

Our Ref 9830cg.11

Contact CLAUDIA GIBNEY

28 January 2011

Mr Aiden Cunningham
Cardno (Qld) Pty Ltd

E: aiden.cunningham@cardno.com.au

**PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 9/ 3 / 11**

Cardno Bowler Pty Ltd
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Dear Aiden

RECONFIGURATION THE RESERVE, FLAGSTONE

1. Introduction

It is understood that the current DA for the residential subdivision includes some changes to existing earthworks, including a slight extension of the batter adjacent to the creek line along the north/east boundary.

As requested an investigation has been carried out to provide advice the following issues:

- Slope stability of fill batters.
- Erosion control issues.
- Acid sulfate soil issues.

This report should be read in conjunction with our attached 'General Notes'.

2. Site Description

The site, at the time of the investigation, had already been subject to the majority of planned bulk earthworks. The main part of the site was flat, with a gentle to moderate batter along the creek boundary, and some fill stockpiles. The site coverage varied from poorly to thickly grassed, with several areas of tall grass.

3. Investigation Work

Fieldwork for the investigation was carried out on the 21 and 27 January, 2011 and included a site walkover and the drilling of 3 boreholes at the positions shown on the location plan, Figure 1. The material encountered at each borehole is described on the attached borehole log sheets. Dynamic Cone Penetrometer tests were also carried out beside each borehole and these tabulated test results are included on the borehole log sheets.

Emerson class tests were carried out on selected near surface samples and these test results are as follows:

<u>Sample</u>	<u>Depth (m)</u>	<u>Emerson Class</u>
#1	0.1-0.15	3
#2	0.05-0.1	3
#3	0.0-0.1	3
#4	0.0-0.1	3

4. Subsurface Profile

The results of the fieldwork indicated that broadly similar subsurface conditions existed at the borehole locations.

Soil profiles encountered included silty clay, sandy clay, clayey sand, clayey gravel and silty sand fill over natural silty/sandy clay and silty sand.

5. Batter Stability

The following drawings were supplied to us by Cardno (Qld) Pty Ltd as part of our assessment:

Drawing Number: 7217/11/04 Figure 1 – Existing Surface Contours
 7217/11/04 Figure 2 – Finished Surface Contours
 7217/11/04 Figure 3 – Earthworks Cut/Fill Plan
 7217/11/04 Figure 4 – Site Sections

With regards to long term stability of the structural fill batters, at present we understand that the existing structural fill batters associated with the estate are to be slightly extended as indicated on the abovementioned drawings.

Based on the control testing works carried out by Cardno Bowler during construction, and the proposed batter profiles of 1V:2H, the required long term factor of safety (FOS) against instability of at least 1.5 should be achieved. As such, the proposed structural fill batters are considered acceptable with regards to global, long term stability.

During and after final structural fill placement, it is recommended that additional assessment and inspection be conducted to confirm the long term stability of the structural batters.

6. Acid Sulfate Soils

The site is understood to be located above RL30m, therefore acid sulfate soil (ASS) conditions would not be expected, and the State Planning Policy relating to ASS would not be triggered.

7. Soil Erodibility

Based on the Emerson Class results of 3, the soils tested are dispersive when remoulded. Therefore, good practices should be adopted to minimise erosion and sedimentation issues during development.

In order to minimise erosion the following measures could be considered:

- The existing ground cover over the site could be preserved for as long as possible. When ground cover has been removed for earthworks operations the ground cover could be replaced or sealed pavements constructed as soon as possible. By promptly re-establishing any disturbed areas, sediment problems can be minimised.
- The staging of large areas of earthworks could be scheduled for the least erosive times of the year. Also, where possible, the disturbed areas could be protected during high rainfall periods. Protection measures include rock, gravel and grass block systems, synthetic mats, vegetation and mulches.
- Any uncontaminated upslope runoff could be diverted around disturbed areas.

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- Site entry and on-site traffic movement could be minimised. Roads could be swept of sediment rather than washed. Also, coarse gravel pads or washing bays may be required to remove mud from tyres.
- Drainage control could be implemented upslope of stockpiles to prevent large volumes of sediment being carried to the sediment basin. Sediment fences and/or catch drains could be placed at the downslope side of stockpiles. Wind borne sediment can be minimised by covers on the stockpiles.
- Sediment fences or straw bales can be used to trap sediment close to the sources.

Should you have any queries in relation to this report please do not hesitate to contact the undersigned on 3800 6446 or 0423 985 345.

Yours faithfully

A handwritten signature in black ink, appearing to read 'Claudia Gibney'.

CLAUDIA GIBNEY
SENIOR GEOTECHNICAL ENGINEER
for **Cardno Bowler**

GENERAL NOTES

April 2005

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GENERAL

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the introduction section(s) of the document. The report should not be used by other parties or for other purposes as it may not contain adequate or appropriate information.

TEST HOLE LOGGING

The information on the Test Hole Logs (Boreholes, Backhoe Pits, Exposures etc.) has been based on a visual and tactile assessment except at the discrete locations where test information is available (field and/or laboratory results).

Reference should be made to our standard sheets for the definition of our logging procedures (Soil and Rock Descriptions).

GROUNDWATER

Unless otherwise indicated the water levels given on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities. Further variations of this level could occur with time due to such effects as seasonal and tidal fluctuations or construction activities. Final confirmation of levels can only be made by appropriate instrumentation techniques and programmes.

INTERPRETATION OF RESULTS

The discussion and recommendations contained within this report are normally based on a site evaluation from discrete test hole data. Generalised or idealised subsurface conditions (including any cross-sections contained in the report) have been assumed or prepared by interpolation/extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in the generalised ground conditions used for this report can occur, particularly between discrete test hole locations. Furthermore, certain design or construction procedures may have been assumed in assessing the soil structure interaction behaviour of the site.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed in this report should be referred to this firm for appropriate assessment and comment.

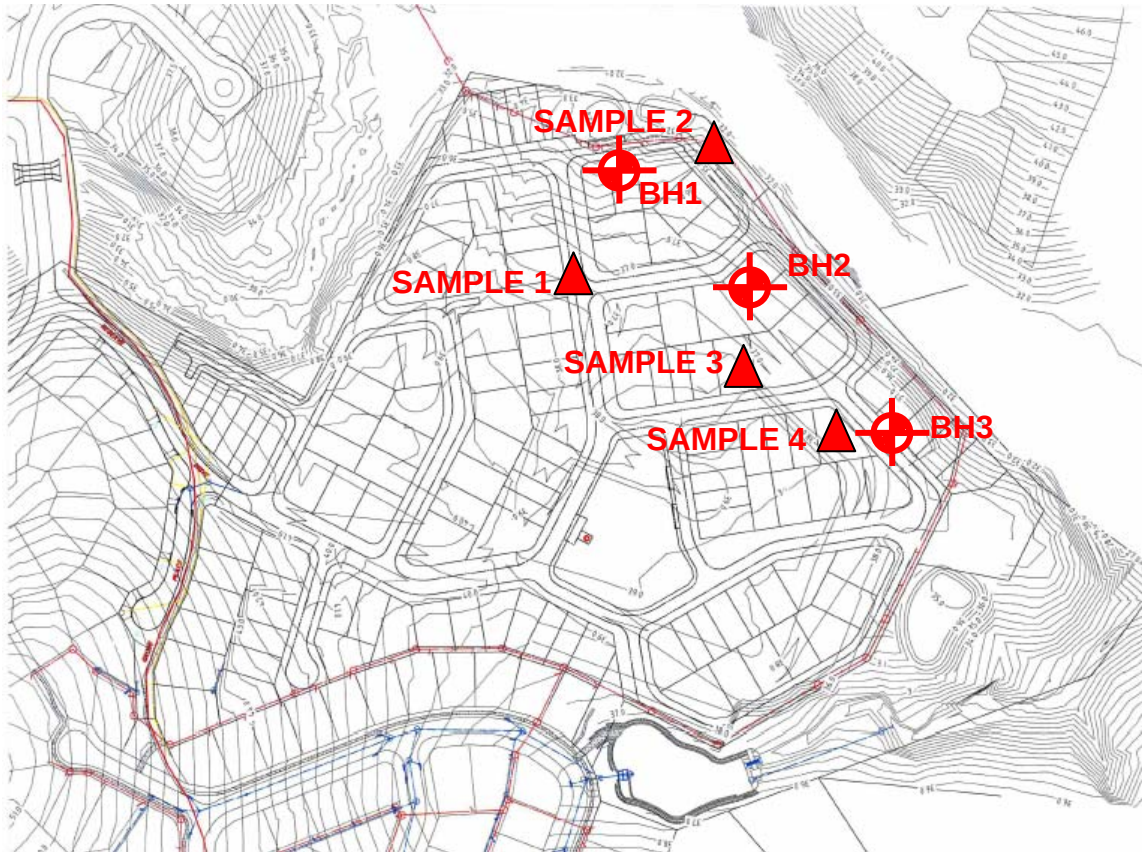
FOUNDATION DEPTH

Where referred to in the report, the recommended depth of any foundation (piles, caissons, footings, etc.) is an engineering estimate of the depth to which they should be constructed. The estimate is influenced and perhaps limited by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The depth remains, however, an estimate and therefore liable to variation. Footing drawings, designs and specifications based upon this report should provide for variations in the final depth depending upon the ground conditions at each point of support.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in this report for the inclusion in the contract documents or engineering specification of the subject development, such reproduction should include at least all the relevant test hole and test data, together with the appropriate standard description sheets and remarks made in the written report of a factual or descriptive nature.

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KEY:



APPROX BOREHOLE LOCATION



APPROX SURFACE SAMPLE LOCATION

SCALE APPROX 1 : 4200

NOTE: PLAN EXTRACTED FROM PLAN SUPPLIED BY CLIENT



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Also at Gold Coast, Ipswich, Geebung, Sunshine Coast, Bundaberg, Rockhampton, Mackay, Moranbah, Townsville, Cairns, Sydney, Melbourne, Geelong and Bendigo (Vic). Associated Offices in Perth, Vietnam and Papua New Guinea.

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INVESTIGATION LOCATION PLAN

PROPOSED RECONFIGURATION

THE RESERVE, FLAGSTONE

JOB NO.:

9830

FIGURE 1

BOREHOLE LOG SHEET

Client: CARDNO (QLD)
Project: BATTER ASSESSMENT
Location: THE RESERVE, FLAGSTONE

Hole No: BH1

Job No: 9830

Sheet: 1 of 1

Position: REFER FIGURE 1

Angle from Horizontal: 90°

Surface Elevation:

Rig Type: QD3000

Bit: TC

Driller: DL

Casing Diameter:

Contractor: CARDNO BOWLER

Date Started : 27/1/11

Date Completed: 27/1/11

Logged By: DL/JL

Date Logged: 27/1/11

Depth (m)	Drilling				Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
	Auger "V" Bit	Auger "TC" Bit	Washbore	Casing								
0.5								3			SM	SILTY SAND, fine to coarse grained sand, brown, with some root matter, dry, medium dense, TOPSOIL
								4				
								10			SC-GC	CLAYEY SAND/CLAYEY GRAVEL, fine to coarse grained sand, fine to medium gravel, brown, trace coarse gravel, dry, medium dense, FILL
								5				
								2			CI-CL	SILTY CLAY/SANDY CLAY, medium to low plasticity, fine to coarse grained sand, grey brown, trace fine gravel, firm, moist, FILL
								3				
								4				
								4			SM-SC	SILTY SAND/CLAYEY SAND, fine to coarse grained sand, brown, dry to moist, medium dense, FILL
								7				
1.0								17				SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, brown orange mottle, dry to moist, hard, FILL?
								20				
1.5											CI-CH	
2.0											SM	SILTY SAND, fine to coarse grained sand, grey, with some wood matter, wet, loose, NATURAL?
2.5												
											CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, brown orange grey mottle, dry to moist, hard, NATURAL
3.0												BOREHOLE TERMINATED AT 3.00 m
3.5												

See Standard Sheets for details of abbreviations & basis of descriptions



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BOREHOLE LOG SHEET

Client: CARDNO (QLD)
Project: BATTER ASSESSMENT
Location: THE RESERVE, FLAGSTONE

Hole No: BH2

Job No: 9830

Sheet: 1 of 1

Position: REFER FIGURE 1

Angle from Horizontal: 90°

Surface Elevation:

Rig Type: QD3000

Bit: TC

Driller: DL

Casing Diameter:

Contractor: CARDNO BOWLER

Date Started : 27/1/11

Date Completed: 27/1/11

Logged By: DL/JL

Date Logged: 27/1/11

Depth (m)	Drilling				Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
	Auger "V" Bit	Auger "TC" Bit	Washbore	Casing								
0.5								1				SILTY SAND, fine to coarse grained sand, brown, with some root matter, dry, medium dense, TOPSOIL
								3				
								2			SM	
								2				
								3				
								7			CL-CL	SILTY CLAY/SANDY CLAY, medium to low plasticity, fine to coarse grained sand, grey brown, trace fine gravel, firm, moist, FILL
								10				
								17				
								20				SILTY SAND, fine to coarse grained sand, orange brown, with some wood matter, trace of clay, dry, loose, FILL
1.0												
1.5											SM	
2.0												
2.5												SILTY SAND, fine to coarse grained sand, pale brown orange, with wood matter, wet, loose, NATURAL?
											SM	
3.0												BOREHOLE TERMINATED AT 3.00 m
3.5												

See Standard Sheets for details of abbreviations & basis of descriptions



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Client: CARDNO (QLD) Project: BATTER ASSESSMENT Location: THE RESERVE, FLAGSTONE						Hole No: BH3											
							Job No: 9830				Sheet: 1 of 1						
Position: REFER FIGURE 1							Angle from Horizontal: 90°				Surface Elevation:						
Rig Type: QD3000							Bit: TC				Driller: DL						
Casing Diameter:							Contractor: CARDNO BOWLER										
Date Started : 27/1/11							Date Completed: 27/1/11				Logged By: DL/JL Date Logged: 27/1/11						
Depth (m)		Drilling				Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)					
		Auger 'V' Bit	Auger 'TC' Bit	Washore	Casing								Coring	Groundwater (m)			
0.5									1		SM	SILT SAND, fine to coarse grained sand, grey, with some root matter, dry, medium dense, TOPSOIL					
								2									
								2									
								4									
0.5									6		CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, trace of fine to medium gravel, brown orange mottle, dry to moist, hard, FILL					
								5									
								4									
								9									
1.0									5		CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, with fine gravel, pale brown, dry to moist, hard, FILL					
								3									
								3									
								3									
1.5									4		SM	SILTY SAND, fine to coarse grained sand, grey white, with some wood matter, wet, loose, FILL?					
								4									
								4									
								4									
2.0									7		CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, pale brown, dry to moist, hard, NATURAL					
								9									
								16									
								20									
2.5											CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, pale brown, dry to moist, hard, NATURAL					
3.0											XW	SANDSTONE					
3.5												BOREHOLE TERMINATED AT 3.00 m					
See Standard Sheets for details of abbreviations & basis of descriptions						 Cardno Bowler 7/98 Anzac Ave HILLCREST QLD 4118 PH: (07) 3800 6446 FAX: (07) 3800 0816											

EMERSON CLASS REPORT SHEET

CLIENT:	CARDNO (QLD) P/L	JOB No.:	9830
ADDRESS:	LOCKED BAG 4006 FORTITUDE VALLEY Q 4006	REPORT No:	1
		DATE ISSUED:	28.1.11
PROJECT:	THE RESERVE, FLAGSTONE		
SAMPLE No.:	147946	LOCATION:	SAMPLE #1
		SAMPLE DEPTH m:	01-0.15M
		DATE SAMPLED:	
TESTED BY:	TV	DATE TESTED:	27.1.11
CHECKED BY:	MJS	DATE CHECKED:	28.1.11

TEST RESULTS

RESULT

**DETERMINATION OF THE PH OF A SOIL
(ELECTROMETRIC METHOD) (AS 1289 4.3.1-1997)**

NR

**DETERMINATION OF THE EMERSON CLASS
NUMBER OF A SOIL (AS 1289 3.8.1-1997)
TYPE OF WATER**

DEIONISED

TEMPERATURE OF WATER °C

26

CLASS NUMBER

3

ELECTRICAL CONDUCTIVITY

NR

SUSPENDED SOLIDS mg/l

NR

DISSOLVED OXYGEN mg/l

NR

TURBIDITY

NR

APPROVED BY: 
M.J. SANDILANDS
NATA Approved Signatory



NATA Accredited Laboratory
Number: 1986

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EMERSON CLASS REPORT SHEET

CLIENT:	CARDNO (QLD) P/L	JOB No.:	9830
ADDRESS:	LOCKED BAG 4006 FORTITUDE VALLEY Q 4006	REPORT No:	2
		DATE ISSUED:	28.1.11
PROJECT:	THE RESERVE, FLAGSTONE		
SAMPLE No.:	147947	LOCATION:	SAMPLE #2
		SAMPLE DEPTH m:	0.05-0.1M
		DATE SAMPLED:	
TESTED BY:	TV	DATE TESTED:	27.1.11
CHECKED BY:	MJS	DATE CHECKED:	28.1.11

TEST RESULTS

RESULT

**DETERMINATION OF THE PH OF A SOIL
(ELECTROMETRIC METHOD) (AS 1289 4.3.1-1997)**

NR

**DETERMINATION OF THE EMERSON CLASS
NUMBER OF A SOIL (AS 1289 3.8.1-1997)
TYPE OF WATER**

DEIONISED

TEMPERATURE OF WATER °C

26

CLASS NUMBER

3

ELECTRICAL CONDUCTIVITY

NR

SUSPENDED SOLIDS mg/l

NR

DISSOLVED OXYGEN mg/l

NR

TURBIDITY

NR

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EMERSON CLASS REPORT SHEET

CLIENT:	CARDNO (QLD) P/L	JOB No.:	9830
ADDRESS:	LOCKED BAG 4006 FORTITUDE VALLEY Q 4006	REPORT No:	3
		DATE ISSUED:	28.1.11
PROJECT:	THE RESERVE, FLAGSTONE		
SAMPLE No.:	147948	LOCATION:	SAMPLE#3
		SAMPLE DEPTH m:	0.0-0.1M
		DATE SAMPLED:	
TESTED BY:	TV	DATE TESTED:	27.1.11
CHECKED BY:	MJS	DATE CHECKED:	28.1.11

TEST RESULTS

RESULT

**DETERMINATION OF THE PH OF A SOIL
(ELECTROMETRIC METHOD) (AS 1289 4.3.1-1997)**

NR

**DETERMINATION OF THE EMERSON CLASS
NUMBER OF A SOIL (AS 1289 3.8.1-1997)
TYPE OF WATER**

DEIONISED

TEMPERATURE OF WATER °C

26

CLASS NUMBER

3

ELECTRICAL CONDUCTIVITY

NR

SUSPENDED SOLIDS mg/l

NR

DISSOLVED OXYGEN mg/l

NR

TURBIDITY

NR

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EMERSON CLASS REPORT SHEET

CLIENT:	CARDNO(QLD) P/L	JOB No.:	9830
ADDRESS:	LOCKED BAG 4006 FORTITUDE VALLEY Q 4006	REPORT No:	4
		DATE ISSUED:	28.1.11
PROJECT:	THE RESERVE, FLAGSTONE		
SAMPLE No.:	147949	LOCATION:	SAMPLE#4
		SAMPLE DEPTH m:	0.0-0.1M
		DATE SAMPLED:	
TESTED BY:	TV	DATE TESTED:	27.1.11
CHECKED BY:	MJS	DATE CHECKED:	28.1.11

TEST RESULTS

RESULT

**DETERMINATION OF THE PH OF A SOIL
(ELECTROMETRIC METHOD) (AS 1289 4.3.1-1997)**

NR

**DETERMINATION OF THE EMERSON CLASS
NUMBER OF A SOIL (AS 1289 3.8.1-1997)
TYPE OF WATER**

DEIONISED

TEMPERATURE OF WATER °C

26

CLASS NUMBER

3

ELECTRICAL CONDUCTIVITY

NR

SUSPENDED SOLIDS mg/l

NR

DISSOLVED OXYGEN mg/l

NR

TURBIDITY

NR

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