



GEOTECHNICAL INVESTIGATION

COWRIE ACCESS TRACK, DENT ISLAND

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Document Control					
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GEOTECHNICAL INVESTIGATION COWRIE ACCESS TRACK, DENT ISLAND

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Our Ref U22036
Contact Andrew Williams



3 April 2007

1. LETTER OF TRANSMITTAL

Hamilton Island Enterprises
PO Box 156
HAMILTON ISLAND Q 4803

Attention: Mike Johnston

GEOTECHNICAL INVESTIGATION COWRIE ACCESS TRACK, DENT ISLAND

Dear Sir,

We are pleased to present our report on the geotechnical investigation undertaken for the Cowrie Access Track, Dent Island.

The report details the scope of investigation works and provides discussion and recommendations on appropriate footing types based on site characteristics. The findings and recommendations are based on the test pitting program and a walkover inspection as per the client's scope undertaken in March 2007 and our knowledge of the local area.

The principal findings on the investigations are as follows:

- o High strength ignimbrite on the beach will need to be allowed for in the design for foundations of jetty structure.
- o No indications of slope instability were observed in the road cut at the time of inspection.
- o Based on the results from the test pitting program, pavement design parameters are provided.

We trust this report meets your requirements and that you will direct any queries to the undersigned.

Yours faithfully,

Andrew Williams
Senior Engineering Geologist
MS.Env.Mgmt., BSc.(Hons), Pg.Dip., CGeol
for **Cardno Ullman & Nolan Geotechnic**

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2. BACKGROUND

Cardno Ullman & Nolan Geotechnical Pty Ltd (Cardno UNG) has undertaken a geotechnical investigation at the site of the proposed landing site adjacent to the offshore Cowrie Island, off Dent Island. The purpose of the investigation was to provide a geotechnical subgrade parameters and recommendations for appropriate footing types.

The investigation undertaken included an inspection and laboratory testing in accordance with the following documentation:

- Australian Standard AS1726 – Geotechnical Site Investigations
- Australian Standards AS1289 – Methods of testing Soil for Engineering Purposes

The scope of the investigation was based on the client's verbal request of the 6th March 2007.

3. GEOTECHNICAL INVESTIGATION

3.1 Fieldwork

Fieldwork was carried out on 8th March 2007 and comprised the excavation of five (5) test pits (nominated as TP1 to TP5) to refusal at some 0.4 to 1.1m depth. A walkover survey of the area was also undertaken. The test pits were excavated using a Komatsu excavator with a 1200mm bucket.

Test pits were logged on site by a senior engineering geologist in accordance with AS1726. The test pit locations were numbered by Cardno UNG. The test pit locations are shown in Figure 1, presented at the end of this report. Test pit logs, DCP results and site photographs are presented in Appendix A.

3.2 Laboratory Testing

One sample of representative natural material was tested for classification purposes. The results are presented in Appendix B.

4. SITE DESCRIPTION AND GEOMORPHOLOGY

The site is located on the eastern slopes of the north-south orientated Dent Island. The site is immediately adjacent to the small, rocky island known as Cowrie Island. The fringing reef in this area is relatively narrow; 40-50m from the beach. The natural beach is also somewhat unusual for Dent Island as it is essentially a wave-cut platform. Boulders and coral debris are scattered across the beach but to far lesser extent than in most areas in Dent Island.

This 'clean' beach and approaches are understood a result from higher velocity natural currents that have been observed at several tidal conditions. Cowrie Island causes a natural restriction to current flows in this area, hence the higher velocities and scouring of the adjacent beaches.

Rock pavement occurs at the surface in the tidal zone. The slopes of Dent Island are steep around the high water mark and then become shallower around the RL10m contour to a typical 15-25%

The slopes above about RL10m comprise colluvial material with rare rock outcrops. The vegetation is predominantly grass with mature hoop pines along the shoreline and grasstrees on the main slope. Two creeks which at the time of inspection were flowing at very low rates (around 0.5-1l/min) cut into the slope. Recent upslope development comprising the preliminary excavation of subdivisional road alignment was observed.

The proposed alignment of the road is shown on Figure 1.

5. GEOLOGY

The geology of Dent Island comprises a combination of volcanoclastic and igneous intrusive rock. The age of the rocks is described on the 1:250,000 Geological Series Maps as Lower Cretaceous. The rock types are primarily ignimbrites and granites. Both rock types form large boulder (corestone) outcrops. Regional north-south trending faults exist in the area and greatly influence joint intensity.

6. GROUND CONDITIONS

Although not investigated as part of the current investigation, the submarine conditions from the beach out to the fringing reef are expected to be an unconsolidated deposit of reef debris, mud and coral heads that deepen away from the shoreline. The depth of this stratum and whether slope boulders are present in these marine sediments. The beach rocks are high to very high strength ignimbrite.

The initial slope above the shore comprises a boulder and rock outcrop

7. ENGINEERING ASSESSMENT & RECOMMENDATIONS

7.1 Beach Area Landing Site

We understand a jetty will be constructed to allow island visitors to transfer from a Hamilton Island ferry to island transport. A jetty will therefore comprise an elevated structure with a deck level some 3-5m above existing beach level.

The beach area has been observed to be formed by a near-horizontal wave-cut platform of high to very high strength, massive ignimbrite rock (photos 2 and 3). This outcrop will provide a strong foundation to the land area structure and warrant the use of anchors. The depth of marine sediments comprising coral debris and mud further out to the fringing reef will need to be further investigated.

An allowable bearing pressure of 5.0MPa can be used for footing design. A rock to grout bond strength of 5MPa can be used in dimensioning anchor, being 10% of the likely unconfined compressive strength of the rock (50MPa). Density of the rock can be taken as 2.6 tonnes/m³ with a 60° failure cone.

7.2 Slope Stability

There were no indications of instability along the alignment of this road. Localised gully erosion of the two creeks was observed. The project will need to be designed and constructed appropriately with adequate drainage, however, to avoid destabilising the soil layers overlying the shallow rock. Drainage will be critical and should not in any way concentrate stormwater or groundwater seepage. The soils are dispersive and will erode rapidly.

There are isolated surface boulders that will need removal or stabilising to ensure they do not roll downslope.

7.3 Excavatability

Based on the field investigation and testing, we would estimate that the excavatability of the colluvial materials can range from Class 1 to 3 in the Kirsten's Classification System (refer to Table 1 on the following page). Extremely to distinctly weathered rock may range from Class 4 to Class 5, with fresh, very high strength ignimbrite requiring extremely hard ripping or more likely blasting, Class 7 to 8.

7.4 Pavement Design

On the basis of our experience of soils in the area and the concept that the road will be a cut to fill, narrow buggy-type formation, we recommend a subgrade strength of CBR 5 be used for design purposes. This assumes that adequate drainage will be installed to prevent moisture build-up in the pavement.

7.5 Retaining Walls

Boulder retaining walls would likely work well and utilise local rock. Care should be taken that the boulders are properly keyed into rock.

Table 1 Definition of Eight Point Excavation Classification System for Soil, Detritus, Rock and Boulders

Material Type	Material Excavation Classification ⁽¹⁾		Description of excavatability	Machine Classification ⁽²⁾	
	Class	Class index boundaries		Crawler Tractor Class No.	Excavator Class No.
Soil/Detritus	1	$N < 0.01$	Hand spade	45C	-
	2	$0.01 < N < 0.1$	Hand pick and spade	60C	55
	3	$0.1 < N < 1.0$	Power tools	105C	100
Rock	4	$1.0 < N < 10$	Easy ripping	150C	135
	5	$10 < N < 100$	Hard ripping	200C	235
	6	$100 < N < 1,000$	Very hard ripping	300C	350
	7	$1,000 < N < 10,000$	Extremely hard ripping/blasting	500C	-
	8	$N < 10,000$	Blasting	-	-

Note: ⁽¹⁾ Kirsten Classification System
⁽²⁾ Australian Standard 2868, Tables 4.1 and 10.1¹
⁽³⁾ Machine classifications are given for comparative purposes only and do not form part of the classification system.

¹ AS 2868 – Classification of Machinery for Earthmoving, Construction, Surface Mining and Agricultural Purposes.

8. LIMITATIONS

Geotechnical services are provided by Cardno UNG in accordance with generally accepted professional engineering and geologic practice in the area where these services are rendered. The client acknowledges that the present standard in the engineering and geologic and environmental profession does not include a guarantee of perfection, and no other warranty, expressed or implied, is extended by Cardno UNG.

It is the reader's responsibility to verify the correct interpretation and intention of the recommendations presented herein. Cardno UNG assumes no responsibility for misunderstandings or improper interpretations that result in unsatisfactory or unsafe work products. It is the reader's further responsibility to acquire copies of any supplemental reports, addenda or responses to public agency reviews that may supersede recommendations in this report.

The findings presented in this report have been based on the investigation described herein. There are always some variations in subsurface conditions across a site, which cannot be fully defined by investigation. It is unlikely that the measurements and values obtained from sampling and testing during the investigation will represent the extremes of conditions that may exist within the site. Hence it is recommended that if any ground conditions significantly different to those described in this report are encountered during construction, further advice should be immediately sought from Cardno Ullman & Nolan Geotechnic.

It is recommended that Cardno Ullman & Nolan Geotechnic be commissioned to provide a review of any design and documentation to confirm that the intents of the geotechnical report are properly reflected in the designs. Similarly, inspection of footing excavations is considered a prudent means of ensuring that ground conditions meet design expectations.

This report has been prepared specifically for Hamilton Island Enterprises and the project designers. Information contained in this report should not be construed as appropriate for other purposes or other users

JOB No.
U22036

UN DWG No.
22036-1A

DATE
28/03

Checked by

Date

NOTES

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HAMILTON ISLAND ENTERPRISES

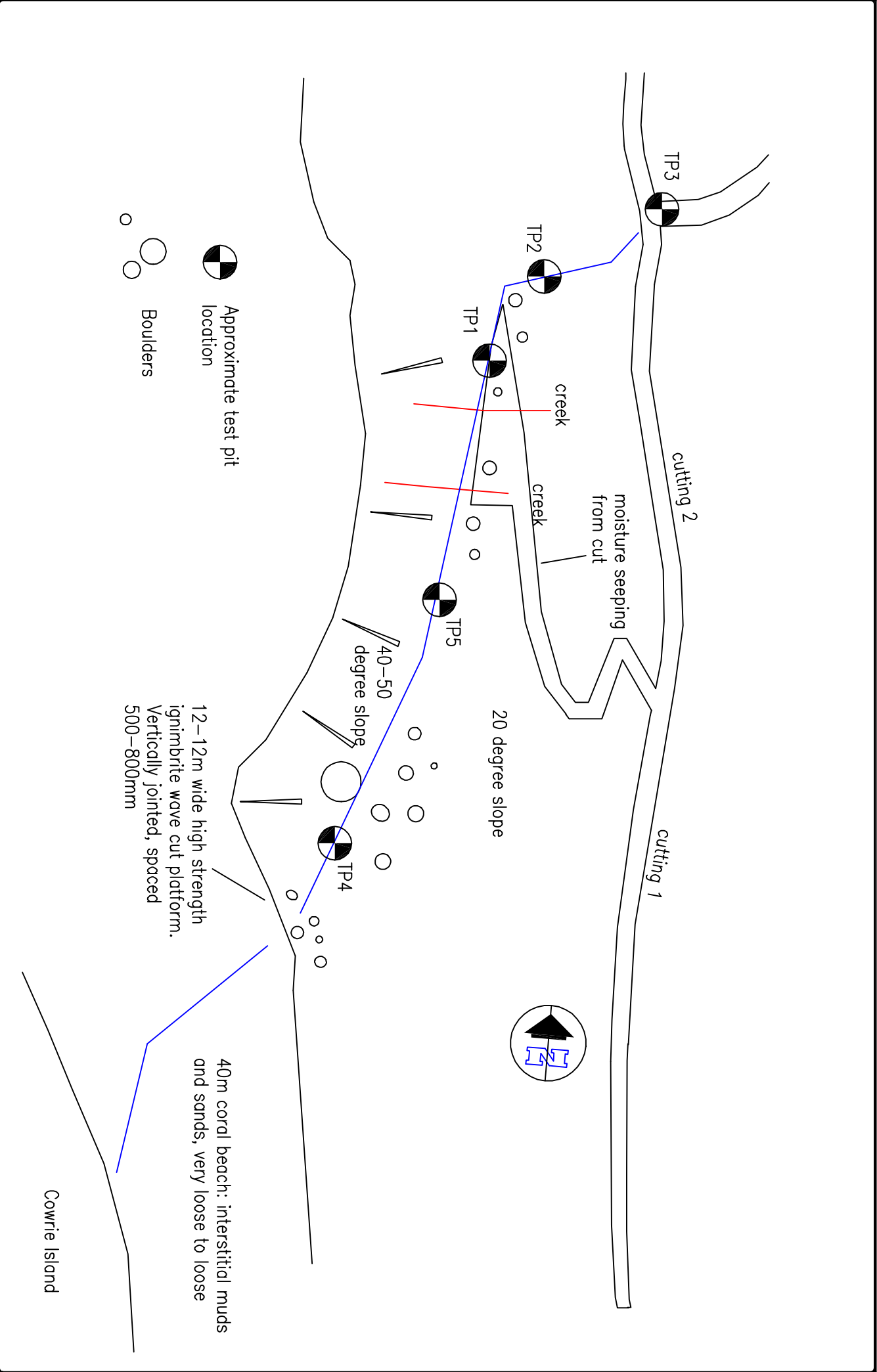
TEST PIT LOCALITY SKETCH

COWRIE ACCESS TRACK

DENT ISLAND

SCALE at A3
NTS

DRAWING No.
1



APPENDIX A

Descriptive Test Pit Logs, Site Photographs

CLIENT: Hamilton Island Enterprises

PROJECT: Geotechnical Investigation

LOCATION: Cowrie Landing Site, Dent Island

TESTED BY: AW DATE: 7.3.07

U&N JOB NO.: U22036

REPORT ON: DESCRIPTIVE TEST PIT LOGS

Equipment Description: Komatsu 200, 1200mm bucket

TEST PIT NO.	DEPTH (m)	MATERIAL DESCRIPTION
Access Track Cutting 1	0.00	Sandy Silty Clay; dark brown, sand is fine to coarse grained, with fine to medium grained gravel, subangular, with boulders to gravels of ignimbrite, moist, stiff. MPS 250 LL 45 P75 60 (CI)
	0.30	Sandy Clay; orange-brown, sand is fine to coarse grained, with occasional boulders to 600mm, moist, stiff. MPS 600 LL 55 P75 60 (CH)
	0.80	Toe of Cut
Cutting 2	0.00	Sandy Silty Clay; dark brown, sand is fine to medium grained, with coarse grained gravel, subangular, with boulders to gravels of ignimbrite, moist, stiff MPS 250 LL 45 P75 55 (CI)
	0.20	Clay; orange-brown, with fine to coarse grained sand, with occasional boulders to 600mm, moist, stiff MPS 800 LL 60 P75 80 (CH)
	1.10	Toe of Cut

Geotechnical Investigation
Cowrie Landing Site, Dent Island

1	0.00-0.25	Sandy Silty Clay; dark brown, sand is fine to medium grained, with coarse grained gravel, subangular, with boulders to gravels of ignimbrite, with grass roots, moist, stiff MPS 250 LL 45 P75 60 (CI)
	0.25-0.60	Sandy Clay; orange-brown mottled, sand is fine to coarse grained, with occasional boulders to 600mm, moist, stiff. MPS 600 LL 55 P75 65 (CH)
	0.60-1.20	Clayey Gravely Sand; grey mottled orange and red, sand is fine to coarse, gravel is coarse and angular, moist, stiff. (Residual) MPS 5 LL 45 P75 40 (SC)
	1.20	Bucket Refusal
2	0.00-0.15	Sandy Silty Clay; dark brown, sand is fine to course grained, with fine to course grained gravel, angular, with boulders to gravels of ignimbrite, with grass roots, moist, stiff MPS 250 LL 40 P75 60 (CI)
	0.15-0.30	Ignimbrite; brown-grey, extremely weathered, highly fractured, medium strength
	0.30-0.40	Ignimbrite; brown-grey, extremely weathered, slightly fractured, medium strength
	0.40	Bucket Refusal

Geotechnical Investigation
Cowrie Landing Site, Dent Island

Club House Intersection – proposed cut area

3	0.00-0.20	Sandy Silty Clay; dark brown, sand is fine to medium grained, with coarse grained gravel, angular, with boulders to gravels of ignimbrite, with grass roots, moist, firm to stiff. (Colluvium) MPS 250 LL 45 P75 60 (CI)
	0.20-0.55	Sandy Silty Clay; orange-dark brown, sand is fine to medium grained, with fine to coarse grained gravel, angular, moist, firm to stiff (Colluvium) MPS 30 LL 45 P75 60 (CI)
	0.55-0.80	Silty Clay; brown, moist, very stiff (Residual) MPS 2.0 LL 60 P75 75 (CH)
	0.80-0.95	Ignimbrite; distinctly to extremely weathered, highly fractured, medium strength
	0.80	Bucket Refusal

Note: Ripping and open excavation could reduce this area up to 1.5m. Below existing surface.

4	0.00-0.25	Sandy Silty Clay; dark brown, sand is fine to coarse grained, with coarse grained gravel, angular, with boulders to gravels of ignimbrite, with grass roots, moist, stiff MPS 250 LL 45 P75 60 (CI)
	0.25-0.50	Sandy Silty Clay; orange-dark brown, sand is fine to medium grained, with fine to coarse grained gravel, angular, moist, firm to stiff (Colluvium) MPS 30 LL 45 P75 60 (CI)
	0.50-0.75	Silty Clay; brown, moist, very stiff (Residual) MPS 2.0 LL 55 P75 65 (CH)
	0.75-0.85	Ignimbrite; extremely weathered, highly fractured, medium strength
	0.85	Bucket Refusal

Geotechnical Investigation
Cowrie Landing Site, Dent Island

Near Creek No 1

5	0.00-0.10	Sandy Silty Clay; dark brown, sand is fine to medium grained, with coarse grained gravel, angular, with boulders to gravels of ignimbrite, with grass roots, moist, stiff MPS 250 LL 45 P75 60 (CI)
	0.10-0.80	Sandy Clay; brown to orangey brown, sand is fine to medium grained, boulders up to 600mm in contact with each other with interstitial Colluvium, fine to stiff, moist MPS 600 LL 40 P75 50 (CI)
	0.80	Bucket Refusal

Note: Description is on a visual classification basis in accordance with AS 1726, Geotechnical Investigations

Checked By: 

Date: 30/3/07

HAMILTON ISLAND ENTERPRISES
Dent Island, Cowrie Island - Access Track



Photo 1
Looking south towards landing site.



Photo 2
Beach showing rock pavement near jetty landing area.

HAMILTON ISLAND ENTERPRISES
Dent Island, Cowrie Island - Access Track



Photo 3
Close up of rock pavement.



Photo 4
Track alignment looking from lower marshalling area.

HAMILTON ISLAND ENTERPRISES
Dent Island, Cowrie Island - Access Track



Photo 5

Existing road cuttings that are upslope of access track.

APPENDIX B

Laboratory Results

ULLMAN & NOLAN Technical Services Pty Ltd

UNGR 1 G

(-/12/05)

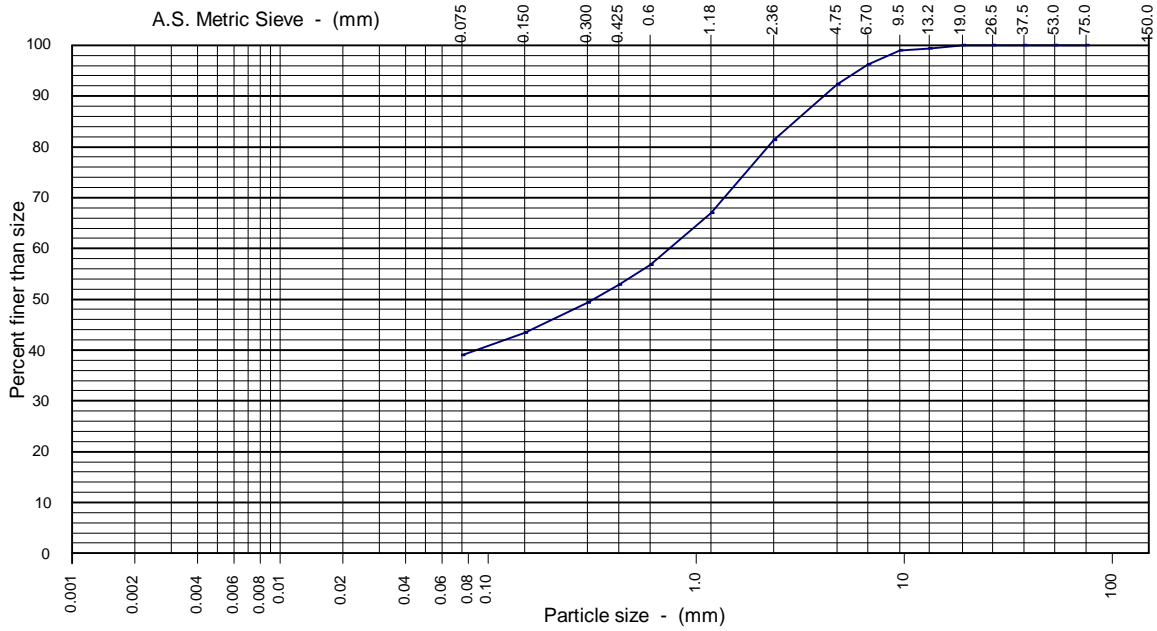
A.C.N. 103 205 205

REPORT ON SOIL CLASSIFICATION

Sheet 1 of 1

Mackay Laboratory

CLIENT: Hamilton Island Enterprises	JOB NO: U22036	LAB REF NO:	07-1091AB
PROJECT: Dent Island Golf Course	SAMPLED BY: CUNG	DATE:	6.3.07
LOCATION: Cowrie Access Track, Test Pit 1, Depth 0.60-1.20m	TESTED BY: TL,CC	DATE:	14.3.07
MATERIAL: Clayey Gravelly Sand; brown	CHECKED BY: CC	DATE:	15.3.07
TEST PROCEDURES: AS 1289.3.1.1,3.2.1,3.3.1,3.4.1,3.6.1	CLIENT REF:	-	



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	39			7	11	24	24	5	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Soil Particle Density (g/cm ³)
150.0				45	17	28	14.0	-
75.0				Classification: Clayey Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained (SC)				
37.5								
19.0	100							
9.5	99							
4.75	92			<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p><u>Preparation History of Atterberg Limits</u></p> <p>Sample : Natural/Air Dried/Oven</p> <p>Sieved: Wet/dry</p> <p><u>Linear Shrinkage Data</u></p> <p>Length of Mould (mm) : 254</p> <p>Sample : -</p> </div> <div style="width: 35%; text-align: center;"> <p>Accredited No. 910</p> <p>Certificate No. 07-1091A</p> <p>Date of Issue 29.11.06</p> <p>This document is issued in accordance with NATA's accreditation requirements.</p> <p>Authorised Signatory N. J. Richardson</p> </div> </div>				
2.36	81							
1.18	67							
0.600	57							
0.425	53							
0.300	49							
0.150	43							
0.075	39							