# REPORT ON GEOTECHNICAL INVESTIGATION

### GARDENS TENNIS – TENNIS COURT CRACKING ASSESSMENT

Reference: U23991



Prepared for Gardens Tennis

29 March 2016



### **Document Information**

Prepared for	Gardens Tennis
Project Name	Gardens Tennis – Tennis Court Cracking Assessment
Project Location	Gardens Tennis, The Gardens, Darwin NT
Job Reference	U23991
Date	29 March 2016

### **Contact Information**

Cardno Ullman and Nolan Geotechnical Pty Ltd ABN 57 051 074 992

Level 6, 93 Mitchell Street Darwin NT 0800 Australia

G.P.O. Box 39623 Winnellie NT 0820 Australia

Telephone: 08 8984 4983 Facsimile: 08 8942 8200

soils@cardno.com.au www.cardno.com.au

## **Document Control**

Version	Date	Author	Author Initials	Reviewer	Reviewer Initials
1	29/03/2016	Matt Thorogood	MT	Andrew Williams	AJW

© Cardno 2016. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

# Letter of Transmittal

Gardens Tennis Darwin Tennis Association GPO Box 2514 DARWIN NT 0801

Attention: Charles Webb

Dear Charles,

A geotechnical investigation was undertaken by Cardno Ullman & Nolan Geotechnic (Cardno UNG) at the Gardens Tennis Complex, Gilruth Avenue, The Gardens NT (herein referred to as 'the site').

The objectives of the investigation was to identify the subsurface conditions at the location and ascertain the underlying causes that are causing the failure and degradation of the playing surface. On development of a conceptual ground model Cardno has provided recommendations on appropriate remedial/redevelopment works.

In total, eight (8) boreholes were positioned across the site and drilled using auger techniques to target depths ranging between 3 and 7.5 metres below existing ground level. Based on the field investigation undertaken, the site is generally underlain by topsoil overlying silty sand.

The consistency of the profile generally comprised of loose to medium dense sands, the consistency generally increasing with depth. However in BH04, BH05, BH06 and BH07 very loose to loose sands were encountered to depths up to 1.2 to 2.3mbgl.

This report provides comments on the geotechnical characteristics of the site and presents geotechnical parameters considered appropriate for future design and construction. The recommendations are based on the results of the field investigation and laboratory testing.

Based on the findings of the field investigation, the high proportion of sandy soils encountered the site, we consider that the site may be classified as a **Class P** in accordance with AS2870.

The possible causes of the pavement failure are discussed with options provided for rehabilitation and repair.

We trust this report meets your requirements. Should you wish to discuss any matters raised in the report, please do not hesitate to contact the undersigned.

Kind regards,

Matthe Things

Matthew Thorogood Engineering Geologist BEng (Hons), FGS For Cardno Ullman & Nolan Geotechnic (NT)

Andrew Williams Snr Principal Engineering Geologist MSEnvMgmt BSc (hons), C.Geol FGS PgDip For Cardno Ullman & Nolan Geotechnic

# **Table of Contents**

Lett	ter of T	ransmitta	al	iii
1	Intro	duction		5
2	Scop	e of Worl	k	6
	2.1	Field Ir	nvestigation	6
	2.2	Labora	tory Testing	7
	2.3	Ground	dwater Monitoring	8
3	Site C	Condition	IS	9
	3.1	Region	al Geology	9
	3.2	Site De	escription	10
	3.3	Subsur	rface Profile	10
	3.4	Ground	dwater	11
4	Engir	neering A	ssessment	13
	4.1	Labora	tory Test Results	13
	4.2	The Ex	isting Court Pavement and Remediation Strategy	13
		4.2.1	Remediation Options	14
	4.3	Site Re	eactivity and Classification	14
	4.4	Allowal	ble Bearing Pressure	14
	4.5	Genera	al Earthworks Recommendations	14
		4.5.1	Stripping Requirements	14
		4.5.2	Site Filling	15
		4.5.3	Excavatability	15
5	Limit	ations		16

# Appendices

APPENDIX A	Site Plan
APPENDIX B	Descriptive Engineering Borehole Logs
APPENDIX C	Dynamic Cone Penetrometer Results
APPENDIX D	Laboratory Test Results
APPENDIX E	Site Photographs

## Tables

urface material sequence	6
urface material sequence	11
ndwater monitoring results	11
ratory test results	13
vable bearing capacities	14
Point Excavation Classification System for Soil and Rock	15
r	urface material sequence ndwater monitoring results ratory test results vable bearing capacities

# 1 Introduction

Cardno Ullman & Nolan Geotechnic (Cardno UNG) were commissioned by Darwin Tennis Association / Gardens Tennis to undertake a geotechnical investigation at the site of the Gardens Tennis Complex situated along Gilruth Avenue in the Gardens, Darwin NT. The site location is defined in the figure below and on the site plan presented in Appendix A.



Figure 1 Location of the study site (red) Gilruth Avenue, The Gardens, Darwin NT (Nearmap.com)

The objectives of this investigation was to investigate the subsurface geological conditions within the site and provide geotechnical interpretation as to the underlying cause of the failure across the tennis courts and to make recommendations on appropriate remedial/redevelopment works.

The geotechnical investigation undertaken by Cardno UNG comprised:

- > Review of project documentation provided and relevant geological literature;
- > Drilling of boreholes and *insitu* testing;
- > Laboratory testing of selected samples; and
- > Analysis of field and laboratory test results and compiling this geotechnical report.

The field investigation, laboratory testing and geotechnical assessment were undertaken with reference to the following Australian Standards:

- > Australian Standard AS1726 Geotechnical Site Investigations;
- > Australian Standards AS1289 Methods of Testing Soil for Engineering Purposes;
- > Australian Standards AS2870 Residential Slabs and Footings; and
- Australian Standard AS3798 Guidelines on Earthworks for Commercial and Residential Developments.

# 2 Scope of Work

The commission has been carried out to the agreed scope of work set out by Cardno UNG, with reference to the Cardno UNG fee proposal, referenced WG15122, dated 17 August 2015.

#### 2.1 Field Investigation

In discussion with the client representatives test locations were positioned across the site, taking into account general site coverage, areas prone to water ponding, and previous failure as well as buried service locations. At the time of the field investigation, test locations were recorded using a hand-held GPS to an accuracy of  $\pm 4.0$  metres.

Subsurface conditions beneath the site were investigated by drilling eight (8) boreholes (nominated BH01 to BH08) and the development of four (4) piezometer standpipes for groundwater monitoring. Boreholes were advanced to target depths ranging between 3.0 and 7.5metres below existing ground level (mbgl). Boreholes were advanced using the Cardno trailer mounted IH3100 drill rig with a 100mm diameter solid-stem auger.

Adjacent to each borehole, Dynamic Cone Penetration (DCP) testing was carried out from the surface to a target depth of 1.5m. Limited additional testing in the form of Standard Penetration Tests (SPTs) were carried out at within the boreholes.

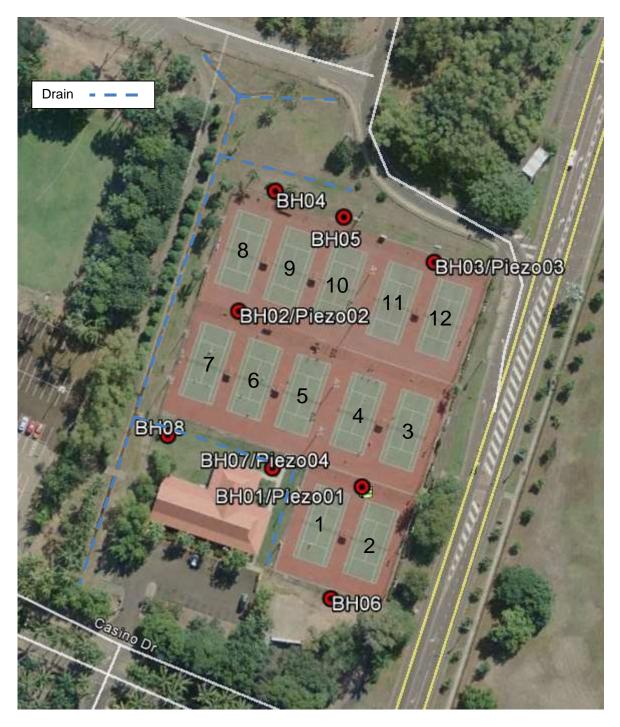
Materials encountered during the investigation were visually classified and logged on site by the supervising Engineering Geologist in accordance with AS1726. At this time, representative samples were collected from the recovered material and transported to our Darwin laboratory for testing.

A site plan showing the borehole locations, together with descriptive borehole logs and DCP test results are presented in Appendix A to C respectively.

Borehole locations are summarised in Table 2-1 below and are shown on the figure on the next page.

Location	Orientation onsite
BH01/Piezo01	On court surface at northern end of 1 & 2
BH02/Piezo02	On court surface at southern end of 8
BH03/Piezo03	On court surface at northern end of 11 & 12
BH04	Off court surface at northern end of 8 on raised embankment, adjacent to large drain
BH05	Off court surface at northern end of 10 on raised embankment, adjacent to large drain
BH06	Off court surface at southern end of 1 & 2
BH07/Piezo04	Off court surface at southern end of 5 adjacent to large drain
BH08	Off court surface at southern end of 7 adjacent to junction between two large drains

#### Table 2-1 Summary of subsurface material sequence



### 2.2 Laboratory Testing

Laboratory testing of selected samples is undertaken to provide geomechanical data for engineering assessment, and to validate the material properties described in the geologists logs. Subsurface characteristics such as composition, strength and mechanical properties are evaluated through a range of laboratory testing.

Selected samples recovered from the boreholes at the time of the field investigation were submitted for the following laboratory tests:

- > Particle size distribution (AS1289.3.6.1);
- > Atterberg limits and linear shrinkage (AS1289.3.1.1, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1,);
- > Modified maximum dry density and optimum moisture content (AS1289.5.2.1); and
- > 4-day soaked California Bearing Ratio at 95% modified maximum dry density (AS1289.6.1.1).

The classification testing was carried out at our NATA accredited Darwin laboratory. Laboratory test results are summarised in Table 4-1 with the laboratory test reports presented in Appendix D.

#### 2.3 Groundwater Monitoring

Groundwater monitoring was undertaken at selected boreholes, with piezometer (standpipes) groundwater monitoring wells installed at four (4) of the borehole locations. Groundwater level monitoring was undertaken on several occasions following the installation of the piezometers to provide data on groundwater level variation to assess the likelihood of tidal or seasonal influence and the potential of fluctuating groundwater impacting on the subgrade of the tennis courts. The results are shown in Table 3.2 on page 11.

# 3 Site Conditions

#### 3.1 Regional Geology

The regional geology of the area is described in the published map and information from the Northern Territory Geological Survey (NTGS), 1:100,000 Geological Map Series titled Darwin and associated map, Sheet 5073.

The region exhibits numerous units from a range of geological formations. Principally the area is underlain by the Darwin Member which underlies most of Darwin City (Basal member of the Bathurst Island Formation) of the Early Cretaceous period (~100Mya) overlying the Burrell Creek Formation (Finniss River Group). The Darwin Member consists of claystones (radiolarian and sandy), sandstones (clayey, quartzitic, and ferruginous/glauconitic), and basal conglomerate units, deposited under shallow marine to paralic (coastal) environments. The formation is commonly referenced as being flat-lying, horizontal beds with a regional dip of 1° to the north; however, strata dip greater than this and striking in varying directions locally.

Within the Darwin Member, at depth, the claystone is montmorillonitic and commonly calcareous. Deep lateritic weathering has changed primary montmorillonitic clay to kaolin with the dissolution and redeposition of iron oxidise and silica (duricrusts). Exposures of the Darwin Member show wide colour variation and mottling due to selective leaching and redeposition of iron oxides (laterite). Silicification in places has produced a moderately hard silcrete-duricrust which is referred to locally as porcellanite.

An unconformity exists between the Darwin Member and the underlying Burrell Creek Formation. The Burrell Creek Formation comprises steeply dipping Proterozoic (~1,700Ma) metasediments. This highly weathered siltstone member was identified at the base of the cliff face along the length of Emery Court. This material was identified as low strength, highly micaceous phyllite and was notably weaker than the overlying conglomerate and porcellanite.

Recent Tertiary (Cainozoic) deposits of unconsolidated sand, clayey sand, ferruginous clayey sand and laterite profiles occur as a thin cover over the lower Burrell Creek and Bathurst Island Formations.

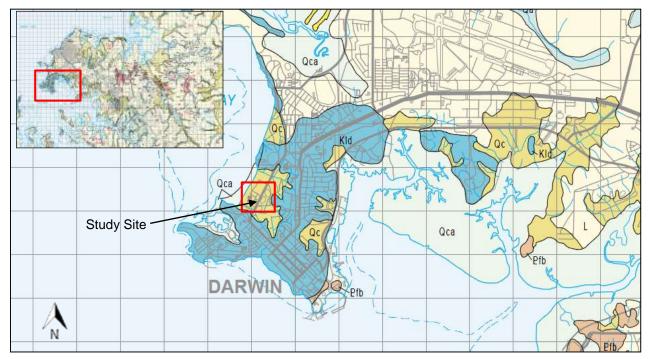


Figure 2 Regional geology of the Darwin Area (Extractive Geology from the Outer Darwin Area 1:100k geological map, part sheets 5072, 5073, 5172 and 5173).

The geological map provided as figure 2 indicates the site falls within proximity of the Darwin Formation ( $K_{Id}$ ), coastal alluvium deposits ( $Q_{ca}$ ) and slope wash deposits ( $Q_c$ ). The Burrell Creek Formation (phyllite) and the Darwin Member (the overlying porcellanite) are associated with higher ground of The gardens and Larrakeyah areas.

#### 3.2 Site Description

The Gardens Tennis complex is situated along Gilruth Avenue between the Sky City casino access and Mindil Beach, The Gardens, Darwin NT, approximately 2km northwest of the Darwin CBD. With the exception of the Casino, the local area is generally undeveloped, comprising of golf course, Mindil beach, little Mindil and the Gardens Oval AFL fields. The tennis complex comprises of clubhouse with large covered patio area, small paved carpark and twelve (12) fenced tennis courts.

The general presentation of the tennis courts seems to be in reasonable condition though representatives of Gardens Tennis identified several courts that are currently considered unsafe to play and localised depressions at the surface where ponding occurs.

The topography of the site and immediate surrounding area comprises of gently sloping to level ground. The low-lying area of the tennis complex and The Gardens is downslope within a distinct water catchment that drains via Mindil Beach to the sea. As previously mentioned the area is generally undeveloped and underlain by sandy soils.

The existing drainage system appears to be inadequate to manage the heavy rainfall events associated with the wet season. During the investigation (February – mid wet season) the site was visited following considerable rainfall events. On several occasions it was noted that the surrounding drainage was inundated and not running. It is likely that the site drainage is being saturated by water running into the area from elsewhere within the catchment. This inundation can be exacerbated by the presence of high tides resulting in localised tide locking of drains or even tidal inundation. Selected site photographs are presented in Appendix E.

#### 3.3 Subsurface Profile

The subsurface profile was investigated by drilling a total of eight (8) boreholes (nominated as BH01 to BH08) across the site. Boreholes were advanced to a target depth of 3.0m though at three locations BH01, BH05 and BH06 target depths were extended to 3.5mbgl, 7.5mbgl and 4.95mbgl respectively. All boreholes were conducted as proposed, however at piezometer 4 was developed in BH07 rather than BH08 due to unfavourable ground conditions being encountered. Unexpectedly a redundant service trench was encountered within BH02 composed of stabilised sand with old copper cable between 0.5 and 1.0mbgl. Additional SPTs were conducted within some boreholes to support the geologist's logs.

The material sequence encountered in the boreholes generally comprised topsoil or fill overlying marine sand (beach sand) and silty sand (mangrove deposits) to termination. Insitu testing and drilling observations indicate the consistency of soils as loose to medium dense, with sporadic harder and softer layers throughout.

The subsurface conditions encountered at each borehole location is summarised in Table 3-1 on the following page.

	Strata								
Location	Topsoil / subsoil	Fill (pavement/court construction)	Fill (other)	Sand (beach deposits)	Silty Sand (mangrove mud)				
BH01	-	0.00 – 0.80	-	0.80 – 2.50	2.50 - 3.50*				
BH02	-	0.00 – 0.45	0.45 – 1.00	1.00 – 1.50	1.50 – 3.00*				
BH03	-	0.00 – 0.50	-	0.50 – 2.40	2.40 - 3.00*				
BH04	0.00 – 0.10	-	0.10 – 1.50	1.50 – 1.65	1.65 – 3.00*				
BH05	0.00 – 0.10	-	0.10 – 0.95	0.95 – 1.55	1.55 – 7.50*				
BH06	0.00 – 0.55	-	-	0.55 – 2.80	2.80 – 4.95*				
BH07	0.00 – 0.15	-	0.15 – 1.05	1.05 – 1.40	1.40 – 3.00*				
BH08	-	-	0.00 – 0.50	0.50 – 1.40	1.40 – 3.00*				
* Termination dept	<sup>μ</sup> h - Λ	lot encountered			1				

 Table 3-1
 Summary of subsurface material sequence

#### 3.4 Groundwater

At the time of the investigation (February – mid wet season), groundwater was encountered at each of the borehole locations within 1.00m of the existing ground surface. Throughout the year, the groundwater table is likely to fluctuate significantly as a result of changes in seasonal weather conditions. Typical groundwater levels within the Darwin area can vary as much as 8 to 9m between the dryer and wetter months, with a mean groundwater level around 5 to 7m. However, localised groundwater level is influenced by several components; including rainfall intensity and duration, soil permeability, surface and sub-surface drainage, proximity to water bodies, tides etc.

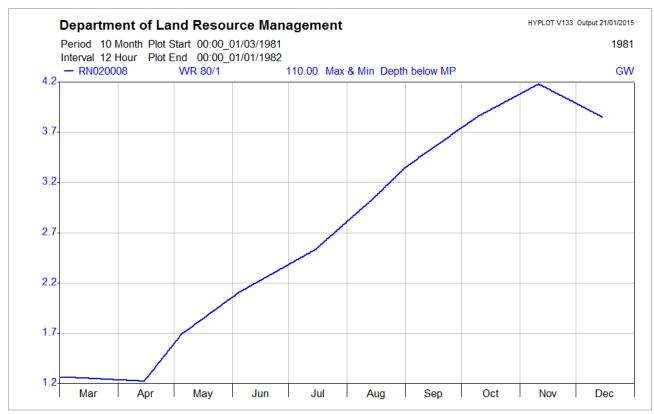
It is also likely that perched water may occur, following periods of intense rainfall, over less permeable clayey layers or an interface between soil and rock.

Four (4) groundwater monitoring wells (piezometers) were constructed as part of this investigation. Monitoring was undertaken following during wetter and dryer periods at high and low tide in an attempt to identify the key influences on groundwater.

			Location, GV	V Level mbgl	
Date / Time	Approximate Tide Level	BH01 / PIEZO01	BH02 / PIEZO02	BH03 / PIEZO03	BH07 / PIEZO04
11/03/16					
08:10	7.62	0.78	0.63	0.70	0.73
10:05	5.54	0.75	0.43	0.43 0.61	
12:10	2.20	0.73	0.43	0.63	0.51
22/03/16					
10:10	3.00	0.63	0.59	0.54	0.62
12:15	1.93	0.635	0.585	0.54	0.63
14:15	3.21	0.63	0.59	0.54	0.62

#### Table 3-2 Summary of groundwater monitoring results

A review of the Northern Territory Government Department of Land Resource Management groundwater database was undertaken to identify the registered wells within the general area of the site. The database identified the closest groundwater well to the study site being situated 9km northeast of the site within Marrara, NT. However within this well, monitoring of groundwater level was only carried out for a 10 month period in 1981. Details of this registered well and recorded groundwater data (m below measured reference point) is summarised in Figure 3 below.



**Figure 3:** Recorded groundwater levels for registered well RN020008 between March and December 1981 (Department of Land Resource Management, www.lrm.nt.gov.au)

This is considered a typical groundwater depth curve for this part of Darwin. However, some wet seasons can be heavier resulting in protracted shallower depths.

## 4 Engineering Assessment

The engineering assessment presented herein has been based on observation made during the site investigation, the material succession encountered within the boreholes together with the field and laboratory test results.

#### 4.1 Laboratory Test Results

A summary of the laboratory test result is provided in Table 4-1 below. Full laboratory test reports are presented in Appendix D.

		Material	Gradi	ing	Atter	berg	OMC	MMDD	CBR <sup>1</sup>
Borehole	Depth (m)	Description (Classification)	Sieve Size (mm)	Passing (%)	Lim (%		(%)	(t/m <sup>3</sup> )	(%)
			19.0	100	LL	33			
DUOF	× 100 000	Clayey	4.75	92	PL	25			
BH05	1.90 – 2.30	gravelly sand (SC)	2.36	87	PI	8	-	-	-
		, , , , , , , , , , , , , , , , , , ,	0.075	10	LS	3.5			
			19.0	100	LL	N/O			
PHOS	0.20 0.55		4.75	100	PL	N/O	14.0	1.88	25
BH06	BH06 0.30 – 0.55		2.36	98	PI	N/P	14.0		35
			0.075	26	LS	0.00			
			19.0	100	LL	N/O			
BH06	4.50 - 4.95		4.75	96	PL	N/O			
	4.50 – 4.95		2.36	90	PI	N/P	-	-	-
			0.075	12	LS	0.0			
Lagandi									
<u>Legend:</u> Grading =	Particle S	Size Distribution	OMO	C =	Optimu	ım Moistur	e Content		
LL =	Liquid Lii	mit	MML	DD =	Modifie	d Maximu	m Dry Dens	ity	
PL =	Plastic L	imit	CBR	R <sup>1</sup> =	Califorr	nia Bearing	g Ratio @ 9	5% MMDD	
PI =	Plasticity	Index							
LS =	Linear Si	hrinkage							

 Table 4-1
 Summary of laboratory test results

### 4.2 The Existing Court Pavement and Remediation Strategy

The tennis courts show surface cracking and distress in many areas with probably the worst area being around BH1. The distress comprises cracking (without vertical displacement) and some pitting and surface break-up. The boreholes have shown that the pavement thicknesses vary as do the materials used in the pavement. This may be a result of the somewhat sporadic development of the facility. It is therefore likely that the materials will vary in the different stages of court development.

The quality of the pavement materials have not been specifically tested during the investigation but may have contributed as a cause to the breakdown of the surface.

The main likely cause of the pavement cracking and break-up is moisture change in the subgrade causing seasonal changes in movement. Although the soils are predominantly sand, the significant fluctuations in the groundwater table can cause pavements to crack. Corrosion in the aggregates in the pavement may also be a cause.

The drainage is regarded as poor across the whole tennis court area and overland flow may also contribute to water occasionally ponding in some areas,

#### 4.2.1 <u>Remediation Options</u>

Superficial, yet cheaper, surface applications of new playing surfaces is regarded as a short term fix only. In the more distressed area we consider the best option will be to remedy the root causes of the problem namely improve the court surface and subsurface drainage. Also replacing and reprofiling the court surfaces should be considered to enhance the drainage and to strengthen the pavement. This will involve replacing some or all of the pavements.

#### 4.3 Site Reactivity and Classification

The proposed structure may be outside the intent of AS2870-Residential Slabs and Footings, but the site classification may still be used as a guide to the predicted ground surface movement as a result of soil moisture variations.

Based on the findings of the field investigation where fill was found around BH1 to 3 up to 800mm, then this area is classed as P in terms of AS2870. The remainder of the site did not show obvious fill and based on the low proportion of low-plasticity soils found in the upper stratum of the site, we consider that this area of the site may be classified as a Class S. A characteristic ground surface movement as a result of moisture variation (ys) in the order of 10 to 15mm has been estimated for the subsurface profile encountered.

#### 4.4 Allowable Bearing Pressure

Although this assessment is not principally related to new structures this may be needed for future developments. Dynamic Cone Penetrometer tests (DCPs) and Standard Penetration Tests (SPTs) were undertaken at the time of the investigation to assess the consistency of the underlying soil and rock profile. An allowable bearing capacity assessment using material descriptions and strengths obtained from the geologist's borehole logs and field test results has been carried out for shallow foundations. This assessment has assumed 1.0m wide pad footing with groundwater at shallow levels. The summary of allowable bearing capacity with depth is presented in Table 4-2 below.

Strata	Depth (m)	Allowable Bearing Capacity (kPa)
Fill (other)	0.00 - 0.8	50
Sand (beach deposits)	0.50 – 2.80	100
Silty Sand (mangrove mud)	1.40 – 3.00	Not advised

#### Table 4-2 Summary of allowable bearing capacities

The soils are basically beach sands overlying mangrove mud hence any heavy structures or earthworks could cause settlement or consolidation of the lower horizons.

#### 4.5 General Earthworks Recommendations

This section applies to all earthworks required for any construction preparation for the project. It is recommended that all earthworks on site are carried out in accordance with the project specifications and drawings, with reference to AS3798-*Guidelines on Earthworks for Commercial and Residential Developments*.

#### 4.5.1 <u>Stripping Requirements</u>

It is recommended that all topsoil and uncontrolled fill be stripped from within the future court footprint and either removed from site or stockpiled for landscaping purposes. Unsuitable material should be defined in the design specification. Any soft or loose areas that are identified at foundation level may need to be removed and replaced with more competent material.

#### 4.5.2 Site Filling

It is recommended that any earthworks are carried out with consideration to Section 8.2 of AS 3798 and in strict accordance with compaction, supervision and testing requirements specified in the project specifications and drawings.

Any proposed fill should be placed in layers not exceeding 200mm (loose thickness) and compacted to a dry density ratio of not less than 95% of Modified Maximum Dry Density (MMDD) and no more than  $\pm 2.0\%$  of Optimum Moisture Content (OMC).

Where excavated material is to be re-used onsite, conformance testing should also be carried out at regular intervals during construction to ensure specified material properties have been achieved. Testing should comprise of Particle Size Distribution, Atterberg Limits, Linear Shrinkage and California Bearing Ratio (CBR incl MMDD) as a minimum.

#### 4.5.3 Excavatability

Based on the field investigation and testing, we can estimate the excavatability using the Kirsten's Classification System (Table 4-3).

A summary of the excavatability of various materials encountered at each of the investigation sites is considered to be Class 1 to 2.

Motorial Turo	Material E	Excavation Classification <sup>(1)</sup>	Description of executability
Material Type	Class	Class index boundaries	<ul> <li>Description of excavatability</li> </ul>
	1	N <0.01	Hand spade
Soil / Detritus	2	0.01 <n<0.1< td=""><td>Hand pick and spade</td></n<0.1<>	Hand pick and spade
	3	0.1 <n<1.0< td=""><td>Power tools</td></n<1.0<>	Power tools
	4	1.0 <n<10< td=""><td>Easy ripping</td></n<10<>	Easy ripping
	5	10 <n<100< td=""><td>Hard ripping</td></n<100<>	Hard ripping
Rock	6	100 <n<1,000< td=""><td>Very hard ripping</td></n<1,000<>	Very hard ripping
	7	1,000 <n<10,000< td=""><td>Extremely hard ripping/blasting</td></n<10,000<>	Extremely hard ripping/blasting
	8	N <10,000	Blasting
Note:	(1) Kirste	en Classification System	

#### Table 4-3 Definition of Eight Point Excavation Classification System for Soil and Rock

## 5 Limitations

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

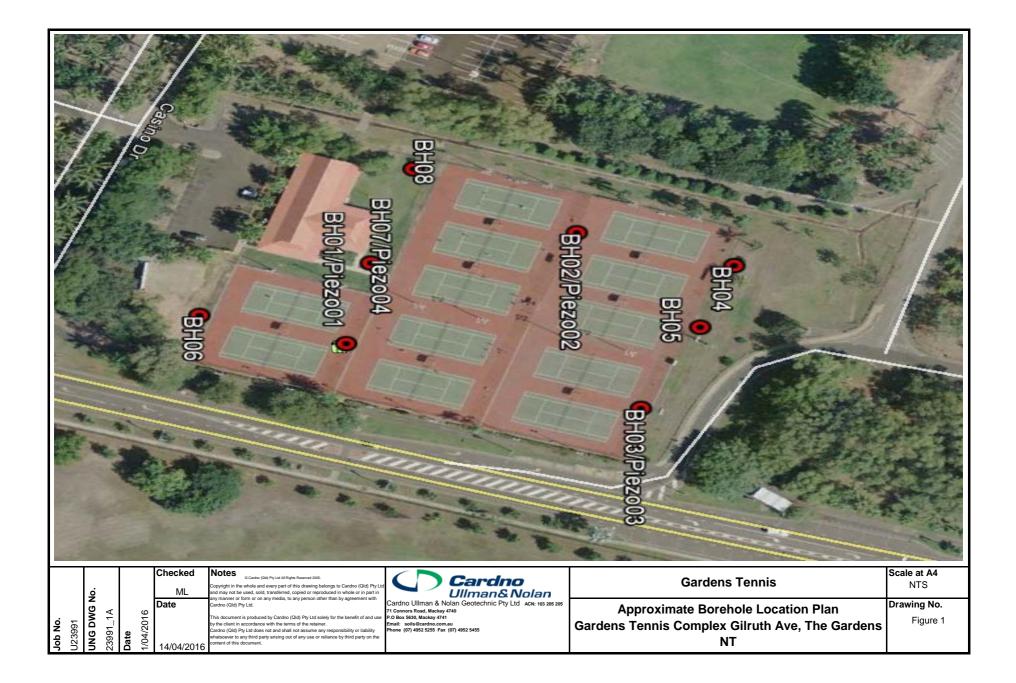
It is the reader's responsibility to verify the correct interpretation and intention of the recommendations presented herein. Cardno UNG assumes no responsibility for misunderstandings or improper interpretations that result in unsatisfactory or unsafe work products. It is the reader's further responsibility 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 UNG.

This report has been prepared specifically for Darwin Tennis Association "Gardens Tennis". Information contained in this report should not be construed as appropriate for other purposes or other users.

# APPENDIX A

Site Plan



# APPENDIX B

Descriptive Engineering Borehole Logs

				U	///	m	r <b>cino</b> an&Nolan e Future			E		REHOL	
Proj Job Site	iect : ( No : : Gar	U2399	chnica 1 Tennis	l Investi s Comple	-	n	Hole Commenced : 12.2.16 Hole Completed : 12.2.16 Logged By : MT Checked By : AW Surface R.L. (m) : AHD	Drill Mou Diar	tractor Rig : Il Inting : neter: rds : G	H3100 Trailei 100 mi	Drill I r m	Rig	
	STF	RATA					VISUAL SOIL DESCRIPTION				DRI	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistancy		Description (SOIL NAME; plasticity/grain size, colour, parti shape, secondary components, minor constitue (ROCK NAME; grain size, colour, minor constitue	ents)		Method & Bit	Support	Sampling	Testing
0.06			_PtSP	М			Court surface; (PAVEMENT) Gravelly Sand; pale brown, fine to coarse grained, fine to sub-rounded gravel, with silt (SELECT FILL) MPS 8 LL 15 P75 10	o coarse,					
0.80 1.0 1.5					MD	- D	Silty Sand; very pale brown with pale grey and yellow flex coarse grained, trace fine to medium, rounded to sub-rou shell fragments throughout (MARINE DEPOSITS) MPS 5 LL 15 P75 5	cks, fine t inded gra	o vel,				
2.0			SW	w						A T	Ν		
2.5			SM				Silty Sand; dark green/brown/grey, fine to coarse grained fragments throughout MPS 3 LL 15 P75 15	d, shell				3.00m	SPT 1, 0, 1 N
3.5—						-	BH01 TERMINATED AT 3.50 m Target depth Groundwater encountered at 0.8mbgl Borehole stable Located off court between courts 1-4 Photos Taken						
Moi D M W	isture Dr Moi: We	y VS st S		very k k nedium de	soft firm stiff v stiff hard bose bose ense ense	MPS LL P75	Maximum particle size     A     Auger     R       Liquid Limit     W     Washbore     B       % passing 75um sieve     P     Percussion     V       H     Hammer     T	Bit Roller Blank V bit TC bit Diamond	C M	port Casing Mud Nil	D	Standard Penetrati Pocket Per Enviro Sa [	ple & Size in Disturbed San

				U	///	m	r <b>dno</b> an&Nola ne Future	an			E		REHOL orehole N	
Pro Job Site	ject : No : e : Gai	U2399	chnica )1 Tennis	al Investi s Comple	-	'n	Hole Comp Logged By Checked By		Drill Mou Diar	ntractor : Rig : IH unting : T meter: 10 ords : GD	3100 Frailer 00 mr	Drill F m	Rig	
	ST	RATA					VISUAL SOIL	DESCRIPTION				DRI	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistancy		shape, seconda	Description plasticity/grain size, colo ary components, minor grain size, colour, minor	constituents)		Method & Bit	Support	Sampling	Testing
- 0.06 - 0.45 - 0.5			GC	М			Court surface; (PAVEME Clayey Sandy Gravel; pa to coarse grained, sub-arr (SELECT FILL) MPS 14 LL 30 P75 15 Sand; grey/brown, fine to (FILL)	ale red/brown mottled g igular to sub-rounded, f	îne to coarse san					
- 1.0			SW			) -	MPS 2 LL 0 P75 10  Sand; brown, fine to coar (MARINE DEPOSITS)	se grained, shell fragma	ents throughout					
- 1.25 - 1.5			SW	-			MPS 2 P75 0 Silty Sand; brown, fine to MPS 2 LL 20 P75 15 Silty Sand; dark green/br fragments throughout			nout	A T	N		
-2.0			SM	w	M	D	MPS 2 LL 20 P75 15							
-2.5						)								
-3.0-							BH02 TERMINATED AT 3 Target depth Groundwater encounterer Borehole stable Located off court between Photos Taken	d at 1.0mbgl						
3.5														
Mo D M W	isture Di Moi Wi	ry VS st S		very k k nedium de	soft firm stiff v stiff hard bose bose ense ense	MPS LL P75	Visual Description Maximum particle size Liquid Limit % passing 75um sieve		Bit R Roller B Blank V V bit T TC bit D Diamond	М		D	itandard Penetrat Pocket Per Enviro Sa	ple & Size in r Disturbed Sam

				Sha	aping	y th	e Future					Sheet:1 of
Proj Job Site	ect : No : : Gar	U2399	chnica 1 Fennis	l Investig	-	1	Hole Completed : 12.2.16Drill RLogged By : MTMountChecked By : AWDiame	ting : T	3100 Trailer 00 mn	Drill F	Rig	
	STF	RATA					VISUAL SOIL DESCRIPTION			DRII	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistency		Description (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)		Method & Bit	Support	Sampling	Testing
0.10		1. A Y a	Pt				Court surface; (PAVEMENT)					
		6 6 6 6 9 9 6 9 9 6 9 9 6 9 9 6 9 9 6 9 9 7	GC	М			Clayey Sandy Gravel Brown; brown, fine to coarse grained, sub-angular to sub-rounded, fine to coarse sand (SELECT FILL) MPS 25 LL 30 P75 15					
0.5		<i>A</i> 0					Sand Dark yellow brown; dark yellow/brown, fine to coarse grained trace fine to medium, sub-rounded gravel, trace silt, Shell fragments throughout (MARINE DEPOSITS) MPS 7 LL 15 P75 5	,				
1.0					D		MF3 / LL 13 F/3 5					
1.5			SP						A T	N		
2.0				w								
2.40												
2.5			SM		MD -	D	Silty Sand Green/brown/grey; dark green/brown/grey, fine to coarse grained, Shell fragments throughout, Flowing sands below the GW table MPS 2 LL 15 P75 15	e				
3.0—		<u>(//)</u>					BH03 TERMINATED AT 3.00 m Target depth Groundwater encountered at 0.8mbgl Borehole stable Located off court between courts 11 & 12 Photos Taken					
3.5												
Moi	sture		Conc	istency			/isual Description Method Bit	Supp	ort		Samplii	na
1VIOI ) 1 V	Sture Di Moi: We	y VS st S	CONS	very	soft L firm F stiff stiff stiff hard	MPS LL P75	Visual Description     Method     Bit       Maximum particle size     A     Auger     R     Roller     C       Liquid Limit     W     Washbore     B     Blank     M       % passing 75um sieve     P     Percussion     V     V bit     N       H     Hammer     T     TC bit       C     Core     D     Diamond       R     Rotary air flush     Image: Non-top of the second se	; C	ort asing Mud Nil	D	Undisturbed Sam D tandard Penetrati Pocket Per	ole & Size in isturbed Sa

				U	///r	na	r <b>dno</b> an&Nol e Future	an			E		REHOL orehole No	
Proj Job Site	ect : 0 No : l : Gar	J2399	hnica 1 ennis	l Investi Comple	-	n	Hole Comp Logged By Checked B		Drill Mou Diar	Rig : unting meter:	r : Card IH3100 : Trailei 100 mi GDA 94	Drill F m	Rig	
	STR	ATA					VISUAL SOIL	DESCRIPTION				DRI	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistency	6	shape, seconda	Description plasticity/grain size, col ary components, minor grain size, colour, minor	constituents)		Method & Bit	Support	Sampling	Testing
0.10			CI	M	MD ·	- D	Gravelly Sandy Clay; da sub-angular to sub-round MPS 15 LL 30 P75 55 Silty Gravelly Sand; pale coarse grained, fine to co (SELECT FILL) MPS 14 LL 30 P75 15	led gravel (TOPSOIL)	l brown, fine to					
1.0 1.5 1.65			SP		ME		Sand; dark yellow/brown, medium, sub-rounded gra MPS 7 LL 15 P75 5				A T	Ν		
2.0			SM	W			Silty Sand; dark green/b MPS 2 LL 15 P75 15	rown/grey, fine to coars	e grained					
3.0-					D	,	BH04 TERMINATED AT Target depth							
3.5							Groundwater encountere Borehole stable Located off courts 8 & 9 o Photos Taken	-						
Moi	isture		Cons	istency			/isual Description	Method	Bit	Su	pport		Samplir	ng
лист Л V	Dr Mois We	t S		very very very k k	soft firm stiff / stiff hard cose cose ense ense	MPS LL P75	Maximum patricle size Liquid Limit % passing 75um sieve	A Auger W Washbore P Percussion H Hammer C Core R Rotary air flush V Vibrocore	R Roller B Blank V V bit	C M N	Casing Mud Nil	D	Undisturbed Sam, D tandard Penetratii Pocket Pen Enviro Sai D	ple & Size in isturbed Sar

Ullman&Nolar
--------------

Sheet:1 of 2

### Shaping the Future

Proj Job Site	ject : ( No : ( : Gar	J2399	chnica 1 Fennis	l Investio		n	Hole Comp Logged By Checked B		Dri Mo Dia	ntractor I Rig : I unting : meter: ords : C	H3100 Trailei 100 mr	Drill F - n	Rig	
		RATA					VISUAL SOIL	DESCRIPTION				DRI	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistency		shape, seconda	Description plasticity/grain size, col ary components, minor grain size, colour, minor	constituents)		Method & Bit	Support	Sampling	Testing
- 0.10			SC		L - 1	ИD	Clayey Gravelly Sand; or medium, sub-angular to s (TOPSOIL)							-
- - - 0.5 - - -			SC	М			MPS 20 LL 30 P75 15 Clayey Gravelly Sand; p grained, fine to medium, FILL) MPS 20 LL 30 P75 15							-
- <i>0.95</i> - 1.0 -			СН				Sandy Clay; very dark gr coarse sand, with fine to subtle organic odour (MA	medium, sub-angular to		avel,				-
- - 1.25 - - - <b>1.5</b> - 1.55 -			SC			-	MPS 12 LL 60 P75 55 Clayey Gravelly Sand; v to medium, sub-angular t MPS 9 LL 30 P75 20 Clayey Sand; dark gree/ to medium, sub-angular t MPS 5 LL 30 P75 20	o sub-rounded gravel brown/grey, fine to coar						
- - - 2.0 - -					L						A T	Ν	1.90m D-PI/PSD	
30.003 Developed by Datge			SC	w										-
0.6			30			)								-
886 LOGS.GPJ < <drawingf< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></drawingf<>														
CP U23(									1	1				_
CU_LIB_06 GLB Log BOREHOLE WITH DCP U23986 LOGS GF0 < <drawingfile>&gt; 2403/2016 16:09 8.30</drawingfile>	isture Dr Mois We	st S		very I very lo lo nedium de	soft firm stiff stiff nard ose ose ense ense	MPS LL P75	Visual Description Maximum particle size Liquid Limit % passing 75um sieve	Method A Auger W Washbore P Percussion H Hammer C Core R Rotary air flush V Vibrocore	Bit R Roller B Blank V V bit T TC bit D Diamond	C M N	oport Casing Mud Nil	D	Standard Penetrati Pocket Per Enviro Sa C	ble & Size in mm isturbed Sample

(					ווע		r <b>cino</b> an&Nol ne Future	an			E		REHOL orehole N	
Pr Jo Si	oject b No te : G	: U239	echnio 91 Tenr	cal Inve	-	on	Hole Comp Logged By Checked B		Drill Mou Diar	Rig : unting meter:	r : Card IH3100 : Trailer 100 mr GDA 94	Drill F n	Rig	
	S	FRATA	١				VISUAL SOIL	DESCRIPTION				DRI	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture		Consistency	shape, second (ROCK NAME; s	Description plasticity/grain size, col ary components, minor grain size, colour, minor	constituents) constituents)		Method & Bit	Support	Sampling	Testing
- - - - 4.{ -	5						Clayey Sand; dark gree/ to medium, sub-angular t MPS 5 LL 30 P75 20	brown/grey, fine to coar	se grained, with f	ine				-
- 5.( -	)													-
- 5.{ - -	5		sc	; W							A T	Ν		-
- - 6.0 - -	)													-
6	5													-
- 7.0														-
	5					-	BH05 TERMINATED AT Target depth Groundwater encountere Borehole stable Located off court 10 on n Photos Taken	ed at 1.05mbgl						
CU_LIB_06.GLB Log BORFHOLE WITH DCP U23986 LOGS.GPU <4DramingFile>> 24/03/2016 15/09 8, 30 003 Developed by Datgel	M	Te Dry VS oist S Vet S VS H VL L MI D VE	St D	ver ver	ery soft soft firm stiff ery stiff hard / loose loose	MPS LL P75	Visual Description Maximum particle size Liquid Limit % passing 75um sieve		B Blank V V bit T TC bit	C M	pport Casing Mud Nil	D	Standard Penetrati Pocket Per Enviro Sa C	ple & Size in mm isturbed Sample

Γ

					U	///		r <b>dno</b> an&Nol e Future	a	n				E		REHOL Borehole N	
	Proj Job Site	ect : ( No : l : Gar	J2399	chnica 1 Fennis	l Investig Comple	-	'n		lete : M y : /	AW		Drill Mou Diar	l Rig untir met	ctor : Card g : IH3100 ng : Trailei er: 100 mi : GDA 94	Drill r m	Rig	
E		STF	RATA					VISUAL SOIL	DE	SCRIPTION					DR	ILLING	TESTING
	Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistancy		shape, second	plas ary c	Description sticity/grain size, colo components, minor n size, colour, minor	cons	stituents)		Method & Bit	Support	Sampling	Testing
-	0.25			SP	м			Silty Sand; pale brown, sub-angular to sub-round MPS 12 LL 20 P75 10	ine i led (	to coarse grained, v gravel (TOPSOIL)	<i>i</i> ith f	ine to mediun	n,			0.30m B-CBR	-
F	0.35			SP		м	D	Silty Sand; brown, fine to MPS 2 LL 15 P75 10	0 00	arse grained (NATL	IRAL	-)					-
-	0.5 0.55							Gravelly Sand; very pale to coarse grained, fine, s shell fragments througho MPS 5 LL 15 P75 5	ub-a	angular to sub-round	led g	ellow flecks, f gravel, trace s	fine silt,				-
-	1.0					L	-										-
_	1.5			SW	w									A T	Ν		
4/03/2016 16:09 8.30.003 Develope	2.0					м	D										
-J < <drawingfile>&gt; 24</drawingfile>	2.5																-
0 U23986 LOGS.GI	2.80			SM				Silty Sand; dark green/b sub-angular to sub-round MPS 3 LL 15 P75 10					ine,				-
TH DCI		sture		Cons	istency			/isual Description	•	Method		Bit	-	Support		Samplir	•
μ	D M W	Dr Mois We	at S	n	very l very lo lo nedium de	soft firm stiff stiff hard oose oose ense	MPS LL P75	Maximum particle size Liquid Limit % passing 75um sieve	A W P H C R V	Auger Washbore Percussion Hammer Core Rotary air flush Vibrocore	R B V T D	Roller Blank V bit TC bit Diamond		Casing Mud Nil	D	Standard Penetrati Pocket Per Enviro Sa	isturbed Sample

Г

					U	///		r <b>dno</b> an&Nol e Future	an					E		REHOL orehole N	
Pr Jo Si	rojec ob No ite : C	t : Ge o : U2 Garde	eotec 2399 <sup>-</sup> ens T	1	I Investig Comple	-	'n	Hole Comr Hole Comp Logged By Checked B Surface R.	oleted: :MT y:AW	12.2.16		Drill Mou Diar	Rig : I nting : neter:	: Card H3100 Trailer 100 mr GDA 94	Drill F - n	Rig	
		STRA						VISUAL SOIL	DESCF	RIPTION					DRI	LLING	TESTING
Depth (m)		KL (M AHU)	Graphic Log	Classification	Moisture	Consistancy		shape, second (ROCK NAME;	plasticity ary comp grain size	e, colour, minor	constituent constituen	s) its)		Method & Bit	Support	Sampling	Testing
	0			SM	w			Silty Sand; dark green/b sub-angular to sub-round MPS 3 LL 15 P75 10	rown/grej	y, fine to coars	e grained, i nts through	trace fii iout	ne,	A T	Ν	4.50m D-PI/PSD	SPT 3, 3, 7 N=10
- <u>- 4.9</u> - 5.0			<u> </u>					BH06 TERMINATED AT Target depth Groundwater encountere Borehole stable Located off courts 1 & 2 P Photos Taken	ed at 0.55	0							
- 5.	5 Ioistu			0000	istency			/isual Description		1ethod	Bit		Qui	port	I	Sameli	
	P	Dry Moist Wet	VS S F VSt H VL L MD D VD		very lo lo nedium de	soft firm stiff v stiff hard bose bose ense ense	MPS LL P75	/isual Description Maximum particle size Liquid Limit % passing 75um sieve	A W P H C	Auger Auger Washbore Percussion Hammer Core totary air flush Vibrocore	R B V T	Roller Blank V bit TC bit mond	C M	pport Casing Mud Nil	D	Standard Penetrati Pocket Per Envirc Sa L	ple & Size in mm Disturbed Sample

Г

				U	///	m	<b>rdno</b> an&Nola e Future	an			E		REHOL orehole N	
Proj Job Site	ect : 0 No : l : Gare	Geotec J2399 dens T	1	I Investig	-	n	Hole Comp Logged By Checked By		Drill Mou Diar	Rig : I Inting : neter:	: Card H3100 Trailer 100 mr DA 94	Drill F n	Rig	
	STR	ATA					VISUAL SOIL	DESCRIPTION				DRII	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistency		shape, seconda	Description plasticity/grain size, colo ary components, minor o grain size, colour, minor	constituents)		Method & Bit	Support	Sampling	Testing
0.15		1	CI		M	D	Gravelly Sandy Clay; da medium, sub-angular to s (TOPSOIL) MPS 8 LL 30 P75 55							
0.5		5 400 5 10 0 1 10 0	GC	М			Clayey Sandy Gravel; br grained, sub-angular to si quartz recovered (FILL) MPS 22 LL 35 P75 20	own mottled orange/bro ub-rounded, fine to coar	wn, fine to coars se sand, cobbles	e s of				
1.0 1.05			SW				Sand; dark yellow/brown, sub-angular to sub-round throughout (MARINE DEI	ed gravel, trace silt, she	trace fine, Il fragments					
1.40 1.5					VL	- L	MPS 5 LL 15 P75 5 Silty Sand; dark green/bu fragments throughout MPS 2 LL 25 P75 20	rown/grey, fine to coarse	e grained, shell		A T	Ν		
2.0			SM	w										
2.5					MD	- D								
·3.0—							BH07 TERMINATED AT Target depth Groundwater encountere Borehole stable Located off courts 1 & 5 o Photos Taken	d at 1.05mbgl						
3.5														
Moi	sture		Cons	istency	 	\	/isual Description	Method	Bit	Sup	port		Sampli	l ng
D M V	Dr Mois We	t S		very very l very lo	soft firm stiff stiff nard ose ose ense	MPS LL P75	Maximum particle size	AAugerWWashborePPercussionHHammer	R Roller B Blank	C M	Casing Mud	D	Undisturbed Sam E tandard Penetrat Pocket Per Envirc Sa	ple & Size in Disturbed Sar

				U		ma	r <b>dno</b> an&Nola e Future	an			E		REHOL orehole N	
Proj Job Site	iect : ( No : ( : Gar	J2399	chnica 1 Fennis	al Investi s Comple	-	n	Hole Comp Logged By Checked B		Drill Mou Diar	ntractor I Rig : II- unting : meter: 1 prds : Gl	H3100 Trailer 100 mr	Drill F r m	Rig	
	STF	RATA					VISUAL SOIL	DESCRIPTION				DRI	LLING	TESTING
Depth (m)	RL (m AHD)	Graphic Log	Classification	Moisture	Consistancy		(SOIL NAME; shape, seconda	Description plasticity/grain size, color ary components, minor grain size, colour, minor	constituents)		Method & Bit	Support	Sampling	Testing
		6 6 9 9 9 9 9 9 9 9 9 9 0 9 9 9 0 9 9 9 0 9 9 0 9 9 0 9 0	GC	м			Clayey Sandy Gravel; or grained, sub-angular to s including part of old oil/fue MPS 20 LL 30 P75 15	ub-rounded, fine to coa						
- 0.5					-		Silty Sand; pale brown, f throughout (MARINE DEI MPS 2 LL 15 P75 15		hell fragments					
- 1.0			SM		L	-								
1.40 1.5				w			Clayey Sand; dark greer fragments throughout MPS 3 LL 35 P75 20	n/brown/grey, fine to coa	arse grained, she	II	A T	N		
2.0			SC		м	D								
2.5														
-3.0-							BH08 TERMINATED AT Target depth Groundwater encountere Borehole stable Located off court 7 on ne Photos Taken	d at 0.50mbgl	drain					
3.5														
Мо	isture		Cons	sistency		\\	/isual Description	Method	Bit	Sup	port		l Samplii	ng
D M W	Dr Mois We	st S		very very very k k nedium de	oose	MPS LL P75	Maximum particle size Liquid Limit % passing 75um sieve	A Auger W Washbore P Percussion H Hammer C Core R Rotary air flush V Vibrocore	R Roller B Blank V V bit T TC bit D Diamond	C M N	Casing Mud Nil	D	Standard Penetrati Pocket Per Envirc Sa L	isturbed Sam

# APPENDIX C

Dynamic Cone Penetrometer Results



GEO\_OF\_ UNGR92 G (-/05/14)

#### **GEOTECHNIC PTY LTD** 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1		DYNAMIC CON				м	lackay Laboratory
CLIENT:	Gardens Tennis			B NO: U23991	LAB RE		
PROJECT:	Geotechnical Investi	gation, Gardens To	enr	nis TESTED BY:	МТ	DA	TE: 12.02.16
LOCATION:	Gardens Tennis Clu	b, Darwin NT		CHECKED B	Y: DH	DA	<b>TE:</b> 17.02.16
TEST PROC	EDURES :	AS 1289.6.3.2		CLIENT REF:			
Ground Su Depth Belo Surface at Soil Descrij Soil Moistu Depth to Gr	start of Test (mm):	A BH01 - 450 Refer to logs Refer to logs Refer to logs		Test No.: Test Location Ground Surfa Depth Below Surface at sta Soil Descriptio Soil Moisture Depth to Grou	ce R.L. (m) : Ground rt of Test (mm): on : Condition:	Refer	to logs to logs to logs
Cumulative	Depth Below	Penetration	]]	Cumulative	Depth Below		Penetration
No. of Blows	Starting Level (mm)	Rate (mm/blow)		No. of Blows	Starting Level (mm)		Rate (mm/blow)
0 8 16 24 33 41 48 54 58 61 68 84 96 HB	0 100 200 300 400 500 600 700 800 900 1000 1100 1150	0 13 13 13 13 14 17 25 33 14 6 4 0		0 9 32 58	0 100 200 280 Refusal		0 11 4 3 0



Accredited No. 910 Certificate No 16-0556A Date of Issue 17,02,16

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australia/inational standards

D. Hoskins



GEO\_OF\_ UNGR92 G (-/05/14)

#### GEOTECHNIC PTY LTD 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1	51				Mackay Laboratory
CLIENT:	Gardens Tennis	J	OB NO: U23991	LAB REF	<b>NO:</b> 16-556CD
PROJECT:	Geotechnical Investigat	ion, Gardens Te	ennis TESTED BY:	МТ	DATE: 12.02.16
LOCATION:	Gardens Tennis Club, E	Darwin NT	CHECKED B	Y: DH	DATE: 17.02.16
TEST PROC	EDURES : AS	1289.6.3.2	CLIENT REF:		
Test No.: Test Locatio Ground Sur Depth Below Surface at s Soil Descrip Soil Moistur	C on/Chainage : BH face R.L. (m) : - w Ground start of Test (mm): 50 otion : Re re Condition: Re	102	Test No.: Test Location/ Ground Surfac Depth Below (	/Chainage : ce R.L. (m) : Ground rt of Test (mm): on : Condition:	D BH03 



Accredited No. Certificate No.

Dale of Issue

910 16-0556C 17.02.16 Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australianational standards, Authorised Signatory

D. Hoskins



GEO\_OF\_ UNGR92 G (-/05/14)

#### **GEOTECHNIC PTY LTD** 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1		DYNAMIC CONE	5 P		EK	N	lackay Laborato	vīv
CLIENT:	Gardens Tennis			B NO: U23991	LAB RE			-
PROJECT:	Geotechnical Investig	gation, Gardens Te	enr	nis TESTED BY:	МТ	DA	<b>TE:</b> 12.02.1	6
LOCATION:	Gardens Tennis Club			CHECKED B	Y: DH	DA	TE: 17,02.1	6
TEST PROC	EDURES :	AS 1289.6.3.2		CLIENT REF:	-			
Ground Surface R.L. (m) : - Depth Below Ground Surface at start of Test (mm): 200 Soil Description : Rei Soil Moisture Condition: Rei		вноз		Soil Descriptic Soil Moisture Depth to Grou	ce R.L. (m) : Ground rt of Test (mm): on : Condition: indwater (m) :	n) : • (mm): 0 Refer to logs : Refer to logs		
Cumulative	Depth Below	Penetration	11	Cumulative	Depth Below		Penetration	
No. of Blows	Starting Level (mm)	Rate (mm/blow)		No. of Blows	Starting Leve (mm)		Rate (mm/blow)	
0 8 13 20 29 37 41 45 52 59 66	0 100 200 300 400 500 600 700 800 900	((111111)) 0 13 20 14 11 13 25 25 14 14 14 14 14		0 2 7 13 21 33 46 58 HB	0 100 200 300 400 500 600 640 Refusal		0 50 20 17 13 8 8 3	



Accredited No. Certificate No. Date of Issue

910

16-0556E

17 02 16

Accredited for compliance with ISO/IEC 17025. The results of the lests, calibrations and/or measurements included in this document are Iraceable to Australia/rational standardy. Authorised Signatory

D. Hoskins



GEO\_OF\_ UNGR92 G (-/05/14)

#### GEOTECHNIC PTY LTD 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1								Mackay	/ Laboratory
CLIENT:	Gardens Tennis		JO	в	NO: U23991	LAB I	REF NO	<b>D:</b> 1	6-556GH
PROJECT:	Geotechnical Investi	gation, Gardens	Ten	ni	s TESTED BY:	МТ	0	DATE:	12.02.16
LOCATION:	Gardens Tennis Clui	o, Darwin NT			CHECKED B	Y: DH	0	DATE:	17.02.16
TEST PROC	EDURES :	AS 1289.6.3.2			CLIENT REF				
Ground Sur Depth Belo Surface at s Soil Descrip Soil Moistur	on/Chainage : rface R.L. (m) : w Ground start of Test (mm): otion : re Condition:	G BH04 - 1100 Refer to logs Refer to logs Refer to logs			Soil Descriptio	ce R.L. (m) : Ground Int of Test (mm): on :	Ref	)5 er to lo er to lo er to lo	ogs
Cumulative	Depth Below	Penetratio	n	Γ	Cumulative	Depth Belo		Pen	etration
No. of	Starting Level	Rate		L	No. of	Starting Lev	/el		Rate
Blows 0	(mm)0	(mm/blow)		H	Blows 0	<u>(mm)</u>	0	(mr	n/blow) 0
6	100	17		L	3	10	0		33
13	200	14	1	L	10	20			14
15	300	50		L	22	21			1
18	400	33			HB	Refus	al		
26 33	500 600	13		L					
40	700	14							
47	800	14		L					
51	900	25		L					
53	1000	50		L					
55 57	1100	50							
57 59	1200 1300	50							
62	1400	33							
64	1500	50							- 1
66	1600	50							
69 70	1700	33							
78 89	1800 1900	11							
03	Terminated	5	'						
	ronniatod			L					
			- 11	L					
					-				



Accredited No. Certificate No. Date of Jssue

910

16-0556G

17 02 16

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australianational standards Authorised Signatory

D. Hoskins



GEO\_OF\_ UNGR92 G (-/05/14)

#### **GEOTECHNIC PTY LTD** 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1						Mac	kay Laboratory
CLIENT:	Gardens Tennis		101	B NO: U23991	LAB RE	F NO:	16-556IJ
PROJECT:	Geotechnical Investig	ation, Gardens Te	ənr	nis TESTED BY:	МТ	DATI	E: 12.02.16
LOCATION:	Gardens Tennis Club	, Darwin NT		CHECKED B	Y: DH	DATI	E: 17.02.16
TEST PROC	EDURES :	AS 1289.6.3.2		CLIENT REF			
Ground Su Depth Belo Surface at Soil Descrip Soil Moistu	rface R.L. (m) :	BH05 Refer to logs Refer to logs Refer to logs Refer to logs Penetration Rate (mm/blow) 0 20 11 100 50 10 50 50 50 100 100		Soil Descriptio	ce R.L. (m) : Ground irt of Test (mm): on :		logs



Accredited No. Certificate No Date of Issue

910

16-05561

17.02.16

Accredited for compliance with ISO/IEC 17025. The results of the lests, calibrations and/or measurements included in this document are traceable to Australia/national signalards

D. Hoskin



GEO\_OF\_ UNGR92 G (-/05/14)

#### **GEOTECHNIC PTY LTD** 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1         CLIENT:       Gardens Tennis         PROJECT:       Geotechnical Investigation, Garden         LOCATION:       Gardens Tennis Club, Darwin NT         TEST PROCEDURES :       AS 1289.6.3.2	ennis TESTED BY: M1 CHECKED BY: DH CLIENT REF: -	
LOCATION: Gardens Tennis Club, Darwin NT	ennis TESTED BY: M1 CHECKED BY: DH CLIENT REF: -	DATE: 12.02.16
LOCATION: Gardens Tennis Club, Darwin NT	CHECKED BY: DH	
Test No.:       K         Test Location/Chainage :       BH07         Ground Surface R.L. (m) :       -         Depth Below Ground       Surface at start of Test (mm):       0         Soil Description :       Refer to logs         Soil Moisture Condition:       Refer to logs         Depth Below       Penetrat         No. of       Starting Level         Blows       (mm)         0       0         3       100         3       350         HB       Refusal	15 17 19 21 22 24 25 27 32 39 49 62 78 100 125	Refer to logs Refer to logs Refer to logs elow Penetration Level Rate



910 16-0556K 17 02 16

Accredited No.

Certificate No

Date of Issue

Accredited for compliance with ISO/IEC 17025. The results of the rests, calibrations and/or measurements included in this document are traceable to Australianational standards. Authorised Signatory - Hosting S. D. Hoskins



#### **CARDNO ULLMAN & NOLAN**

GEO\_OF\_ UNGR92 G (-/05/14)

#### **GEOTECHNIC PTY LTD** 71 CONNORS ROAD MACKAY QLD DYNAMIC CONE PENETROMETER

Page 1 of 1						I	Mackay	Laboratory
CLIENT: Gardens Te	nnis	J	OE	<b>3 NO:</b> U23991	LAB R	EF NC	):	16-556M
PROJECT: Geotechnica	al Investigatio	on, Gardens Te	enn	is TESTED BY:	МТ	D	ATE:	12.02.16
LOCATION: Gardens Ter	nnis Club, Da	arwin NT		CHECKED B	Y: DH	D	ATE:	17.02.16
TEST PROCEDURES :	AS	1289.6.3.2		CLIENT REF:	<u>21</u>			
Test No.: Test Location/Chainage Ground Surface R.L. (m) Depth Below Ground Surface at start of Test (n Soil Description : Soil Moisture Condition: Depth to Groundwater (m Cumulative Depth	:: - mm): 800 Refe n): Refe Below	er to logs er to logs er to logs Penetration		Soil Description Soil Moisture of Depth to Grou Cumulative	ce R.L. (m) : Ground rt of Test (mm): on : Condition: andwater (m) : Depth Below			etration
No. of Starting		Rate		No. of	Starting Lev	el		Rate
Blows     (mi       0     2       4     21       23     26       29     32       35     38       40     41       42     44       47     51       58     64       69     75       80     88       96     Term	m) 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 hinated	(mm/blow) 0 50 6 50 33 33 33 33 33 50 100 100 100 50 33 25 14 17 20 17 20 17 20 13 13 13		0	(mm)	0	<u>(mr</u>	n/blow) 0



910 16-0556M 17,02,16

Accredited No.

Certificate No.

Dale of Issue

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Austratia/national slandards

D. Hoskins

#### APPENDIX D

Laboratory Test Results



Laboratory: Darwin Laboratory Phone: 08 8947 2780 Fax:

Email: Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

## **QUALITY OF MATERIALS REPORT**

Client:	Cardno Ullman	And Nolan				Report N	Number:	21791/R/102	286-2	
Client Address:	Level 6, 93 Mitchell Street, Darwin					Project I	Number:	21791/P/206	5	
Project:	Geotechnical In	Geotechnical Investigations					nber:	Tennis Cour	t	
Location:	Darwin					Internal	Test Request:	21791/T/466	9	
Component:							eference/s:	U23991 / PC	)# 14795	5
Area Description:	Gardens Tennis					Report [	Date / Page:	30/03/2016		Page 1 of 3
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2, /	AS1289.3.2.1	89.3.4.1, AS	51289.2.1	.1, AS 1289.3.	3.1			
Sample Number	21791/S/33871				Location 1			BH05		
Sampling Method	AS1289.1.2.1 C	l 6.5.2			Location 2			1.90-2.30		
Date Sampled	16/02/2016				Location 3					
Sampled By	Client Sampled				Location 4					
Date Tested	17/02/2016				Material So	urce	Insitu			
Att. Drying Method	Air Dried				Material Ty	ре	Existing			
Atterberg Preparation	Dry Sieved				Material De	scription	-			
AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum			ARTICLE	E SIZE DIST		GRAPH	ſ
19.0		100		1	00				-	
16.0		98						-	-	
13.2		97			80 -			-		
9.5		96		<u>,</u>						
6.7		94		0	60		/			
4.75		92		1 55			/			
2.36		87		4			/			
1.18		80		Percent Passing ( $w$ )	40	/				
0.600		72		å						
0.425		67			20 -	/				
0.300		60			1					
0.150		27			0					un automation of the second se
0.075		10			0,075	0,150	0, 0, 0 ,425 AS Siev	1. 23 1. 26 e Size (mm)	6.7 4.75	19,0 13,2 9,5
Test Result	Specification Minimum	Result	Specification Maximum		Test Resul	t	Specification Minimum	Resu	lit	Specification Maximum
Liquid Limit (%)		33		0.075	5/0.425 Fine:	s Ratio		0.1	5	
Plastic Limit (%)		25		PIX	).425 Ratio (	%)		536.	0	
Plastic Index (%)		8		LS x	0.425 Ratio	(%)		234.	5	
Linear Shrinkage (%)		3.5		Partic	cle Size Dist	. Moisture	e Content (%)	27.	1	
Linear Shrinkage Defec	ts Crack									

Re-Issued Report Replaces Report No 21791/R/10286-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025



Remarks

Accreditation Number: Corporate Site Number: 1986 21791

Uh O

Approved Signatory: Christopher White Form ID: W85MCRep Rev 1



2

Cardno Construction Sciences ABN: 74 128 806 735 Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

٩

Email: Darwin.lab@cardno.com.au

Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

mmah Bus' Park Northern Territory 0828

QUALITY OF MATERIALS REPORT
-----------------------------

Client:	Cardno Ullmai	And Nelan				_	Poport	Number:	2470	91/R/10286-2	) )	
											-	
Client Address:		tchell Street, Dai	win				-	Number:		91/P/206		2
Project:	Geotechnical I	nvestigations					Lot Nun	nber:	Teni	nis Court		
Location:	Darwin						Internal	Test Request:	2179	91 <b>/</b> T/4669		
Component:							Client R	eference/s:	U23	991 / PO <b>#</b> 14	795	
Area Description:	Gardens Tenn	is					Report I	Date / Page:	30/0	3/2016		Page 2 of
Test Procedures	AS1289.3.6.1,	AS1289.3.1.2, A	S1289.3.2.1	, AS12	289.3.4	4.1, AS	1289.3.	3.1				
Sample Number	21791/S/33872	2			Loca	ition 1	•		BH06	3		
Sampling Method	AS1289.1.2.1	S1289.1.2.1 CI 6.5.2				ition 2			4.50-	4.95		
Date Sampled	16/02/2016				Loca	tion 3						
Sampled By	Client Sampled	t			Loca	tion 4						
Date Tested	17/02/2016				Mate	rial So	urce	Insitu				
Att. Drying Method					Mate	rial Typ	ре	Existing				
Atterberg Preparation	521				Mate	rial De	scription	Sand				
AS Sieve (mm)	Specification Minimum	n Percent Passing (%)	Specification Maximum			PA	RTICL	E SIZE DIST	RIBU	ITION GRA	PH	
19.0		100		1 1	00 T				-			
4.75		100			1			-				
2.36		98		1	80 -			/				
1.18		96		13				/				
0.600		93		(a) (b)	60							
0.425		91		nissi n			1					1
0.300		86		Percent Passing (%)			/					
0.150		56		s Cer	40 -	1	/					1
0.075		26		Ъ		1						1
					20 -							1
					1							
		1 1			οL		·····					
						0,075	0,150	0,600 0,425 0,300	1,18	4,75	9.5 6.7	19.0
		1 1				2	50					90
		_						AS Siev	e Size	(mm)	_	
Test Result	Specification Minimum	Result	Specification Maximum		Tes	st Result		Specification Minimum		Result		ecification Aaximum
Liquid Limit (%)		Not Obtainable		0.075	5/0.425	5 Fines	Ratio			0.29		
Plastic Limit (%)		Not Obtainable		PIx0	).425 F	Ratio (%	%)					
Plastic Index (%)		Non Plastic		LS x	0.425	Ratio (	%)			0.0		
Linear Shrinkage (%)	· · · · · · · · · · · · · · · · · · ·	0.0		Partic	le Siz	e Dist.	Moisture	e Content (%)		24.2		
Linear Shrinkage Defe	cts -											

Remarks Re-Issued Report Replaces Report No 21791/R/10286-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

1986

21791

Accreditation Number: Corporate Site Number: .....

Cuh Q

Approved Signatory: Christopher White Form ID: W85MCRep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Email: Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

**QUALITY OF MATERIALS REPORT** 

Client:	Cardno Ulimar	n And Nolan				Report I	Number:	21791/R/102	286-2	
Client Address:	Level 6, 93 Mil	chell Street, Dar	win			Project I	Number:	21791/P/206	6	
Project:	Geotechnical I	nvestigations				Lot Num	ber:	Tennis Cour	t	
Location:	Darwin					Internal	Test Request:	21791/T/466	9	
Component:						Client R	eference/s:	U23991 / PC	)# 14795	5
Area Description:	Gardens Tenn	is				Report [	Date / Page:	30/03/2016		Page 3 of 3
Test Procedures	AS1289.3.6.1,	AS1289.3.1.2, A	S1289.3.2.1	89.3.4.1, AS	5 1289.3.3	3.1				
Sample Number	21791/S/3387	3			Location 1			BH06		
Sampling Method	S1289.1.2.1 CI 6.5.2 Location 2							0.30-0.55		
Date Sampled	16/02/2016				Location 3					
Sampled By	Client Sampled	t			Location 4					
Date Tested	17/02/2016				Material So	ource	Insitu			
Att. Drying Method	-				Material Ty	ре	Existing			
Atterberg Preparation					Material De	escription	In-situ			
AS Sieve (mm)	Specificatio Minimum	n Percent Passing (%)	Specification Maximum			ARTICLI	E SIZE DIST	RIBUTION	GRAPH	
19.0		100			00				-	
16.0		100						-		
13.2		100			80 -		-			
9.5		99		2			1			
6.7		97		(%) buissed	60 -		1			
4.75		96		assir	-		/			
2.36		90		6	10	1	/			
1.18		85		Percent	40 -	1				
0.600		79		L &						
0.425		73			20 -	/				
0.300		63			1 1					
0.150		24			۰ ــــــــــــــــــــــــــــــــــــ					
0.075		12			0.075	0.150	0,600 0,425 0,300	2,36 1.18	6.7 4.75	19.0 13.2 9.5
					សី	8		•	01	10 0
								e Size (mm)		
Test Result	Specification Minimum	<sup>1</sup> Result	Specification Maximum		Test Resu	it	Specification Minimum	Resu	ılt	Specification Maximum
Liquid Limit (%)		Not Obtainable	•	0.07	5/0.425 Fine	s Ratio		0.1	6	
Plastic Limit (%)		Not Obtainable	•	PIX	0.425 Ratio (	(%)				
Plastic Index (%)		Non Plastic		LS x	0.425 Ratio	(%)		0.0		
Linear Shrinkage (%)		0.0		Parti	cle Size Dist	. Moisture	e Content (%)	16.	7	
Linear Shrinkage Defec	ts -									

Re-Issued Report Replaces Report No 21791/R/10286-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

1986

21791



Remarks

Accreditation Number: Corporate Site Number:

Uh C

Approved Signatory: Christopher White Form ID: W85MCRep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Email: Darwin.lab@cardno.com.au

Address: Unil 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

SHRINK SWELL INDEX

Client:	Cardno Ullman Ar	nd Nolan		Report Number:	21791/R/10288-2		
Client Address:	Level 6, 93 Mitche	ell Street, Darwin		Project Number:	21791/P/206		
Project:	Geotechnical Inve	estigations		Lot Number:	Tennis Court		
Location:	Darwin			Internal Test Request:	21791/T/4669		
Component:				Client Reference/s:	U23991 / PO# 14795		
Area Description:	Gardens Tennis			Report Date / Page:	30/03/2016	Page 1 of 1	
Test Procedures:	AS1289.7.1.1, AS	1289.2.1.1	Location 1		BH06		
Sample Number	21791/S/33872		Location 2		4.50-4.95		
Sampling Method	AS1289.1.2.1 CI 6	6.5.2	Location 3				
Date Sampled	16/02/2016		Location 4				
Sampled By	Client Sampled		Material So	ource Insitu			
Date Tested	27/02/2016		Material Ty	pe Existing			
Soil Description:		Sand					
Cracking / Crumbling:		Slight					
Estimated Inert Inclusi	ons (%):	0.00	Swell Pre-S	Soak Moisture Content (*	%) 12.1		
Shrinkage Moisture Co	ontent (%):	16.5	Swell Post-	Soak Moisture Content	(%) 12.5		
Shrinkage Strain (9	⁄0)	0.0	ci. ·	-  - / <b>C</b>	0.0		
Swell Strain (%) 0.0			Shrink / Swell Index 0.0				

Remarks

Re-Issued Report Replaces Report No 21791/R/10288-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Accreditation Number: Corporate Site Number:

1986 21791

Clih Q

Approved Signatory: Christopher White Form ID: W21Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Ernail: Darwin.lab@cardno.com.au

#### Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

#### SHRINK SWELL INDEX

Client:	Cardno Ullman And N	Volan	Report Number:	21791/R/10321-1			
Client Address:	Level 6, 93 Mitchell S	Level 6, 93 Mitchell Street, Darwin			21791/P/206		
Project:	Geotechnical Investigations			Lot Number:	Tennis Court		
Location:	Darwin			Internal Test Request:	21791/T/4669		
Component:				Client Reference/s:	U23991 / PO# 14795		
Area Description:	Gardens Tennis			Report Date / Page:	4/03/2016	Page 1 of 1	
Test Procedures:	AS1289.7.1.1, AS128	39.2.1.1	Location 1		BH06		
Sample Number	21791/S/33872		Location 2				
Sampling Method	AS1289.1.2.1 CI 6.5.2 Location 3						
Date Sampled	16/02/2016 Location 4						
Sampled By	Client Sampled		Material So	ource Insitu			
Date Tested	27/02/2016		Material Ty	pe Existing			
Soil Description:	San	d					
Cracking / Crumbling:	Slig	ht					
Estimated Inert Inclusi	ons (%): 0.00	)	Swell Pre-S	Soak Moisture Content (9	%) 12.1		
Shrinkage Moisture Co	ontent (%): 16.5	5	Swell Post-	Soak Moisture Content (	(%) 12.5		
Shrinkage Strain (9	⁄0)	0.0	Ch:	nle / Courall Indoor	0.0		
Swell Strain (%) 0.0			- Shrink / Swell Index 0.0				

Remarks	
	Contraction of the second seco
Verifed By:	Drew Cooper
	W21Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

CALIFORNIA	BEARING	RATIO	REPORT
------------	---------	-------	--------

Email:

Client:	Cardno Ullma	n And Nolan				Report N	lumber:	21791/R/10320-2		
Client Address:	Level 6, 93 Mi	tchell Street, Darwir	n			Project N	lumber:	21791/P/206		
Project:	Geotechnical	Investigations			Lot Num	ber:	Tennis Court			
Location:	Darwin				Internal 1	Fest Request:	21791/T/4669			
Component:						Client Re	eference/s:	U23991 / PO# 147	95	
Area Description:	Gardens Tenr	nis					ate / Page:	30/03/2016	Page 1 of 1	
							ate / Fage.	50/00/2010		
Test Procedures		AS1289.5.2.1, AS1	289.2.1.1							
Sample Number	21791/S/3387						Sampl	e Location		
Sampling Method	AS1289.1.2.1	CI 6.5.2			ocation 1			BH06		
Date Sampled	16/02/2016			L	ocation 2			0.30-0.55		
Sampled By	Client Sample	d		L	ocation 3					
Date Tested	23/02/2016			L	ocation 4					
Material Source	Insitu			N	/laterial Lim	it Start		-		
Material Type	Existing			N	Aaterial Lim	it End		-		
Client Reference			C	Compactive	Effort		Modified			
Material Description	In-situ									
Maximum Dry Density	(t/m³):	1.88					NETRATIO	NPLOT		
Optimum Moisture Cor	ntent (%):	14.0	1000			ÇDITTE				
Field Moisture Content	t (%):	16.7	12000							
Sample Percent Overs	ize (%)	0.0								
Oversize Included / Ex	cluded	Excluded	10000	0					/	
Target Density Ratio (	%):	95		1						
Target Moisture Ratio	(%):	100	8000	0						
Placement Dry Density	/ (t/m³):	1.78	~							
Placement Dry Density	/ Ratio (%):	94.5	(N) peor							
Placement Moisture Co	ontent (%):	14.1	තු <b>6000</b>			/				
Placement Moisture Ra	atio (%):	99.5	-	-		/				
Test Condition / Soakir	ng Period:	Soaked / 4 Days	4000	0 -		/				
CBR Surcharge (kg)		4.5			/					
Dry Density After Soak	(t/m³):	1.77	2000	0 -	/					
Moisture (top 30mm) A	fter Soak (%)	17.1		-	/					
Moisture (remainder) A	fter Soak (%)	16.6								
CBR Swell (%):		0.0		0.5	1.0	Ņω	<b>5</b> .0 <b>4</b> .0	7.5	10	
Minimum CBR Specific	ation (%):	<b>a</b>		ហ	0 10 0	υo	0 0	τi	10.0	
CBR Value @ 5.0mm	(%):	35					Penetratio	n (mm)		

Remarks Re-Issued Report Replaces Report No 21791/R/10320-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Accreditation Number: Corporate Site Number: 1986 21791

Uh O

Approved Signatory: Christopher White Form ID: W7Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Email: Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road

Berrimah Bus' Park Northern Territory 0828

# **QUALITY OF MATERIALS REPORT**

Client:	Cardno Ullman	And Nolan				Report	Number:	21791/R/103	319-2	
Client Address:	Level 6, 93 Mito		nvin				Number:	21791/P/206		
		Geotechnical Investigations								
Project:		vestigations				Lot Nun		Tennis Cour		
Location:	Darwin					Internal	Test Request:	21791/T/466	9	
Component:						Client R	eference/s:	U23991 / PC	# 1479	5
Area Description:	Gardens Tennis	i				Report	Date / Page:	30/03/2016		Page 1 of 3
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2, J	AS1289.3.2.1	, AS12	89.3.4.1, AS	61289.2.1	.1, AS 1289.3.3	3.1		
Sample Number	21791/S/33871				Location 1			BH05		
Sampling Method	AS1289.1.2.1 C	AS1289.1.2.1 CI 6.5.2 Location 2						1.90-2.30		
Date Sampled	16/02/2016				Location 3					
Sampled By	Client Sampled				Location 4					
Date Tested	17/02/2016	7/02/2016 Material Sou					Insitu			
Att. Drying Method	Air Dried				Material Ty		Existing			
Atterberg Preparation		r			Material De	scription	-			
AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum			ARTICL	E SIZE DIST	RIBUTION	GRAPH	1
19.0		100			00					
16.0		98			90			-	-	
13.2		97			80					
9.5		96			70					
6.7		94		ಶಿ						
4.75		92		guis	60		1			
2.36		87		Pas	50		/			
1.18		80		Cent	40					
0.600		72		à	30	1				
0.425		67		b	20	1				
0.300		60				/				
0.150		27			10 🧹 🍼					
0.075		10			0 1		<del> huduud</del>			ndrad.cod
					0,075	0,150	0,600 0,425 0,300	2,36	6.7 4.75	19.0 13.2 9.5
					2	8			01	N 0
							r	e Size (mm)		
Test Result	Specification Minimum	Result	Specification Maximum		⊺est Resul	t	Specification Minimum	Resu	lt	Specification Maximum
Liquid Limit (%)	· · · · · · · · · · · · · · · · · · ·	33		0.075	5/0.425 Fine:	s Ratio		0.15	5	
Plastic Limit (%)		25		PIX	).425 Ratio (	%)		536.	0	
Plastic Index (%)		8		LS x	0.425 Ratio	(%)		234.	5	
Linear Shrinkage (%)		3.5		Linea	ır Shrinkage	Defects	Crack			

Re-Issued Report Replaces Report No 21791/R/10319-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025



Remarks

Accreditation Number: Corporate Site Number: 1986 21791

Uh C

Approved Signatory: Christopher White Form ID: W85Rep Rev 1



 $\widetilde{\mathbf{w}}$ 

Cardno Construction Sciences ABN: 74 128 806 735

Address:

Laboratory: Darwin Laboratory Phone: 08 8947 2780 Fax:

5

Email: Darwin.lab@cardno.com.au

Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

_	_	_						_		
Q	UA	L	ITY	OF	MA	TERI	AL	SR	EP	ORT

Oliente	0 1					T				
Client:	Cardno Ullma						Number:	21791/R/10	319-2	
Client Address:	Level 6, 93 M	litchell Street, Da	rwin			Project	Number:	21791/P/206	5	e.?
Project:	Geotechnical	Investigations				Lot Nu	mber:	Tennis Cour	t	
Location:	Darwin					Interna	I Test Request:	21791/T/466	69	
Component:						Client f	Reference/s:	U23991 / PC	) <b># 14</b> 79	5
Area Description:	Gardens Teni	nis				Report	Date / Page:	30/03/2016		Page 2 of
Test Procedures	AS1289.3.6.1	, AS1289.3.1.2, /	AS1289.3.2.1	I, AS12	89.3.4.1, A	S 1289.3	.3.1			
Sample Number	21791/S/3387	<sup>7</sup> 2			Location 1	۰.		BH06		
Sampling Method	AS1289.1.2.1	CI 6.5.2			Location 2	2		4.50-4.95		
Date Sampled	16/02/2016				Location 3	i				
Sampled By	Client Sample	d			Location 4	ļ				
Date Tested	17/02/2016				Material S	ource	Insitu			
Att. Drying Method	-				Material T	уре	Existing			2
Atterberg Preparation					Material D	escriptior	Sand			
AS Sieve (mm)	Specificatio Minimum		Specification Maximum			ARTICL	E SIZE DIST	RIBUTION	GRAPH	
19.0		100		1	00					
4.75		100			90 -		1			j.
2.36		98		;	80 -		1			
1.18		96		-	70		/			
0.600		93		1.0	1	/				1
0.425		91		11S	60	1				
0.300		86			50	1				
0.150		56		Pe cent	40	/				
0.075		26		å :	30   /	/				
		1			20 -					
					10					
					0			·····		
					0.075	0,150	0.600 0.425 0.300	2,36 1.18	6.7 4.75	19.0 13,2 9,5
					U.	0		Suc (mm)		
Test Result	Specification Minimum	n Result	Specification Maximum		Test Resu	lt	Specification Minimum	Resu	t	Specification Maximum
Liquid Limit (%)		Not Obtainable		0.075	/0.425 Fine	s Ratio		0.29		
Plastic Limit (%)		Not Obtainable		PI x 0	.425 Ratio	(%)		-		
Plastic Index (%)		Non Plastic		LSx(	.425 Ratio	(%)		0.0		
Linear Shrinkage (%)		0.0		Linea	r Shrinkage	Defects	<b>1</b>			

Remarks

Re-Issued Report Replaces Report No 21791/R/10319-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Accreditation Number: Corporate Site Number: **1986** 21791

Cuh Q

Approved Signatory: Christopher White Form ID W85Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 6947 2780Fax:

Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

# **QUALITY OF MATERIALS REPORT**

Email:

				_		r			
Client:	Cardno Ullmar	n And Nolan				Report I	Number:	21791/R/10319-2	
Client Address:	Level 6, 93 Mit	chell Street, Dar	win			Project	Number:	21791/P/206	
Project:	Geotechnical I	nvestigations				Lot Num	iber:	Tennis Court	
Location:	Darwin					Internal	Test Request:	21791/T/4669	
Component:						Client R	eference/s:	U23991 / PO <b># 14</b> 7	'95
Area Description:	Gardens Tenni	is				Report [	Date / Page:	30/03/2016	Page 3 of 3
Test Procedures	AS1289.3.6.1,	AS1289.3.1.2, A	S1289.3.2.1	AS12	89.3.4.1, AS	6 1289.3.3	3.1		
Sample Number	21791/S/33873	3			Location 1			BH06	
Sampling Method	AS1289.1.2.1	CI 6.5.2			Location 2			0.30-0.55	
Date Sampled	16/02/2016				Location 3				
Sampled By	Client Sampled	1			Location 4				
Date Tested	17/02/2016				Material Sc	ource	Insitu		
Att. Drying Method	<u>s</u>				Material Ty	pe	Existing		
Atterberg Preparation	-				Material De	escription	In-situ		
AS Sieve (mm)	Specification Minimum	n Percent Passing (%)	Specification Maximum			ARTICLE	E SIZE DIST	RIBUTION GRAF	эн
19.0		100		1	00			~	
16.0		100			90 -				
13.2		100			80		-		
9.5		99			70 -		1		
6.7		97		8	1		1		
4.75		96		5u s	60		1		
2.36		90			50		/		
1.18		85		ent	40	/			
0.600		79		Percent 6	30 -	1			
0.425		73			1	1			
0.300		63			20				
0.150		24			10 -				
0.075		12			0				
					0,075	0.150	0,600 0,425 0,300	4.75 2.36 1.18	19.0 13.2 9.5 6.7
					01	0		e Size (mm)	
Test Result	Specificatior Minimum	Result	Specification Maximum		Test Resu	lt	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		Not Obtainable	•	0.07	5/0.425 Fine	s Ratio		0.16	
Plastic Limit (%)		Not Obtainable		PIX	0.425 Ratio (	(%)		-	
Plastic Index (%)		Non Plastic		LS x	0.425 Ratio	(%)		0.0	
Linear Shrinkage (%)		0.0		Linea	ar Shrinkage	Defects	-	A	·
Enear Onnikaye (70)		0.0		Lines	. on intrage	5010013			

Remarks Re-Issued Report Replaces Report No 21791/R/10319-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

1986

21791



Accreditation Number: Corporate Site Number:

Uh C

Approved Signatory: Christopher White Form ID: W85Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2760Fax:

Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

## **CALIFORNIA BEARING RATIO REPORT**

Email:

Client:	Cardno Ullma	n And Nolon			Report N	lumban	21791/R/10320-1	
Client Address:	Level 6, 93 Mi	itchell Street, Darwir	1		Project I	Number:	21791/P/206	
Project:	Geotechnical	Investigations			Lot Num	ber:	Tennis Court	
Location:	Darwin				Internal	Test Request:	21791/T/4669	
Component:					Client R	eference/s:	U23991 / PO# 14795	
Area Description:	Gardens Tenr	nis			Report D	)ate / Page:	4/03/2016	Page 1 of 1
Test Procedures	AS1289.6.1.1,	, AS1289.5.2.1, AS1	289.2.1.1					
Sample Number	21791/S/3387	3				Sampl	e Location	
Sampling Method	AS1289.1.2.1	CI 6.5.2		Location 1			BH06	
Date Sampled	16/02/2016			Location 2				
Sampled By	Client Sample	d		Location 3				
Date Tested	23/02/2016			Location 4				
Material Source	Insitu			Material Lir	nit Start			
Material Type	Existing			Material Lir	nit End		-	
Client Reference			Compactive	e Effort		Modified		
Material Description	In-situ							
Maximum Dry Density	(t/m³):	1.88			CBR P	ENETRATIO		
Optimum Moisture Cor	ntent (%):	14.0	12000 -		ÇDIT I			
Field Moisture Content	: (%):	16.7	12000					
Sample Percent Overs	ize (%)	0.0	-					
Oversize Included / Ex	cluded	Excluded	10000 -					
Target Density Ratio (%	%):	95						
Target Moisture Ratio	(%):	100	8000					91.
Placement Dry Density	v (t/m³):	1.78	÷ 1			/		
Placement Dry Density	ς, ,	94.5	(N) peo -			/		
Placement Moisture Co		14.1	Log		/			
Placement Moisture Ra	· <i>`</i>	99.5	4000		/			
Test Condition / Soakir	ng Period:	Soaked / 4 Days	1000	/				
CBR Surcharge (kg)	(11 - 7)	4.5		/				
Dry Density After Soak	. ,	1.77	2000 -	/				
Moisture (top 30mm) A	• • •	17.1		/				
Moisture (remainder) A	atter Soak (%)	16.6	0 4	hunburloute	untexclass a	-le		
CBR Swell (%): Minimum CBB Specific	ation (%)	0.0		2,0 1,5 1,0	2,5 5	5.0 4.0	7.5	10.0
Minimum CBR Specific CBR Value @ 5.0mm	· /	- 35				Penetralio	n (mm)	
	(/0]-							

 Remarks

 The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

 Accreditation Number:
 1986

 Corporate Site Number:
 21791

 Approved Signatory:
 Drew Cooper

 Form ID:
 W7Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

**MOISTURE CONTENT REPORT** 

Email:

Client:	Cardno UI	Iman And Nolan		Rep	ort Number:	21791/R	2/10292-2	
Client Address:	Level 6, 93	3 Mitchell Street, Darwin		Proj	ect Number:	21791/P	/206	
Project:	Geotechni	cal Investigations		Lot I	Number:	Tennis (	Court	
Location:	Darwin			Inter	mal Test Request:	21791/T	/4669	
Component:				Clie	nt Reference/s:	U23991	/ PO# 14795	
Area Description:	Gardens T	ennis		Rep	ort Date / Page:	30/03/20		Page 1 of 1
Test Procedures:		AS1289.2.1.1						
Sample Number		21791/S/33873	T		1		(	
ID / Client ID		-						
Lot Number		Tennis Court						
Date / Time Sampled		16/02/2016						
Date Tested		17/02/2016						
Material Source		Insitu						
Material Type		Existing						
Location 1		BH06						
Location 2		0.30-0.55						
Location 3								
Location 4								
Moisture Content (%)		19.3						
Sample Description		In-situ						
Sample Number								
ID / Client ID								
Lot Number								
Date / Time Sampled								
Date Tested								
Material Source								
Material Type				- í				
Location 1								
Location 2								
Location 3								
Location 4								
Moisture Content (%)								
Sample Description								

Remarks

Re-Issued Report Replaces Report No 21791/R/10292-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Accreditation Number: Corporate Site Number:

1986 21791

Uh O

Approved Signatory: Christopher White Form ID: W95Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Email: Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

**QUALITY OF MATERIALS REPORT** 

Client:	Cardno Uliman	And Nolan				Report I	lumber:	21791/R/10319-1	
Client Address:	Level 6, 93 Mitcl		avia				Number:	21791/P/206	
			I WHEN						
Project:	Geotechnical Inv	vestigations				Lot Nurr		Tennis Court	
Location:	Darwin					Internal	Test Request:	21791/T/4669	
Component:						Client R	eference/s:	U23991 / PO# 14	795
Area Description:	Gardens Tennis					Report (	Date / Page:	4/03/2016	Page 1 of 3
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2,	AS1289.3.2.1	, AS12	89.3.4.1, AS	1289.2.1	.1, AS 1289.3.3	3.1	
Sample Number	21791/S/33871				Location 1			BH05	
Sampling Method	AS1289.1.2.1 C	6.5.2			Location 2				
Date Sampled	16/02/2016 Location 3								
Sampled By	Client Sampled Location 4								
Date Tested	17/02/2016								
Att. Drying Method	Air Dried						Existing		
Atterberg Preparation	Dry Sieved				Material De	scription	-		
AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum			ARTICLE	E SIZE DIST	RIBUTION GRA	РН
19.0		100		1	00				
16.0		98			90			-	
13.2		97			80 🗐		- 6		
9.5		96		-	70				
6.7		94		ð.			1		
4.75		92		ging	60		1		
2.36		87		5ed	50 -		/		
1.18		80		Cent	40	/			
0.600		72		Peo	30	1			
0.425		67			1	1			
0.300		60			20	/			
0.150		27			10 🧹				
0.075		10			0 1				
					0.075	0.150	0.600 0.425 0.300	4.75 2.36 1.18	19,0 13,2 9,5 6,7
					23	8			20
							-	e Size (mm)	
Test Result	Specification Minimum	Result	Specification Maximum		Test Resul	t	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		33		0.075	5/0.425 Fine	s Ratio		0.16	
Plastic Limit (%)		25		PIX	).425 Ratio (	%)		534.4	
Plastic Index (%)		8		LS x	0.425 Ratio	(%)		233.8	
Linear Shrinkage (%)		3.5		Linea	ar Shrinkage	Defects	Crack		

Remarks

The second 

Verifed By: Drew Cooper Form ID: W85Rep Rev 1



 $\widetilde{\mathbf{r}}$ 

Cardno Construction Sciences ABN: 74 128 806 735 Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

. . . .

Email: Darwin.lab@cardno.com.au

Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

QUALITY	OF M	ATERIALS	REPORT

Client:	Carden Lillion	- A I.N. I							
	Cardno Ulima						Number:	21791/R/10319-1	
Client Address:		itchell Street, Da	rwin			Project	Number:	21791/P/206	- e
Project:	Geotechnical	Investigations				Lot Nur	nber:	Tennis Court	
Location:	Darwin					Internal	Test Request:	21791/T/4669	
Component:						Client F	Reference/s:	U23991 / PO <b># 14</b> 7	95
Area Description:	Gardens Tenr	nis				Report	Date / Page:	4/03/2016	Page 2 of 3
Test Procedures	AS1289.3.6.1	AS1289.3.1.2,	AS1289.3.2.1	, AS12	89.3.4.1, AS	1289.3.	3.1		
Sample Number	21 <b>7</b> 91/S/3387	2			Location 1	*		BH06	
Sampling Method	AS1289.1.2.1	CI 6.5.2			Location 2				
Date Sampled	16/02/2016								
Sampled By	Client Sample	d			Location 4				
	17/02/2016				Material So	urce	Insitu		
, ,	÷				Material Ty	pe	Existing		
Atterberg Preparation					Material De	scription	Sand		
AS Sieve (mm)	Specificatio Minimum	n Percent Passing (%)	Specification Maximum			RTICL	E SIZE DIST	RIBUTION GRAP	'nн
19.0		100		] 1	00				
4.75		100		1	90		1		
2.36		98			80		1		
1.18		96			70				
0.600		93		$N_{\rm OC}$	1	/			
0.425		91		Sing.	50 -	1			
0.300		86		Se <sup>q</sup>	50 -	/			
0.150		56		(.%) Enise5 tració	ŧ0	/			
0.075		26		5 3	30 /				
					20				
					1				
				1	10 -				
					0		- shoots of the second	-1	tenting
					0.075	0.150	0,600 0,425 0,300	4.75 2.36 1.18	19.0 9.5 9.5
					ហ	8		: Sug (mm)	12 2
	Creatification		O if i .						
Test Result	Specification Minimum	Result	Specification Maximum		Test Result		Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		Not Obtainable		0.075	/0.425 Fines	Ratio		0.29	
Plastic Limit (%)		Not Obtainable		PI x 0	.425 Ratio ('	%)	1		
Plastic Index (%)		Non Plastic		LS×C	).425 Ratio (	%)		0.0	
Linear Shrinkage (%)		0.0		Linear	r Shrinkage I	Defects	÷.		

.

Remarks

The second Commence

Verifed By: Drew Cooper Form ID: W85Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

**QUALITY OF MATERIALS REPORT** 

Email:

Client:	Cardno Ullmar	And Nolan				Report N	Number:	21791/R/10319-1	
Client Address:	Level 6, 93 Mit	chell Street, Dar	win			Project I	Number:	21791/P/206	
Project:	Geotechnical I	nvestigations				Lot Num	iber:	Tennis Court	
Location:	Darwin					Internal	Test Request:	21791/T/4669	
Component:						Client R	eference/s:	U23991 / PO# 147	95
Area Description:	Gardens Tenn	is				Report [	Date / Page:	4/03/2016	Page 3 of 3
Test Procedures	AS1289.3.6.1,	AS1289.3.1.2, A	S1289.3.2.1	, AS12	89.3.4.1, AS	6 1289.3.3	3.1		
Sample Number	21791/S/33873	3			Location 1			BH06	
Sampling Method	AS1289.1.2.1	CI 6.5.2			Location 2				
Date Sampled	16/02/2016	16/02/2016 Location 3							
Sampled By	Client Sampleo	1		1	Location 4				
Date Tested	17/02/2016				Material Sc	ource	Insitu		
Att. Drying Method	-				Material Ty	pe	Existing		
Atterberg Preparation	-				Material De	escription	In-situ		
AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum			ARTICLE	E SIZE DISTI	RIBUTION GRAP	н
19.0		100		1 1	00				
16.0		100			90				
13.2		100			80		-		
9.5		99			70		/		
6.7		97		(%)	70		1		
4.75		96		Duis	60		/		
2.36		90		Percent Passing (%)	50 -		/		
1.18		85		ent	40	/			
0.600		79		Paro	30 -	/			
0.425		73							
0.300		63			20				
0.150		24			10 🚽 🧹				
0.075		12			o 1				]
					0.0	2	0,600 0,425 0,300	4.75 2.36 1.18	19,0 13,2 9,5
		1 1			0.075	0.150	0,600 0,425 0,300	ω % ď	ν Ν ο
							AS Sleve	e Size (mm)	
Test Result	Specification Minimum	Result	Specification Maximum		Test Resu	t	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		Not Obtainable		0.075	5/0.425 Fine	s Ratio		0.17	
Plastic Limit (%)		Not Obtainable		PIXO	).425 Ratio (	(%)			
Plastic Index (%)		Non Plastic		LS x	0.425 Ratio	(%)		0.0	
Linear Shrinkage (%)		0.0		Linea	r Shrinkage	Defects			
			E0						

Remarks

A Comment Ż

Verifed By: Drew Cooper Form ID: W85Rep Rev 1



Laboratory:Darwin LaboratoryPhone:08 8947 2780Fax:

Darwin.lab@cardno.com.au

Address: Unit 2, 15 Miles Road Berrimah Bus' Park Northern Territory 0828

## **CALIFORNIA BEARING RATIO REPORT**

Email:

Client:	Cardno Ullma	n And Nolan			Report Numbe	эг:	21791/R/10289-2	
Client Address:	level 6 93 M	itchell Street, Darwii	n		Project Numbe		21791/P/206	
Project:		·			-			
,		Investigations			Lot Number:		Tennis Court	
Location:	Darwin				Internal Test F	Request:	21791/T/4669	
Component:					Client Referen	ce/s:	U23991 / PO# 14795	
Area Description:	Gardens Tenr	nis		1	Report Date /	Page:	30/03/2016	Page 1 of 1
Test Procedures	AS1289.6.1.1	, AS1289.5.2.1, AS1	289.2.1.1					
Sample Number	21791/S/3387	3				Sample	e Location	
Sampling Method	AS1289.1.2.1	CI 6.5.2		Location 1			BH06	
Date Sampled	16/02/2016			Location 2			0.30-0.55	
Sampled By	Client Sample	d		Location 3				
Date Tested	23/02/2016			Location 4				
Material Source	Insitu			Material Lir	nit Start		5	
Material Type	Existing			Material Lir	nit End		¥.	
Client Reference	Ē.			Compactive	e Effort		Modified	
Material Description	In-situ							
Maximum Dry Density	(t/m³):	1.88			CBR PENET	RATIO	N PLOT	
Optimum Moisture Cor	ntent (%):	14.0	12000					
Field Moisture Content	: (%):	16.7	12000					
Sample Percent Overs	ize (%)	0.0						
Oversize Included / Ex	cluded	Excluded	10000					
Target Density Ratio (%		95	-					
Target Moisture Ratio (		100	8000 -					
Placement Dry Density	. ,	1.78	2			/		
Placement Dry Density		94.5	(N) 020		/			
Placement Moisture Co	. ,	14.1	Loi					
Placement Moisture Ra	• •	99.5	4000		/			
Test Condition / Soakin	ig Period:	Soaked / 4 Days	1000	1				
CBR Surcharge (kg)	(*/==3)	4.5	0000	/				
Dry Density After Soak Moisture (top 30mm) A	. ,	1.77 17,1	2000 -	/				
Moisture (remainder) A		16.6						
CBR Swell (%):	noi Ouak (70)	0.0	0 🚽					
Minimum CBR Specific	ation (%).	0.0		2.0 1.5 0.5	4,0 3,0 2,5	5.0	7.5	10.0
CBR Value @ 5.0mm (	. ,	35			Pe	netration	n (mm)	

Remarks Re-Issued Report Replaces Report No 21791/R/10289-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

1986

21791

Accreditation Number: Corporate Site Number:

NÆ

Uh C

Approved Signatory: Christopher White Form ID: W7Rep Rev 1



Laboratory: Darwin Laboratory 08 8947 2780 Fax: Phone: Email:

Darwin.lab@cardno.com.au

#### Address: Unit 2, 15 Miles Road

Berrimah Bus' Park Northern Territory 0828

## SHRINK SWELL INDEX

Swell Strain (%)		0.0		IIK / JWCH HIUCK	0.0			
Shrinkage Strain (9	/0)	0.0	Shri	nk / Swell Index	0.0			
Shrinkage Moisture Co	ontent (%):	16.5	Swell Post	Soak Moisture Content (	(%) 12.5			
Estimated Inert Inclusi		0.00		Soak Moisture Content (				
Cracking / Crumbling:		Slight						
Soil Description:		Sand						
Date Tested	27/02/2016		Material Ty	Гуре Existing				
Sampled By	Client Sampled		Material So					
Date Sampled	16/02/2016		Location 4					
Sampling Method	AS1289.1.2.1 C	6.5.2	Location 3					
Sample Number	21791/S/33872		Location 2		4.50-4.95			
Test Procedures:	AS1289.7.1.1, A	S1289.2.1.1	Location 1		BH06			
Area Description:	Gardens Tennis			Report Date / Page:	30/03/2016	Page 1 of 1		
Component:				Client Reference/s:	U23991 / PO# 14795			
Location:	Darwin			Internal Test Request:	21791/T/4669			
Project:	Geotechnical In	vestigations		Lot Number:	Tennis Court			
Client Address:	Level 6, 93 Mitc	hell Street, Darwin		Project Number:	21791/P/206			
Client:	Cardno Ullman	And Nolan		Report Number:	21791/R/10321-2			

Remarks

Re-Issued Report Replaces Report No 21791/R/10321-1.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Accreditation Number: 1986 Corporate Site Number: 21791

Cuh Q

Approved Signatory: Christopher White Form ID: W21Rep Rev 1

### APPENDIX E

Site Photographs



Photo 1: Typical Cracking



Photo 2: Cracking onsite