin of Coordinates & Levels : Tuva (3)
  - Easting 57366.48
  - Northing 8057002.15
  - Reduce Level 3.96
- ⇨ Data for Tuva (3) supplied by Tuvalu Lands & Survey Dept
- ⇨ Contour Interval = 0.50m
- ⇨ Instruments used - Sokkia Set 3B
- ⇨ Date of Survey - 10/01/05 to 13/01/05
- ⇨ All dimensions are in Metres

Rev No	Revision note	Date	Signature	Checked	Issued	No.	Name	Date

WOOD & JEPSEN CONSULTANTS
CIVIL ENGINEERS SURVEYORS PLANNERS
POBox 1248 SUVA
10 HOLLAND ST, SUVA
FIJI
Ph: (679) 3311077
FAX: (679) 3303381
E-MAIL: woodjepsen@connect.com.fj

Client	Engineered Designs
Project	Survey of Funafuti Power Station Funafuti , Tuvalu
Drawing Title	Dimensions for Existing Structures
Surveyed by	TW
Field by	458
Scale	1:200
Computer #	TW
Checked by	RGJ
Approved by – date	22 / 01 / 2005
Drawing No.	4744
Edition	#
Sheet	1 OF 1

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:

YACHIYO ENGINEERING CO. LTD	3 copies
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ENGINEERED DESIGNS	1 copy

February 2005

Job no: 750468

Table of contents

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.

Table 1: Water content results

		TEST NUMBER			
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/m^3)
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[1]. The islands are geologically young, having been formed during the last 3000 years[1]

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:

[1] SOPAC Preliminary Report 38 (1991). Mapping survey and baseline study of coastal erosion on the islands of Tuvalu.

（２）　地質調査結果

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[2].

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.

[2] NZS.4203:1992, Code of practice for general structural design and design loadings for buildings.

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:

.....

Steven Drury

Authorised for Tonkin & Taylor by:

.....

Chris Freer

PROJECT CO-ORDINATOR

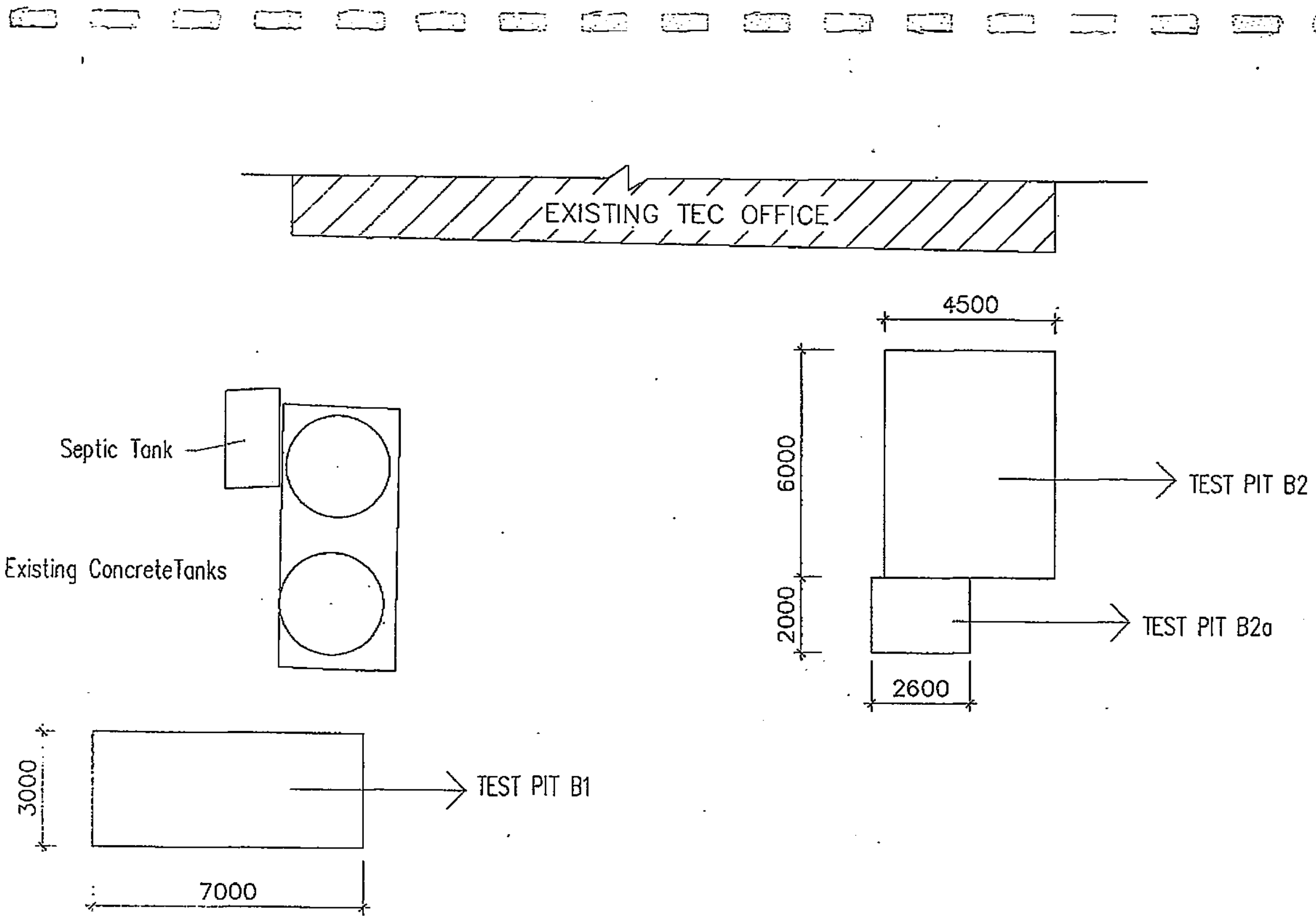
SXD

J:\750468\sxd030205.rep.doc

Appendix A: Site Plans and Test Locations

Test Pit Logs and Dynamic Cone Penetrometer Results

TEST PIT LOGS



Engineered Designs

Project Title: FUNAFUTI POWER PROJECT

Drawing Title: TEST PIT LOCATION

Test By	Drawn	Job No	Date	Division
SVC	HK	170/05	JAN 05	GT

Scale	Drawing No	Revision
1:150	1	

Engineered Designs
Consulting Civil & Structural Engineers

TEST PIT NUMBER:B1

PROJECT: Funafuti Power Project. | LOCATION: Funafuti, Tuvalu. | JOB NUMBER 170/04

EXPOSURE TYPE: Trial Pit | HOLE STARTED: 13/01/2005 | LOGGED BY: SVC
EQUIPMENT: 12 Tonne Digger | HOLE FINISHED: 13/01/2005 | CHECKED BY: V.K
Dimension: 7.0 x 3.0(M)

GEOLOGICAL				ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	WATER	TEST	R.L. (m) DEPTH (m)	GRAPICAL LOG	CLASSIFICATION SYMBOL	MOISTURE/WEATHERING	STRENGTH/ DENSITY		DEFECT SPACING (mm)	**SOIL DESCRIPTION** MAIN\ minor components,strength,colour,structure,weathering. **ROCK DESCRIPTION** SUBSTANCE: Rock Type,Particle size,Colour, minor components DEFECTS: Type,Inclination,thickness,roughness,filling
WEATHERED RESIDUAL SOIL?					SM	M	L			SILTYSAND,Very fine grained,black with occasional organic fragments; rootlets,wood,leaves.
CORAL ROCK FORMATION						D	H			Coral rock(formation),cemented,creamy white,Vesicular(<5% Surface) with some shell fossils)
			1.00							
			2.00							
			3.00							
			4.00							
			6.00							**END OF TEST PIT at 6.20m.** **Unable to penetrate further.(Coral Rock Formation)**

Engineered Designs
Geotechnical & Structural Engineers

TEST PIT NUMBER:B2

PROJECT:Funafuti Power Project. | LOCATION:Funafuti,Tuvalu. | 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

GEOLOGICAL					ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	WATER	TEST	R.L. (m)	DEPTH (m)	GRAPICAL LOG	CLASSIFICATION SYMBOL	MOISTURE/ WEATHERING	STRENGTH/ DENSITY	DEFECT SPACING (mm)	SOIL DESCRIPTION MAIN\ minor components,strength,colour,structure,weathering. ROCK DESCRIPTION SUBSTANCE: Rock Type,Particle size,Colour, minor components DEFECTS: Type,inclination,thickness,roughness,filling	
WEATHERED RESIDUAL SOIL?										SILTYSAND,Very fine grained,black with occasional rootlets and coral fragments < 50mm dia,sub angular to angular,hard.	
CORAL ROCK FORMATION				1.00						200- grades brownish with coral fragments > 100mm diameter,subangular to angular,hard.	
				2.00						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.	
				3.00							
				4.00						END OF TEST PIT at 0.25m. Unable to penetrate further.(Coral Rock Formation)	
				5.00							

Engineered Designs
Consulting Civil & Structural Engineers

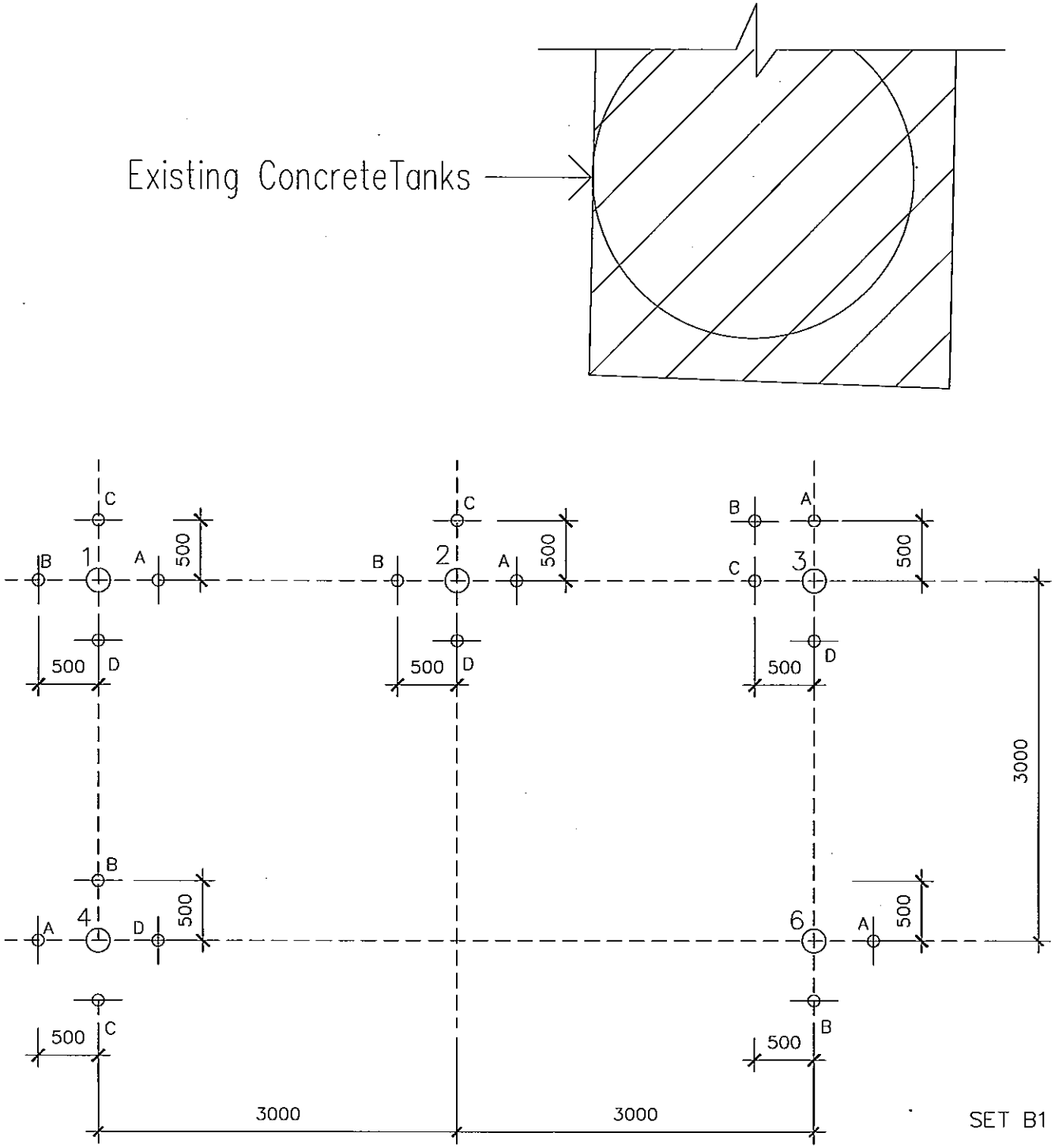
TEST PIT NUMBER:B2A

PROJECT:Funafuti Power Project. | LOCATION:Funafuti,Tuvalu. | JOB NUMBER 170/04

EXPOSURE TYPE: Trial Pit | HOLE STARTED: 13/01/2005 | LOGGED BY: SVC
EQUIPMENT: 12 Tonne Digger | HOLE FINISHED: 13/01/2005 | CHECKED BY: V.K
Dimension: 2.60 x 2.0(M)

GEOLOGICAL				ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	WATER	TEST	R.L. (m) DEPTH (m)	GRAPICAL LOG	CLASSIFICATION SYMBOL	MOISTURE/WEATHERING	STRENGTH/ DENSITY		DEFECT SPACING (mm)	**SOIL DESCRIPTION** MAIN, minor components,strength,colour, structure,weathering. **ROCK DESCRIPTION** SUBSTANCE: Rock Type,Particle size,Colour, minor components DEFECTS: Type,Inclination,thickness,roughness,filling
WEATHERED RESIDUAL SOIL?										SILTYSAND,Very fine grained,black with occasional rootlets and coral fragments < 50mm dia,sub angular to angular,hard.
CORAL ROCK FORMATION										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							
			3.00							**END OF TEST PIT at 0.60m.** **Unable to penetrate further.(Coral Rock Formation)**
			4.00							
			5.00							

DYNAMIC CONE PENETROMETER RESULTS FOR SET B1



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email : edesigns@is.com.fj

Project Title
FUNAFUTI POWER PROJECT

Drawing Title
DYNAMIC CONE PENETROMETER TEST LOCATION

Scale	Test By
1:50	SVC
	Drawn HK

Job No	Date	Division
170/05	JAN 05	GT

Drawing No
2a

Revision

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project. Job No:170/05

TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

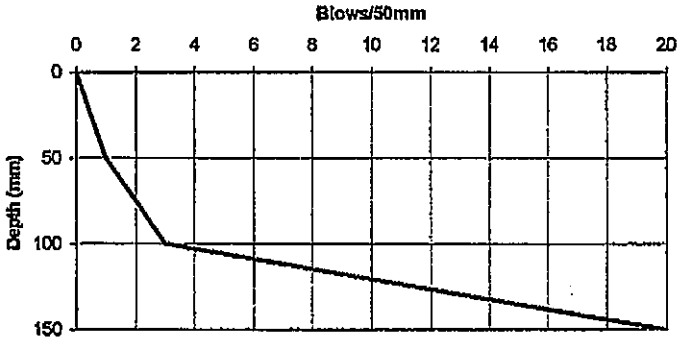
Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

DYNAMIC CONE PENETROMETER — SCALA

TEST 1

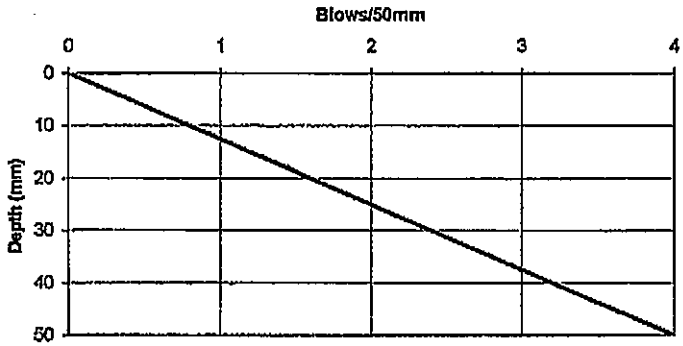
Vertical Distance driven (mm)	Number of blows
50	1
100	3
150	20
200	>30
250	
300	
350	
400	
450	
500	



REMARKS

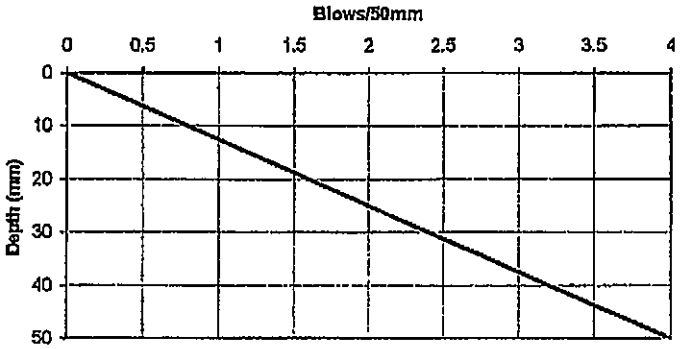
TEST 1A

50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



TEST 1B

50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project.

Job No:170/05

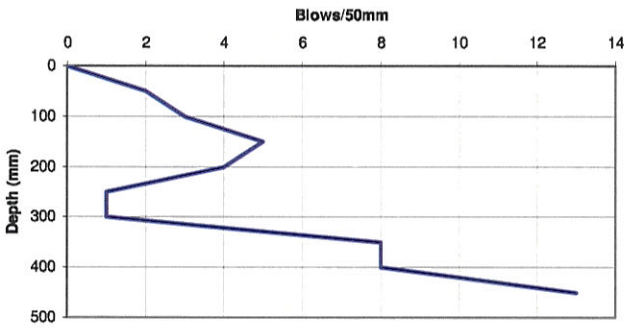
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

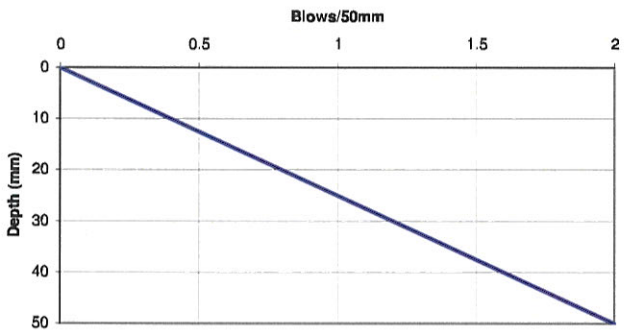
Vertical Distance driven (mm)	Number of blows
TEST 1C	
50	2
100	3
150	5
200	4
250	1
300	1
350	8
400	8
450	13
500	>30

DYNAMIC CONE PENETROMETER --- SCALA



REMARKS

TEST 1D	
50	2
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project. Job No:170/05

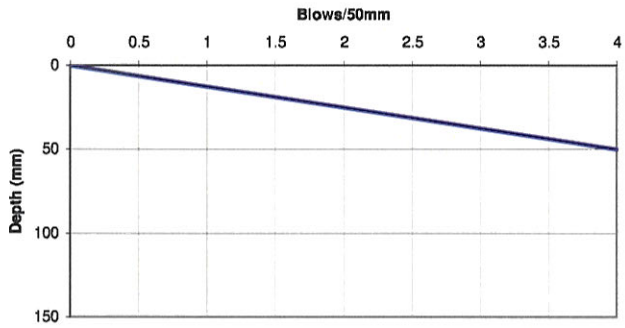
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

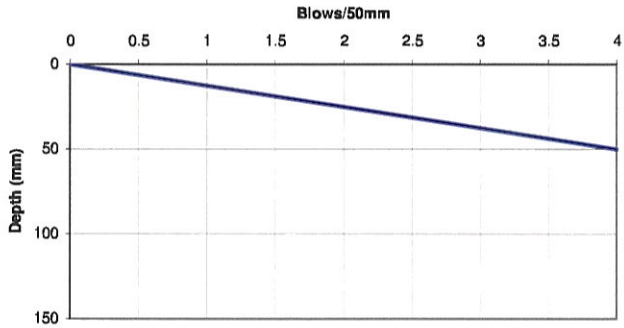
SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

DYNAMIC CONE PENETROMETER --- SCALA

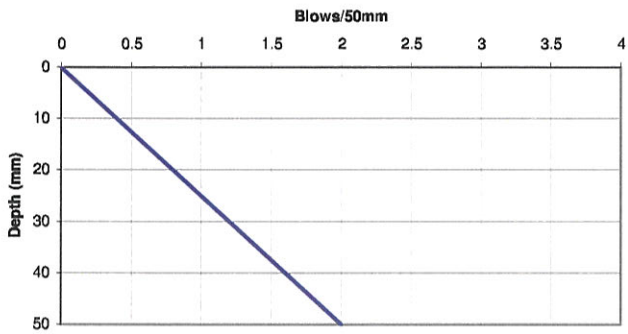
Vertical Distance driven (mm)	Number of blows
TEST 2	
50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



Vertical Distance driven (mm)	Number of blows
TEST 2A	
50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



Vertical Distance driven (mm)	Number of blows
TEST 2B	
50	2
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



REMARKS

TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project.

Job No:170/05

TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

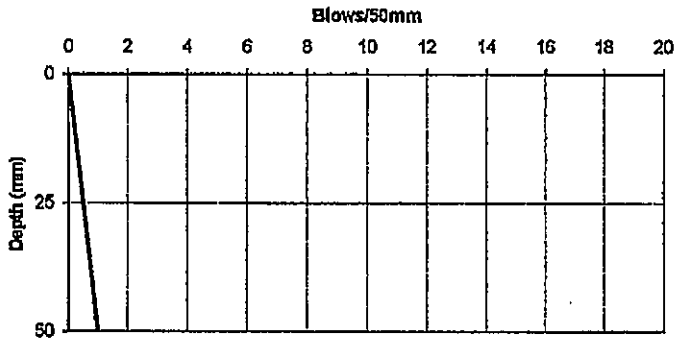
Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

DYNAMIC CONE PENETROMETER --- SCALA

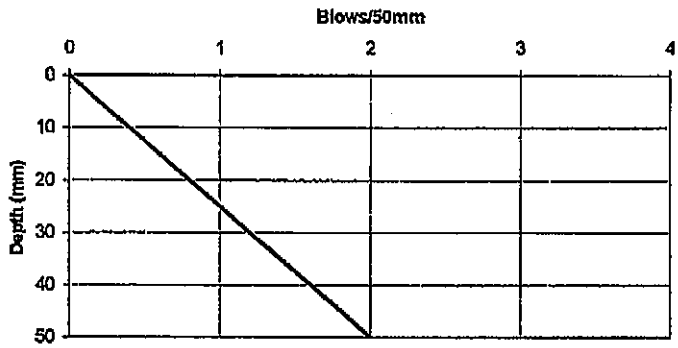
TEST 2C

Vertical Distance driven (mm)	Number of blows
50	1
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



TEST 2D

Vertical Distance driven (mm)	Number of blows
50	2
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



REMARKS

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project.

Job No:170/05

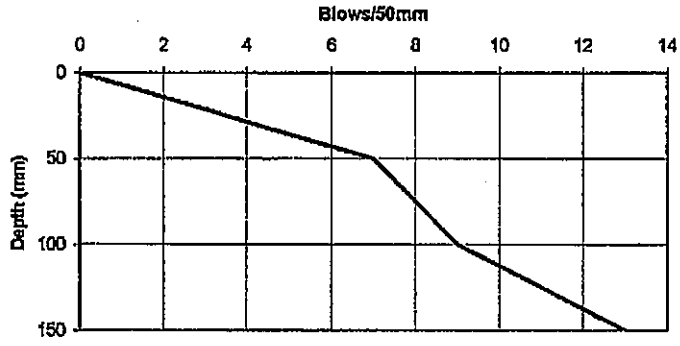
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

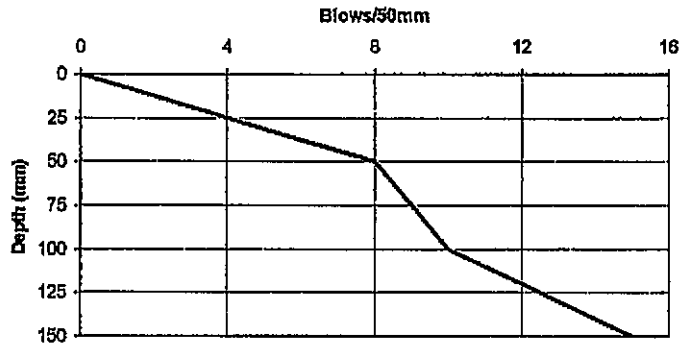
Vertical Distance driven (mm)	Number of blows
TEST 3	
50	7
100	9
150	13
200	>30
250	
300	
350	
400	
450	
500	

DYNAMIC CONE PENETROMETER --- SCALA

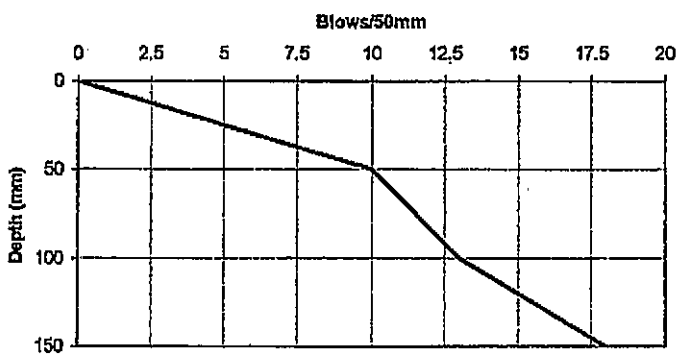


REMARKS

TEST 3A	
50	8
100	10
150	15
200	>30
250	
300	
350	
400	
450	
500	



TEST 3B	
50	10
100	13
150	18
200	>30
250	
300	
350	
400	
450	
500	



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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project.

Job No:170/05

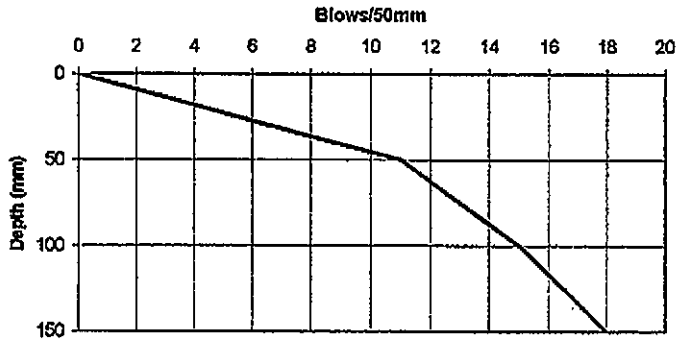
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

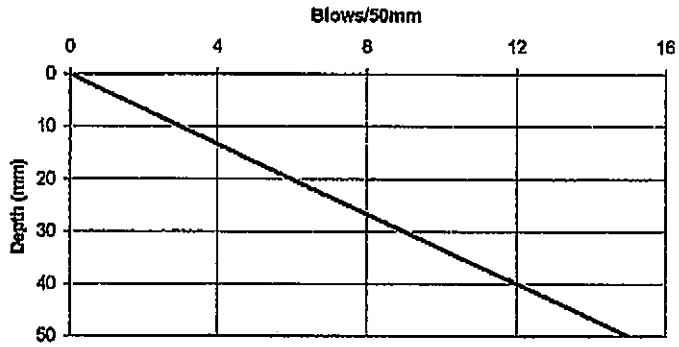
Vertical Distance driven (mm)	Number of blows
TEST 3C	
50	11
100	15
150	18
200	>30
250	
300	
350	
400	
450	
500	

DYNAMIC CONE PENETROMETER — SCALA



REMARKS

TEST 3D	
50	15
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



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Job Name:Funafuti Power Project.

Job No:170/05

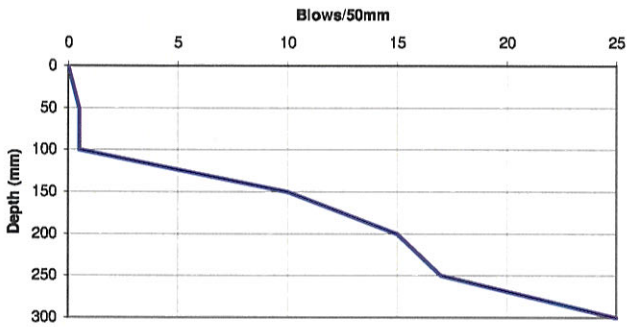
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

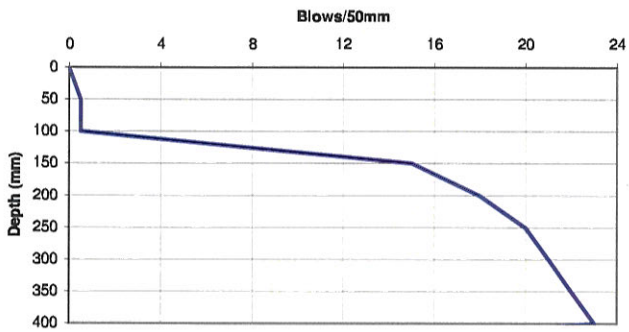
SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

DYNAMIC CONE PENETROMETER --- SCALA

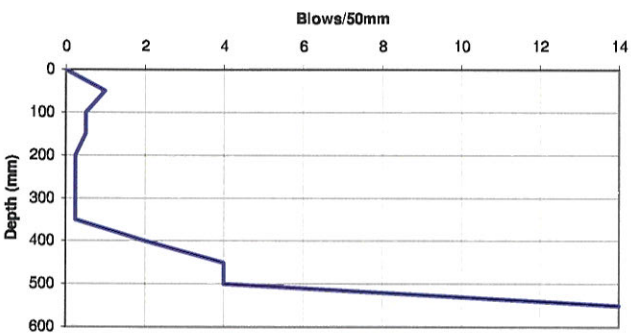
Vertical Distance driven (mm)	Number of blows	REMARKS
TEST 4		
50	0.5	
100	0.5	
150	10	
200	15	
250	17	
300	25	
350	>30	
400		
450		
500		



Vertical Distance driven (mm)	Number of blows
TEST 4A	
50	0.5
100	0.5
150	15
200	18
250	20
300	21
350	22
400	23
450	>30
500	



Vertical Distance driven (mm)	Number of blows
TEST 4B	
50	1
100	0.5
150	0.5
200	0.25
250	0.25
300	0.25
350	0.25
400	2
450	4
500	4
550	14
600	>30



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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project. Job No:170/05

TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

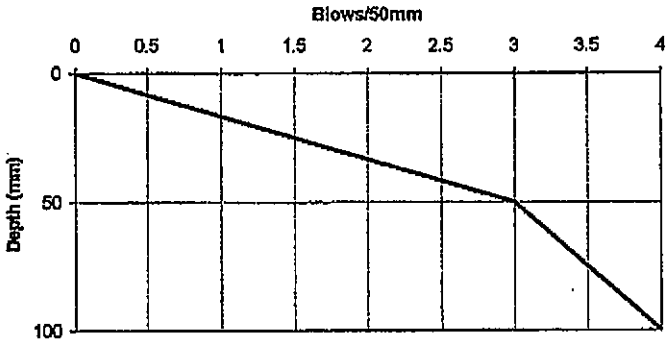
SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

DYNAMIC CONE PENETROMETER --- SCALA

REMARKS

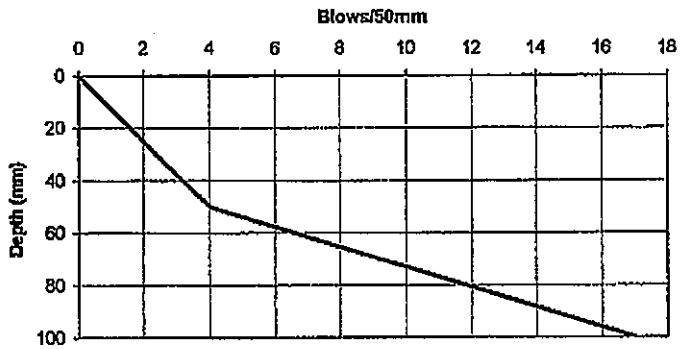
TEST 4C

Vertical Distance driven (mm)	Number of blows
50	3
100	4
150	>30
200	
250	
300	
350	
400	
450	
500	



TEST 4D

Vertical Distance driven (mm)	Number of blows
50	4
100	17
150	>30
200	
250	
300	
350	
400	
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project. Job No:170/05

TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

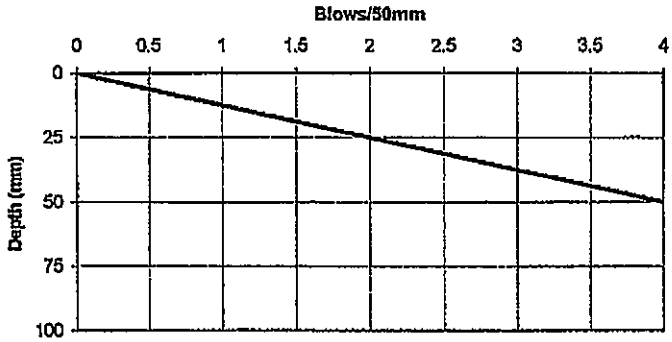
Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	Grey, mottled with light black SAND with medium to coarse GRAVEL, dry tightly packed subangular to subrounded.

DYNAMIC CONE PENETROMETER --- SCALA

TEST 6

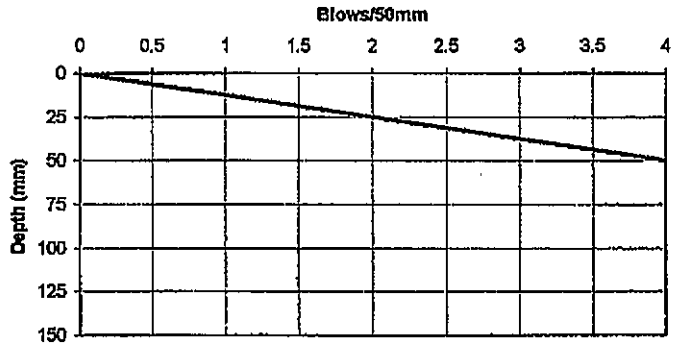
Vertical Distance driven (mm)	Number of blows
50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



REMARKS

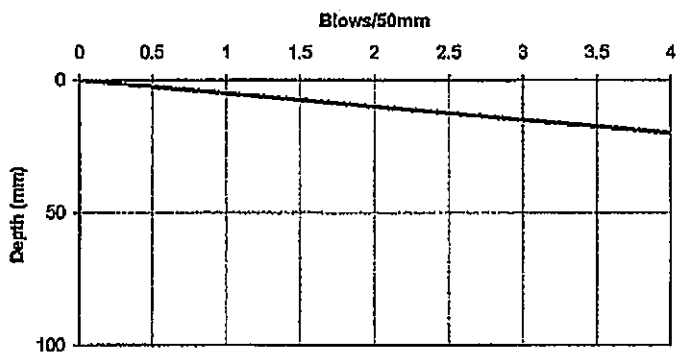
TEST 6A

Vertical Distance driven (mm)	Number of blows
50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



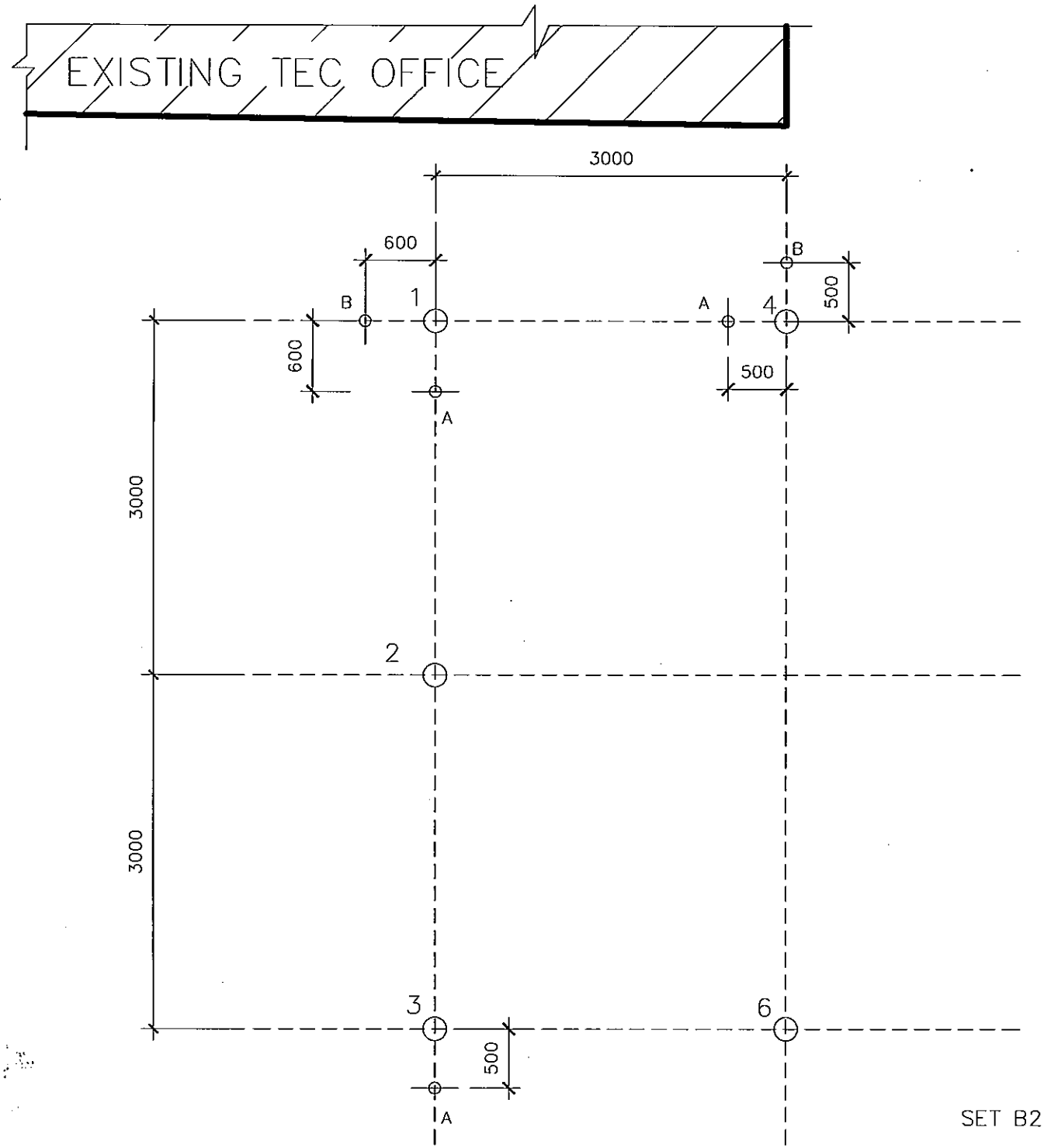
TEST 6B

Vertical Distance driven (mm)	Number of blows
50	4
100	>30
150	
200	
250	
300	
350	
400	
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

DYNAMIC CONE PENETROMETER RESULTS FOR SET B2



SET B2

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Project Title
FUNAFUTI POWER PROJECT

Drawing Title
DYNAMIC CONE PENETROMETER TEST LOCATION

Scale	Test By
1:50	SVC
	Drawn: HK

Job No	Date	Division
170/05	JAN 05	GT

Drawing No
2b

Revision

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Site: Funafuti,Tuvalu. Page 1

Job Name:Funafuti Power Project. Job No:170/05

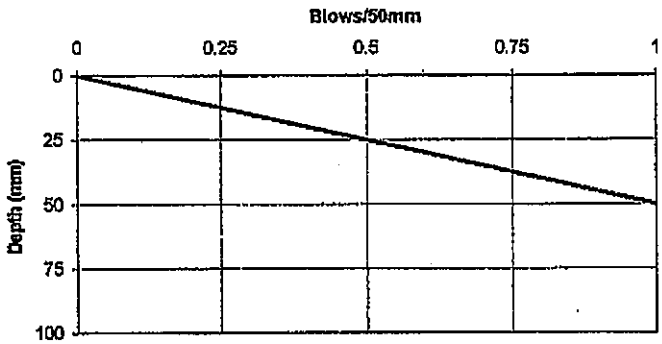
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

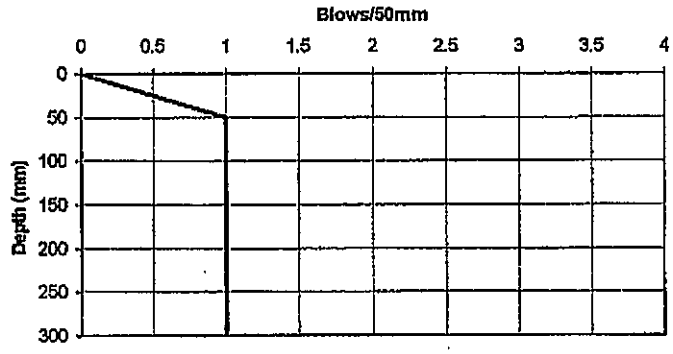
DYNAMIC CONE PENETROMETER --- SCALA

Vertical Distance driven (mm)	Number of blows
TEST 1	
50	1
100	>30
150	
200	
250	
300	
350	
400	
450	
500	

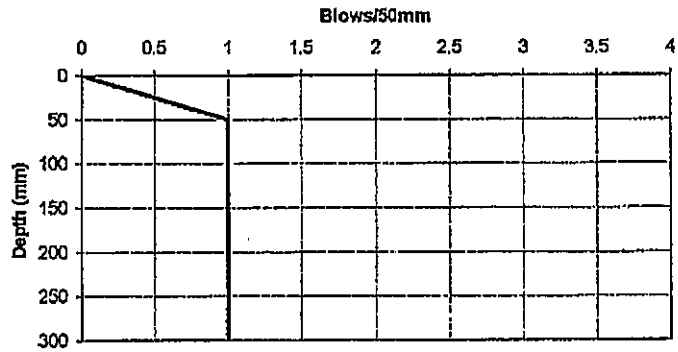


REMARKS

TEST 1A	
50	1
100	1
150	1
200	1
250	1
300	1
350	1
400	>30
450	
500	



TEST 1B	
50	1
100	1
150	1
200	1
250	1
300	1
350	>30
400	
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project. Job No:170/05

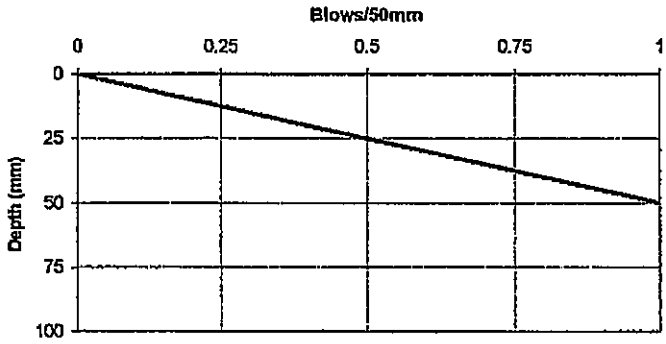
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

Vertical Distance driven (mm)	Number of blows
TEST 2	
50	1
100	1
150	1
200	2
250	>30
300	
350	
400	
450	
500	

DYNAMIC CONE PENETROMETER --- SCALA



REMARKS

TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

Engineered Designs
Consulting Civil & Structural Engineers
Suite A10 - A12 Grantham Plaza
PO Box 117 Suva Fiji
Telephone:[679] 3383788
Fax:[679] 3370354
Email: edesigns@connect.com.fj

Site: Funafuti,Tuvalu.

Job Name:Funafuti Power Project. Job No:170/05

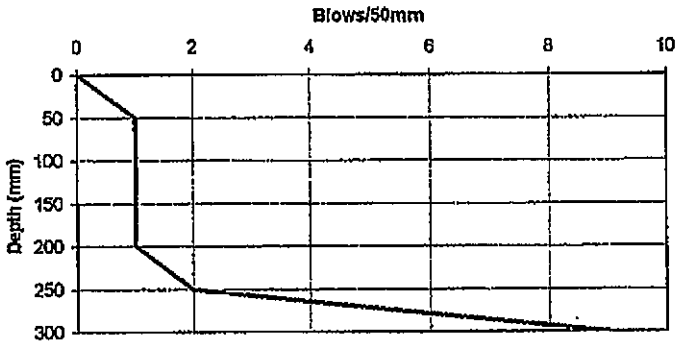
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

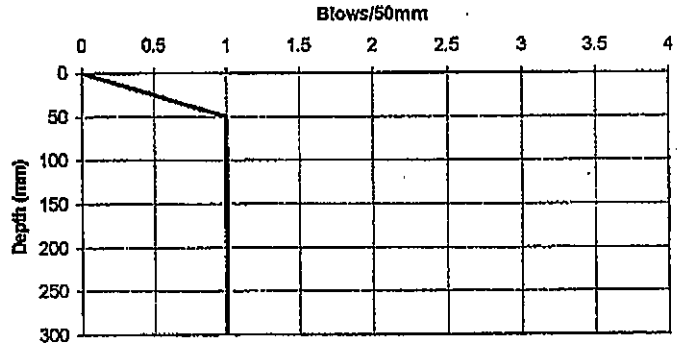
DYNAMIC CONE PENETROMETER — SCALA

Vertical Distance driven (mm)	Number of blows
TEST 3	
50	1
100	1
150	1
200	1
250	2
300	9
350	>30
400	
450	
500	



REMARKS

TEST 3A	
50	1
100	1
150	1
200	1
250	1
300	1
350	>30
400	
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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Site: Funafuti,Tuvalu. Page 6

Job Name:Funafuti Power Project. Job No:170/05

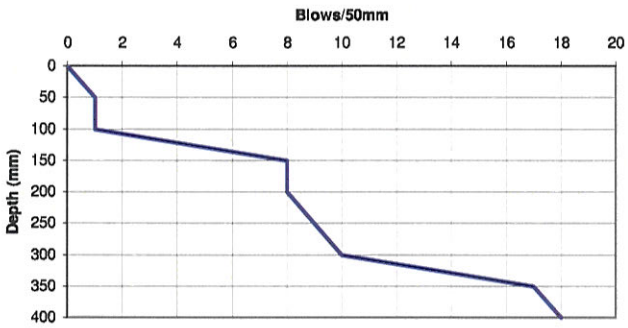
TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

Vertical Distance driven (mm)	Number of blows
TEST 6	
50	1
100	1
150	8
200	8
250	9
300	10
350	17
400	18
450	>30
500	

DYNAMIC CONE PENETROMETER --- SCALA



REMARKS

TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

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TEST METHOD USED: NZS 4402 : 1988 Test 6.5.2 Dynamic Cone Penetrometer

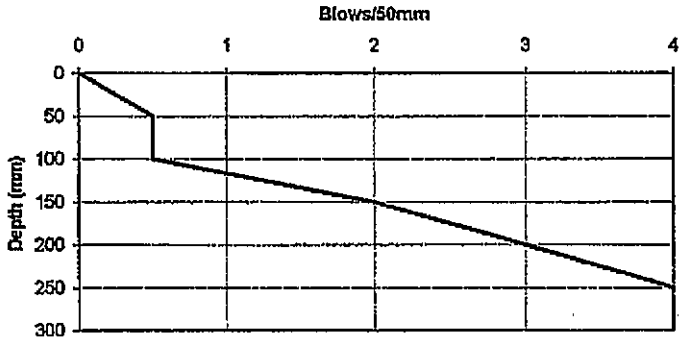
Depth from ground surface to commencement of penetration: 0.00m

SOIL DESCRIPTION MAIN\ minor components,strength,colour structure,weathering.	REFER TO TEST PIT LOGS

TEST 4

Vertical Distance driven (mm)	Number of blows
50	0.5
100	0.5
150	2
200	3
250	4
300	4
350	4
400	>30
450	
500	

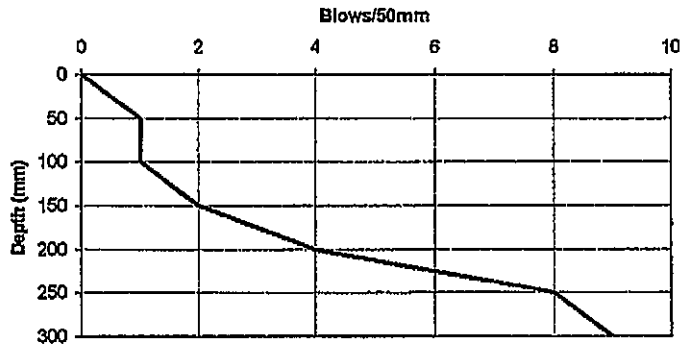
DYNAMIC CONE PENETROMETER --- SCALA



REMARKS

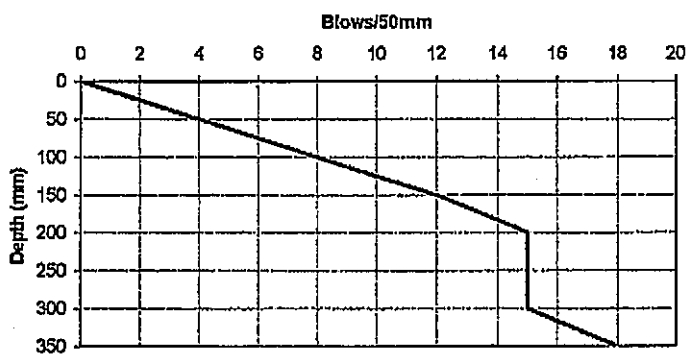
TEST 4A

Vertical Distance driven (mm)	Number of blows
50	1
100	1
150	2
200	4
250	8
300	9
350	>30
400	
450	
500	



TEST 4B

Vertical Distance driven (mm)	Number of blows
50	4
100	8
150	12
200	15
250	15
300	15
350	18
400	>30
450	
500	



TESTED BY: SVC DATE: 11/01/05 AUTHORISED BY: VK

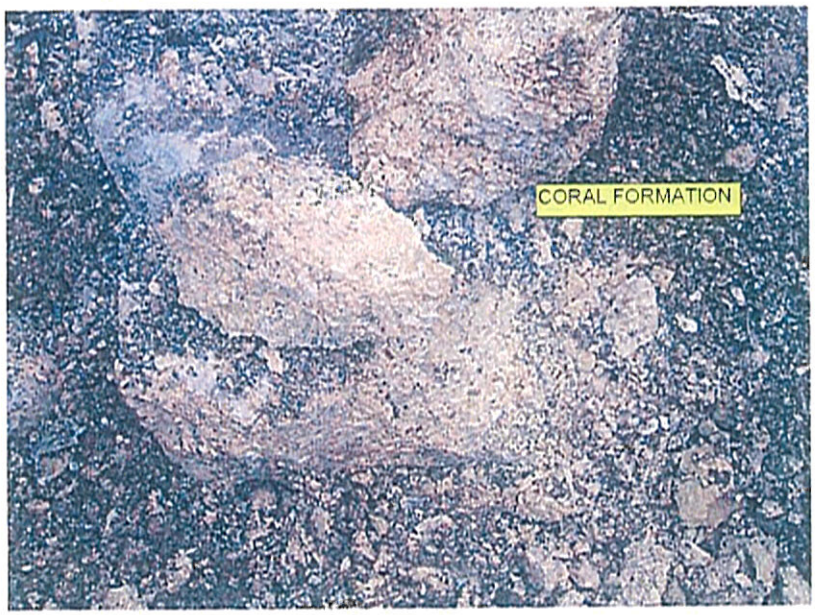
Appendix B: Site Photos

Appendix B: Site Photos

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

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

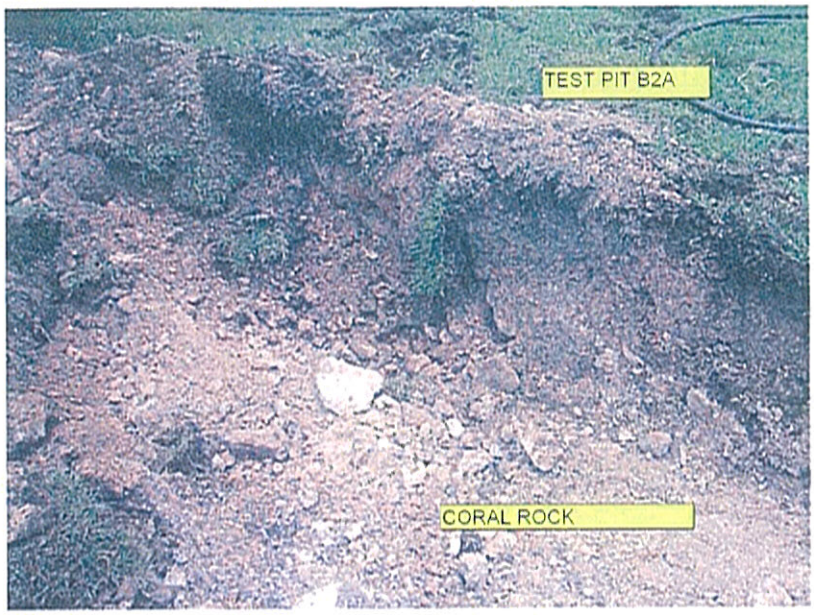
Photo(3)



Photo(4): Coral Formation

Photo(5): Test Pit B1 / Coral Formation

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



Photo(7): Test Pit B2A / Coral rock

Appendix C: Laboratory Test Results

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Site: Funafuti.Tuvalu.	Page: 1
Job Name: **Funafuti Power Project.**	Job Number: 170/2004
Test Method Used: NZS 4402 : 1986 Test 2.1 Determination of Water Content	
(delete non-applicable) ~~NZS 4407 : 1991 Test 3.1 Water Content of Aggregate~~	
~~NZS 3111 : Aggregate Moisture Content~~	

WATER CONTENT

Date in oven	20-Jan-05	20-Jan-05	20-Jan-05	Average moisture content
Sample No.	B1	B1	B1	
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 content
Sample No.	B2	B2	B2	
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 content
Sample No.	B2	B2	B2	
Depth(mm)	200	200	200	
Tin No.	**AO7**	**AO8**	**AO9**	
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: SVC DATE: 20/01/05

GEOTECHNICS LTD
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TELEPHONE (09) 3556020 FAX (09) 3070265

Plate No.:

Site : Funafuti Power Station, Funafuti, Tuvalu Islands

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/m^3)	2.62	2.48	2.47	2.62

Tested by: ST Date: 14-2-05 Checked by: GJO Date: 14/2/05

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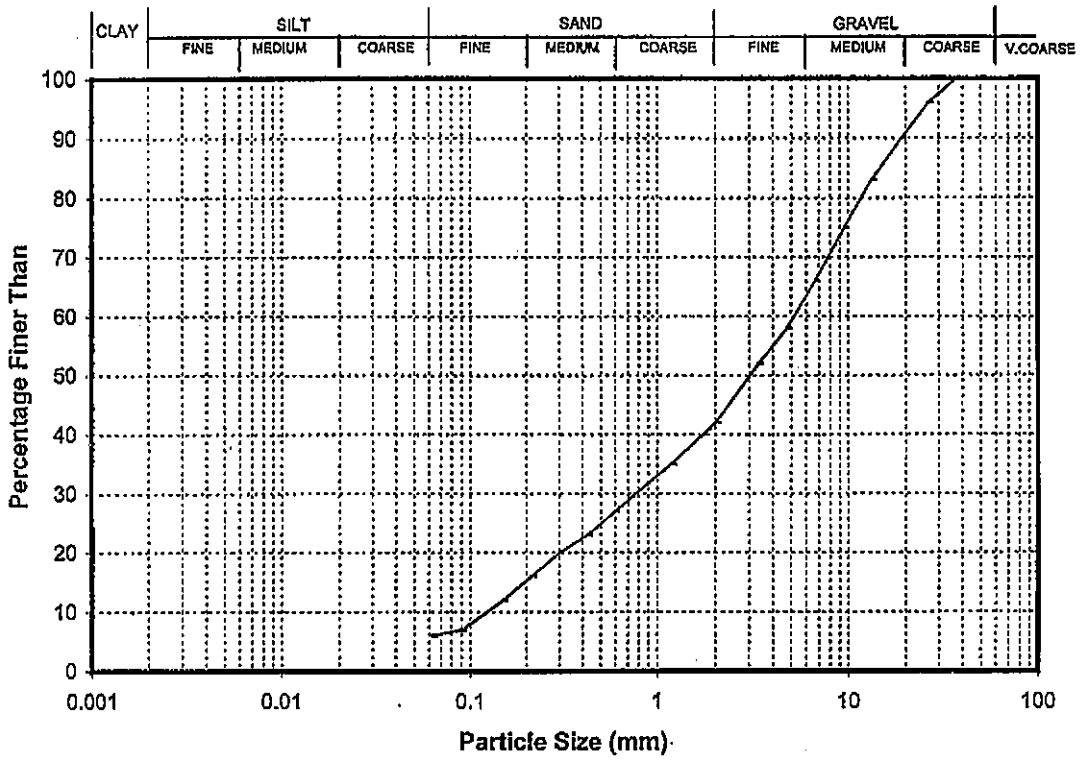
TELEPHONE: (09)3556020 FAX: (09)3070265

Form No.: S5
Form Date: JANUARY 2004
File: M:\sieve\750468\BH1_1_0.1m

Plate No.:
Page of
Site : **Funafuti Power Station, Funafuti, Tuvalu Islands**
Job No. : 750468
BH/Test Pit No.: B1 Sample No. : 1
Depth : 0.1 (m)
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	100
26.5	96
19.0	90
13.2	83
9.50	75
6.70	66
4.75	58
3.35	52

Sieve (mm)	Total % Passing
2.00	42
1.18	35
0.600	27
0.425	23
0.300	20
0.212	16
0.150	12
0.090	7
0.063	6

Sample history : As received at natural water content.

Description : CORAL mixed with sand, loose, medium to dark brown with grey/white.

Remarks: Percentage passing the finest sieve was obtained by difference.

Entered by : ST Date : 14/2/05 Checked by : GTT Date : 14/2/05

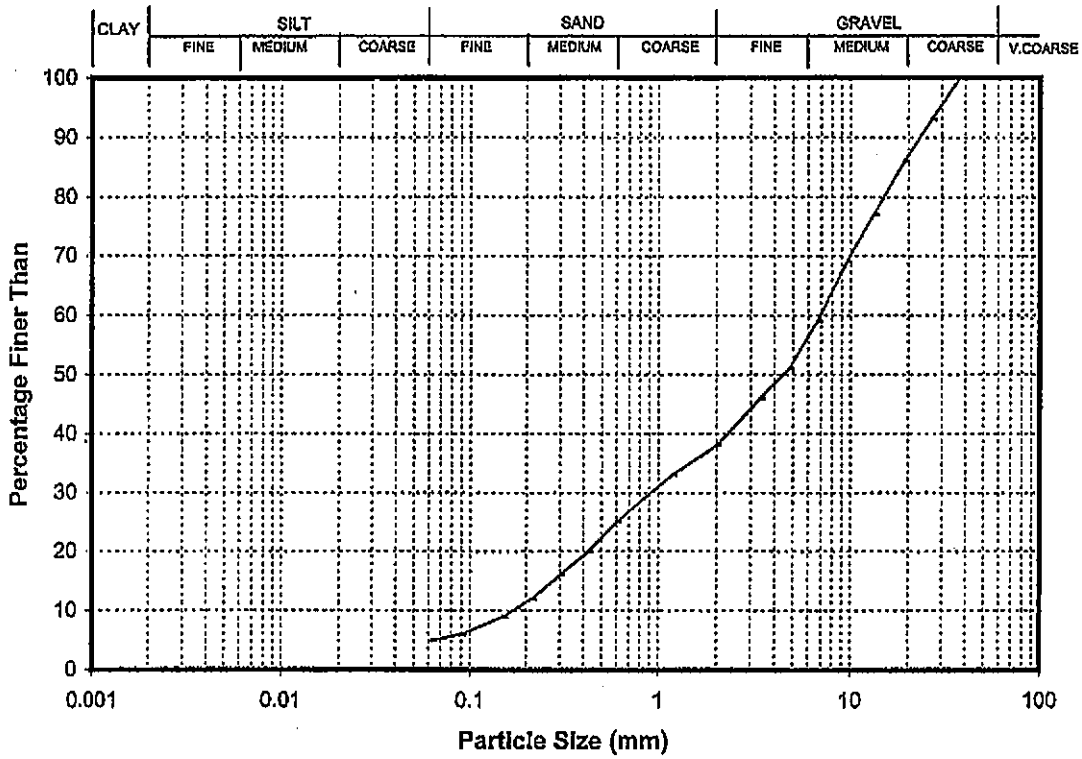
GEOTECHNICS LTD
23 MORGAN ST. NEWMARKET, AUCKLAND.
TELEPHONE: (09)3556020 FAX: (09)3070265

Form No.: S5
Form Date: JANUARY 2004
File: M:\sieve\750468\BH2_1_0.1m

Plate No.:
Site : **Funafuti Power Station, Funafuti, Tuvalu Islands**
BH/Test Pit No.: B2 Sample No. : 1
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

Page of
Job No. : 750468
Depth : 0.1 (m)

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	100
26.5	93
19.0	86
13.2	77
9.50	69
6.70	59
4.75	51
3.35	46

Sieve (mm)	Total % Passing
2.00	38
1.18	33
0.600	25
0.425	20
0.300	16
0.212	12
0.150	9
0.090	6
0.063	5

Sample history : As received at natural water content.

Description : CORAL mixed with sand, loose, medium to dark brown with grey/white.

Remarks: Percentage passing the finest sieve was obtained by difference.

Entered by : ST Date : 14/2/05 Checked by : GJO Date : 14/2/05

GEOTECHNICS LTD
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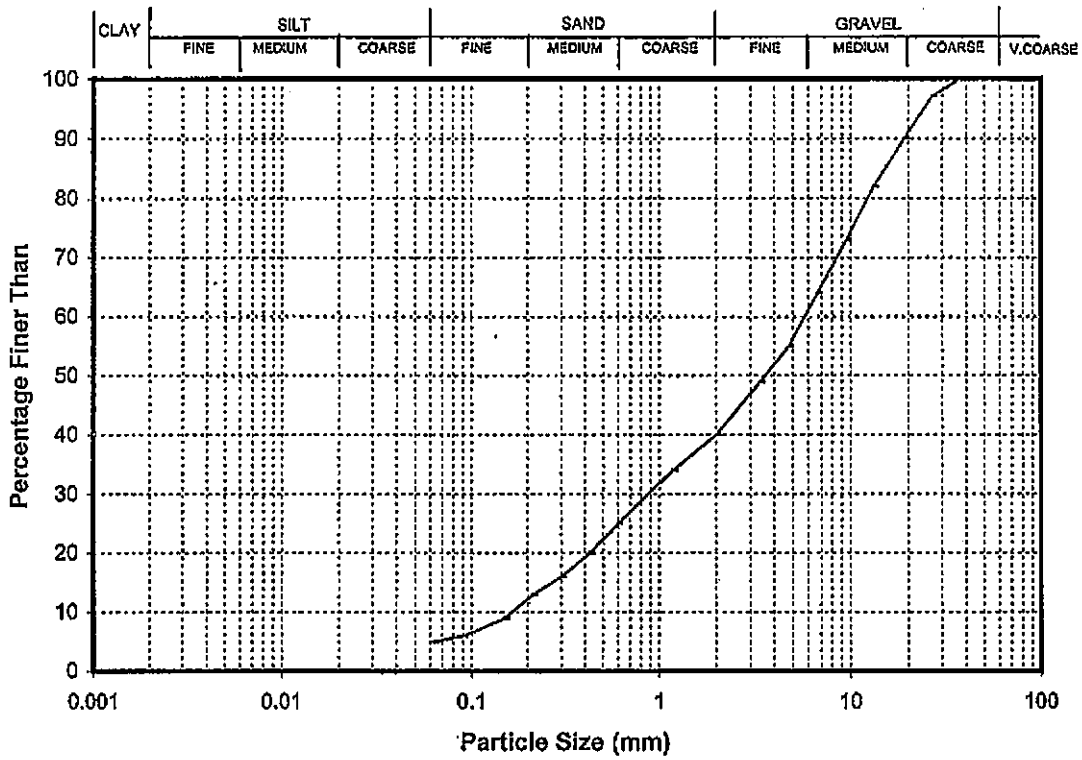
TELEPHONE: (09)3556020 FAX: (09)3070265

Form No.: S5	
Form Date: JANUARY 2004	
File: M:\sieve\750468\BH2_2_0.2m	

Plate No.: Page of
Site : **Funafuti Power Station, Funafuti, Tuvalu Islands** Job No. : **750468**
BH/Test Pit No.: B2 Sample No. : 2 Depth : 0.2 (m)
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	100
26.5	97
19.0	90
13.2	82
9.50	73
6.70	64
4.75	55
3.35	49

Sieve (mm)	Total % Passing
2.00	40
1.18	34
0.600	25
0.425	20
0.300	16
0.212	13
0.150	9
0.090	6
0.063	5

Sample history : As received at natural water content.

Description : CORAL mixed with sand, loose, medium to dark brown with grey/white.

Remarks: Percentage passing the finest sieve was obtained by difference.

Entered by : ST Date : 14-12-04 Checked by : [signature] Date : 14/12/05

GEOTECHNICS LTD
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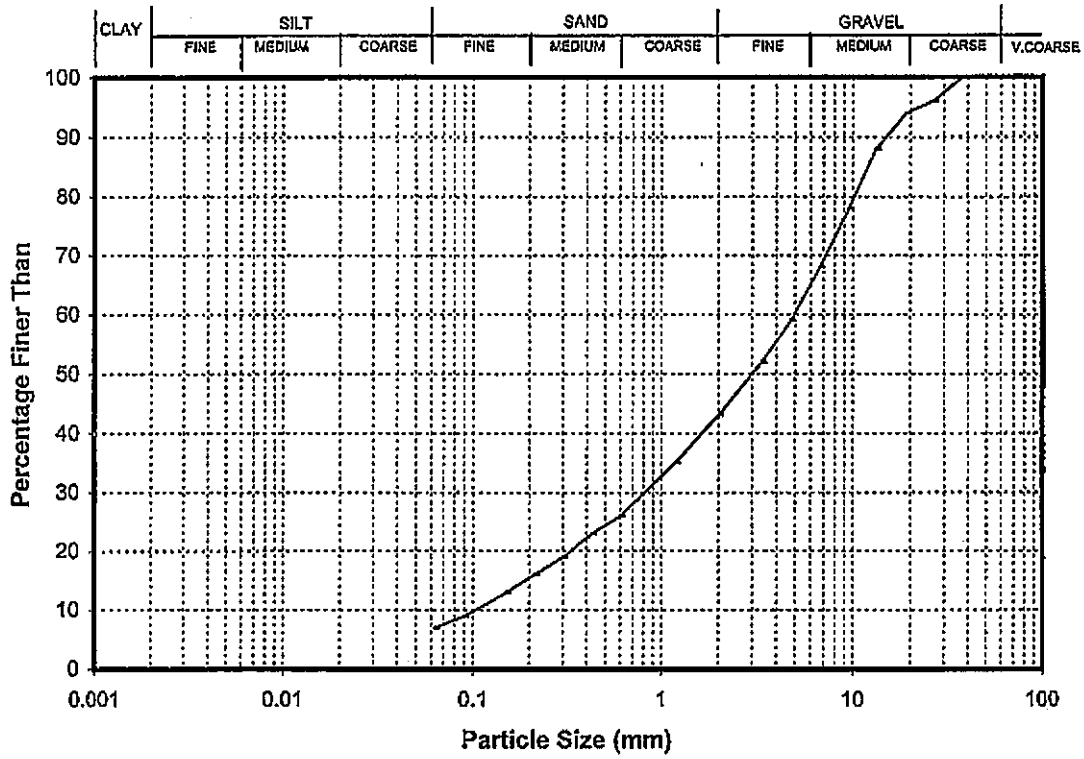
TELEPHONE: (09)3556020 FAX: (09)3070265

Form No.: S5
Form Date: JANUARY 2004
File: M:\sieve\750468\BH2A_1_0.2m

Plate No.:
Site : **Funafuti Power Station, Funafuti, Tuvalu Islands**
BH/Test Pit No.: B2A Sample No. : 1
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

Page of
Job No. : 750468
Depth : 0.2 (m)

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	100
26.5	96
19.0	94
13.2	88
9.50	78
6.70	68
4.75	59
3.35	52

Sieve (mm)	Total % Passing
2.00	43
1.18	35
0.600	26
0.425	23
0.300	19
0.212	16
0.150	13
0.090	9
0.063	7

Sample history : As received at natural water content.

Description : CORAL mixed with sand, loose, medium to dark brown with grey/white.

Remarks: Percentage passing the finest sieve was obtained by difference.

Entered by : ST Date : 14/2/05 Checked by : GJO Date : 14/2/05